Software Manual

Spectrum Analysis Options
for R&S® ZVL

ROHDE&SCHWARZ

This Software Manual describes the following options of the R&S® ZVL:

◆ R&S® ZVL-K1, Spectrum Analysis, stock no. 1306.0301.02

◆ The supplementary spectrum analysis options described in chapter 1, Introduction

The following abbreviations are used throughout this manual:

R&S® ZVL is abbreviated as R&S ZVL, . R&S® FSL-xxx as . R&S FSL-xxx

Contents of this Manual

The present documentation describes the application of an R&S ZVL for spectrum analysis, using the software option R&S ZVL-K1, which can be supplemented by various additional spectrum analyzer options. For a description of the general instrument functionality and the network analyzer mode please refer to the R&S ZVL quick start guide and to the operating manual on your documentation CD-ROM. The quick start guide also contains a general overview of the R&S ZVL user documentation.

This manual is available as online help system and as printable (*.pdf) version. The printable version contains all chapters listed below. The help system contains only chapter 2 and chapter 3.

Chapter 1	*Introduction*	
	Provides a short description of the spectrum analyzer mode and the spectrum analysis options	
Chapter 2	*Advanced Measurement Examples*	
	Explains how to perform spectrum analysis with the R&S ZVL using typical measurements as examples	
Chapter 3	*Instrument Functions*	
	Describes the manual operation providing detailed information on all functions of the user interface	
Chapter 4	*Remote Control - Commands*	
	Describes all remote control commands for spectrum analysis	
Chapter 5	*Remote Control - Programming Examples*	
	Provides programming examples	
Chapter 6	*Error Messages*	
	Lists error messages	

Conventions Used in the Documentation

To visualize important information quickly and to recognize information types faster, a few conventions have been introduced. The following character formats are used to emphasize words:

Bold	All names of graphical user interface elements as dialog boxes, softkeys, lists, options, buttons etc.
	All names of user interface elements on the front and rear panel as keys, connectors etc.
Courier	All remote commands (apart from headings, see below)
Capital letters	All key names (front panel or keyboard)

The description of a softkey (Operating Manual and Online Help) always starts with the softkey name, and is followed by explaining text and one or more remote control commands framed by two lines. Each remote command is placed in a single line.

The description of remote control commands (Operating Manual and Online Help) always starts with the command itself, and is followed by explaining text including an example, the characteristics and the mode (standard or only with certain options) framed by two grey lines. The remote commands consist of abbreviations to accelerate the procedure. All parts of the command that have to be entered are in capital letters, the rest is added in small letters to complete the words and transport their meaning.

Contents of Chapter 1

1   Introduction

The R&S ZVL network analyzer can be upgraded with various hardware and software options, providing enhanced flexibility and an extended measurement functionality. The available options are listed in the *SETUP – More – System Info – Versions + Options* dialog. Options can be enabled by means of a license key, to be entered in the SETUP menu after an appropriate firmware version has been installed. The new supported options for each firmware version are listed in the "What's New..." section of the network analyzer help system.

The R&S ZVL options can be grouped as follows:

- Measurement modes: The option enables a special operating mode. Only one measurement mode can be active at a given time. The basic instrument modes are *Network Analyzer* (NWA, no option required) and *Spectrum Analyzer* (SAN, with option R&S ZVL-K1). The SAN mode is described in this operating manual; it provides a number of supplementary measurement modes, e.g. *WiMAX OFDM/OFDMA Analysis* mode (with option R&S FSL.K93). The supplementary SAN modes also require option R&S ZVL-K1.

- Additional measurements: The option extends a particular measurement mode, providing additional measurement functionality. The analyzer provides additional measurements for the NWA and the SAN modes.

The relationship between the R&S ZVL options and measurement modes is shown below.
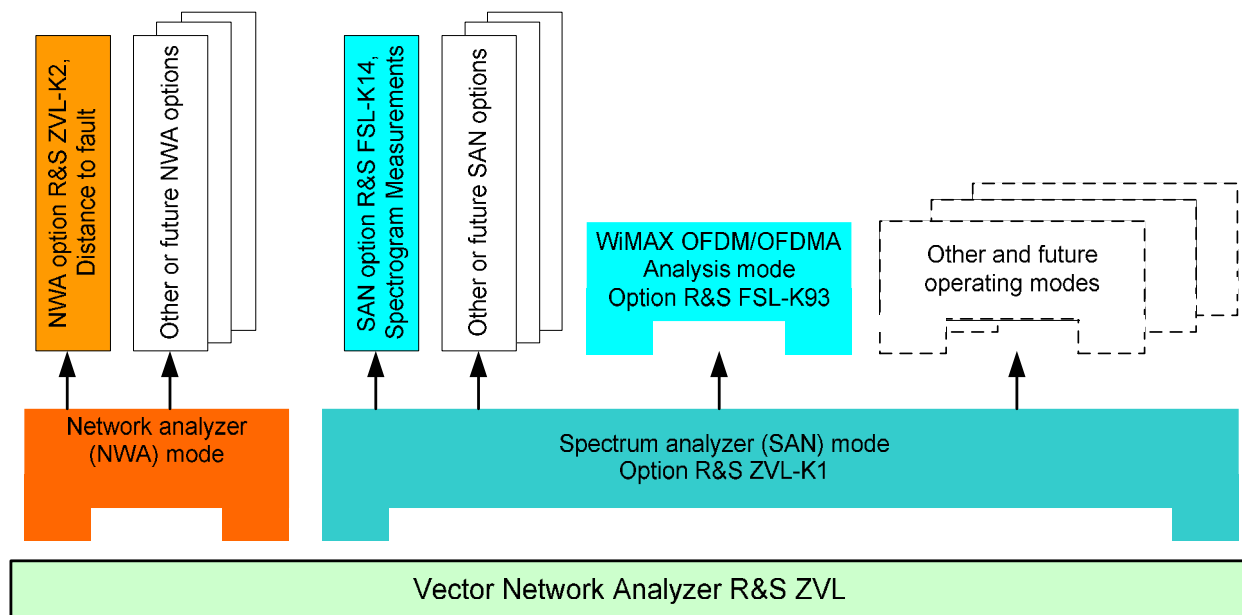
Accessing measurement modes, remote control

All measurement modes are accessed by means of the MODE front panel key. When a new mode is selected, the appearance of the user interface and the control elements change. At the same time, the instrument adjusts its remote-control command set to the functionality of the selected operating mode.

While a particular measurement mode is active, the functionality of the other modes is generally not available. The same applies to the remote-control commands. Basic instrument functions, i.e. the softkeys associated with the FILE, SETUP, PRINT, and MODE front panel keys and the related commands, are available in all operating modes.

The present manual describes the SAN modes and options listed below. For a complete list of options, accessories, and extras refer to the R&S ZVL product brochure.

Option	Option Type	Functionality
ZVL-K1, Spectrum Analysis	SAN option, measurement mode	Basis spectrum analyzer functions providing the frequency spectrum of the measured RF signal. The option also provides a wide range of pre-configured power measurements.
FSL-B6, TV Trigger	SAN option	TV trigger, especially for service in the analog TV field.
FSK-B8, Gated Sweep	SAN option	Gated sweep, especially for the modulation spectrum of GSM signals or bursted WLAN signals.
FSL-K7, AM/FM/φM Measurement Demodulator	SAN option	Analog modulation analysis for amplitude, frequency or phase modulated signals.
FSL-K8, Bluetooth Measurements	SAN option	Bluetooth transmitter (TX) tests in line with the Bluetooth$^®$ RF test specification, including EDR tests.
FSL-K14, Spectrogram Measurements	SAN option	Spectrogram display and trace recording for general spectrum measurements.
FSL-K30, Noise Figure and Gain Measurements)	SAN option, measurement mode	Noise figure and noise temperature measurements, especially suited for manufacturers of amplifiers.
FSL-K72, WCDMA Measurements (3GPP/FDD BTS)	SAN option, measurement mode	Transmitter (TX) tests on 3GPP/FDD downlink signals including HSDPA and HSUPA channels.
FSL-K91, WLAN OFDM Analysis	SAN option, measurement mode	Transmitter (TX) tests on WLAN signals in line with the WLAN standards IEEE 802.11a/b/g/j.
FSL-K93, WiMAX OFDM/OFDMA Analysis	SAN option, measurement mode	Transmitter (TX) tests on WLAN signals in line with standard IEEE 802.16-2004 and IEEE 802.16e-2005 for mobile WiMAX-Signals including WiBro.

The following sections provide a short introduction to the software options.

Spectrum Analysis (R&S ZVL-K1)

The spectrum analysis option provides the basic functionality for measuring an arbitrary RF signal in the frequency domain. Evaluation tools such as markers and limit lines allow a refined analysis of the measurement results. A wide range of predefined power measurements cover typical RF measurement tasks, in particular:

- Zero span power measurements

- Channel and adjacent channel power measurement

- Measurement of occupied bandwidth

- CCDF measurement (amplitude statistics of signals)

Option R&S ZVL-K1 is a prerequisite for all supplementary spectrum analyzer (SAN) options; see table and figure above.

TV Trigger (R&S FSL-B6)

Option R&S FSL-B6 adds a TV trigger to option ZVL-K1, in order to select different sections of a TV video signal for display and facilitate the analysis. This option is especially suited for all doing any service in the analog TV field.

Gated Sweep (R&S FSL-B8)

The gated sweep mode removes switching transients from the spectrum. This is advantageous for the analysis of pulsed-carrier signals, e. g. to investigate the modulation spectrum of GSM signals or WLAN signals.

AM/FM/φM Measurement Demodulator (R&S FSL-K7)

The AM/FM/φM Measurement Demodulator option R&S FSL-K7 converts the ZVL into an analog modulation analyzer for amplitude, frequency or phase modulated signals. It measures not only characteristics of the useful modulation, but also factors such as residual FM or synchronous modulation.

Bluetooth Measurements (R&S FSL-K8)

Option R&S FSL-K8 provides measurements on Bluetooth transmitters. All measurements are carried out in line with the Bluetooth® RF test specification Rev. 2.0+DER and cover basic rate as well as Enhanced Data Rate (EDR) packets.

Spectrogram Measurements (R&S FSL-K14)

Option FSL-K14 adds a spectrogram display and trace recording to the ZVL. The spectrogram view gives a history of the spectrum and helps to analyze intermittent problems or variations in frequency and level versus time.

Noise Figure and Gain Measurements (R&S FSL-K30)

Option R&S FSL-K30 adds the capability to measure noise figure and noise temperature. This enables manufacturers of amplifiers to analyze all necessary characteristics, e.g. noise figure, nonlinear parameters such as harmonics, intermodulation or ACPR, as well as S-parameters.
In addition to the spectrum analyzer option R&S ZVL-K1, option R&S FSL-K30 also requires option R&S FSL-B5, Additional Interfaces (providing the noise source control voltage), and an external preamplifier to specify the measurement uncertainties. DC supply for the external preamplifier can be derived from the probe power socket; a matching connector can be ordered as spare part (1065.9480.00).
Noise source: E.g. NC 346 types from Noisecom.

WCDMA Measurements (3GPP/FDD BTS) (R&S FSL-K72)

The R&S FSL-K72 adds transmitter (TX) measurements on 3GPP downlink signals including HSDPA/HSUPA signals. The measurement types comprise code domain power, signal channel power, adjacent channel power, and spectrum emission mask.

WLAN OFDM Analysis (R&S FSL-K91)

Option R&S FSL-K91 provides transmitter (TX) tests, especially spectrum and modulation measurements, on signals in line with the WLAN standards IEEE 802.11a/b/g/j.

WiMAX OFDM/OFDMA Analysis (R&S FSL-K93)

Option R&S FSL-K93 provides transmitter (TX) tests, especially spectrum and modulation measurements on signals in line with IEEE 802.16-2004 and IEEE 802.16e-2005 for mobile WiMAX-Signals including WiBro.

Contents of Chapter 2

2   Advanced Measurement Examples

This chapter explains how to operate the R&S ZVL using typical measurements as examples. Additional background information on the settings is given. Examples of more basic character are provided in the Quick Start Guide, chapter 5, as an introduction. The following topics are included in the Quick Start Guide:

- Measuring a Sinusoidal Signal

  - Measuring the Level and Frequency Using Markers

  - Measuring the Signal Frequency Using the Frequency Counter

- Measuring Harmonics of Sinusoidal Signals

  - Measuring the Suppression of the First and Second Harmonic of an Input Signal

- Measuring Signal Spectra with Multiple Signals

  - Separating Signals by Selecting the Resolution Bandwidth

  - Measuring the Modulation Depth of an AM–Modulated Carrier (Span > 0)

  - Measuring of AM–Modulated Signals

- Measurements with Zero Span

  - Measuring the Power Characteristic of Burst Signals

  - Measuring the Signal–to–Noise Ratio of Burst Signals

  - Measurement of FM–Modulated Signals

- Storing and Loading Instrument Settings

  - Storing an Instrument Configuration (without Traces)

  - Storing Traces

  - Loading an Instrument Configuration (with Traces)

  - Configuring Automatic Loading

Test Setup

All of the following examples are based on the standard settings of the analyzer. These are set with the **PRESET** key. A complete listing of the standard settings can be found in chapter "Instrument Functions", section "Initializing the Configuration – PRESET Key".

In the following examples, a signal generator is used as a signal source. The RF output of the signal generator is connected to the RF input of R&S ZVL.

If a 65 MHz signal is required for the test setup, as an alternative to the signal generator, the internal 65 MHz reference generator can be used:

1. Switch on the internal reference generator.

   – Press the **SETUP** key.

   – Press the **Service** softkey.

   – Press the **Input RF/Cal/TG** softkey, until **Cal** is highlighted.

   The internal 65 MHz reference generator is now on. The R&S ZVL's RF input is switched off.

2. Switch on the RF input again for normal operation of the analyzer. Two ways are possible:

   – Press the **PRESET** key

   – Press the **SETUP** key.

   – Press the **Service** softkey.

   – Press the **Input RF/Cal/TG** softkey, until **RF** is highlighted.

   The internal signal path of the R&S ZVL is switched back to the RF input in order to resume normal operation.

Measurement of Harmonics

Measuring the harmonics of a signal is a frequent problem which can be solved best by means of a spectrum analyzer. In general, every signal contains harmonics which are larger than others. Harmonics are particularly critical regarding high–power transmitters such as transceivers because large harmonics can interfere with other radio services.

Harmonics are generated by nonlinear characteristics. They can often be reduced by lowpass filters. Since the spectrum analyzer has a nonlinear characteristic, e.g. in its first mixer, measures must be taken to ensure that harmonics produced in the analyzer do not cause spurious results. If necessary, the fundamental wave must be selectively attenuated with respect to the other harmonics with a highpass filter.

When harmonics are being measured, the obtainable dynamic range depends on the second harmonic intercept of the spectrum analyzer. The second harmonic intercept is the virtual input level at the RF input mixer at which the level of the 2nd harmonic becomes equal to the level of the fundamental wave. In practice, however, applying a level of this magnitude would damage the mixer. Nevertheless the available dynamic range for measuring the harmonic distance of a DUT can be calculated relatively easily using the second harmonic intercept.

As shown in Fig. 2–1, the level of the 2nd harmonic drops by 20 dB if the level of the fundamental wave is reduced by 10 dB.
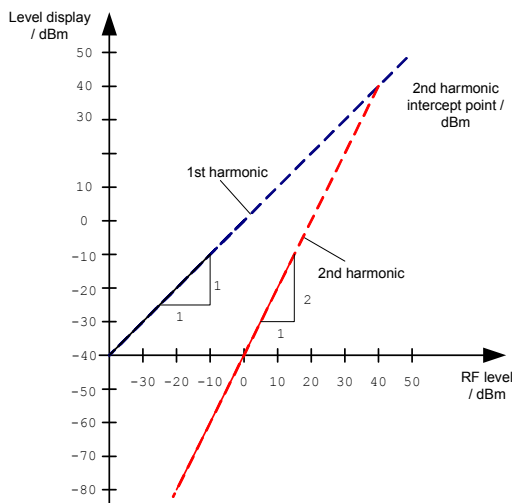
Fig. 2–1   Extrapolation of the 1st and 2nd harmonics to the 2nd harmonic intercept at 40 dBm

The following formula for the obtainable harmonic distortion d_2 in dB is derived from the straight–line equations and the given intercept point:

$d_2 = S.H.I – P_I$ (1)

d_2 =   harmonic distortion

P_I =   mixer level/dBm

S.H.I.   =   second harmonic intercept

> **Note:**   *The mixer level is the RF level applied to the RF input minus the set RF attenuation.*

The formula for the internally generated level P_1 at the 2nd harmonic in dBm is:

$$P_1 = 2 \cdot P_I - S.H.I. \qquad (2)$$

The lower measurement limit for the harmonic is the noise floor of the spectrum analyzer. The harmonic of the measured DUT should – if sufficiently averaged by means of a video filter – be at least 4 dB above the noise floor so that the measurement error due to the input noise is less than 1 dB.

The following rules for measuring high harmonic ratios can be derived:

- Select the smallest possible IF bandwidth for a minimal noise floor.

- Select an RF attenuation which is high enough to just measure the harmonic ratio.

The maximum harmonic distortion is obtained if the level of the harmonic equals the intrinsic noise level of the receiver. The level applied to the mixer, according to (2), is:

$$P_I = \frac{P_{noise} \, / \, dBm + IP2}{2} \qquad (3)$$

At a resolution bandwidth of 10 Hz (noise level −143 dBm, S.H.I. = 40 dBm), the optimum mixer level is − 51.5 dBm. According to (1) a maximum measurable harmonic distortion of 91.5 dB minus a minimum S/N ratio of 4 dB is obtained.

Note: *If the harmonic emerges from noise sufficiently (approx. >15 dB), it is easy to check (by changing the RF attenuation) whether the harmonics originate from the DUT or are generated internally by the spectrum analyzer. If a harmonic originates from the DUT, its level remains constant if the RF attenuation is increased by 10 dB. Only the displayed noise is increased by 10 dB due to the additional attenuation. If the harmonic is exclusively generated by the spectrum analyzer, the level of the harmonic is reduced by 20 dB or is lost in noise. If both – the DUT and the spectrum analyzer – contribute to the harmonic, the reduction in the harmonic level is correspondingly smaller.*

High–Sensitivity Harmonics Measurements

If harmonics have very small levels, the resolution bandwidth required to measure them must be reduced considerably. The sweep time is, therefore, also increased considerably. In this case, the measurement of individual harmonics is carried out with the spectrum analyzer set to a small span. Only the frequency range around the harmonics will then be measured with a small resolution bandwidth.

Signal generator settings (e.g. R&S SMU):

Frequency: 128 MHz

Level: − 25 dBm

Procedure:

1. Set the spectrum analyzer to its default state.

    - Press the **PRESET** key.

        The R&S ZVL is set to its default state.

2. Set the center frequency to 128 MHz and the span to 100 kHz.

− Press the **CENTER** key.

  The frequency menu is displayed.

− In the dialog box, enter *128* using the numeric keypad and confirm with the **MHz** key.

− Press the **SPAN** key.

− In the dialog box, enter *100* using the numeric keypad and confirm with the **kHz** key.

  The R&S ZVL displays the reference signal with a span of 100 kHz and resolution bandwidth of 3 kHz.

3. Switching on the marker.

   − Press the **MKR** key.

     The marker is positioned on the trace maximum.

4. Set the measured signal frequency and the measured level as reference values

   − Press the Phase Noise/Ref Fixed softkey.

     The position of the marker becomes the reference point. The reference point level is indicated by a horizontal line, the reference point frequency with a vertical line. At the same time, the delta marker 2 is switched on.

   − Press the **Ref Fixed** softkey.

     The mode changes from phase noise measurement to reference fixed, the marker readout changes from dB/Hz to dB.
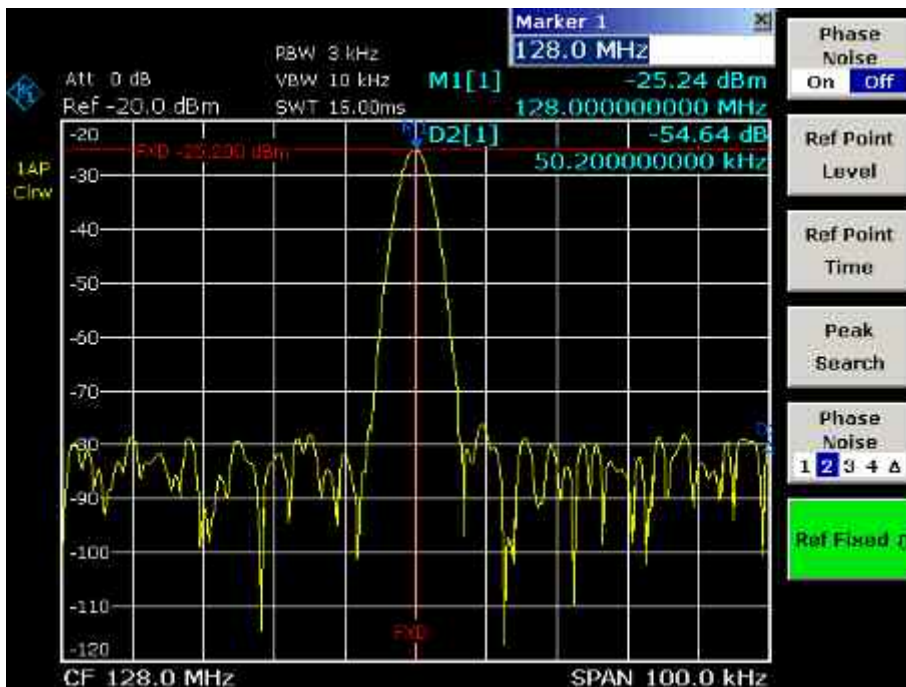
Fig. 2–2   Fundamental wave and the frequency and level reference point

5. Make the step size for the center frequency equal to the signal frequency

   − Press the **CENTER** key.

     The frequency menu is displayed.

   − Press the **CF–Stepsize** softkey and press the **= Marker** softkey in the submenu.

The step size for the center frequency is now equal to the marker frequency.

6. Set the center frequency to the 2nd harmonic of the signal

    –   Press the **CENTER** key.

        The frequency menu is displayed.

    –   Press the **UPARROW** key once.

        The center frequency is set to the 2nd harmonic.

7. Place the delta marker on the 2nd harmonic.

    –   Press the **MKR–>** key.

    –   Press the **Peak** softkey.

        The delta marker moves to the maximum of the 2nd harmonic. The displayed level result is relative to the reference point level (= fundamental wave level).
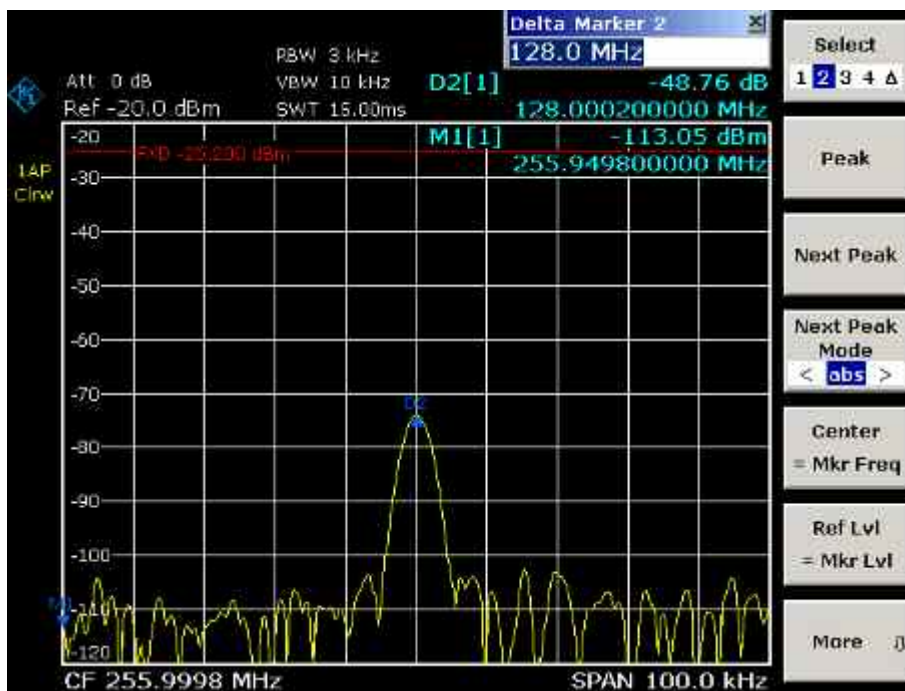
Fig. 2–3   Measuring the level difference between the fundamental wave (= reference point level) and the 2nd harmonic

The other harmonics are measured with steps 5 and 6, the center frequency being incremented or decremented in steps of 128 MHz using the **UPARROW** or **DNARROW** key.

Measuring the Spectra of Complex Signals

Separating Signals by Selecting an Appropriate Resolution Bandwidth

A basic feature of a spectrum analyzer is being able to separate the spectral components of a mixture of signals. The resolution at which the individual components can be separated is determined by the resolution bandwidth. Selecting a resolution bandwidth that is too large may make it impossible to distinguish between spectral components, i.e. they are displayed as a single component.

An RF sinusoidal signal is displayed by means of the passband characteristic of the resolution filter (RBW) that has been set. Its specified bandwidth is the 3 dB bandwidth of the filter.

Two signals with the same amplitude can be resolved if the resolution bandwidth is smaller than or equal to the frequency spacing of the signal. If the resolution bandwidth is equal to the frequency spacing, the spectrum display screen shows a level drop of 3 dB precisely in the center of the two signals. Decreasing the resolution bandwidth makes the level drop larger, which thus makes the individual signals clearer.

If there are large level differences between signals, the resolution is determined by selectivity as well as by the resolution bandwidth that has been selected. The measure of selectivity used for spectrum analyzers is the ratio of the 60 dB bandwidth to the 3 dB bandwidth (= shape factor).

For the R&S ZVL, the shape factor for bandwidths is < 5, i.e. the 60 dB bandwidth of the 30 kHz filter is < 150 kHz.

The higher spectral resolution with smaller bandwidths is won by longer sweep times for the same span. The sweep time has to allow the resolution filters to settle during a sweep at all signal levels and frequencies to be displayed. It is given by the following formula.

$$\text{SWT} = k \bullet \text{Span/RBW}^2 \quad (4)$$

SWT	=	max. sweep time for correct measurement
k	=	factor depending on type of resolution filter
		= 1 for digital IF filters
Span	=	frequency display range
RBW	=	resolution bandwidth

If the resolution bandwidth is reduced by a factor of 3, the sweep time is increased by a factor of 9.

> *Note:*   *The impact of the video bandwidth on the sweep time is not taken into account in (4). For the formula to be applied, the video bandwidth must be ≥ 3 x the resolution bandwidth.*

FFT filters can be used for resolution bandwidths up to 30 kHz. Like digital filters, they have a shape factor of less than 5 up to 30 kHz. For FFT filters, however, the sweep time is given by the following formula:

$$SWT = k \cdot span/RBW \quad (5)$$

If the resolution bandwidth is reduced by a factor of 3, the sweep time is increased by a factor of 3 only.

Intermodulation Measurements

If several signals are applied to a transmission two–port device with nonlinear characteristic, intermodulation products appear at its output by the sums and differences of the signals. The nonlinear characteristic produces harmonics of the useful signals which intermodulate at the characteristic. The

intermodulation products of lower order have a special effect since their level is largest and they are near the useful signals. The intermodulation product of third order causes the highest interference. It is the intermodulation product generated from one of the useful signals and the 2nd harmonic of the second useful signal in case of two–tone modulation.

The frequencies of the intermodulation products are above and below the useful signals. Fig. 2–4 shows intermodulation products P_{I1} and P^{I2} generated by the two useful signals P_{U1} and P_{U2}.
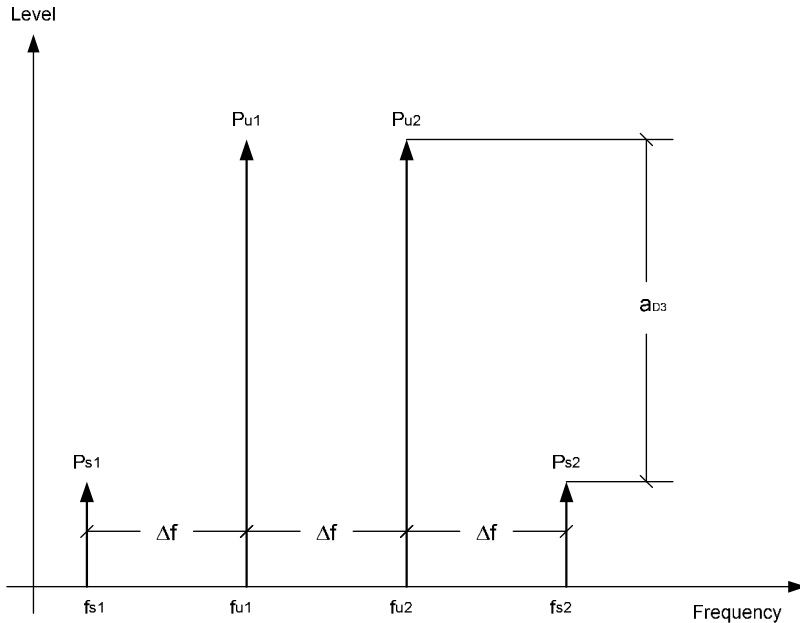
Fig. 2–4   Intermodulation products P_{U1} and P_{U2}

The intermodulation product at f_{I2} is generated by mixing the 2nd harmonic of useful signal P_{U2} and signal P_{U1}, the intermodulation product at f_{I1} by mixing the 2nd harmonic of useful signal P_{U1} and signal P_{U2}.

$$f_{i1} = 2 \times f_{u1} - f_{u2} \quad (6)$$

$$f_{i2} = 2 \times f_{u2} - f_{u1} \quad (7)$$

The level of the intermodulation products depends on the level of the useful signals. If the two useful signals are increased by 1 dB, the level of the intermodulation products increases by 3 dB, which means that spacing a_{D3} between intermodulation signals and useful signals are reduced by 2 dB. This is illustrated in Fig. 2–5.
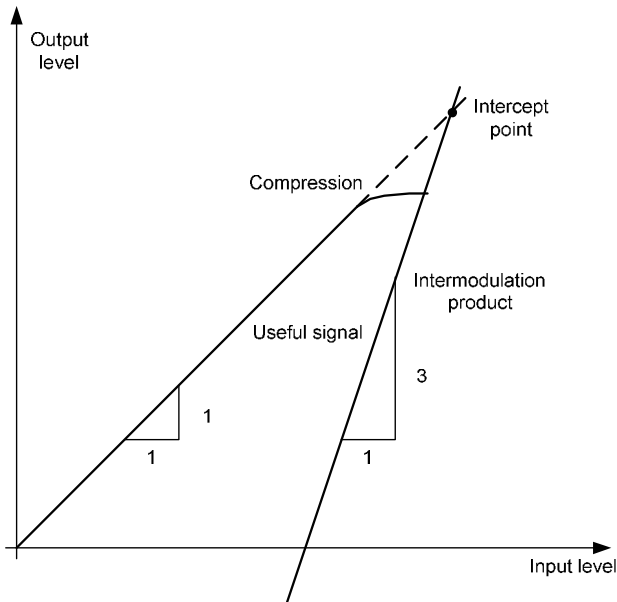
Fig. 2–5   Dependence of intermodulation level on useful signal level

The useful signals at the two–port output increase proportionally with the input level as long as the two–port is in the linear range. A level change of 1 dB at the input causes a level change of 1 dB at the output. Beyond a certain input level, the two–port goes into compression and the output level stops increasing. The intermodulation products of the third order increase three times as much as the useful signals. The intercept point is the fictitious level where the two lines intersect. It cannot be measured directly since the useful level is previously limited by the maximum two–port output power.

It can be calculated from the known line slopes and the measured spacing a_{D3} at a given level according to the following formula.

$$IP3 = \frac{a_{D3}}{2} + P_N \qquad (8)$$

The 3rd order intercept point (TOI), for example, is calculated for an intermodulation of 60 dB and an input level P_U of –20 dBm according to the following formula:

$$IP3 = \frac{60}{2} + (-20dBm) = 10dBm \qquad (9)$$

Measurement example – Measuring the R&S ZVL's intrinsic intermodulation

Test setup:
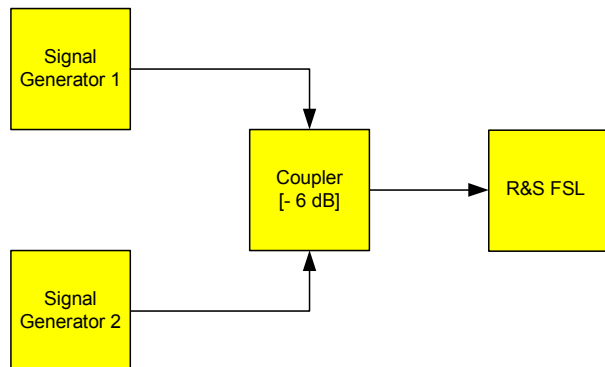
Signal generator settings (e.g. R&S SMU):

	Level	Frequency
Signal generator 1	–4 dBm	999.7 MHz
Signal generator 2	–4 dBm	1000.3 MHz

Procedure:

1. Set the spectrum analyzer to its default settings.

   – Press the **PRESET** key.

   The R&S ZVL is in its default state.

2. Set center frequency to 1 GHz and the frequency span to 3 MHz.

   – Press the **CENTER** key and enter *1 GHz*.

   – Press the **SPAN** key and enter *3 MHz*.

3. Set the reference level to –10 dBm and RF attenuation to 0 dB.

   – Press the **AMPT** key and enter *–10 dBm*.

   – Press the **RF Atten Manual** softkey and enter *0 dB*.

4. Set the resolution bandwidth to 10 kHz.

   – Press the **BW** key.

   – Press the **Res BW Manual** softkey and enter *10 kHz*.

   The noise is reduced, the trace is smoothed further and the intermodulation products can be clearly seen.

   – Press the **Video BW Manual** softkey and enter *1 kHz*.

5. Measuring intermodulation by means of the 3rd order intercept measurement function

   – Press the **MEAS** key.

   – Press the **TOI** softkey.

The R&S ZVL activates four markers for measuring the intermodulation distance. Two markers are positioned on the useful signals and two on the intermodulation products. The 3rd order intercept is calculated from the level difference between the useful signals and the intermodulation products. It is then displayed on the screen:
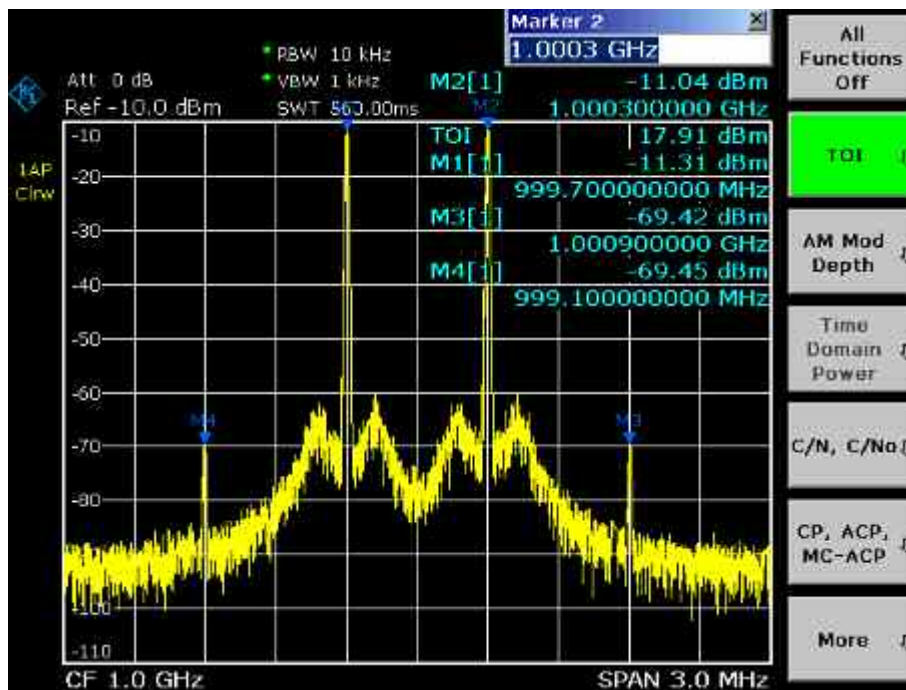
Fig. 2–6   Result of intrinsic intermodulation measurement on the R&S ZVL. The 3rd order intercept (TOI) is displayed at the top right corner of the grid.

The level of a spectrum analyzer's intrinsic intermodulation products depends on the RF level of the useful signals at the input mixer. When the RF attenuation is added, the mixer level is reduced and the intermodulation distance is increased. With an additional RF attenuation of 10 dB, the levels of the intermodulation products are reduced by 20 dB. The noise level is, however, increased by 10 dB.

6.   Increasing RF attenuation to 10 dB to reduce intermodulation products.

   −   Press the **AMPT** key.

   −   Press the **RF Atten Manual** softkey and enter *10 dB*.

   The R&S ZVL's intrinsic intermodulation products disappear below the noise floor.
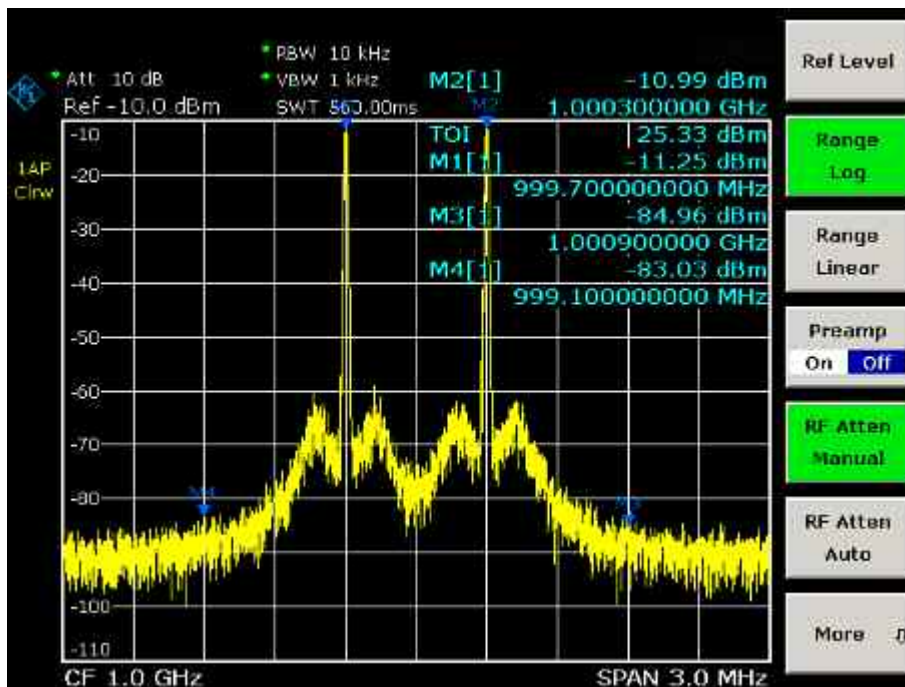
Fig. 2–7   If the RF attenuation is increased, the R&S ZVL's intrinsic intermodulation products disappear below the noise floor.

Calculation method:

The method used by the R&S ZVL to calculate the intercept point takes the average useful signal level P_u in dBm and calculates the intermodulation d_3 in dB as a function of the average value of the levels of the two intermodulation products. The third order intercept (TOI) is then calculated as follows:

$$TOI/dBm = \tfrac{1}{2}\, d_3 + P_u$$

Intermodulation– free dynamic range

The **Intermodulation – free dynamic range,** i.e. the level range in which no internal intermodulation products are generated if two–tone signals are measured, is determined by the 3rd order intercept point, the phase noise and the thermal noise of the spectrum analyzer. At high signal levels, the range is determined by intermodulation products. At low signal levels, intermodulation products disappear below the noise floor, i.e. the noise floor and the phase noise of the spectrum analyzer determine the range. The noise floor and the phase noise depend on the resolution bandwidth that has been selected. At the smallest resolution bandwidth, the noise floor and phase noise are at a minimum and so the maximum range is obtained. However, a large increase in sweep time is required for small resolution bandwidths. It is, therefore, best to select the largest resolution bandwidth possible to obtain the range that is required. Since phase noise decreases as the carrier–offset increases, its influence decreases with increasing frequency offset from the useful signals.

The following diagrams illustrate the intermodulation–free dynamic range as a function of the selected bandwidth and of the level at the input mixer (= signal level – set RF attenuation) at different useful signal offsets.

Distortion free Dynamic Range
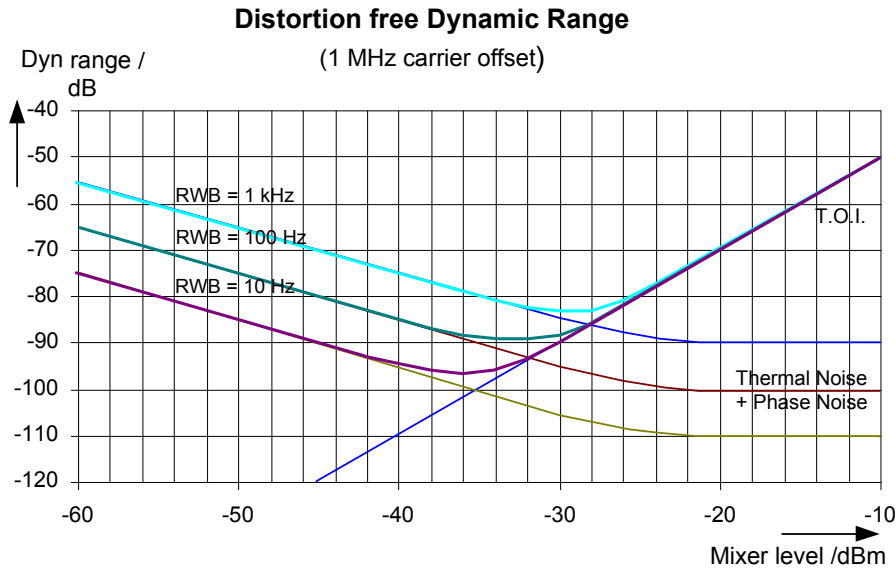
Fig. 2–8   Intermodulation–free range of the R&S ZVL as a function of level at the input mixer and the set resolution bandwidth (useful signal offset = 1 MHz, DANL = –145 dBm /Hz, TOI = 15 dBm; typical values at 2 GHz)

The optimum mixer level, i.e. the level at which the intermodulation distance is at its maximum, depends on the bandwidth. At a resolution bandwidth of 10 Hz, it is approx. –35 dBm and at 1 kHz increases to approx. –30 dBm.

Phase noise has a considerable influence on the intermodulation–free range at carrier offsets between 10 and 100 kHz (Fig. 2–9). At greater bandwidths, the influence of the phase noise is greater than it would be with small bandwidths. The optimum mixer level at the bandwidths under consideration becomes almost independent of bandwidth and is approx. –40 dBm.

Distortion free Dynamic Range
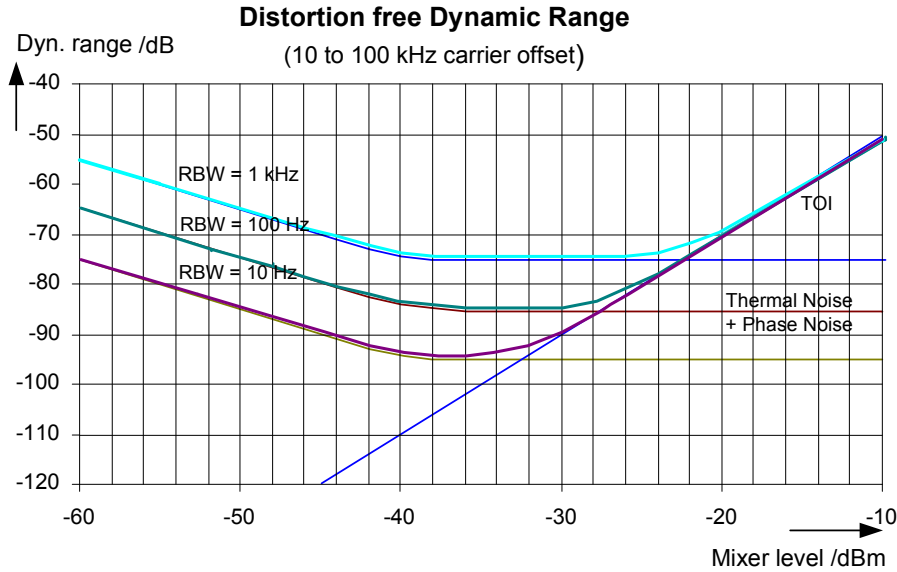
Fig. 2–9   Intermodulation–free dynamic range of the R&S ZVL as a function of level at the input mixer and of the selected resolution bandwidth (useful signal offset = 10 to 100 kHz, DANL = –145 dBm /Hz, TOI = 15 dBm; typical values at 2 GHz).

> **Note:**   If the intermodulation products of a DUT with a very high dynamic range are to be measured and the resolution bandwidth to be used is therefore very small, it is best to measure the levels of the useful signals and those of the intermodulation products separately using a small span. The measurement time will be reduced– in particular if the offset of the useful signals is large. To find signals reliably when frequency span is small, it is best to synchronize the signal sources and the R&S ZVL.

Measuring Signals in the Vicinity of Noise

The minimum signal level a spectrum analyzer can measure is limited by its intrinsic noise. Small signals can be swamped by noise and therefore cannot be measured. For signals that are just above the intrinsic noise, the accuracy of the level measurement is influenced by the intrinsic noise of the spectrum analyzer.

The displayed noise level of a spectrum analyzer depends on its noise figure, the selected RF attenuation, the selected reference level, the selected resolution and video bandwidth and the detector. The effect of the different parameters is explained in the following.

Impact of the RF attenuation setting

The sensitivity of a spectrum analyzer is directly influenced by the selected RF attenuation. The highest sensitivity is obtained at a RF attenuation of 0 dB. The attenuation can be set in 10 dB steps up to 70 dB. Each additional 10 dB step reduces the sensitivity by 10 dB, i.e. the displayed noise is increased by 10 dB.

Impact of the resolution bandwidth

The sensitivity of a spectrum analyzer also directly depends on the selected bandwidth. The highest sensitivity is obtained at the smallest bandwidth (for the R&S ZVL: 10 Hz, for FFT filtering: 1 Hz). If the bandwidth is increased, the reduction in sensitivity is proportional to the change in bandwidth. The R&S ZVL has bandwidth settings in 1, 3, 10 sequence. Increasing the bandwidth by a factor of 3 increases the displayed noise by approx. 5 dB (4.77 dB precisely). If the bandwidth is increased by a factor of 10, the displayed noise increases by a factor of 10, i.e. 10 dB.

Impact of the video bandwidth

The displayed noise of a spectrum analyzer is also influenced by the selected video bandwidth. If the video bandwidth is considerably smaller than the resolution bandwidth, noise spikes are suppressed, i.e. the trace becomes much smoother. The level of a sinewave signal is not influenced by the video bandwidth. A sinewave signal can therefore be freed from noise by using a video bandwidth that is small compared with the resolution bandwidth, and thus be measured more accurately.

Impact of the detector

Noise is evaluated differently by the different detectors. The noise display is therefore influenced by the choice of detector. Sinewave signals are weighted in the same way by all detectors, i.e. the level display for a sinewave RF signal does not depend on the selected detector, provided that the signal–to–noise ratio is high enough. The measurement accuracy for signals in the vicinity of intrinsic spectrum analyzer noise is also influenced by the detector which has been selected. For details on the detectors of the R&S ZVL refer to chapter "Instrument Functions", section "Detector overview" or the Online Help.

Measurement example – Measuring level at low S/N ratios

The example shows the different factors influencing the S/N ratio.

Signal generator settings (e.g. R&S SMU):

Frequency: 128 MHz

Level: – 80 dBm

Procedure:

1. Set the spectrum analyzer to its default state.

   – Press the **PRESET** key.

     The R&S ZVL is in its default state.

2. Set the center frequency to 128 MHz and the frequency span to 100 MHz.

   – Press the **CENTER** key and enter *128 MHz*.

   – Press the **SPAN** key and enter *100* MHz.

3. Set the RF attenuation to 60 dB to attenuate the input signal or to increase the intrinsic noise.

   – Press the **AMPT** key.

   – Press the **RF Atten Manual** softkey and enter *60 dB*.

     The RF attenuation indicator is marked with an asterisk (*Att 60 dB) to show that it is no longer coupled to the reference level. The high input attenuation reduces the reference signal which can no longer be detected in noise.
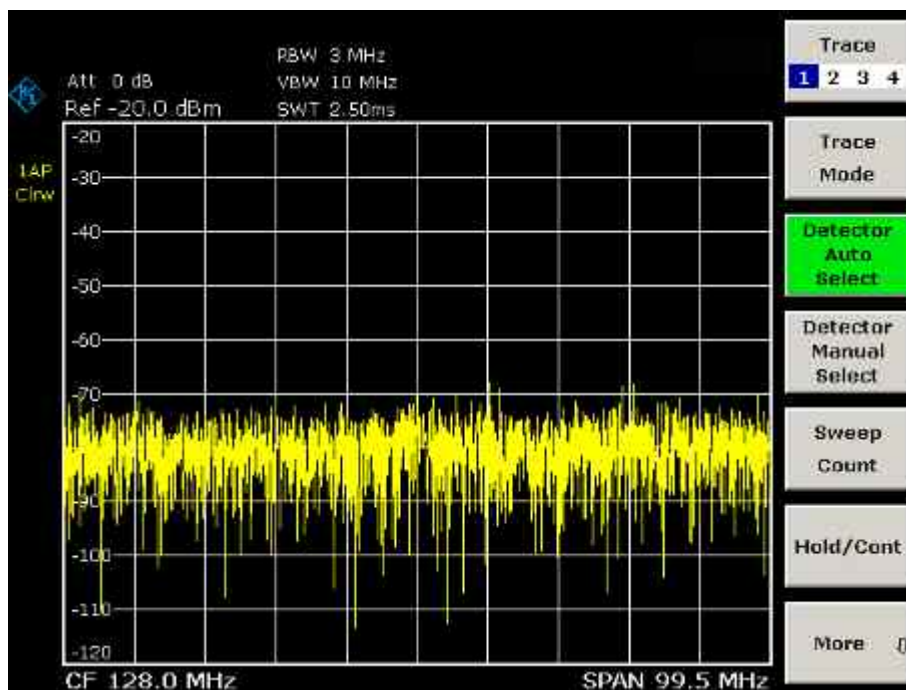
Fig. 2–10   Sinewave signal with low S/N ratio. The signal is measured with the auto peak detector and is completely hidden in the intrinsic noise of the spectrum analyzer.

4. To suppress noise spikes the trace can be averaged.

   – Press the **TRACE** key.

   – Press the **Trace Mode** key.

   – In the **Trace Mode** dialog box, mark **Average** using the rotary knob or the arrow keys and confirm using the rotary knob or the **ENTER** key.

   The traces of consecutive sweeps are averaged. To perform averaging, the R&S ZVL automatically switches on the sample detector. The RF signal, therefore, can be more clearly distinguished from noise.
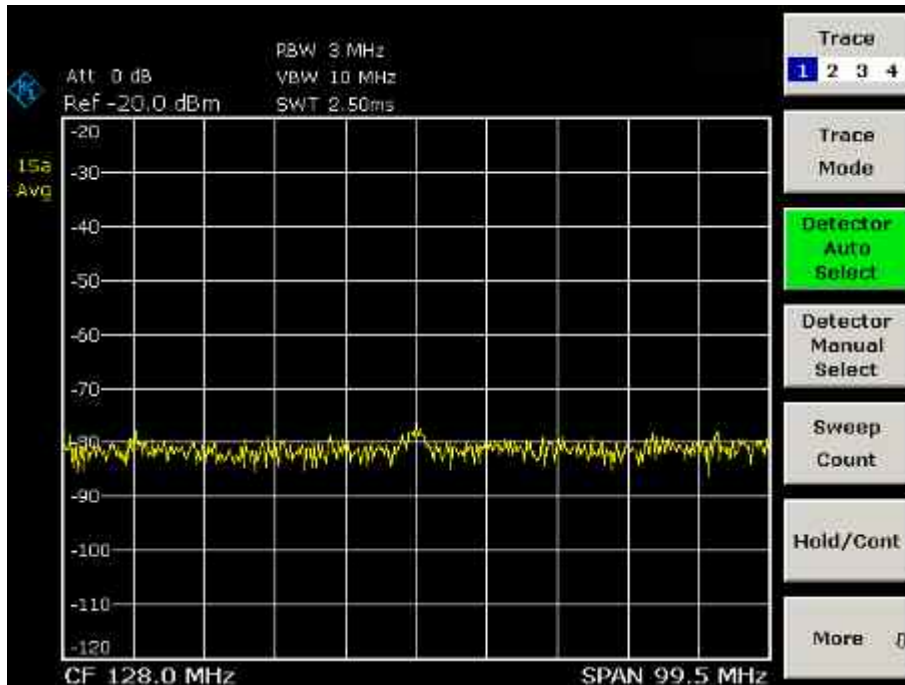
Fig. 2–11   RF sinewave signal with low S/N ratio if the trace is averaged.

5. Instead of trace averaging, a video filter that is narrower than the resolution bandwidth can be selected.

   – Press the **Trace Mode** key.

   – In the **Trace Mode** dialog box, mark **Clear Write** using the rotary knob or the arrow keys and confirm using the rotary knob or the **ENTER** key.

   – Press the **BW** key.

   – Press the **Video BW Manual** softkey and enter *10 kHz*.

   The RF signal can be more clearly distinguished from noise.
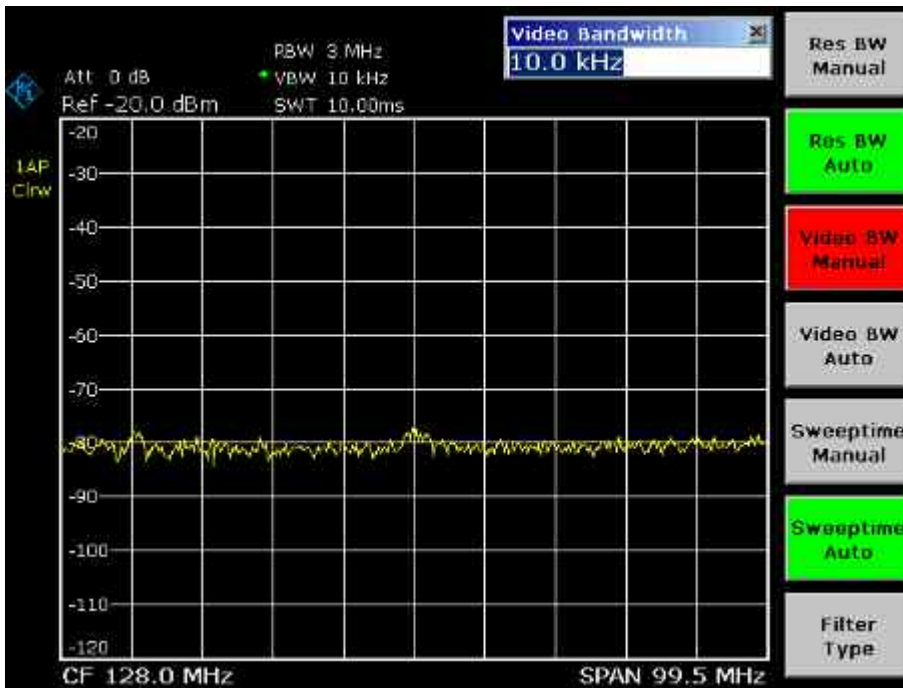
Fig. 2–12   RF sinewave signal with low S/N ratio if a smaller video bandwidth is selected.

6.   By reducing the resolution bandwidth by a factor of 10, the noise is reduced by 10 dB.

   –   Press the **Res BW Manual** softkey and enter *300 kHz*.

      The displayed noise is reduced by approx. 10 dB. The signal, therefore, emerges from noise by about 10 dB. Compared to the previous setting, the video bandwidth has remained the same, i.e. it has increased relative to the smaller resolution bandwidth. The averaging effect of the video bandwidth is therefore reduced. The trace will be noisier.
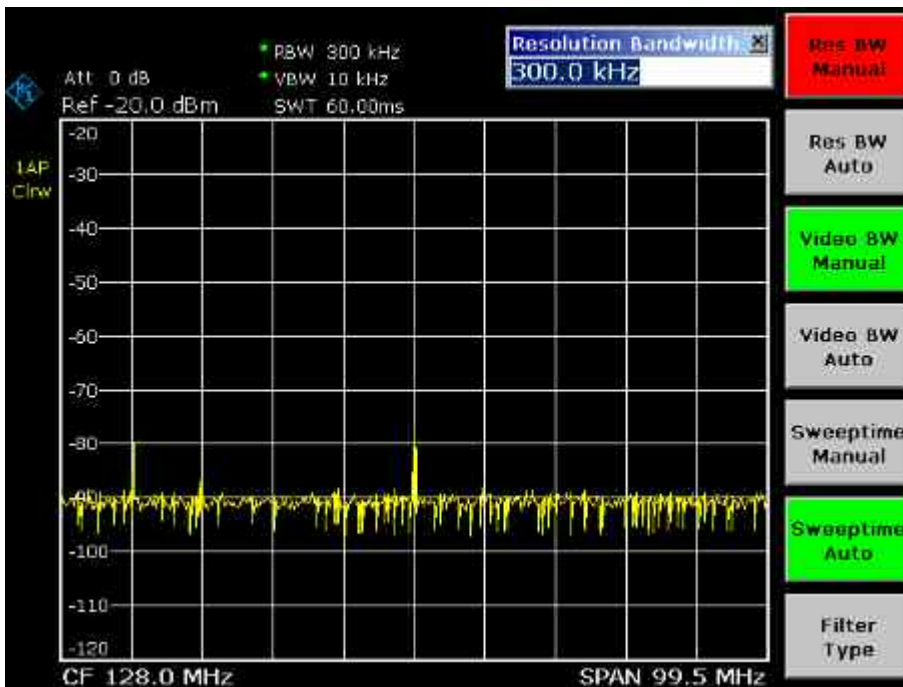
Fig. 2–13   Reference signal at a smaller resolution bandwidth

Noise Measurements

Noise measurements play an important role in spectrum analysis. Noise e.g. affects the sensitivity of radio communication systems and their components.

Noise power is specified either as the total power in the transmission channel or as the power referred to a bandwidth of 1 Hz. The sources of noise are, for example, amplifier noise or noise generated by oscillators used for the frequency conversion of useful signals in receivers or transmitters. The noise at the output of an amplifier is determined by its noise figure and gain.

The noise of an oscillator is determined by phase noise near the oscillator frequency and by thermal noise of the active elements far from the oscillator frequency. Phase noise can mask weak signals near the oscillator frequency and make them impossible to detect.

Measuring Noise Power Density

To measure noise power referred to a bandwidth of 1 Hz at a certain frequency, the R&S ZVL provides marker function. This marker function calculates the noise power density from the measured marker level.

Measurement example – Measuring the intrinsic noise power density of the R&S ZVL at 1 GHz and calculating the R&S ZVL's noise figure

Test setup:
No signal connected to the RF input; RF input terminated with 50 Ω.

Procedure:

1. Set the spectrum analyzer to its default state.

   – Press the **PRESET** key.

     The R&S ZVL is in its default state.

2. Set the center frequency to 1.234 GHz and the span to 1 MHz.

   – Press the **CENTER** key and enter *1.234 GHz*.

   – Press the **SPAN** key and enter *1 MHz*.

3. Switch on the marker and set the marker frequency to 1.234 GHz.

   – Press the **MKR** key and enter *1.234 GHz*.

4. Switch on the noise marker function.

   – Switch on the **Noise Meas** softkey.

     The R&S ZVL displays the noise power at 1 GHz in dBm (1Hz).

> *Note:*   *Since noise is random, a sufficiently long measurement time has to be selected to obtain stable measurement results. This can be achieved by averaging the trace or by selecting a very small video bandwidth relative to the resolution bandwidth.*

5. The measurement result is stabilized by averaging the trace.

    –   Press the **TRACE** key.

    –   Press the **Trace Mode** key.

    –   In the **Trace Mode** dialog box, mark **Average** using the rotary knob or the arrow keys and confirm pressing the rotary knob or the **ENTER** key.

        The R&S ZVL performs sliding averaging over 10 traces from consecutive sweeps. The measurement result becomes more stable.

Conversion to other reference bandwidths

The result of the noise measurement can be referred to other bandwidths by simple conversion. This is done by adding 10 · log (BW) to the measurement result, BW being the new reference bandwidth.

Example

A noise power of –150 dBm (1 Hz) is to be referred to a bandwidth of 1 kHz.
$P_{[1kHz]}$ = –150 + 10 * log (1000) = –150 +30 = –120 dBm (1 kHz)

Calculation method for noise power

If the noise marker is switched on, the R&S ZVL automatically activates the sample detector. The video bandwidth is set to 1/10 of the selected resolution bandwidth (RBW).

To calculate the noise, the R&S ZVL takes an average over 17 adjacent pixels (the pixel on which the marker is positioned and 8 pixels to the left, 8 pixels to the right of the marker). The measurement result is stabilized by video filtering and averaging over 17 pixels.

Since both video filtering and averaging over 17 trace points is performed in the log display mode, the result would be 2.51 dB too low (difference between logarithmic noise average and noise power). The R&S ZVL, therefore, corrects the noise figure by 2.51 dB.

To standardize the measurement result to a bandwidth of 1 Hz, the result is also corrected by –10 * log (RBW_{noise}), with RBW_{noise} being the power bandwidth of the selected resolution filter (RBW).

Detector selection

The noise power density is measured in the default setting with the sample detector and using averaging. Other detectors that can be used to perform a measurement giving true results are the average detector or the RMS detector. If the average detector is used, the linear video voltage is averaged and displayed as a pixel. If the RMS detector is used, the squared video voltage is averaged and displayed as a pixel. The averaging time depends on the selected sweep time (=SWT/501). An increase in the sweep time gives a longer averaging time per pixel and thus stabilizes the measurement result. The R&S ZVL automatically corrects the measurement result of the noise marker display depending on the selected detector (+1.05 dB for the average detector, 0 dB for the RMS detector). It is assumed that the video bandwidth is set to at least three times the resolution bandwidth. While the average or RMS detector is being switched on, the R&S ZVL sets the video bandwidth to a suitable value.

The Pos Peak, Neg Peak, Auto Peak and Quasi Peak detectors are not suitable for measuring noise power density.

Determining the noise figure

The noise figure of amplifiers or of the R&S ZVL alone can be obtained from the noise power display. Based on the known thermal noise power of a 50 Ω resistor at room temperature (–174 dBm (1Hz)) and the measured noise power P_{noise} the noise figure (NF) is obtained as follows:

$NF = P_{noise} + 174 – g,$

where g = gain of DUT in dB

Example

The measured internal noise power of the R&S ZVL at an attenuation of 0 dB is found to be –143 dBm/1 Hz. The noise figure of the R&S ZVL is obtained as follows

$NF = -143 + 174 = 31 \ dB$

> *Note:*   If noise power is measured at the output of an amplifier, for example, the sum of the internal noise power and the noise power at the output of the DUT is measured. The noise power of the DUT can be obtained by subtracting the internal noise power from the total power (subtraction of linear noise powers). By means of the following diagram, the noise level of the DUT can be estimated from the level difference between the total and the internal noise level.
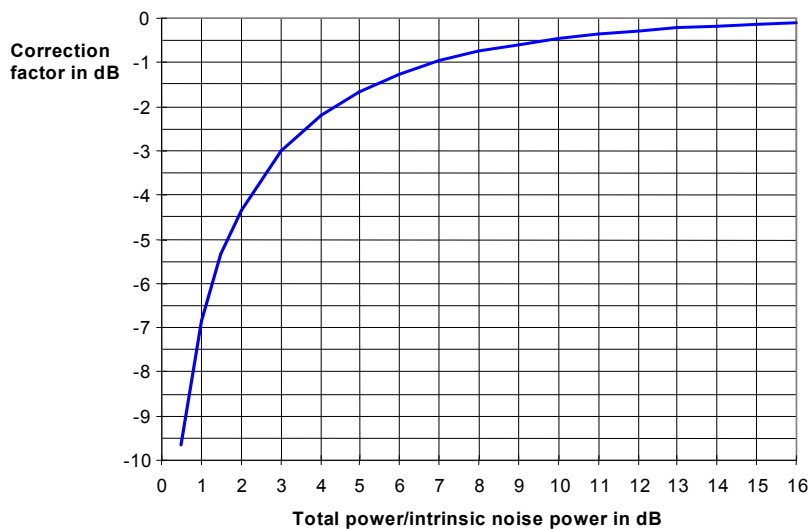
Fig. 2–14   Correction factor for measured noise power as a function of the ratio of total power to the intrinsic noise power of the spectrum analyzer

Measurement of Noise Power within a Transmission Channel

Noise in any bandwidth can be measured with the channel power measurement functions. Thus the noise power in a communication channel can be determined, for example. If the noise spectrum within the channel bandwidth is flat, the noise marker from the previous example can be used to determine the noise power in the channel by considering the channel bandwidth. If, however, phase noise and noise that normally increases towards the carrier is dominant in the channel to be measured, or if there are discrete spurious signals in the channel, the channel power measurement method must be used to obtain correct measurement results.

Measurement example – Measuring the intrinsic noise of the R&S ZVL at 1 GHz in a 1.23 MHz channel bandwidth with the channel power function

Test setup:
The RF input of the R&S ZVL remains open–circuited or is terminated with 50 Ω.

Procedure:

1. Set the spectrum analyzer to its default state.

    –   Press the **PRESET** key.

        The R&S ZVL is in its default state.

2. Set the center frequency to 1 GHz and the span to 1 MHz.

    –   Press the **CENTER** key and enter *1 GHz.*

    –   Press the **SPAN** key and enter *2 MHz*.

3. To obtain maximum sensitivity, set RF attenuation on the R&S ZVL to 0 dB.

    –   Press the **AMPT** key.

    –   Press the **RF Atten Manual** softkey and enter *0 dB*.

4. Switch on and configure the channel power measurement.

    –   Press the **MEAS** key.

    –   Press the **CP, ACP, MC–ACP** softkey.

        The R&S ZVL activates the channel or adjacent channel power measurement according to the currently set configuration.

    –   Press the **CP/ACP Config** softkey.

        The submenu for configuring the channel is displayed.

    –   Press the **Channel Settings** softkey.

        The submenu for channel settings is displayed.

    –   Press the **Channel Bandwidth** softkey and enter *1.23 MHz*.

        The R&S ZVL displays the 1.23 MHz channel as two vertical lines which are symmetrical to the center frequency.

–   Press the **Adjust Settings** softkey.

The settings for the frequency span, the bandwidth (RBW and VBW) and the detector are automatically set to the optimum values required for the measurement.
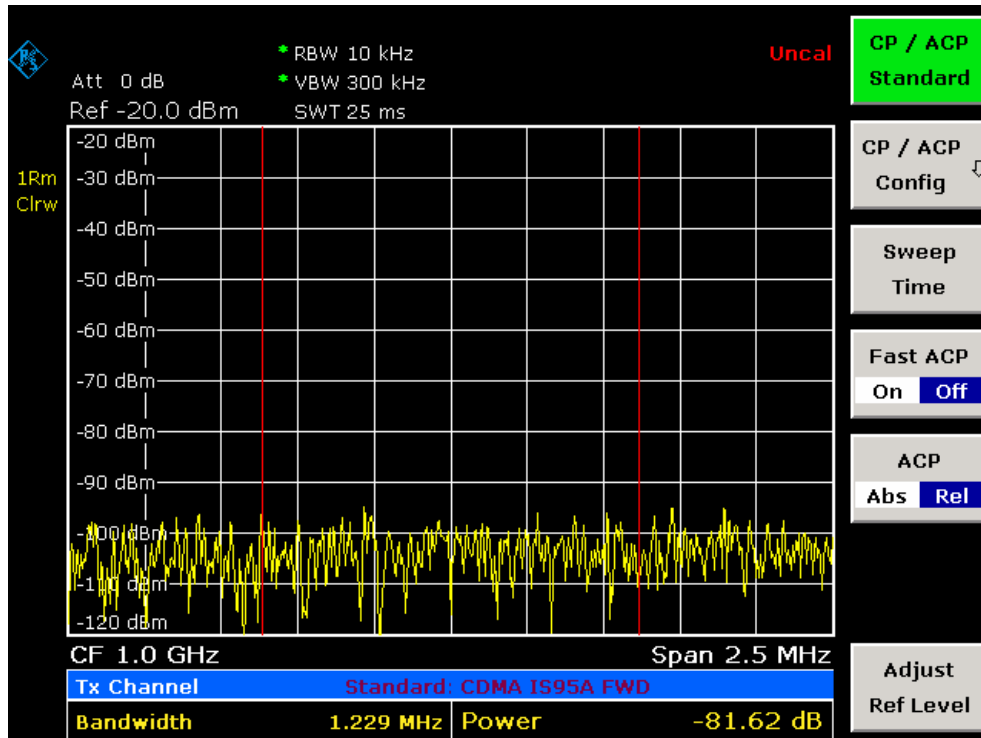
Fig. 2–15   Measurement of the R&S ZVL's intrinsic noise power in a 1.23 MHz channel bandwidth.

5.   Stabilizing the measurement result by increasing the sweep time

–   Press the ▲ key twice.

The main menu for channel and adjacent channel power measurement is displayed.

–   Press the **Sweep Time** softkey and enter *1 s*.

The trace becomes much smoother because of the RMS detector and the channel power measurement display is much more stable.

Method of calculating the channel power

When measuring the channel power, the R&S ZVL integrates the linear power which corresponds to the levels of the pixels within the selected channel. The analyzer uses a resolution bandwidth which is far smaller than the channel bandwidth. When sweeping over the channel, the channel filter is formed by the passband characteristics of the resolution bandwidth (see Fig. 2–16).
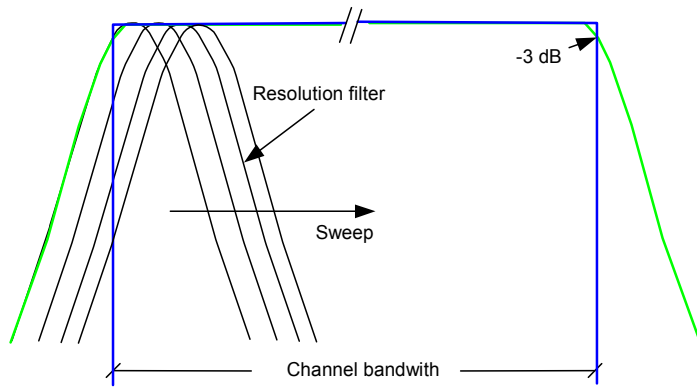
Fig. 2–16   Approximating the channel filter by sweeping with a small resolution bandwidth

The following steps are performed:

- The linear power of all the trace pixels within the channel is calculated.

  $P_i = 10^{(L_i/10)}$

  where P_i = power of the trace pixel i

           L_i = displayed level of trace point i

- The powers of all trace pixels within the channel are summed up and the sum is divided by the number of trace pixels in the channel.
- The result is multiplied by the quotient of the selected channel bandwidth and the noise bandwidth of the resolution filter (RBW).

Since the power calculation is performed by integrating the trace within the channel bandwidth, this method is also called the IBW method (**I**ntegration **B**and**w**idth method).

Parameter settings

For selection of the sweep time, see next section. For details on the parameter settings refer to chapter "Instrument Functions", section "Settings of the CP / ACP test parameters" or the Online Help.

Sweep time selection

The number of A/D converter values, N, used to calculate the power, is defined by the sweep time. The time per trace pixel for power measurements is directly proportional to the selected sweep time.

If the sample detector is used, it is best to select the smallest sweep time possible for a given span and resolution bandwidth. The minimum time is obtained if the setting is coupled. This means that the time per measurement is minimal. Extending the measurement time does not have any advantages as the number of samples for calculating the power is defined by the number of trace pixels in the channel.

If the RMS detector is used, the repeatability of the measurement results can be influenced by the selection of sweep times. Repeatability is increased at longer sweep times.

Repeatability can be estimated from the following diagram:
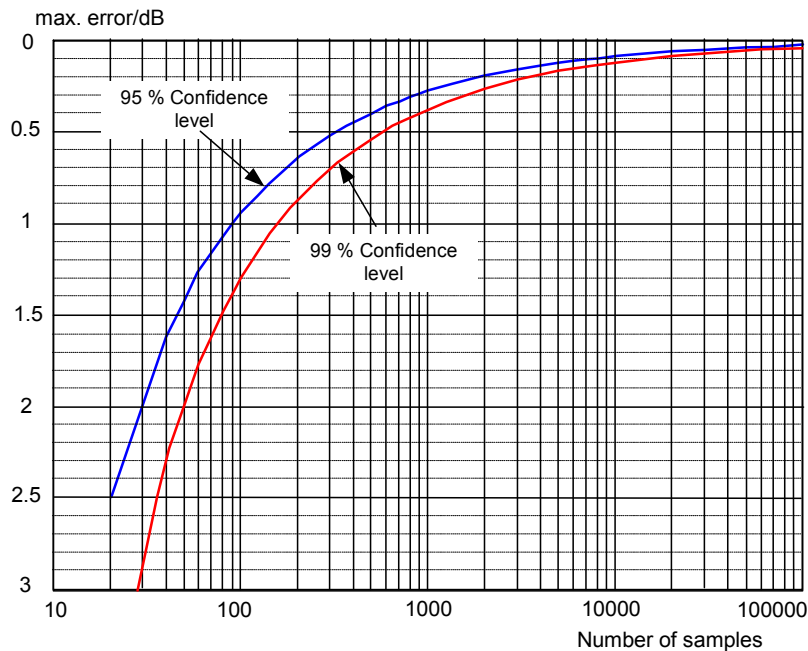
Fig. 2–17   Repeatability of channel power measurements as a function of the number of samples used for power calculation

The curves in Fig. 2–17 indicate the repeatability obtained with a probability of 95% and 99% depending on the number of samples used.

The repeatability with 600 samples is ± 0.5 dB. This means that – if the sample detector and a channel bandwidth over the whole diagram (channel bandwidth = span) is used – the measured value lies within ± 0.5 dB of the true value with a confidence level of 99%.

If the RMS detector is used, the number of samples can be estimated as follows:

Since only uncorrelated samples contribute to the RMS value, the number of samples can be calculated from the sweep time and the resolution bandwidth.

Samples can be assumed to be uncorrelated if sampling is performed at intervals of 1/RBW. The number of uncorrelated samples is calculated as follows:

$$N_{decorr} = SWT \cdot RBW \ (N_{decorr} \text{ means uncorrelated samples})$$

The number of uncorrelated samples per trace pixel is obtained by dividing N_{decorr} by 501 (= pixels per trace).

Example

At a resolution bandwidth of 30 kHz and a sweep time of 100 ms, 3000 uncorrelated samples are obtained. If the channel bandwidth is equal to the frequency display range, i.e. all trace pixels are used for the channel power measurement, a repeatability of 0.2 dB with a probability of 99% is the estimate that can be derived from Fig. 2–17.

Measuring Phase Noise

The R&S ZVL has an easy–to–use marker function for phase noise measurements. This marker function indicates the phase noise of an RF oscillator at any carrier in dBc in a bandwidth of 1 Hz.

Measurement example – Measuring the phase noise of a signal generator at a carrier offset of 10 kHz

Test setup:
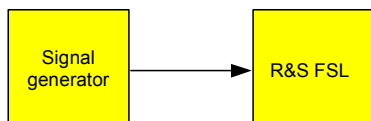
Signal generator settings (e.g. R&S SMU):

Frequency: 100 MHz

Level: 0 dBm

Procedure:

1. Set the spectrum analyzer to its default state.

    – Press the **PRESET** key.

    R&S ZVL is in its default state.

2. Set the center frequency to 100 MHz and the span to 50 kHz.

    – Press the **CENTER** key and enter *100 MHz*.

    – Press the **SPAN** key and enter *50 kHz*.

3. Set the R&S ZVL's reference level to 0 dBm (=signal generator level).

    – Press the **AMPT** key and enter *0 dBm*.

4. Enable phase noise measurement.

    – Press the **MKR** key.

    – Press the Phase Noise/Ref Fixed softkey.

    The R&S ZVL activates phase noise measurement. Marker 1 (=main marker) and marker 2 (= delta marker) are positioned on the signal maximum. The position of the marker is the reference (level and frequency) for the phase noise measurement. A horizontal line represents the level of the reference point and a vertical line the frequency of the reference point. The dialog box for the delta marker is displayed so that the frequency offset at which the phase noise is to be measured can be entered directly.

5. Set the frequency offset to 10 kHz for determining phase noise.

    – Enter *10 kHz*.

The R&S ZVL displays the phase noise at a frequency offset of 10 kHz. The magnitude of the phase noise in dBc/Hz is displayed in the delta marker output field at the top right of the screen (Phn2).

6. Stabilize the measurement result by activating trace averaging.

   – Press the **TRACE** key.

   – Press the **Trace Mode** key.

   – In the **Trace Mode** dialog box, mark **Average** using the rotary knob or the arrow keys and confirm using the rotary knob or the **ENTER** key.

Fig. 2–18   Measuring phase noise with the phase–noise marker function

The frequency offset can be varied by moving the marker with the rotary knob or by entering a new frequency offset as a number.

Measurements on Modulated Signals

For measurements on AM and FM signals refer to the Quick Start Guide, chapter 5, "Basic Measurements Examples".

Measuring Channel Power and Adjacent Channel Power

Measuring channel power and adjacent channel power is one of the most important tasks in the field of digital transmission for a spectrum analyzer with the necessary test routines. While, theoretically, channel power could be measured at highest accuracy with a power meter, its low selectivity means that it is not suitable for measuring adjacent channel power as an absolute value or relative to the transmit channel power. The power in the adjacent channels can only be measured with a selective power meter.

A spectrum analyzer cannot be classified as a true power meter, because it displays the IF envelope voltage. However, it is calibrated such as to correctly display the power of a pure sinewave signal irrespective of the selected detector. This calibration cannot be applied for non–sinusoidal signals. Assuming that the digitally modulated signal has a Gaussian amplitude distribution, the signal power within the selected resolution bandwidth can be obtained using correction factors. These correction factors are normally used by the spectrum analyzer's internal power measurement routines in order to determine the signal power from IF envelope measurements. These factors apply if and only if the assumption of a Gaussian amplitude distribution is correct.

Apart from this common method, the R&S ZVL also has a true power detector, i.e. an RMS detector. It correctly displays the power of the test signal within the selected resolution bandwidth irrespective of the amplitude distribution, without additional correction factors being required. The absolute measurement uncertainty of the ZVL is < 1.5 dB and a relative measurement uncertainty of < 0.5 dB (each with a confidence level of 95%).

There are two possible methods for measuring channel and adjacent channel power with a spectrum analyzer:

*   IBW method (**I**ntegration **B**andwidth **M**ethod)
    The spectrum analyzer measures with a resolution bandwidth that is less than the channel bandwidth and integrates the level values of the trace versus the channel bandwidth. This method is described in section "Method of calculating the channel power".

*   Using a channel filter
    For a detailed description, refer to the following section.

Measurement using a channel filter

In this case, the spectrum analyzer makes zero span measurements using an IF filter that corresponds to the channel bandwidth. The power is measured at the output of the IF filter. Until now, this method has not been used for spectrum analyzers, because channel filters were not available and the resolution bandwidths, optimized for the sweep, did not have a sufficient selectivity. The method was reserved for special receivers optimized for a particular transmission method. It is available in R&S FSQ, FSU, FSP, FSL and ZVL series.

The R&S ZVL has test routines for simple channel and adjacent channel power measurements. These routines give quick results without any complex or tedious setting procedures.

Measurement example 1 – ACPR measurement on an CDMA 2000 signal

Test setup:
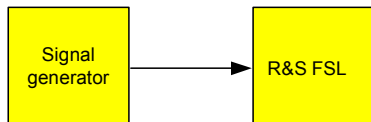
Signal generator settings (e.g. R&S SMU):

Frequency:　　　850 MHz

Level:　　　　　0 dBm

Modulation:　　CDMA 2000

Procedure:

1. Set the spectrum analyzer to its default state.

   − Press the **PRESET** key.

   The R&S ZVL is in its default state.

2. Set the center frequency to 850 MHz and span to 4 MHz.

   − Press the **CENTER** key and enter *850 MHz*.

   − Press the **SPAN** key and enter *4 MHz*.

3. Set the reference level to +10 dBm.

   − Press the **AMPT** key and enter *10 dBm*.

4. Configuring the adjacent channel power for the CDMA 2000 MC1.

   − Press the **MEAS** key.

   − Press the **CP, ACP, MC–ACP** softkey.

   − Press the **CP / ACP Standard** softkey.

   − In the standards list, mark **CDMA 2000 MC1** using the rotary knob or the arrow keys and confirm pressing the rotary knob or the **ENTER** key.

   The R&S ZVL sets the channel configuration according to the 2000 MC1 standard for mobile stations with 2 adjacent channels above and below the transmit channel. The spectrum is displayed in the upper part of the screen, the numeric values of the results and the channel configuration in the lower part of the screen. The various channels are represented by vertical lines on the graph.

   The frequency span, resolution bandwidth, video bandwidth and detector are selected automatically to give correct results. To obtain stable results – especially in the adjacent channels (30 kHz bandwidth) which are narrow in comparison with the transmission channel bandwidth (1.23 MHz) – the RMS detector is used.

5. Set the optimal reference level and RF attenuation for the applied signal level.

   − Press the **Adjust Ref Level** softkey.

The R&S ZVL sets the optimal RF attenuation and the reference level based on the transmission channel power to obtain the maximum dynamic range. Fig. 2–19 shows the result of the measurement.
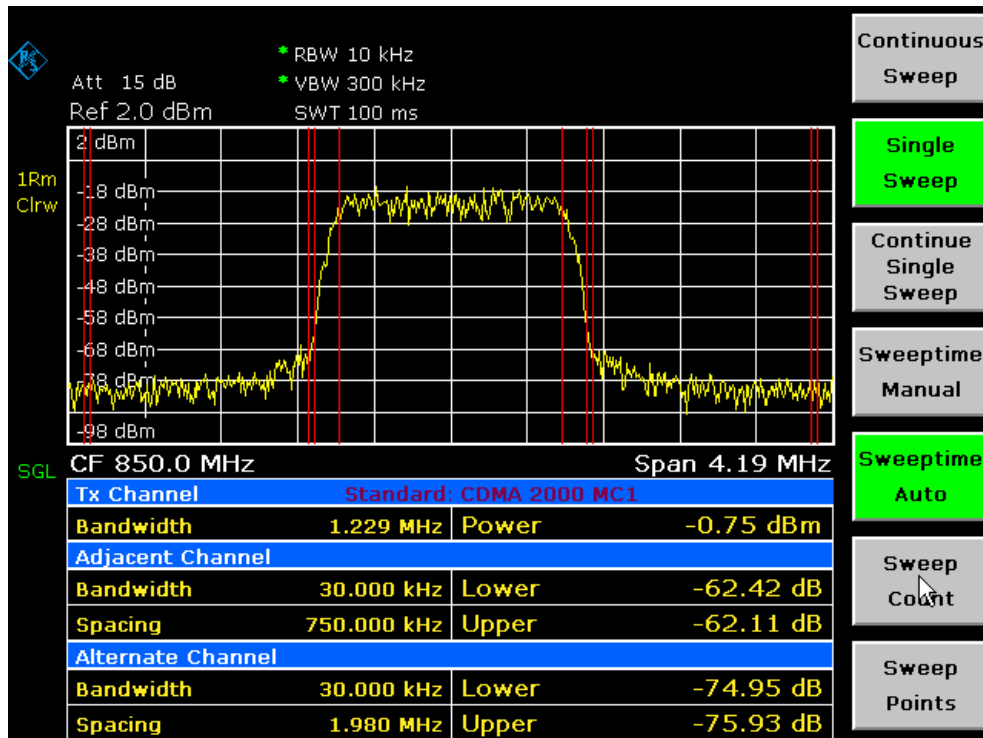

Fig. 2–19   Adjacent channel power measurement on a CDMA 2000 MC1 signal

The repeatability of the results, especially in the narrow adjacent channels, strongly depends on the measurement time since the dwell time within the 30 kHz channels is only a fraction of the complete sweep time. A longer sweep time may increase the probability that the measured value converges to the true value of the adjacent channel power, but this increases measurement time.

To avoid long measurement times, the R&S ZVL measures the adjacent channel power with zero span (fast ACP mode). In the fast ACP mode, the R&S ZVL measures the power of each channel at the defined channel bandwidth, while being tuned to the center frequency of the channel in question. The digital implementation of the resolution bandwidths makes it possible to select filter characteristics that is precisely tailored to the signal. In case of CDMA 2000 MC1, the power in the useful channel is measured with a bandwidth of 1.23 MHz and that of the adjacent channels with a bandwidth of 30 kHz. Therefore the R&S ZVL changes from one channel to the other and measures the power at a bandwidth of 1.23 MHz or 30 kHz using the RMS detector. The measurement time per channel is set with the sweep time. It is equal to the selected measurement time divided by the selected number of channels. The five channels from the above example and the sweep time of 100 ms give a measurement time per channel of 20 ms.

Compared to the measurement time per channel given by the span (= 5 MHz) and sweep time (= 100 ms, equal to 0.600 ms per 30 kHz channel) used in the example, this is a far longer dwell time on the adjacent channels (factor of 12). In terms of the number of uncorrelated samples this means 20000/33 µs = 606 samples per channel measurement compared to 600/33µs = 12.5 samples per channel measurement.

Repeatability with a confidence level of 95% is increased from ± 1.4 dB to ± 0.38 dB as shown in Fig. 2–17. For the same repeatability, the sweep time would have to be set to 1.2 s with the integration method. Fig. 2–20 shows the standard deviation of the results as a function of the sweep time.
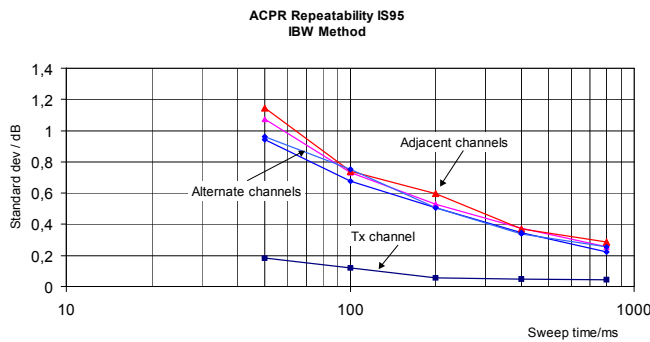
Fig. 2–20   Repeatability of adjacent channel power measurement on CDMA 2000 standard signals if the integration bandwidth method is used

6.   Switch to fast ACP mode to increase the repeatability of results.

−   Switch the **Fast ACP** softkey to **On**.

The R&S ZVL measures the power of each channel with zero span. The trace represents power as a function of time for each channel (see Fig. 2–23). The numerical results over consecutive measurements become much more stable.

Fig. 2–21   Measuring the channel power and adjacent channel power ratio for 2000 MC1 signals with zero span (Fast ACP)

Fig. 2–22 shows the repeatability of power measurements in the transmit channel and of relative power measurements in the adjacent channels as a function of sweep time. The standard deviation of measurement results is calculated from 100 consecutive measurements as shown in Fig. 2–22. Take scaling into account if comparing power values.
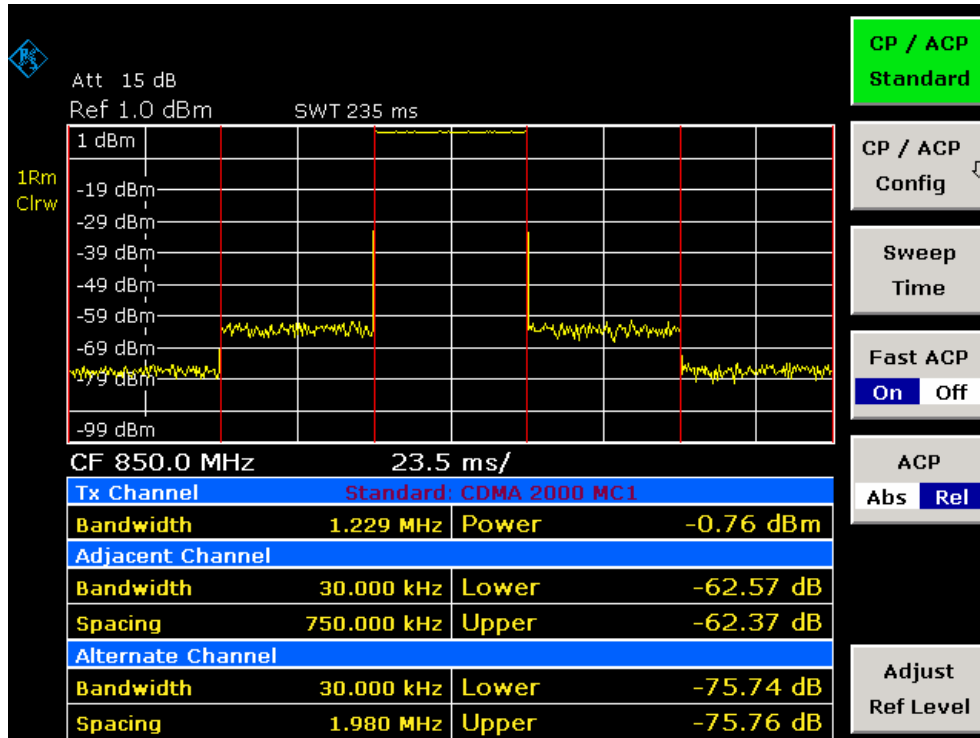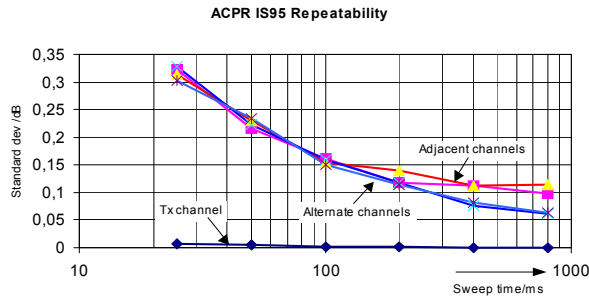

Fig. 2–22   Repeatability of adjacent channel power measurements on CDMA 2000 signals in the fast ACP mode

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Note on adjacent channel power measurements on 2000 MC1 base–station signals:
When measuring the adjacent channel power of 2000 MC1 base–station signals, the frequency spacing of the adjacent channel to the nominal transmit channel is specified as ±750 kHz. The adjacent channels are, therefore, so close to the transmit channel that the power of the transmit signal leaks across and is also measured in the adjacent channel if the usual method using the 30 kHz resolution bandwidth is applied. The reason is the low selectivity of the 30 kHz resolution filter. The resolution bandwidth, therefore, must be reduced considerably, e.g. to 3 kHz to avoid this. This causes very long measurement times (factor of 100 between a 30 kHz and 3 kHz resolution bandwidth).
This effect is avoided with the zero span method which uses steep IF filters. The 30 kHz channel filter implemented in the R&S ZVL has a very high selectivity so that even with a ± 750 kHz spacing to the transmit channel the power of the useful modulation spectrum is not measured.

The following figure shows the passband characteristics of the 30 kHz channel filter in the R&S ZVL.

Fig. 2–23   Frequency response of the 30 kHz channel filter for measuring the power in the 2000 MC1 adjacent channel

Measurement example 2 – Measuring adjacent channel power of a W–CDMA uplink signal

Test setup:

Signal generator → R&S FSL

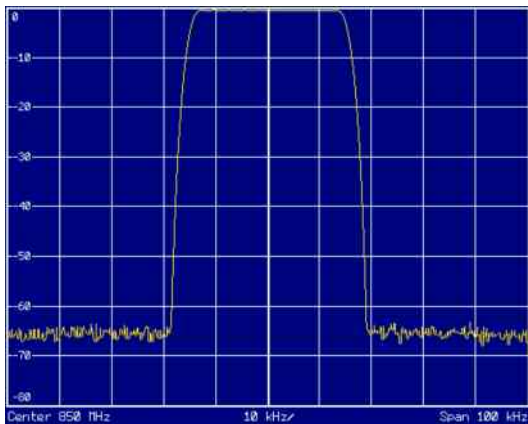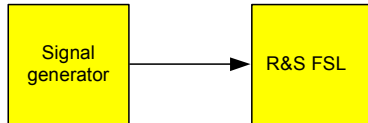**Signal generator settings (e.g. R&S SMU):**

Frequency: 1950 MHz

Level: 4 dBm

Modulation: 3 GPP W–CDMA Reverse Link

Procedure:

1. Set the spectrum analyzer to its default state.

   − Press the **PRESET** key.

     The R&S ZVL is in its default state.

2. Set the center frequency to 1950 MHz.

   − Press the **CENTER** key and enter *1950 MHz*.

3. Switch on the ACP measurement for W–CDMA.

   − Press the **MEAS** key.

   − Press the **CP, ACP, MC–ACP** softkey.

   − Press the **CP / ACP Standard** softkey.

   − In the standards list, mark **W–CDMA 3GPP REV** using the rotary knob or the arrow keys and confirm pressing the rotary knob or the **ENTER** key.

   The R&S ZVL sets the channel configuration to the 3GPP W–CDMA standard for mobiles with two adjacent channels above and below the transmit channel. The frequency span, the resolution and video bandwidth and the detector are automatically set to the correct values. The spectrum is displayed in the upper part of the screen and the channel power, the level ratios of the adjacent channel powers and the channel configuration in the lower part of the screen. The individual channels are displayed as vertical lines on the graph.

4. Set the optimum reference level and the RF attenuation for the applied signal level.

   − Press the **Adjust Ref Level** softkey.

   The R&S ZVL sets the optimum RF attenuation and the reference level for the power in the transmission channel to obtain the maximum dynamic range. The following figure shows the result of the measurement.
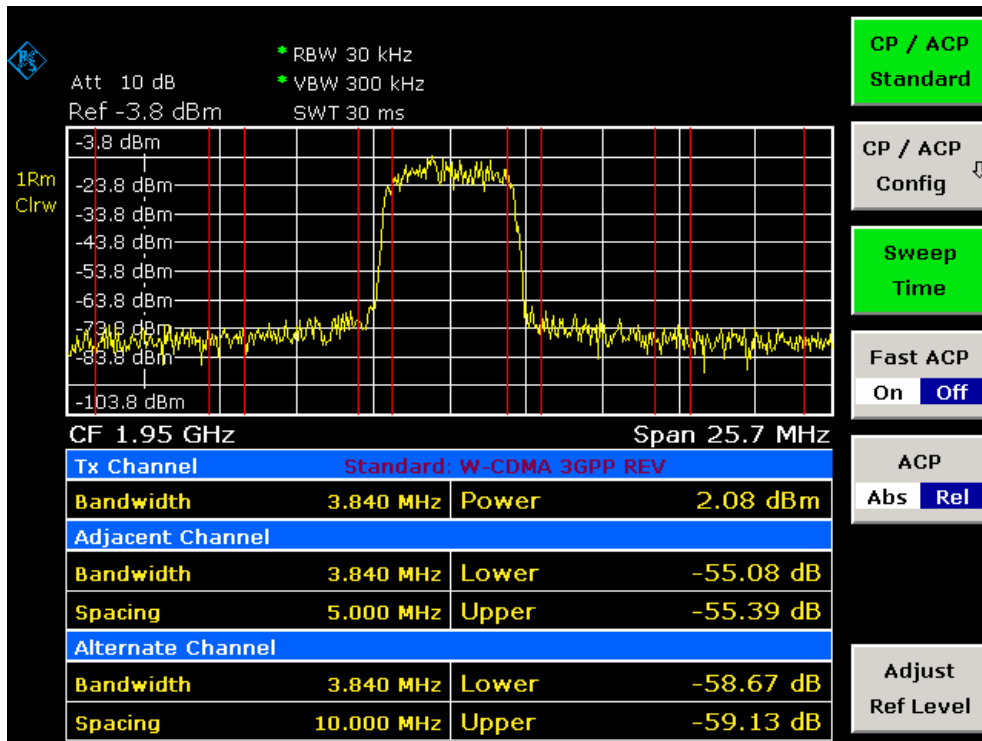
Fig. 2–24   Measuring the relative adjacent channel power on a W–CDMA uplink signal

5.   Measuring adjacent channel power with the fast ACP mode.

   −   Set **Fast ACP** softkey to **On**.

   −   Press the **Adjust Ref Level** softkey.

   The R&S ZVL measures the power of the individual channels with zero span. A root raised cosine filter with the parameters α = 0.22 and chip rate 3.84 Mcps (= receive filter for 3GPP W–CDMA) is used as channel filter.
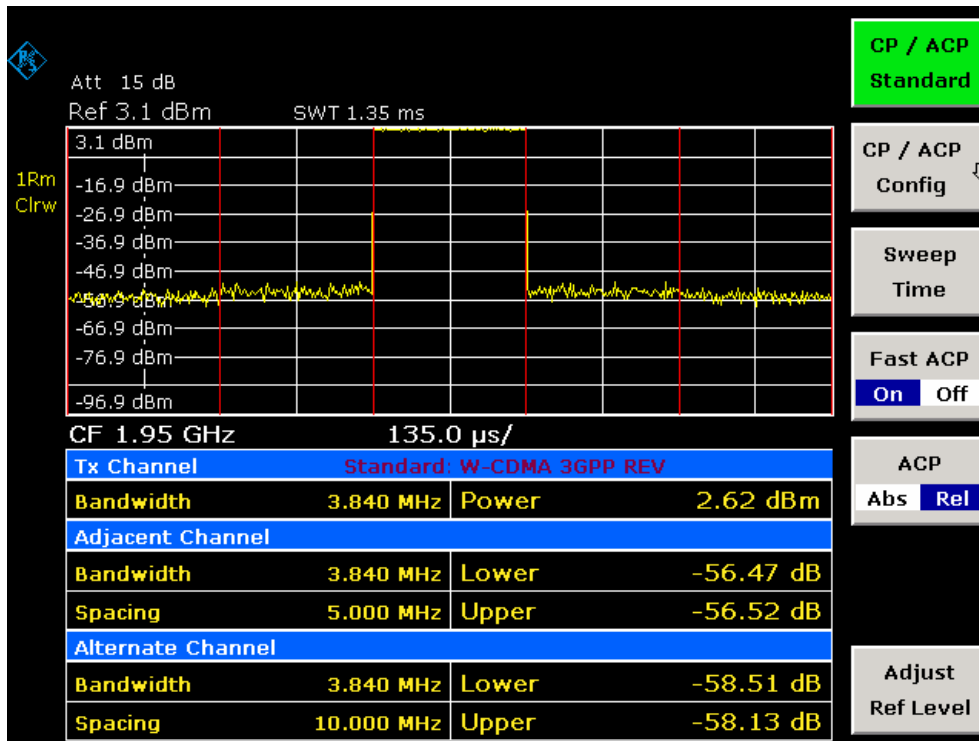
Fig. 2–25   Measuring the adjacent channel power of a W–CDMA signal with the fast ACP mode

> *Note:*   *With W–CDMA, the R&S ZVL's dynamic range for adjacent channel measurements is limited by the 12–bit A/D converter. The greatest dynamic range is, therefore, obtained with the IBW method.*

Optimum Level Setting for ACP Measurements on W–CDMA Signals

The dynamic range for ACPR measurements is limited by the thermal noise floor, the phase noise and the intermodulation (spectral regrowth) of the spectrum analyzer. The power values produced by the R&S ZVL due to these factors accumulate linearly. They depend on the applied level at the input mixer. The three factors are shown in the figure below for the adjacent channel (5 MHz carrier offset).
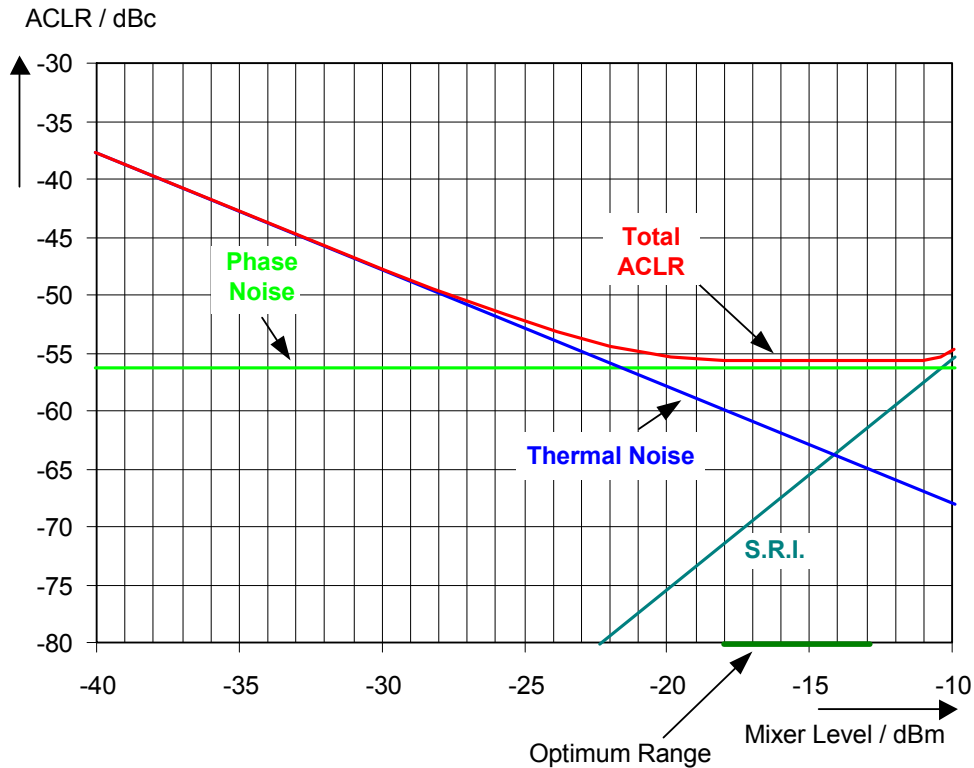
Fig. 2–26   The R&S ZVL's dynamic range for adjacent channel power measurements on W–CDMA uplink signals is a function of the mixer level.

The level of the W–CDMA signal at the input mixer is shown on the horizontal axis, i.e. the measured signal level minus the selected RF attenuation. The individual components which contribute to the power in the adjacent channel and the resulting relative level (total ACPR) in the adjacent channel are displayed on the vertical axis. The optimum mixer level is –21 dBm. The relative adjacent channel power (ACPR) at an optimum mixer level is –65 dBc. Since, at a given signal level, the mixer level is set in 10 dB steps with the 10 dB RF attenuator, the optimum 10 dB range is shown in the figure: it spreads from –16 dBm to –26 dBm. In this range, the obtainable dynamic range is 62 dB.

To set the attenuation parameter manually, the following method is recommended:

- Set the RF attenuation so that the mixer level (= measured channel power – RF attenuation) is between –11 dBm and –21 dBm.

- Set the reference level to the largest possible value where no overload (IFOVL) is indicated.

This method is automated with the **Adjust Ref Level** function. Especially in remote control mode, e.g. in production environments, it is best to correctly set the attenuation parameters prior to the measurement, as the time required for automatic setting can be saved.

> *Note:*   *To measure the R&S ZVL's intrinsic dynamic range for W–CDMA adjacent channel power measurements, a filter which suppresses the adjacent channel power is required at the output of the transmitter. A SAW filter with a bandwidth of 4 MHz, for example, can be used.*

Amplitude Distribution Measurements

If modulation types are used that do not have a constant zero span envelope, the transmitter has to handle peak amplitudes that are greater than the average power. This includes all modulation types that involve amplitude modulation –QPSK for example. CDMA transmission modes in particular may have power peaks that are large compared to the average power.

For signals of this kind, the transmitter must provide large reserves for the peak power to prevent signal compression and thus an increase of the bit error rate at the receiver.

The peak power or the crest factor of a signal is therefore an important transmitter design criterion. The crest factor is defined as the peak power / mean power ratio or, logarithmically, as the peak level minus the average level of the signal.

To reduce power consumption and cut costs, transmitters are not designed for the largest power that could ever occur, but for a power that has a specified probability of being exceeded (e.g. 0.01%).

To measure the amplitude distribution, the R&S ZVL has simple measurement functions to determine both the APD = Amplitude Probability Distribution and CCDF = Complementary Cumulative Distribution Function.

In the APD display mode, the probability of occurrence of a certain level is plotted against the level.

In the CCDF display mode, the probability that the mean signal power will be exceeded is shown in percent.

Measurement example – Measuring the APD and CCDF of white noise generated by the R&S ZVL

1. Set the spectrum analyzer to its default state.

    – Press the **PRESET** key.

        The R&S ZVL is in its default state.

2. Configure the R&S ZVL for APD measurement

    – Press the **AMPT** key and enter *–60 dBm*.

        The R&S ZVL's intrinsic noise is displayed at the top of the screen.

    – Press the **MEAS** key.

    – Press the **More** softkey.

    – Press the **APD** softkey.

        The R&S ZVL sets the frequency span to 0 Hz and measures the amplitude probability distribution (APD). The number of uncorrelated level measurements used for the measurement is 100000. The mean power and the peak power are displayed in dBm. The crest factor (peak power – mean power) is output as well.
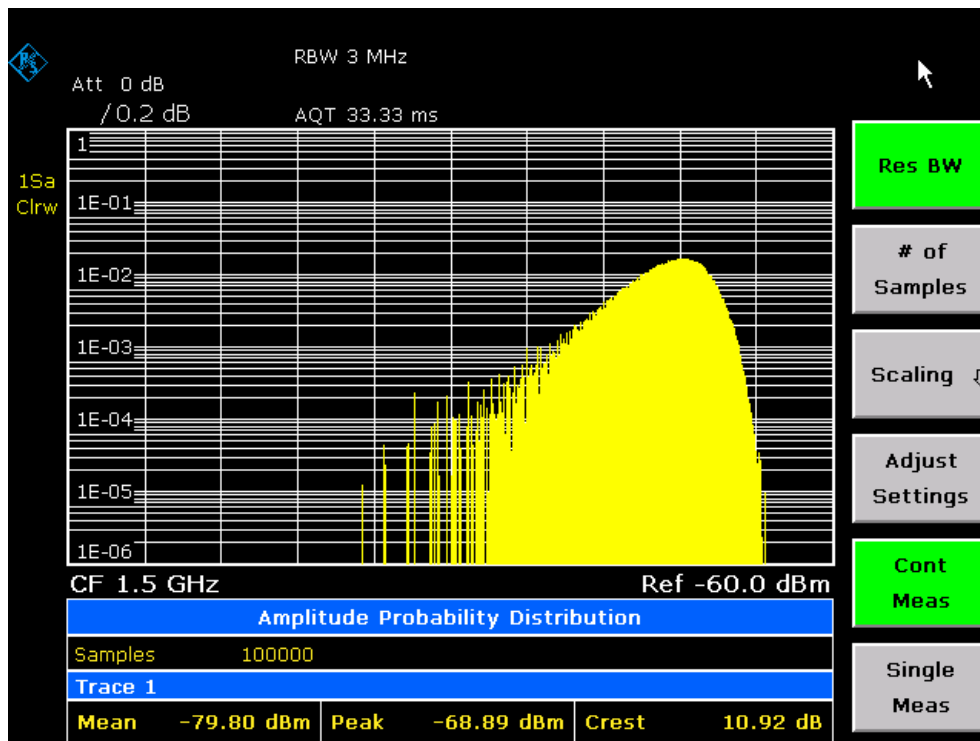
Fig. 2–27   Amplitude probability distribution of white noise

3.   Switch to the CCDF display mode.

   −   Press the ▲ key.

   −   Press the **CCDF** softkey.

      The CCDF display mode is switched on.
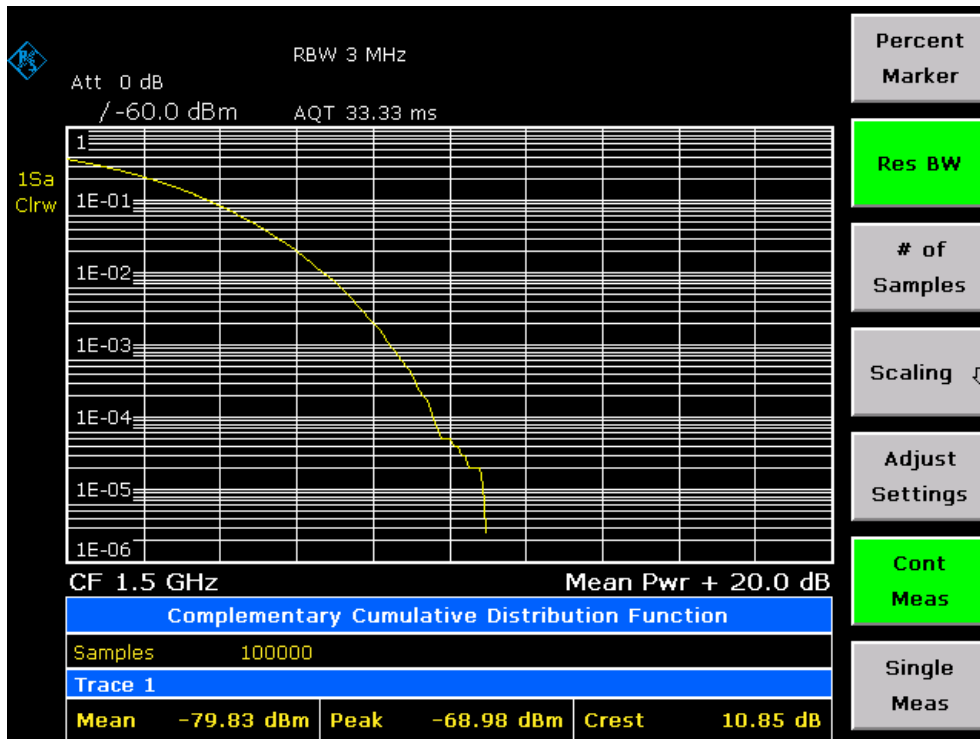
Fig. 2–28   CCDF of white noise

The CCDF trace indicates the probability that a level will exceed the mean power. The level above the mean power is plotted along the x–axis of the graph. The origin of the axis corresponds to the mean power level. The probability that a level will be exceeded is plotted along the y–axis.

4. Bandwidth selection

When the amplitude distribution is measured, the resolution bandwidth must be set so that the complete spectrum of the signal to be measured falls within the bandwidth. This is the only way of ensuring that all the amplitudes will pass through the IF filter without being distorted. If the resolution bandwidth which is selected is too small for a digitally modulated signal, the amplitude distribution at the output of the IF filter becomes a Gaussian distribution according to the central limit theorem and so corresponds to a white noise signal. The true amplitude distribution of the signal therefore cannot be determined.

5. Selecting the number of samples

For statistics measurements with the R&S ZVL, the number of samples $N_{Samples}$ is entered for statistical evaluation instead of the sweep time. Since only statistically independent samples contribute to statistics, the measurement or sweep time is calculated automatically and displayed. The samples are statistically independent if the time difference is at least 1/RBW. The sweep time SWT is, therefore, expressed as follows:

$SWT = N_{Samples} / RBW$

Bluetooth Measurements (Option K8)

This section gives background information on Bluetooth Measurements (option K8).

For further information on measurement examples refer also to the Quick Start Guide, chapter 5 "Basic Measurement Examples".

Bluetooth Overview

This section provides general information on Bluetooth measurements:

Bluetooth technical parameters

Table 2–1 Common Parameters

frequency bands	2402 + (0...78) MHz
channel spacing	1 MHz
symbol rate	1 Msym/s
slot length (frequency hopping)	625 μsec
packet sizes	1, 3, 5 slot packets

Table 2–2 Modulation Parameters Basic Rate

modulation	GFSK
TX filter	Gaussian
BT /	0.5
modulation index	0.28 – 0.35 nominal 0.32
frequency deviation	160 kHz settled 141 kHz 010101 suite
bandwidth –3dB –20dB	220 kHz 1 MHz
bit rate	1 Mbps

Table 2–3 Modulation Parameters Enhanced Data Rate

modulation	π/4–DQPSK	8DPSK
TX filter	RRC	RRC
roll–off factor	0.4	0.4
bandwidth –3dB	± 500kHz	± 500kHz
bit rate	2 Mbps	3 Mbps

Power classes

Power Class	Maximum (P_{max})	Nominal	Minimum (P_{min})	Power Control
1	100 mW (20 dBm)		1 mW (0 dBm)	from P_{min} (< +4 dBm) to P_{max}
2	2.5 mW (4dBm)	1 mW (0 dBm)	0.25 mW (–6dBm)	optional
3	1 mW (0dBm)			optional

Structure of a Bluetooth data packet

Every Bluetooth data packet is divided into 3 basic section: access code, header and payload. The following figures show the order and bit lengths of the individual sections:

access code 72 bits			54 bits	240 / 1496 / 2744 bits
4 bits	64 bits	4 bits	header	payload*)
preamble	sync word	trailer		

*) During EUT evaluation the payload contains certain bit sequences: PRBS9 (Pseudo Random Bit Sequence) or 11110000 or 10101010.

The sync word is transmitted as the major part of the access code. For this purpose, the LAP (lower address part) of the BD address is expanded to 64 bit by adding the BCH code and baker.

sync word 64 bits		
BCH code 34 bits	LAP 24 bits	Barker 6 bits

The LAP (lower address part) of the BD address serves as a basis for the sync word.

BD – address 48 bits		
NAP 16 bits	UAP 8 bits	LAP 24 bits

In case of EDR packets the payload is divided into 6 other sections:

	DPSK				
guard	SYNC	payload	user payload	CRC	trailer
5µs		header	0–2723Symb	code	

Supported Tests

The Bluetooth Measurements Option supports measurements according to the Bluetooth RF Test Specification (Bluetooth SIG) , Revision 2.0.E.3, Mar 2005, on the R&S ZVL spectrum analyzer. The following tests are currently implemented according to this specification:

- Output Power
- TX Output Spectrum – Adjacent Channel Power
- Modulation Characteristics
- Initial Carrier Frequency Tolerance (ICFT)
- Carrier Frequency Drift

- EDR Relative Transmit Power
- EDR Carrier Frequency Stability and Modulation Accuracy
- EDR Differential Phase Encoding
- EDR In–band Spurious Emissions

Overview of Transmitter Tests

Table 2–4 Basic Rate Measurements

	Output Power	TX Output Spectrum – Adjacent Channel Power	Modulation Characteristics	Initial Carrier Frequency Tolerance	Carrier Frequency Drift
Hop	on	off	off	on / off	on / off
Trigger	extern	–	–	–	–
Synchronization	Yes (p0), but also possible without	no	yes (p0)	yes (p0)	yes (p0)
Packet Type	longest supported	DH1	longest supported	DH1	all supported packets (DH1/3/5)
Payload	PRBS 9	PRBS 9	11110000 10101010	PRBS 9	10101010
Test Mode	loop back	loop back	loop back	loop back	loop back
Operating Mode	IQ mode	analyzer zero span	IQ mode	IQ mode	IQ mode
RBW	3 MHz	100 kHz	–	–	–
VBW	3 MHz	300 kHz	–	–	–
Power	supported maximum	supported maximum	supported maximum	supported maximum	not specified
Sweep Time	one complete packet	79s per sweep (= 100ms * 10 * 79)	one complete packet	–	one complete packet
Sweep Count	–	10	10 (extern)	10	10
Trace Mode	Maxh	Maxh	–	–	–
Detector	Peak	Aver	–	–	–
Frequency in MHz	low / middle / high	each channel	low / middle / high	low / middle / high	low / middle / high
Span	–	–	–	–	–
Test cond	norm / ext	norm / ext	norm / ext	norm / ext	norm / ext
Results	peak and average power 1) $P_{AV} < 100$ mW (20 dBm) 2) $P_{PK} < 200$ mW (23 dBm) 3) $P_{max} > P_{AV}$ $> P_{min}$ at maximum power step $P_{AV} < 1$ mW (0 dBm)	channel power of all channels 1) $P_{TX}(f) \leq -20$ dBm for $|M{-}N| = 2$ 2) $P_{TX}(f) \leq -40$ dBm for $|M{-}N| \geq 3$	all 8 bit peak deviations and average deviations	carrier offset within the 4 preamble bits	carrier offsets of the 4 bit preamble, of all 10 bit payload sequences; maximum drift rate of all 10 bit payload sequences at 50 µs offset

Table 2–5 Enhanced Data Rate Measurements

	EDR Relative TX Power	EDR Carrier Frequency Stability and Modulation Accuracy	EDR Differential Phase Encoding	EDR In–band Spurious Emissions
Hop	off	off	off	off
Trigger	–	–	–	extern/ IF power
Synchronization	yes	yes	yes	yes, needed for gate adjustment
Packet Type	longest supported	longest supported	longest supported	longest supported
Payload	PRBS 9	PRBS9	PRBS9	PRBS9
Test Mode	loop back	loop back	TX mode	loop back
Operating Mode	IQ mode	IQ mode	IQ mode	analyzer zero span
RBW	3 MHz	–	–	100 kHz
VBW	3 MHz	–	–	300 kHz
Power	supported minimum/ maximum	supported minimum/ maximum	supported minimum/ maximum	supported minimum/ maximum
Sweep Time	one complete packet	one complete packet	one complete packet	10*79* gate length
Sweep Count	10	200 blocks	100	10
Trace Mode	ClrWr	–	–	Maxh
Detector	Aver	–	–	Aver
Frequency in MHz	low / middle / high	low / middle / high	low / middle / high	each channel
Span	–	–	–	79 MHz
Test cond	norm / ext	norm / ext	norm / ext	norm / ext
Results	ratio of DPSK and GFSK power	carrier frequency stability and error vector magnitude	number of failed packets	channel power of all channels

Functional Description – Block Diagram

The Adjacent Channel Power and EDR In–band Spurious Emissions measurements are performed in the spectrum analyzer operating mode of the analyzer. For this test case the complete frequency band is scanned using a sequence of zero span measurements.

All other test cases are based on a digital I/Q demodulator which determines the temporal characteristics of power and frequency. The output data of the demodulator are the basis for calculation of all relevant measurement results like modulation characteristics or output power. The demodulator reaches a maximum in accuracy and temperature stability by sampling the IF signal and converting it digitally down into the base band (I/Q area).

The measurements are performed by passing the following signal processing steps:

- LAP (Lower Address Part) trigger detection

- Resampling

- Channel filtering

- Automated packet and bit pattern detection

- Limit check

- Parallel display of measurement curves and numeric results on the screen

Fig. 2–1 shows the analyzer hardware from the IF to the processor. The analog IF filter is fixed to 20MHz. The A/D converter samples the 20 MHz IF signal with a sampling frequency of 65.83 MHz.

Low pass filtering is performed after the signal has been down–converted into the complex base band and the data rate is reduced in the sequence. The amount of decimation depends on the selected oversampling factor = points / symbol. The default setting is 4, resulting in a 4 MHz sampling rate. For EDR–measurements, the oversampling factor is always fixed to 4. The resulting I/Q data are stored in a memory of 512 k words for I and Q respectively. The hardware trigger (external or IF power) controls the memory access.
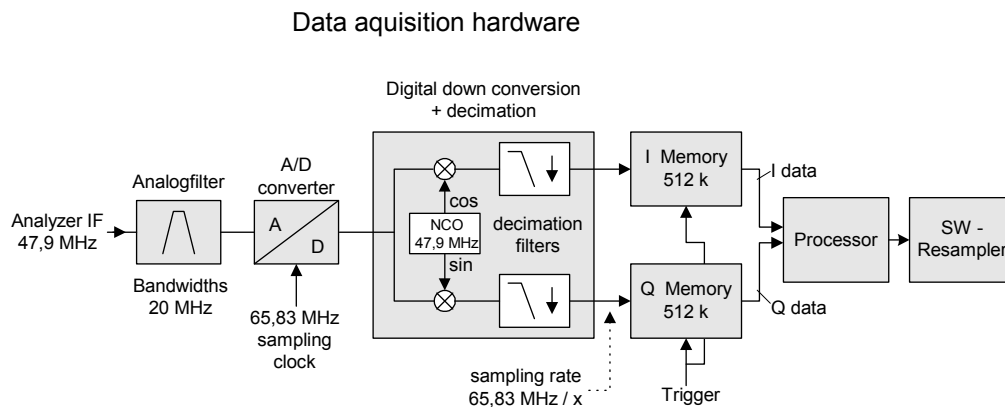
Data aquisition hardware

Fig. 2–29 Block diagram of the signal processing architecture of the analyzer

Bandwidths

The Bluetooth RF Specification defines a minimal bandwidth of 3 MHz. The digital bandwidth depends on the selected oversampling factor (= points / symbol). With the default setting of 4, the digital bandwidth is 3 MHz. This digital filter has a flat amplitude characteristics and does not affect the frequency deviation of the signal.

Measurement Filter (Meas Filter On)

The RF Specification allows high distortion power in the first adjacent channels. The 3 MHz filter does not suppress this kind of distortion, which leads to a high interference in modulation. Therefore a precise measurement of the frequency deviation is not possible.

In order to obtain correct deviation results, the analyzer supplies an optional filter with a passband only appropriate for the channel to measure. This filter is used by default. The Bluetooth spectrum has a bandwidth of 1 MHz. The filter is flat within 1.04 MHz (ripple: only 0.02 dB) and has steep edges. This measurement filter is not dependent on the selected oversampling factor. As a result the displayed deviation value is increased by 3.2%, but without the filter the displayed deviation value can increase dramatically due to interference from adjacent channels. Generally the result is more precise, if the displayed deviation is lower with filtering than without filtering. In these cases the inaccuracy caused by the adjacent channel interference is higher than the systematic inaccuracy caused by the filter.
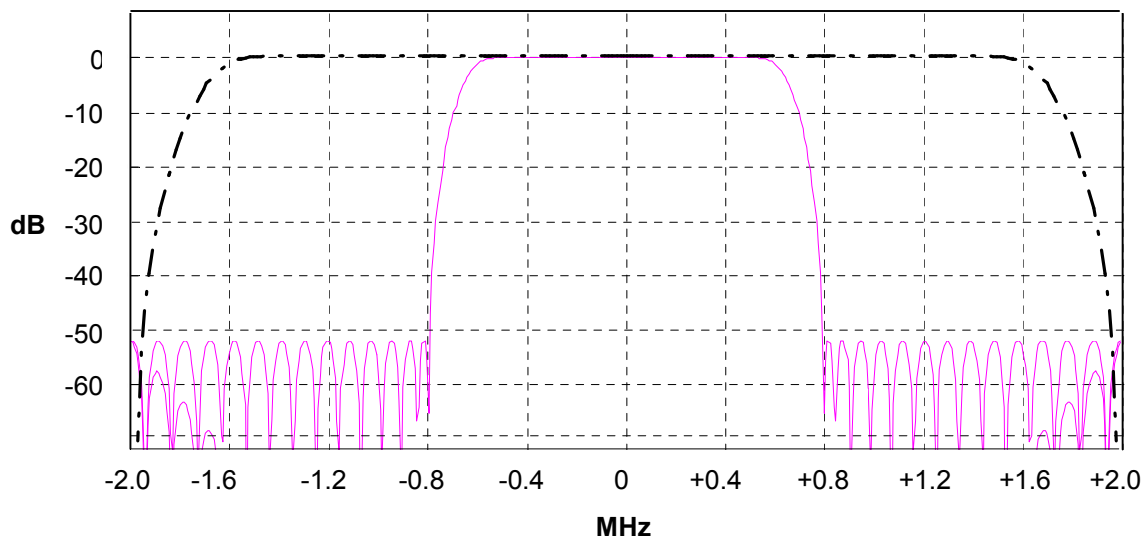

Fig. 2–30 Selection of digital filters

        Dashed–dotted curve: Standard filter with 4 points / symbol

        Solid curve: Optional measurement filter, independent of the points / symbol setting

Oversampling

The number of samples per symbol is equivalent to the sampling rate in MHz (due to the symbol length of 1 µs).
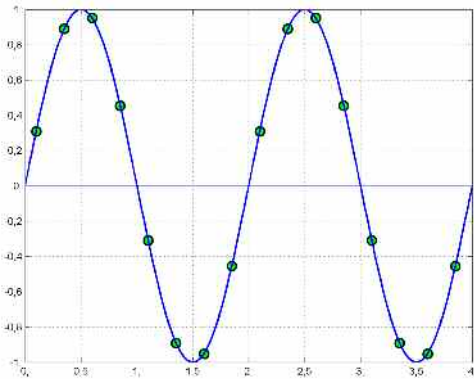
Digital bandwidth (flat area)	Points per Symbol	Sampling rate
10 MHz	32	32 MHz
8 MHz	16	16 MHz
5 MHz	8	8 MHz
3.0 MHz	4	4 MHz
1.6 MHz	2	2 MHz

According to the RF Test Specification an oversampling factor of 4 is required at minimum. For Basic Rate measurements, this oversampling factor can be selected as oversampling factor in a range from 2 to 32. For EDR–measurements, the oversampling factor is fixed to 4 which is also the default value.

Although possible but not recommended is a value > 4. It increases the measurement time due to the extended calculation effort. Additionally the resulting bandwidth will be larger than required, which leads to lower measurement accuracy, unless the optional measurement filter (Meas Filter On) is used as described in section Bandwidths.

The analyzer uses a timing offset correction in order to move the samples to the zero trespassing points. As a result there is one sample per symbol time, which is especially important for a 0101 symbol sequence in order to obtain the precise value for the peak frequency deviation.

Sampling times before timing offset correction   Sampling times after timing offset correction
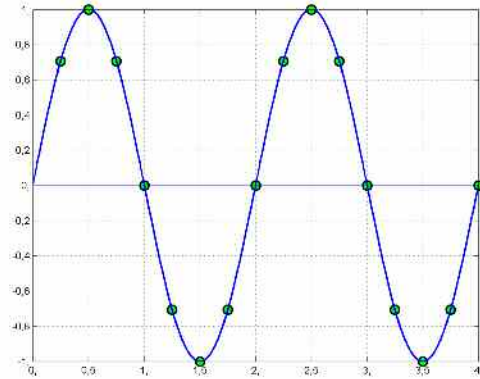

Fig. 2–31 Operation of the timing offset correction

Advantages of the timing offset correction:

- No jitter with low sampling rates
- With one sample per zero, the trespassing point is always a sample in the middle of the bit length. Therefore the maximum values in the frequency deviation of 0101 bit patterns can be detected precisely also with low sampling rates.
- The immunity to interference when determining the data bits is improved.
- Higher suppression of the distortion during peak detection.

Determining Average or Max/Min Values

These functions are very useful in order to obtain more stable results or to find sporadic spurious signals not included in every burst. In many cases the RF Test Specification defines measurements over a 10 burst period.

The number of measurements can be selected using sweep count function, thus adapting the measurement to the individual requirements.

In single sweep mode, the calculation of average or maximum / minimum values is performed over a well–defined number of sweeps (= sweep count).

Continuous sweep mode yields continuous averaging and calculation of maximum / minimum values over the whole measurement time.

Modulation measurements

They are performed in the **Clear Write** trace mode.

In continuous sweep mode, a "live" display is obtained, which allows e.g. an instant view of changes during alignment of a DUT.

In single sweep mode and with the sweep count set to 10, the analyzer will evaluate 10 bursts as required by the RF Test Specification. This means that a result is obtained after exactly 10 bursts.

Power measurements

They are performed in the **Maxhold** trace mode in relation with the defined measurement time. The measurement time is selected in order to make sure that always one complete burst is acquired. In this case, several sweeps are combined to one trace before this result trace is evaluated.

Impact of the sweep count on the measurement results

Trace Mode	Continuous Sweep	Single Sweep & Sweep Count
Clear Write	All measurement results (min., max., average) are updated with every sweep. The corresponding values are calculated based on the current curve.	Starts a measurement with n sweeps (n = sweep count). All measurement results (min., max., average) are calculated based on these n sweeps.
AVG, MaxHold, MinHold	All measurement results (min., max., average) are updated with every sweep. The corresponding values are calculated based on the current curve. The trace is the continuous average value (AVG) or the extreme value (MaxHold, MinHold) since the start of the measurement.	Starts a measurement with n sweeps (n = sweep count). n defines the number of sweeps that are taken into account for the trace math functions (AVG, MaxHold, MinHold). The n sweeps result in one trace and the measurement results (Min, Max, Average) are calculated based on this summarized trace.

The functions described above differ from the detector functions of the instrument:

- Detectors combine the measurement data obtained by oversampling to *one measurement point* on the screen. The kind of combination (Max Peak, Min Peak, Average, RMS) can be selected.

- The trace functions affect complete measurement curves: A resulting curve is calculated from *several subsequent sweeps*. The method of calculation (Average, Maxhold, Minhold) can be selected here as well.

Thus the detector is the arithmetic rule for how sample data collected with a high data rate are combined to a measurement point of one individual measurement curve, whereas the trace mode is the rule of how samples taken from several measurement curves are to be combined to a new resulting curve.

For the ACP measurement, the Average detector is set.

Trigger Concepts

As the DUT (Device Under Test) uses frequency hopping, a trigger method is necessary for two reasons:

- A measurement is only possible during the period of time, when there is a TX signal (burst) at the frequency under request.

- In order to determine the modulation characteristics correctly, a synchronization with the preamble of the signal must be supplied.

If the **Find Sync** softkey is activated, the synchronization is supplied towards the 64 bit sync word. For this purpose, in a first step a burst is searched automatically within the RF signal, or, if selected, the external trigger or the IF power trigger are used to determine the burst position.

In a second step the sync word position is searched by correlation of the signal with the sync word defined in the initialization phase. The correlation is performed directly with the FM signal, not with the data bits, which are only available after the phase shifter has been processed. The find burst process is continued as long as no sync word is found.

After the position of the sync word has been determined, the position of the p0 bit is calculated from the average value of all zero trespassing points, as defined in the RF test specification. Finally the samples are moved in a way that each sample matches one zero trespassing point (phase shifting).

The only measurement possible without synchronization is the Output Power measurement. The specified measurement time is 20% to 80% of the burst length. Without synchronization the burst length is defined via the –3dB points of the power curve. With synchronization the burst starts with the p0 bit.

Therefore varying measurement results is possible if the power of the EUT is not constant within the burst.

In order to supply stable synchronization the EUT must be operated in reduced hopping mode. The EUT is only allowed to toggle between two frequencies, because otherwise the repetition time for the same frequency would become higher than the record length.

If the test environment supplies an external trigger that marks the channel to be measured a synchronization is also possible with normal hopping operation.

Noise Figure Measurements Option (K30)

This chapter describes measurement examples for the Noise Figure Measurements option (K30). For further information on measurement examples refer to the Quick Start Guide, chapter 5 "Basic Measurement Examples", or the Operating Manual on CD, chapter "Advanced Measurement Examples".

Direct Measurements

Direct measurements are designed for DUTs without frequency–conversion, e.g. amplifiers. For details refer also to the Operating Manual on CD, chapter "Instrument Functions", section "Noise Figure Measurements Option (K30)".
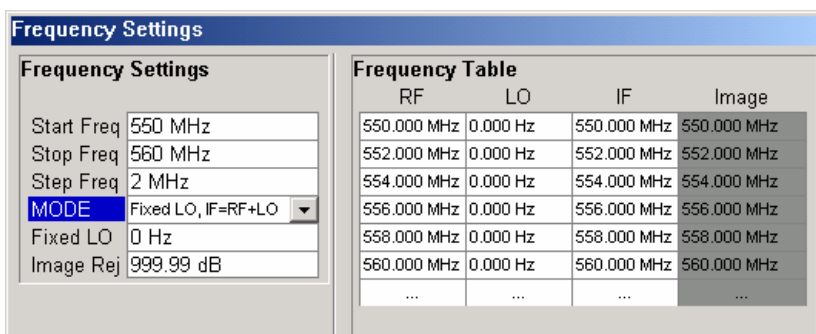
Basic Measurement Example

This section provides step–by–step instructions for working through an ordinary noise figure measurement. The following steps are described:

1. Setting up the measurement

2. Performing the calibration

3. Performing the main measurement

The gain and noise figure of an amplifier are to be determined in the range from 220 MHz to 320 MHz.

Setting up the measurement

1. Activate the **Noise** mode (for details refer to chapter "Instrument Functions", section "Measurement Mode Selection – MODE Key").

2. Press the **Freq Settings** softkey to open the **Frequency Settings** dialog box.

Frequency Settings		Frequency Table			
		RF	LO	IF	Image
Start Freq	550 MHz	550.000 MHz	0.000 Hz	550.000 MHz	550.000 MHz
Stop Freq	560 MHz	552.000 MHz	0.000 Hz	552.000 MHz	552.000 MHz
Step Freq	2 MHz	554.000 MHz	0.000 Hz	554.000 MHz	554.000 MHz
MODE	Fixed LO, IF=RF+LO	556.000 MHz	0.000 Hz	556.000 MHz	556.000 MHz
Fixed LO	0 Hz	558.000 MHz	0.000 Hz	558.000 MHz	558.000 MHz
Image Rej	999.99 dB	560.000 MHz	0.000 Hz	560.000 MHz	560.000 MHz
		...	...	...	...

– In the **Start Freq** field, enter *550 MHz*.

– In the **Stop Freq** field, enter *560 MHz*.

– In the **Step Freq** field, enter *2 MHz*.

A measurement at 6 frequency points is performed: 550 MHz, 552 MHz, 554 MHz, ..., 560 MHz.

3. Press the **ENR Settings** softkey to open the **ENR** dialog box.

ENR				
ENR Settings		**ENR Table**		
			RF	ENR
Selection	Constant	550 MHz	5 dB	
ENR Constant	15 dB	560 MHz	10 dB	
Room Temperature	293 K	570 MHz	20 dB	
		...	...	

–   In the **ENR Constant** field, enter the average ENR value of the used noise source for the frequency range of interest, for example *15 dB*.

4. Press the **Meas Settings** softkey to open the **Measurement Settings** dialog box.

Measurement Settings	
Calibration	
2nd Stage Correction	
Analyzer Settings	
RBW	1 MHz
Sweep Time	100 ms
Settling Time	50 ms
Average	1
RF Attenuation	0 dB
Automatic Ref Level	✓
Ref Level	-61 dBm
Range	30 dB
Preamplifier	

–   Activate the **2nd Stage Correction** option to perform the measurement as accurately as possible.

Performing the calibration

1. Connect the noise source to the RF input of the spectrum analyzer (see Fig. 2–32).

2. If you perform the measurement in an environment with radiated emissions, you may consider to connect a lowpass filter to the voltage supply input of the noise source.

3. Provide the voltage supply for the noise source by connecting it to the +28 V connector of the analyzer (labeled NOISE SOURCE CONTROL on the rear panel of the instrument) via a coax cable and the lowpass filter. Connect the lowpass filter between the noise source itself and the NOISE SOURCE CONTROL connector of the analyzer as shown in Fig. 2–32.

    The purpose of the lowpass filter is to suppress any interference (e.g. due to RF interference), including interference from the supply line. This makes it possible to perform very precise measurements.
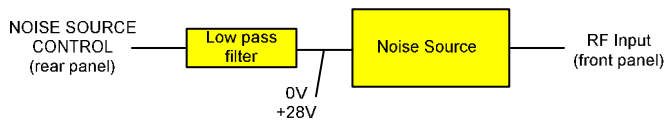
Fig. 2–32:　　　　Preparation for calibration

4.　Start the calibration for the Noise Figure Measurements option.

−　Press the **SWEEP** key.

−　Press the **Cal** softkey.

The progress bar indicates the progress of the calibration measurement. After successful calibration, in the status bar, a corresponding message is displayed and the title bar at the top of the screen shows the status on the right–hand–side.

Performing the main measurement

1.　Insert the DUT (in this example, the amplifier) into the test setup between the noise source and RF input of the R&S ZVL (see Fig. 2–33).
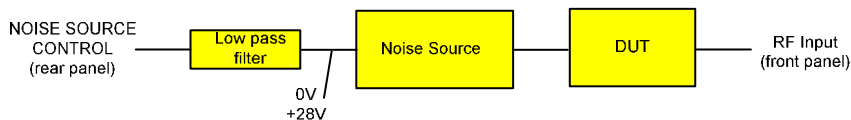
Fig. 2–33:　　　　Test setup for the main measurement

2.　To select the sweep mode, press the **SWEEP** key.

3.　Press the **RUN** key to start the measurement.

Measurement results are updated as the measurement is in progress. The results are displayed in graphical form. There are two traces, one for noise figure/temperature and one for the gain of the DUT.

4.　To change the display from the graphical form to a tabular list of measurement points, press the **Display List/Graph** softkey.

Note:　If a measurement is started while another measurement is still in progress, the first measurement is aborted and the new measurement started immediately.

DUTs with very Large Gain

If the gain of the DUT exceeds 60 dB, the total gain must be reduced by an external attenuator. The total gain of the DUT together with the external attenuator should lie within the range from 10 dB to 60 dB. A total gain of 20 dB to 30 dB is recommended. For a DUT with a gain of e.g. 64 dB, it is recommended to use an external 40 dB–attenuator.

If an external attenuator is used, in the **Measurement Settings** dialog box, the entry in the **Range** field should be modified according to the total gain (= G_{DUT} – external attenuator).

The attenuation values of the external attenuator are entered in the **Loss Settings** dialog box under **Loss Output Settings**.

Inaccuracies when entering this attenuation mainly influence the measured gain. The noise figure remains to a large extent unaffected.
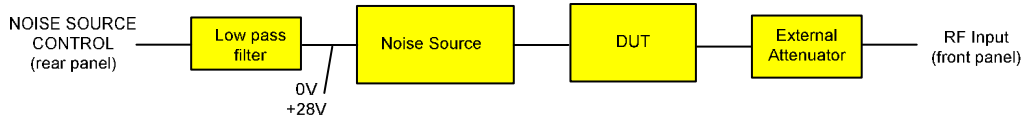
Calibration
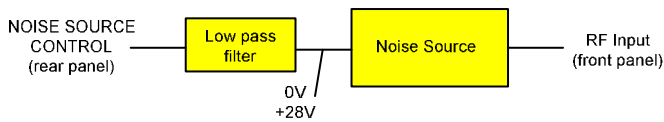
Measurement

Fig. 2–34:   Calibration and measurement on DUTs with a high gain

Frequency–Converting Measurements

The frequency–converting measurement is used for DUTs with an output frequency that differs from the input frequency, e.g. mixers and frequency converters. The frequency–converting measurement allows many variations, which differ from each other in two criteria:

- Fixed LO Measurements
- Image–Frequency Rejection (SSB, DSB)

Fixed LO Measurements

In the **Frequency Settings** dialog box, select one of the following settings for the **Mode** parameter:

- fixed LO, IF=RF+LO, for up–converting devices
- fixed LO, IF=abs(RF–LO), for down converters or image measurements

Image–Frequency Rejection (SSB, DSB)

Frequency–converting DUTs often do not only convert the desired input frequency but also the image frequency. A broadband noise source offers noise to the DUT not only at the input frequency but also at the image frequency. If the noise power at the IF gate is measured, the origin of the noise can no longer be determined. It may have been converted both from the input and from the image frequency range.

Test setup

|	
IF (intermediate frequency)	100 MHz
RF (input frequency)	400 MHz
LO (local oscillator frequency)	500 MHz
Image (image frequency)	600 MHz
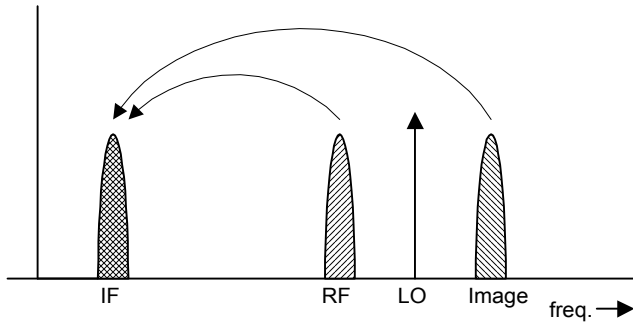
If a DUT, which equally converts the useful signal and the image to the IF frequency, is measured using the conventional y factor method or with the 2nd stage correction switched on, a measuring error of 3 dB is produced. The noise figure is displayed 3 dB lower and the gain 3 dB higher. The following examples help to configure the test setup in order to measure the actual values.

Measurement on a single–sideband mixer
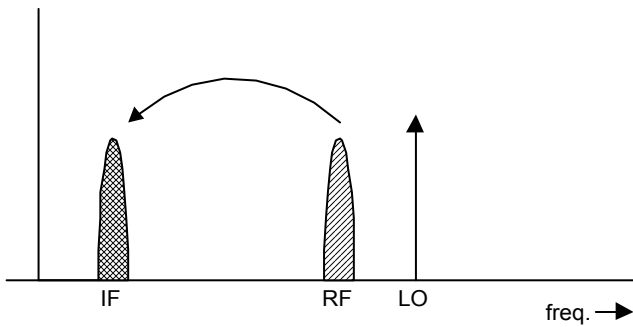
In general, a single–sideband mixer with a very high image rejection causes very few problems. The measurement is analogous to an amplifier. In this case, set the image rejection in the **Frequency Settings** dialog box to a large value (e.g. 999.99 dB).

**Measurement on a mixer without sideband suppression**
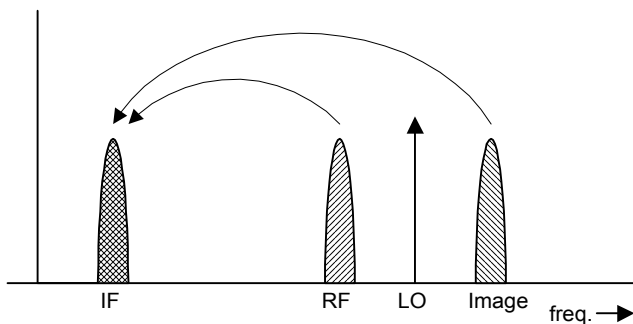
If the input and image frequencies are converted with the same application, an error of 3 dB occurs in the measurement results if the image rejection is not taken into account. In this case, set the image rejection in the **Frequency Settings** dialog box to a small value (e.g. 0.0 dB).

Measurement on a mixer with an average sideband suppression
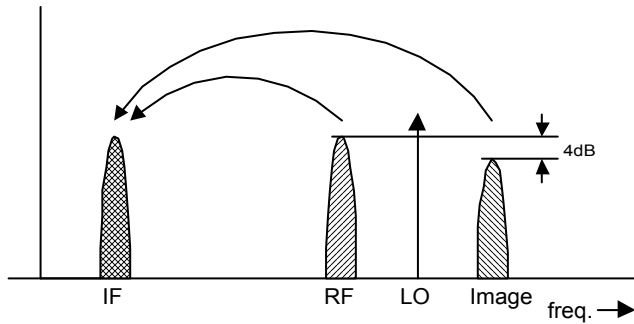
For measurements on a mixer with a low image–frequency rejection, a measuring error of 0 to 3 dB is obtained if the image–frequency rejection is not taken into account. In this case, set the image rejection in the **Frequency Settings** dialog box to 4 dB to produce the correct results.

Measurement on a mixer with unknown sideband suppression
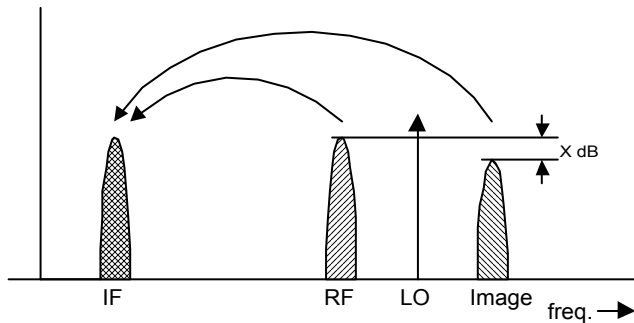
If the image rejection is not known, accurate noise results can still be produced. However, the gain of the DUT must be known and an additional filter is required.
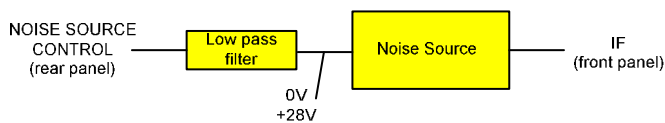
Test setup

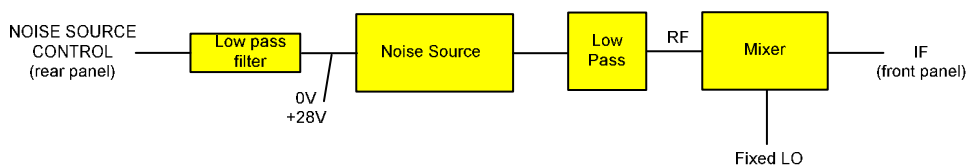Fig. 2–35:   Preparation for calibration

Fig. 2–36:   Test setup for the main measurement

In this test setup, a low pass filter prevents noise from the noise source from being fed in at the image frequency. Depending on the position of the frequency bands, a highpass or bandpass filter may also be necessary for the RF frequency instead of the lowpass filter. The important point is that noise from

the noise source is not converted by a further receive path of the mixer. The noise of the noise source at the receive frequency must not be reduced. The insertion loss must be considered, if applicable.

With this test setup, the measurement on a mixer without sideband suppression corresponds to the measurement on a single–sideband mixer. As in that case, set the image rejection in the **Frequency Settings** dialog box to a large value (e.g. 999.99 dB) to produce accurate results.

To take the characteristics of the filter into account, in the **Loss Settings** dialog box, enter the insertion loss of the filter at the RF frequency. To consider the actual filter suppression at the image frequency, do not enter 999 dB but the actual attenuation for the image rejection.

Measurement on a harmonics mixer

For a harmonics mixer, the input signals are not only converted to the IF by the wanted harmonic, but also by the harmonic of the LO signal produced in the mixer. In many cases, the mixer even features a lower conversion loss in the case of unwanted harmonics. For measurements on this type of mixer, a bandpass filter must be used to make sure that that there is only noise at the desired input frequency at the input of the DUT. This measurement is similar to measurements on a mixer with an average sideband suppression.

3GPP Base Station Measurements (Option K72)

This chapter explains basic 3GPP FDD base station tests by means of a setup with a signal generator, e.g. an R&S SMU. It describes how operating and measurement errors can be avoided using correct settings. The measurements are performed with an R&S ZVL equipped with the 3GPP Base Station Measurements option (K72).

For measurements on base–station signals in line with 3GPP, test models with different channel configurations are specified in the document "Base Station (BS) conformance testing (FDD)" (3GPP TS 25.141 V7.4.0).

For further information on measurement examples refer also to the Quick Start Guide, chapter 5 "Basic Measurement Examples".

Measurement 1: Signal Channel Power

The R&S ZVL measures the unweighted RF signal power in a bandwidth of

$$f_{BW} = 5\,MHz \geq (1+\alpha)\cdot 3.84\,MHz \quad | \quad \alpha = 0.22$$

The power is measured in zero span using a digital channel filter of 5 MHz in bandwidth. According to the 3GPP standard, the measurement bandwidth (5 MHz) is slightly larger than the minimum required bandwidth of 4.7 MHz.

Test setup:

Connect the RF output of the signal generator to the RF input of the R&S ZVL (coaxial cable with N connectors).

Signal generator settings (e.g. R&S SMU):

Frequency: 2.1175 GHz

Level: 0 dBm

Standard: WCDMA/3GPP

Test model: 1, 32 DPCH channels

Procedure:

1. Set the spectrum analyzer to its default state.

    −   Press the **PRESET** key.

        The R&S ZVL is set to its default state.

2. Change into the **3G FDD BTS** mode.

    −   Press the **MODE** key and activate the **3G FDD BTS** option.

3. Set the center frequency to 2.1175 GHz.

    −   Press the **CENTER** key.

        The frequency menu is displayed.

    −   In the dialog box, enter *2.1175* using the numeric keypad and confirm with the **GHz** key.

4. Set the reference level to 0 dBm.

    −   Press the **AMPT** key and enter *0 dBm*.

6. Start the Power measurement.

    −   Press the **MEAS** key.

    −   Press the **Power** softkey.

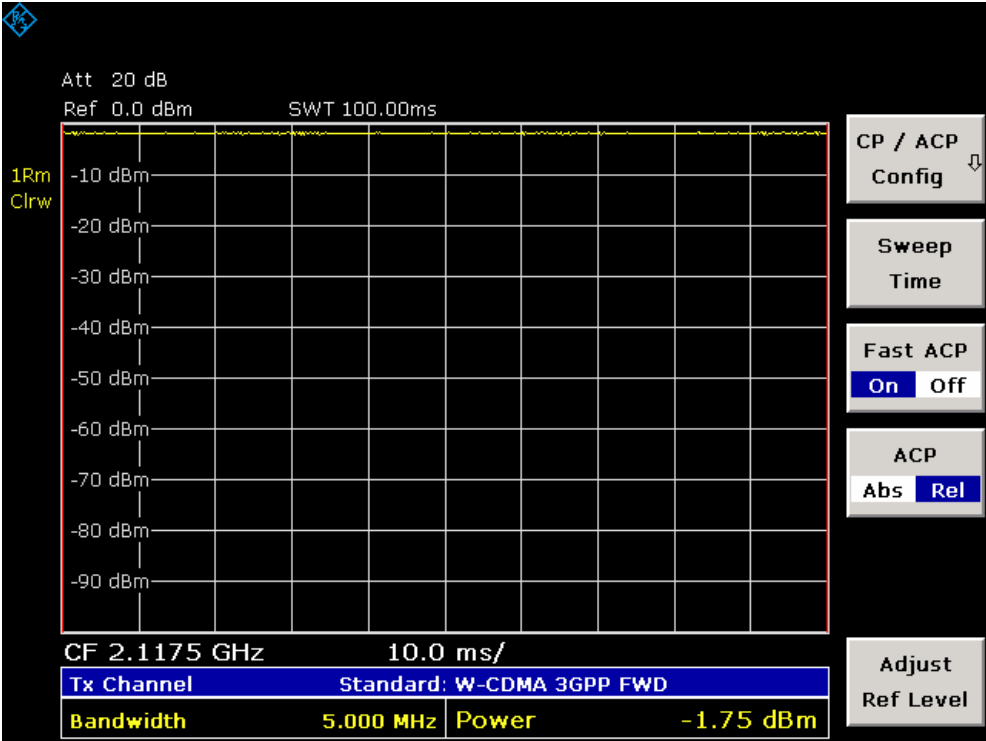   The signal channel power of the WCDMA signal is displayed.

Fig. 2–37   Power measurement

Measurement 2: Spectrum Emission Mask

The 3GPP specification defines a measurement that monitors compliance with a spectral mask in a range of at least ±12.5 MHz around the WCDMA carrier. To assess the power emissions in the specified range, the signal power is measured in the range near the carrier by means of a 30 kHz filter, and in the ranges far away from the carrier by means of a 1 MHz filter. The resulting trace is compared to a limit line defined in the 3GPP specification.

Test setup:

Connect the RF output of the signal generator to the RF input of the R&S ZVL (coaxial cable with N connectors).

Signal generator settings (e.g. R&S SMU):

Frequency: 2.1175 GHz

Level: 0 dBm

Standard: WCDMA/3GPP

Test model: 1, 32 DPCH channels

Procedure:

1. Set the spectrum analyzer to its default state.

    −   Press the **PRESET** key.

        The R&S ZVL is set to its default state.

2. Change into the **3G FDD BTS** mode.

    −   Press the **MODE** key and activate the **3G FDD BTS** option.

3. Set the center frequency to 2.1175 GHz.

    −   Press the **CENTER** key.

        The frequency menu is displayed.

    −   In the dialog box, enter *2.1175* using the numeric keypad and confirm with the **GHz** key.

4. Set the reference level to 0 dBm.

    −   Press the **AMPT** key and enter *0 dBm*.

5. Start the Spectrum Emission Mask measurement.

    −   Press the **MEAS** key.

    −   Press the Spectrum Emission Mask softkey.

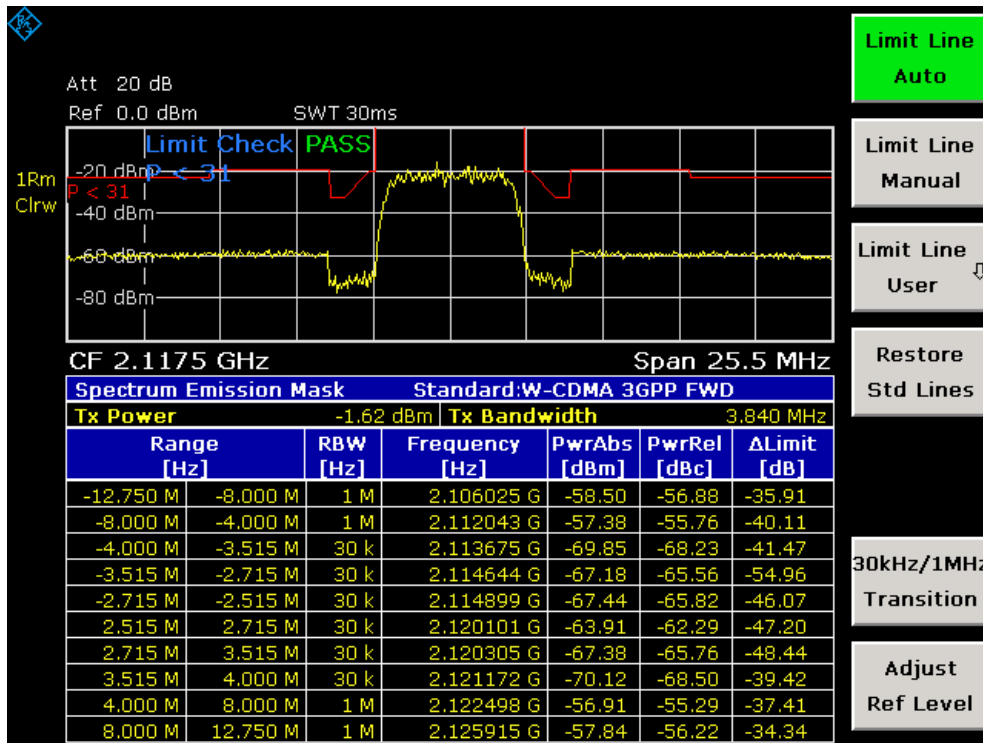   The spectrum of the 3GPP FDD signal is displayed.

Fig. 2–38   Spectrum Emission Mask measurement

Measurement 3: Relative Code Domain Power

A code domain power measurement on one of the test models (model 1 with 32 channels) is shown in the following. To demonstrate the effects, the basic parameters of the Code Domain Power measurements permitting an analysis of the signal are changed one after the other from values adapted to the measurement signal to non–adapted values.

Test setup:

Connect the RF output of the signal generator to the input of the R&S ZVL.

Connect the reference input (EXT REF) on the rear panel of the analyzer to the reference input of the signal generator (coaxial cable with BNC connectors).

Signal generator settings (e.g. R&S SMU):

Frequency: 2.1175 GHz

Level: 0 dBm

Standard: WCDMA/3GPP

Test model: 1, 32 DPCH channels

Procedure:

1. Set the spectrum analyzer to its default state.

    −   Press the **PRESET** key.

        The R&S ZVL is set to its default state.

2. Change into the **3G FDD BTS** mode.

    −   Press the **MODE** key and activate the **3G FDD BTS** option.

3. Set the center frequency to 2.1175 GHz.

    −   Press the **CENTER** key.

        The frequency menu is displayed.

    −   In the dialog box, enter *2.1175* using the numeric keypad and confirm with the **GHz** key.

4. Adjust the reference level and scrambling code.

    −   Press the **MEAS** key.

        The measurement menu is displayed.

    −   Press the **Auto Level & Code** softkey.

        The firmware adjusts the reference level and then searches the scrambling code automatically.

5. Select the Code Domain Power measurement.

    −   Press the **MEAS** key.

    −   Press the Code Dom Power Diagram softkey.

        The Code Domain Power of signal according to test model 1 with 32 channels is displayed.
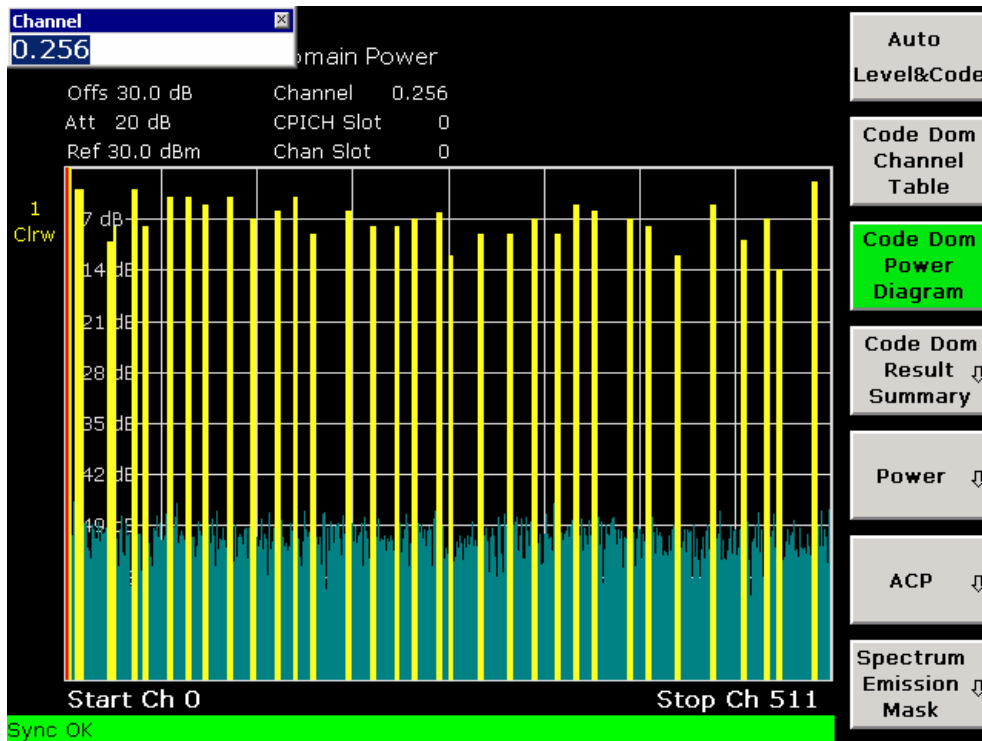
Fig. 2–39　Relative Code Domain Power measurement

Synchronization of the Reference Frequencies

Synchronization of the reference oscillators both of the DUT and the analyzer strongly reduces the measured frequency error.

1. Press the **SETUP** key.

2. Press the **Reference Int/Ext** softkey to switch to external reference.

    The displayed frequency error should be <10 Hz.

Behavior with Deviating Center Frequency Setting

In the following, the behavior of the DUT and the analyzer with an incorrect center frequency setting is shown.

1. Tune the center frequency of the signal generator in 0.5 kHz steps.

2. Watch the analyzer screen.

    A Code Domain Power measurement on the R&S ZVL is still possible with a frequency error of up to approx. 1 kHz. Up to 1 kHz, a frequency error causes no apparent difference in the accuracy of the Code Domain Power measurement.

    Above a frequency error of 1 kHz, the probability of impaired synchronization increases. With continuous measurements, all channels are at times displayed in blue with almost the same level.

    Above a frequency error of approx. 2 kHz, a Code Domain Power measurement cannot be performed. The R&S ZVL displays all possible codes in blue with a similar level.

3. Set the signal generator center frequency to 2.1175 GHz again.

Behavior with Incorrect Scrambling Code

A correct Code Domain Power measurement can be carried out only if the scrambling code set on the analyzer is identical to that of the transmitted signal.

1. Set the scrambling code of the signal generator to 0001.

    With the scrambling code still set to 0 (default setting), the Code Domain Power Diagram result display of the R&S ZVL shows all possible codes with approximately the same level.

2. Set the correct scrambling code on the R&S ZVL.

    −   Press the **MENU** key.

    −   Press the **Scrambling Code** softkey.

    −   In the submenu, press the **Scrambling Code** softkey and enter *1* using the numeric keypad.

        The Code Domain Power display again shows the test model.

Measurement 4: Triggered Measurement of Relative Code Domain Power

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

Test setup:

Connect the RF output of the signal generator to the input of the R&S ZVL.

Connect the reference input (EXT REF) on the rear panel of the R&S ZVL to the reference input of the signal generator (coaxial cable with BNC connectors).

Connect the external trigger input on the rear panel of the R&S ZVL (EXT TRIGGER/GATE IN) to the external trigger output of the signal generator.

Signal generator settings (e.g. R&S SMU):

Frequency: 2.1175 GHz

Level: 0 dBm

Standard: WCDMA/3GPP

Test model: 1, 32 DPCH channels

Procedure:

1. Set the spectrum analyzer to its default state.

   − Press the **PRESET** key.

     The R&S ZVL is set to its default state.

2. Change into the **3G FDD BTS** mode.

   − Press the **MODE** key and activate the **3G FDD BTS** option.

3. Set the center frequency to 2.1175 GHz.

   − Press the **CENTER** key.

     The frequency menu is displayed.

   − In the dialog box, enter *2.1175* using the numeric keypad and confirm with the **GHz** key.

4. Adjust the reference level and scrambling code.

   − Press the **MEAS** key.

     The measurement menu is displayed.

   − Press the **Auto Level & Code** softkey.

     The firmware adjusts the reference level and then searches the scrambling code automatically.

5. Select the Code Domain Power measurement.

   − Press the **MEAS** key.

   − Press the Code Dom Power Diagram softkey.

6. Select an external trigger source.

     −   Press the **TRIG** key.

     −   Press the **Trigger Source** softkey and select the **External** option.

         The Code Domain Power of signal according to test model 1 with 32 channels is displayed.

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

Trigger Offset

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

1. Press the **TRIG** key.

2. Press the **Trigger Offset** softkey and enter *100* using the numeric keypad and confirm with the **µs** key.

Setup for Base Station Tests

This section describes how to set up the R&S ZVL for 3GPP FDD base station tests. As a prerequisite for starting the test, the instrument must be correctly set up and connected to the AC power supply as described in the Quick Start Guide, chapter 1. Furthermore, the R&S ZVL must be equipped with the 3GPP Base Station Measurements option (R&S FSL–K72). Installation instructions are provided in the Quick Start Guide, chapter 3.:
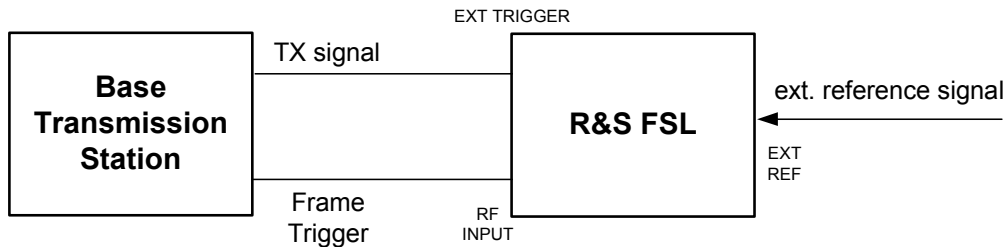
Standard Test Setup

Fig. 2–40   Base Transmission station test setup

➢ Connect the antenna output (or TX output) of the base transmission station to RF input of the R&S ZVL via a power attenuator of suitable attenuation.

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

Max. power	Recommended ext. attenuation
≥55 to 60 dBm	35 to 40 dB
≥50 to 55 dBm	30 to 35 dB
≥45 to 50 dBm	25 to 30 dB
≥40 to 45 dBm	20 to 25 dB
≥35 to 40 dBm	15 to 20 dB
≥30 to 35 dBm	10 to 15 dB
≥25 to 30 dBm	5 to 10 dB
≥20 to 25 dBm	0 to 5 dB
<20 dBm	0 dB

➢ For signal measurements at the output of two–port networks, connect the reference frequency of the signal source to the reference input of the R&S ZVL (*EXT REF*).

➢ To ensure that the error limits specified by the 3GPP standard are met, the R&S ZVL should use an external reference frequency for frequency measurements on base stations. For instance, a rubidium frequency standard may be used as a reference source.

➢ If the base station is provided with a trigger output, connect this output to the trigger input of the R&S ZVL (*EXT TRIGGER/GATE IN*).

Basic Settings

1. Enter the external attenuation).

2. Enter the reference level.

3. Enter the center frequency.

4. Set the trigger.

5. Select the standard and measurement.

WLAN TX Measurements (Option K91)

This section describes measurement examples for the WLAN TX Measurements option (K91) and gives details to signal processing. For further information on measurement examples refer also to the Quick Start Guide, chapter 5 "Basic Measurement Examples".

Basic Measurement Example

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

1. Setting up the measurement

2. Performing the level detection

3. Performing the main measurement

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.

Setting up the measurement

1. Activate the **WLAN** mode (for details refer to chapter "Instrument Functions", section "Measurement Mode Selection – MODE Key").

2. Press the **Settings** softkey once to select and open the **General Settings** dialog box.

   – In the **Frequency** field, enter the desired frequency to measure.

   If a frequency is entered, which maps to a specific channel, the **Channel No** field updates.

–   Under **Level Settings**, deactivate the **Auto Lvl** option. In this example the level detection measurement is executed manually (for details see Performing the level detection).

3. Press the **Settings** softkey once to select and open the **Demod Settings** dialog box.
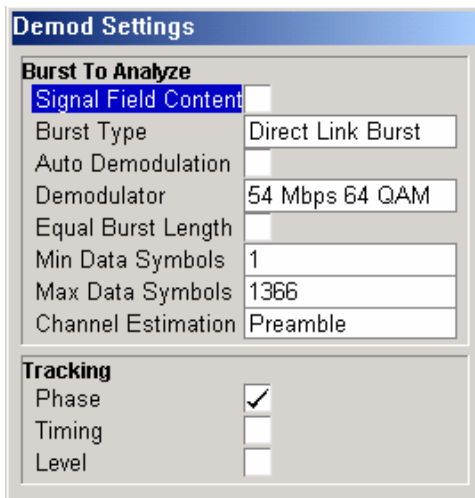
–   In the **Demodulator** field, select the used modulation scheme.

Performing the level detection

1. Connect the DUT to the RF input of the spectrum analyzer.
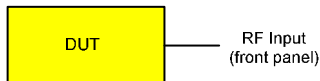
2. Start the level detection measurement by pressing the **SWEEP** hardkey and then the **Auto Level** softkey.

    During the level detection measurement the text **Running** is displayed in the status bar at the bottom of the screen.

    After successful level detection, the status message **Measurement Complete** is displayed, the signal level field for the selected input displays the detected signal level and the Magnitude Capture Buffer (screen A) displays the zero span trace obtained during the measurement sequence.

Performing the main measurement

1. Select single sweep measurements by pressing the **SWEEP** hardkey and then the **Meas** softkey to select **Single**.

2. Start the measurement by pressing the **RUN** hardkey.

    During the measurement, the status message **Running** is displayed.

    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).

Signal Processing of the IEEE 802.11a application

Abbreviations

$a_{l,k}$	symbol at symbol l of sub carrier k
EVM_k	error vector magnitude of sub carrier 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 sub carrier k
k	channel index $k = [-31, 32]$
K_{mod}	modulation dependant normalization factor
ξ	relative clock error of reference oscillator
$r_{l,k}$	sub carrier k of symbol l

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

A diagram of the interesting blocks is shown in Fig. 2–41 First the RF signal is down converted to the IF frequency f_{IF} = 20.4 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} = 81.6 MHz. This digital sequence is resampled to the new sampling frequency of f_{s2} = 80 MHz which is a multiple of the Nyquist rate (20 MHz). The subsequent digital down converter shifts the IF signal to the complex base band. In the next step the base band signal is filtered by a FIR filter. To get an idea, the rough transfer function is plotted in the figure. This filter fulfills two tasks: first it suppresses the IF image frequency, secondly it attenuates the aliasing frequency bands caused by the subsequent down sampling. After filtering, the sequence is sampled down by the factor of 4. 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.
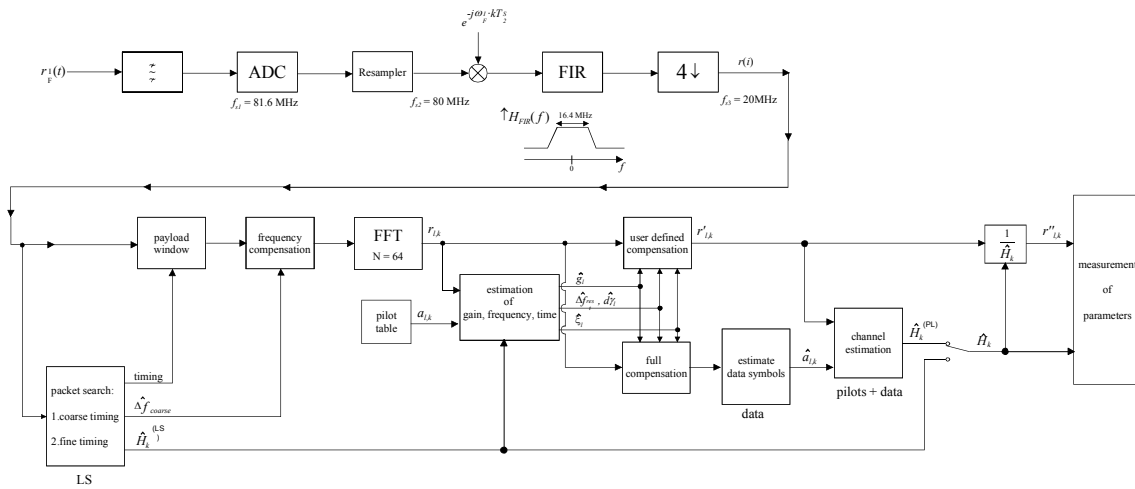
Fig. 2–41　　Signal processing of the IEEE 802.11a application

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 $\Delta\hat{f}_{coarse}$ [1] of the Rx–Tx frequency offset Δf is derived from the metric in [6]. This can easily be understood because the phase of $r(i) \cdot r^*(i+N)$ is determined by the frequency offset. As the frequency deviation Δf can exceed half a bin (distance between neighbor 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 $\hat{H}_k^{(LS)}$, 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 $\Delta\hat{f}_{coarse}$. This is necessary because otherwise inter channel interference (ICI) would occur in the frequency domain.

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

　　the symbol index $l = [1, nof\_symbols]$ and

　　the channel index $k = [-31, 32]$.

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

---

[1] The hat generally describes an estimate. Example: $\hat{x}$ is the estimate of x.

$$r_{l,k} = K_{\mathrm{mod}} \times a_{l,k} \times g_l \times H_k \times e^{j(phase_l^{(common)} + phase_{l,k}^{(timing)})} + n_{l,k} \quad (10)$$

with

the modulation–dependant normalization factor K_{mod},

the symbol $a_{l,k}$ of sub–carrier k at symbol l,

the gain g_l at the symbol l in relation to the reference gain $g = 1$ at the long symbol (LS),

the channel frequency response H_k at the long symbol (LS),

the common phase drift $phase_l^{(common)}$ of all sub–carriers at symbol l (see below),

the phase $phase_{l,k}^{(timing)}$ of sub–carrier k at symbol l caused by the timing drift (see below),

the independent Gaussian distributed noise samples $n_{l,k}$.

The common phase drift in equation (10) is given by

$$phase_l^{(common)} = 2\pi \times N_s / N \times \Delta f_{rest} T \times l + d\gamma_l \quad (11)$$

with

$N_s = 80$ being the number of Nyquist samples of the symbol period,

$N = 64$ being the number of Nyquist samples $N = 64$ of the useful part of the symbol,

Δf_{rest} being the (not yet compensated) frequency deviation,

$d\gamma_l$ being the phase jitter at the symbol l.

In general, the coarse frequency estimate $\Delta \hat{f}_{coarse}$ (see figure 1) is not error–free. Therefore the remaining frequency error Δf_{rest} represents the not yet compensated frequency deviation in $r_{l,k}$. Consequently the overall frequency deviation of the device under test (DUT) is calculated by $\Delta f = \Delta \hat{f}_{coarse} + \Delta f_{rest}$. Remark: The only motivation for dividing the common phase drift in equation (11) 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 equation (11) 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. Please note that besides the nonlinear part the phase jitter $d\gamma_l$ also contains a constant part. This constant part is caused by the not yet compensated frequency deviation Δf_{rest}. To understand this, please 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 equation (10) represents the channel at the long symbol of the preamble. Consequently the not yet compensated frequency deviation Δf_{rest} 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 $phase_l^{(common)}$ 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 FSL–K91.

Furthermore the timing drift in equation (10) is given by

$$phase_{l,k}^{(timing)} = 2\pi \times N_s / N \times \xi \times k \times l \quad (12)$$

with ξ being the relative clock deviation of the reference oscillator. Normally a symbol–wise timing jitter is negligible and thus not modeled in equation (12). 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 $\xi_{max} = 20$ ppm. Furthermore a long packet with $nof\_symbols = 400$ symbols is assumed. From equations (10) and (12), it results 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 $phase_{l,k}^{(timing)}$ is not part of the requirements. Therefore the "time tracking" (Tracking Time) is not activated as the default setting of the R&S FSL–K91.

The time tracking option should rather be seen as a powerful analyzing option.

In addition the tracking of the gain g_l in equation (10) 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 $\hat{H}_k^{(LS)}$ is calculated. This makes sense since the sequence $r'_{l,k}$ is compensated by the coarse channel transfer function $\hat{H}_k^{(LS)}$ 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 FSL–K91.

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 $d\gamma_l = 0$. Referring to equation (10) the log likelihood function[2]

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

with

$$\widetilde{phase}_l^{(common)} = 2\pi \times N_S / N \times \Delta \widetilde{f}_{rest} T \times l$$

$$\widetilde{phase}_l^{(timing)} = 2\pi \times N_S / N \times \widetilde{\xi} \times k \times l$$

(13)

must be calculated as a function of the trial parameters $\Delta \widetilde{f}_{rest}$ and $\widetilde{\xi}$. The trial parameters leading to the minimum of the log likelihood function are used as estimates $\Delta \hat{f}_{rest}$ and $\hat{\xi}$. In equation (13)(13) the known pilot symbols $a_{l,k}$ are read from a table.

In the second step for every symbol l the log likelihood function

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

with

$$\widetilde{phase}_l^{(common)} = 2\pi \times N_S / N \times \Delta \hat{f}_{rest} T \times l + d\widetilde{\gamma}_l$$

$$\hat{phase}_l^{(timing)} = 2\pi \times N_S / N \times \hat{\xi} \times k \times l$$

---

2 The tilde generally describes an estimate. Example: $\widetilde{x}$ is the trial parameter of x.

is calculated as a function of the trial parameters $\widetilde{g}_l$ and $d\widetilde{\gamma}_l$. 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 <u>compensation blocks</u>.

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 $r'_{l,k}$.

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 <u>estimation of the data symbols</u> $\hat{a}_{l,k}$ is performed. From equation (10) it is clear that first the channel transfer function H_k must be removed. This is achieved by dividing the known coarse channel estimate $\hat{H}_k^{(LS)}$ calculated from the LS. Usually an error free estimation of the data symbols can be assumed.

In the next block a better channel estimate $\hat{H}_k^{(PL)}$ 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 $\hat{H}_k^{(LS)}$) leads to a nearly error–free channel estimate.

In the following equalizer block $r'_{l,k}$ is compensated by the channel estimate. The resulting channel–compensated sequence is described by $r''_{l,k}$. The user may either choose the coarse channel estimate $\hat{H}_k^{(LS)}$ (from the long symbol) or the nearly error–free channel estimate $\hat{H}_k^{(LS)}$ (from the payload) for equalization. In case of using the improved estimate $\hat{H}_k^{(LS)}$ 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 $\hat{H}_k^{(LS)}$ (from the long symbol) has to be used for equalization. Therefore the default setting of the R&S FSL–K91 is equalization from the coarse channel estimate derived from the long symbol.

In the last block the <u>measurement variables</u> are calculated. The most important variable is the error vector magnitude

$$EVM_k = \sqrt{\frac{1}{nof\_symbols} \sum_{l=1}^{nof\_symbols} \left| r''_{l,k} - K_{\mod} \times a_{l,k} \right|^2} \qquad (14)$$

of the sub–carrier k of the current packet. Furthermore the packet error vector magnitude

$$EVM = \sqrt{\frac{1}{52} \sum_{k=-26(k\neq 0)}^{26} EVM_k^2} \qquad (15)$$

is derived by averaging the squared EVM_k versus k. Finally the average error vector magnitude

$$\overline{EVM} = \sqrt{\frac{1}{nof\_packets} \sum_{counter=1}^{nof\_packets} EVM^2(counter)} \qquad (16)$$

is calculated by averaging the packet EVM of all $nof\_packets$ detected packets. This parameter is equivalent to the so–called "RMS average of all errors $Error_{RMS}$" of the IEEE 802.11a measurement commandment (see [6], *Chapter 17.3.9.7*).

Literature

[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

Signal Processing of the IEEE 802.11b application

Abbreviations

ε	timing offset
Δf	frequency offset
$\Delta \phi$	phase offset
$\mathrm{A}RG\{\ldots\}$	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
$\mathrm{REAL}\{\ldots\}$	calculation of the real part of a complex value
$\mathrm{IMAG}\{\ldots\}$	calculation of the imaginary part of a complex value

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

A block diagram of the measurement application is shown in Fig. 2–42. The baseband signal of an IEEE 802.11b wireless LAN system transmitter is sampled with a sampling rate of 44 MHz.
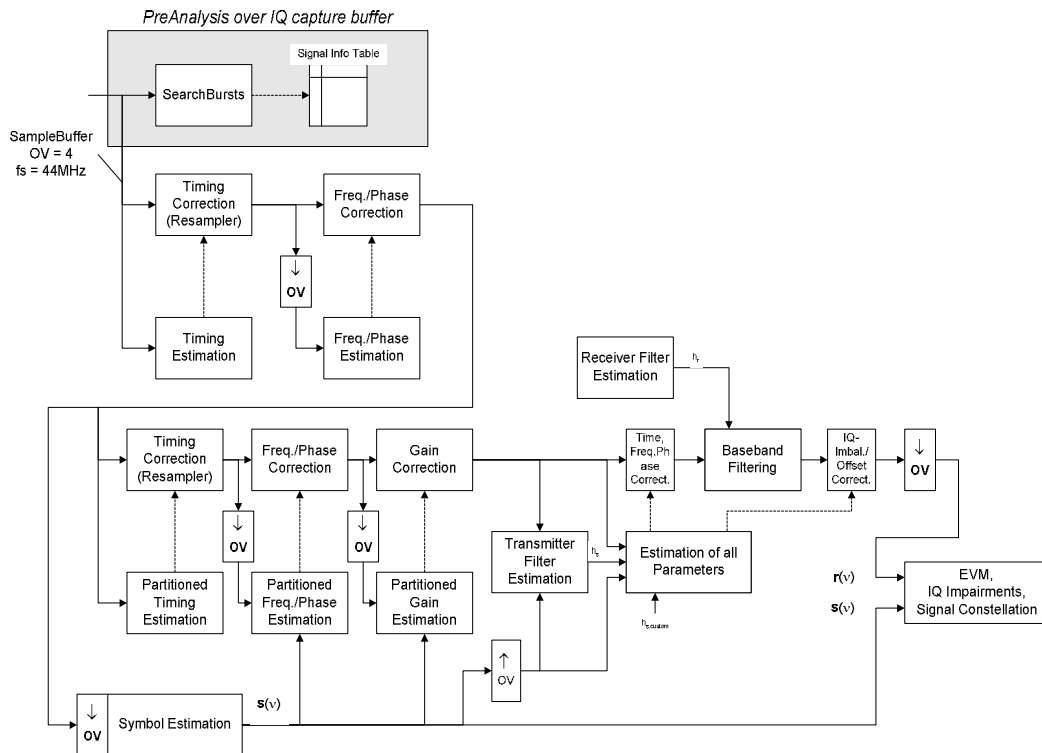

Fig. 2–42   Signal processing of the IEEE 802.11b application

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 demodulation settings menu.

Knowing the normalized power and undisturbed reference signal, the transmitter baseband filter is estimated by minimizing the cost function

$$L_1 = \sum_{v=0}^{N-1} \left| r(v) \times e^{-j2\pi\Delta\tilde{f}v} \times e^{-j\Delta\tilde{\phi}} - \sum_{i=-L}^{+L} \tilde{h}_s(i) \times \hat{s}_n(v-i) - \tilde{o}_I - j\tilde{o}_Q \right|^2 \qquad (17)$$

of a maximum–likelihood–based estimator, where $r(v)$ is the over sampled measurement signal, $\hat{s}_n(v)$ the over sampled power normalized and undisturbed reference signal, N the observation length, L the filter length, $\Delta\tilde{f}$, $\Delta\tilde{\phi}$, $\tilde{o}_I$, $\tilde{o}_Q$ and $\tilde{h}_s(v)$ the variation parameters of the frequency–, the phase, the IQ–offset and 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

$$L_2 = \sum_{v=0}^{N-1} \left| r(v-\tilde{\varepsilon}) \times e^{-j2\pi\tilde{f}v} \times e^{-j\Delta\tilde{\phi}} - \tilde{g}_I \times s_I(v) - j\tilde{g}_Q \times s_Q(v) + \Delta\tilde{g}_Q \times s_Q(v) - \tilde{o}_I - j\tilde{o}_Q \right|^2 \qquad (18)$$

where $\tilde{g}_I$ resp. $\tilde{g}_Q$ are the variation parameters of the gain used in the I– resp. the Q–branch, $\Delta\tilde{g}_Q$ is the crosstalk factor of the Q–branch into the I–branch and $s_I(v)$ resp. $s_Q(v)$ are the filtered reference signal of the I– resp. the 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 quadratur–mismatch and the normalized IQ–offset are displayed by the measurement software. The IQ–imbalance

$$IQ - Imbalance = \left| \frac{\hat{g}_Q + \Delta\hat{g}_Q}{\hat{g}_I} \right| \qquad (19)$$

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, the quadrature–mismatch

$$Quadrature - Mismatch = ARG\left\{ \hat{g}_Q + j \times \Delta\hat{g}_Q \right\} \qquad (20)$$

is a measure for the crosstalk of the Q–branch into the I–branch. The normalized IQ–offset

$$IQ - Offset = \frac{\sqrt{\hat{o}_I^2 + \hat{o}_Q^2}}{\sqrt{\frac{1}{2} \cdot \left[\hat{g}_I^2 + \hat{g}_Q^2 \right]^2}} \qquad (21)$$

is defined as the magnitude of the IQ–offset normalized by the magnitude of the reference signal.

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 $\hat{s}(v)$ the modulation quality parameters can be calculated. The mean error vector magnitude (EVM)

$$EVM = \frac{\sqrt{\sum_{v=0}^{N-1} \left| r(v) - \hat{s}(v) \right|^2}}{\sqrt{\sum_{v=0}^{N-1} \left| \hat{s}(v) \right|^2}} \qquad (22)$$

is the quotient of the root–mean–square values of the error signal power and the reference signal power, whereas the instant error vector magnitude

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

(23)

is the momentary error signal magnitude normalized by the root mean square value of the reference signal power.

In [2] a different algorithm is proposed to calculate the error vector magnitude. In a first step the IQ–offset in the I–branch

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

(24)

and the IQ–offset of the Q–branch

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

(25)

are estimated separately, 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

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

(26)

and the IQ–imbalance of the Q–branch

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

(27)

are estimated in a non–linear estimation in a second step. Finally, the mean error vector magnitude

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

(28)

can be calculated with a non data aided calculation. The instant error vector magnitude

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

(29)

is the error signal magnitude normalized by the root mean square value of the estimate of the measurement signal power. 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 equation (17). If the EVM value is dominated by Gaussian noise this method yields similar results as equation (18).

Literature

[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.

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.

Measurement with R&S spectrum analyzers

The RF carrier suppression as defined in the standard is a determination of peak ratios. The unscrambled 01 data sequence provides a spectrum with distinct peaks enveloped by the transmit filter spectrum. An IQ offset leads to an additional peak at the center frequency.

The following measurement sequence can be used in normal spectrum mode:

1. Use power trigger or external trigger

3. Use gated sweep with gate delay at payload start and gate length = payload length (Delay–Comp ON and RBW = 50 MHz for gate settings)

4. Set RBW = 100 kHz

5. Set Sweep Time = 100 ms

6. Set Span = 20 MHz

7. Set Detector = RMS

8. Set Marker 1 to center frequency

9. Use Marker 2 as Delta Marker and set it to max. peak

Fig. 2–43 is a screenshot of this measurement. The delta marker shows directly the RF carrier suppression in dB (white circled value).
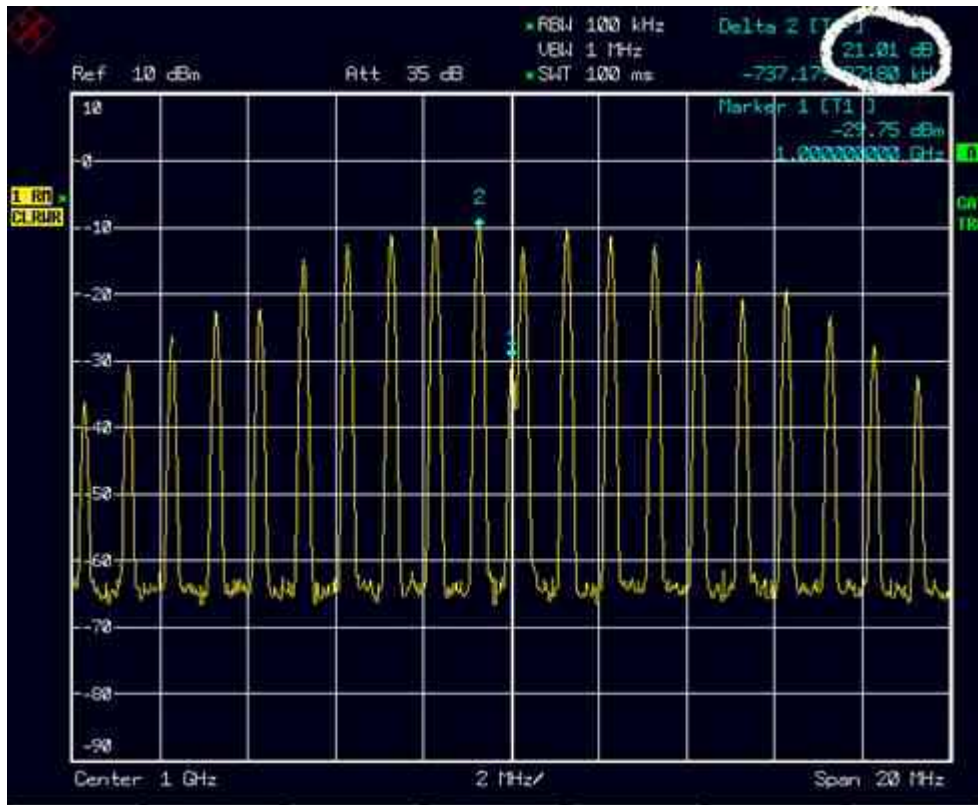
Fig. 2–43   RF carrier suppression measurement

Comparison to IQ offset measurement in K91 list mode

The IQ offset measurement in K91 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 K91 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 $\left(\pm 0.5 \text{ dB} \right)$:

Transmit filter	$-$IQ-Offset [dB] $-$ RF-Carrier-Suppression [dB]
rectangular	11 dB
Root raised cosine, $\alpha = 0.22$	10 dB
Gaussian, $\alpha = 0.3$	9 dB

IQ Impairments

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.
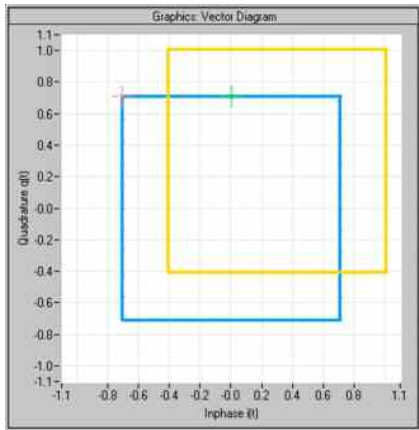
Gain Imbalance

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] = $20\log\left(\,|\,\mathrm{Gain_Q}\,|\,/\,|\,\mathrm{Gain_I}\,|\,\right)$

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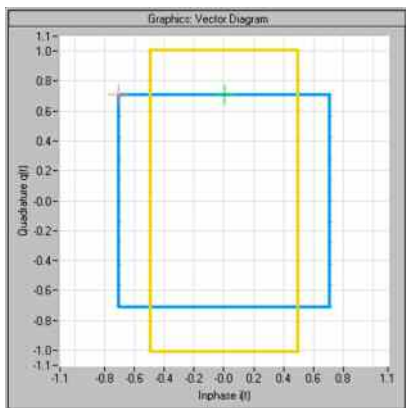
Negative values mean that the I vector is amplified more than the Q vector by the corresponding percentage:
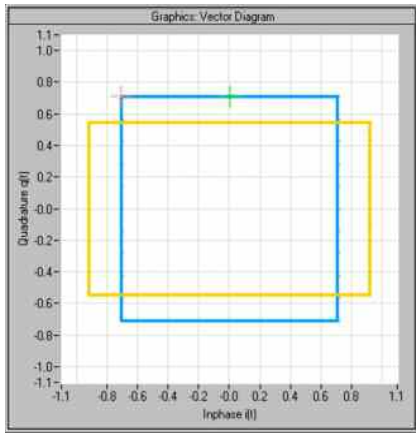
Quadrature Error

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:
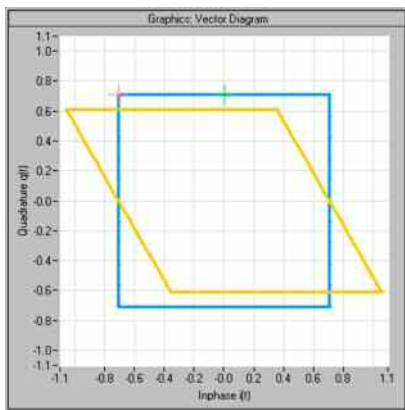
A negative quadrature error means a phase angle less than 90 degrees:
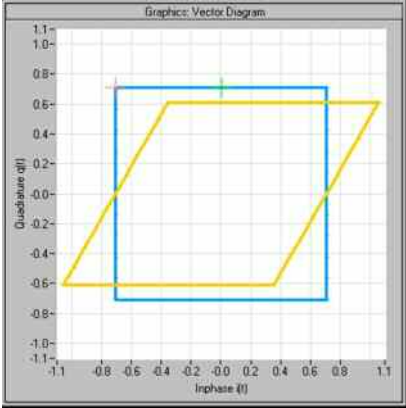
WiMAX, WiBro Measurements (Option K93)

This chapter describes measurement examples for the WiMAX IEEE 802.16 OFDM, OFDMA Measurements option (R&S FSL–K93) and gives details to signal processing. For further information on measurement examples refer also to the Quick Start Guide, chapter 5 "Basic Measurement Examples".

Basic Measurement Example

This section provides step–by–step instructions for working through an ordinary measurement.

Test setup

In this example, a DUT using IEEE 802.16–2004 is used. The DUT is connected to the analyzer using the RF input of the analyzer. The DUT generates a signal modulated using 16QAM 2/3.

Setting up the measurement

1. Activate the **WIMAX** mode (for details refer to chapter "Instrument Functions", section "Measurement Mode Selection – MODE Key").

2. Press the **Settings General/Demod** softkey once to select and open the **General Settings** dialog box.

General Settings

Signal Characteristics
Standard	IEEE 802.16 - 2004
Frequency	3 GHz
Channel No	…
Frequency Band	ETSI 3.410-4.200 GHz
Channel BW	1.75 MHz
Sampling Rate	2 MHz
G = Tg/Tb	1/4

Level Settings
Signal Level	Auto Lev ✓ -30 dBm
Ext Att	0 dB

Data Capture Settings
Capture Time	15 ms
Burst Count	
Analyze Bursts	1
Sweep Time	Auto ✓ 2 s
Sweep Count	1

Trigger Settings
Trigger Mode	Free Run
Trigger Offset	-10 µs
Power Level	Auto Lvl 0 dBm

Input Settings Advanced
Auto Level time	100 ms
Ref. Level	-20 dBm
Attenuation	0 dB

IQ Settings
Swap IQ	

Result Settings
RSSI, CINR avg.	0.01
List Results Unit	dB

Advanced Settings ✓

– In the **Frequency** field, enter the desired frequency to measure.

   If a frequency is entered, which maps to a specific channel, the **Channel No** field updates.
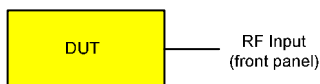
- In the **Frequency Band** field, select the signal to be analyzed. The target band is either one of the bands given as example in the IEEE 802.16–2004 standard[3] or an unspecified band.

- In the **Channel BW** or **Sampling Rate** field depending on the characteristics of the signal to be analyzed, select a value. The second parameter is derived from the first according to the standard[4].

- In the **G = Tg/Tb** field, select a useful time ratio according to the characteristics of the signal to be analyzed.

- Under **Level Settings**, deactivate the **Auto Lev** option. In this example, the level detection measurement is executed manually (for details see Performing the level detection).

3. Press the **Settings General/Demod** softkey twice to select and open the **Demod Settings** dialog box.
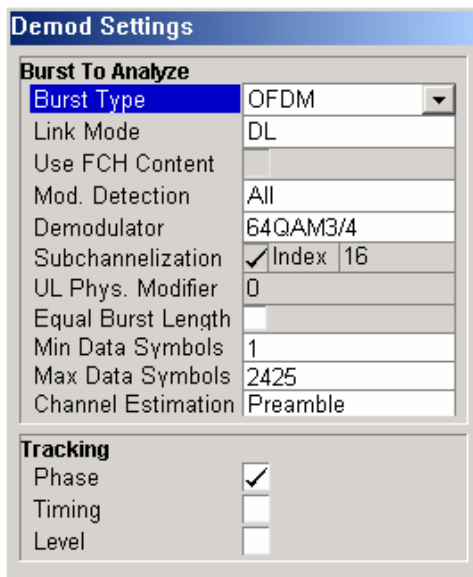
- In the **Link Mode** field, select the link mode of the bursts to be analyzed.

- In the **Demodulator** field, select the used modulation scheme.

Performing the level detection

1. Connect the DUT to the RF input of the spectrum analyzer.

2. Start the level detection measurement by pressing the **SWEEP** hardkey and then the **Auto Level** softkey.

During the level detection measurement the status message **Running** is displayed in the status bar at the bottom of the screen.

After successful level detection, the status message **Measurement Complete** is displayed, the signal level field for the selected input displays the detected signal level and the Magnitude Capture Buffer (screen A) displays the zero span trace obtained during the measurement sequence.

---

3 B.3.2 Wireless MAN-OFDM/OFDMA PHY symbol and performance parameters.

4 8.3.2.2 Derived Parameter definitions

Note: *An automatic level detection can be performed in two ways:*
                  *Once by pressing the **Auto Level** softkey in the sweep menu.*
                  *At the start of each measurement sweep by activating the **Auto Lev** option in the **General**
                  settings** dialog box under **Level Settings**.*

Performing the main measurement

1. Select single sweep measurements by pressing the **SWEEP** hardkey and then the **Run** softkey to select **Single**.

2. Start the measurement by pressing the **RUN** hardkey.

   During the measurement, the status message **Running** is displayed.

   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 Graph/List** softkey (in the WiMAX/WiBro menu or trace menu).

Signal Processing of the IEEE 802.16–2004 OFDM Measurement Application

Abbreviation	Description
$N_{FFT} = 256$	FFT length
$a_{l,k}$	symbol from the alphabet at symbol–index l of sub carrier k
EVM_k	error vector magnitude of sub carrier 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 sub carrier k
k	channel index $k = [-128, 127]$
K_{mod}	modulation dependent normalization factor
ξ	relative clock error of reference oscillator
$r_{l,k}$	received symbol at symbol–index l of sub carrier k
	Pilots = {–88, –63, –38, –13, 13, 38, 63, 88}

This description gives a rough view of the IEEE 802.16–2004 OFDM measurement application signal processing. Details are disregarded in order to get a concept overview.

A diagram of the interesting blocks is shown in Fig. 2–44. First the RF signal is down–converted to the IF frequency $f_{IF} = 20.4$ 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 $f_{s1} = 81.6$ MHz. This digital sequence is resampled to the new sampling frequency of $f_{s2} = 80$ MHz which is a multiple of the Nyquist rate (20 MHz). The subsequent digital down–converter shifts the IF signal to the complex base band. In the next step the base band signal is filtered by a FIR filter. To get an idea, the rough transfer function is plotted in the figure. This filter fulfils two tasks: first it

suppresses the IF image frequency, secondly it attenuates the aliasing frequency bands caused by the subsequent down–sampling. After filtering, the sequence is sampled down by the factor of 4. 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.
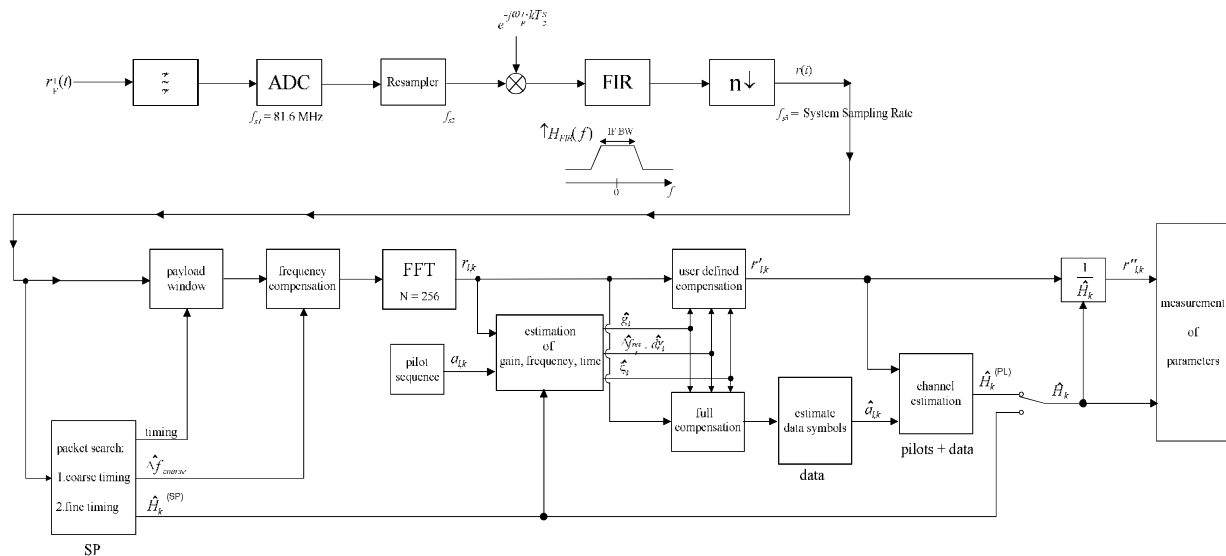

Fig. 2–44   Signal processing of the IEEE 802.16 OFDM measurement application

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 Short Preamble (SP) 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 SP after $N = N_{FFT}/2 = 128$ samples. Note this cyclic repetition occurs also in the Long Preamble (LP). Numerous treatises exist on this subject, e.g. [1]–[3]. Furthermore a coarse estimate $\Delta \hat{f}_{coarse}$ [5] of the Rx–Tx frequency offset Δf is derived from the metric in [6]. This can easily be understood because the phase of $r(i) \cdot r^*(i + N)$ is determined by the mod 2π frequency offset. As the frequency deviation Δf can exceed several bins (distance between neighbor sub–carriers) the SP is further used to solve this n2π [offset over several bins] ambiguities.

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 $\hat{H}_k^{(SP)}$, with $k = [-100, 100]$ denoting the channel index of the occupied sub–carriers. First the FFT of the SP is calculated. After the FFT calculation the known symbol information of the SP 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 SP 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.

---

5 In this paper the hat generally describes an estimate. Example: $\tilde{x}$ is the estimate of x.

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

The transition to the frequency domain is achieved by an <u>FFT</u> of length 256. 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

the symbol index $l = [\, 1\, , nof\_symbols\,]$ and

the channel index $k = [\, -128\, , 127\,]$.

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

$$r_{l,k} \;=\; K_{\text{mod}} \cdot a_{l,k} \cdot g_l \cdot H_k \cdot e^{\,j\left(phase_l^{(\text{commom})}+phase_{l,k}^{(\text{timing})}\right)} \;\;+\;\; n_{l,k} \qquad (30)$$

with

the modulation–dependent normalization factor K_{mod}

the alphabet symbol $a_{l,k}$ at symbol–index l of sub–carrier k

the gain g_l at the symbol l in relation to the reference gain $g = 1$ at the Short Preamble (SP)

the channel frequency response H_k at the Short Preamble (SP)

the common phase drift $phase_l^{(\text{common})}$ of all sub–carriers at symbol l (see below)

the phase $phase_{l,k}^{(\text{timing})}$ of sub–carrier k at symbol l caused by the timing drift (see below)

the independent Gaussian distributed noise samples $n_{l,k}$

The common phase drift in equation (29) is given by

$$phase_l^{(\text{common})} \;=\; 2\pi \cdot N_s/N \cdot \Delta f_{rest}\, T \cdot l \;+\; d\gamma_l \qquad (31)$$

with

$N_s = N_g + N_b$ being the number of Nyquist samples of the symbol period

$N = N_b = 256$ being the number of Nyquist samples of the useful part of the symbol

Δf_{rest} being the (not yet compensated) frequency deviation

$d\gamma_l$ being the phase jitter at the symbol l

In general, the coarse frequency estimate $\Delta \hat{f}_{coarse}$ (see Fig. 2–44) is not error–free. Therefore the remaining frequency error Δf_{rest} represents the not yet compensated frequency deviation in $r_{l,k}$. Consequently the overall frequency deviation of the device under test (DUT) is calculated by $\Delta f \;=\; \Delta \hat{f}_{coarse} + \Delta f_{rest}$. Remark: The only motivation for dividing the common phase drift in equation (11) 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 equation (11) 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. Please note that besides the nonlinear part the phase jitter $d\gamma_l$ also contains a constant part. This constant part is caused by the not yet compensated frequency deviation Δf_{rest}. To understand this, please 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 equation (29) represents the channel at the Short Preamble of the preamble.

Consequently the not yet compensated frequency deviation Δf_{rest} produces a phase drift between the Short Preamble 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 802.16–2004 measurement standard *Chapter 8.3.10.1.2 "Transmitter constellation error and test method"* [6], the common phase drift $phase_l^{(common)}$ must be estimated and compensated from the pilots. Therefore the "symbol wise phase tracking" (Tracking Phase) is activated as the default setting of the R&S FSL–K93.

Furthermore the timing drift in equation (29) is given by

$$phase_{l,k}^{(timing)} = 2\pi \cdot N_s / N \cdot \xi \cdot k \cdot l \qquad (32)$$

with ξ being the relative clock deviation of the reference oscillator. Normally a symbol–wise timing jitter is negligible and thus not modeled in equation (32). 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 $\xi_{max} = \pm 8$ ppm. Furthermore the maximal length of a frame $nof\_symbols = 2420$ symbols[6] is assumed. From equations (29) and (32), it results that the phase drift of the highest sub–carrier $k = 100$ in the last symbol $l = nof\_symbols$ is to–do 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 802.16–2004 measurement standard [6], the timing drift $phase_{l,k}^{(timing)}$ is not part of the requirements. Therefore the "time tracking" (Tracking Time) is not activated as the default setting of the R&S FSL–K93.

The time tracking option should rather be seen as a powerful analyzing option.

In addition the tracking of the gain g_l in equation (29) is supported for each symbol in relation to the reference gain $g = 1$ at the time instant of the Short Preamble (SP). At this time the coarse channel transfer function $\hat{H}_k^{(SP)}$ is calculated. This makes sense since the sequence $r'_{l,k}$ is compensated by the coarse channel transfer function $\hat{H}_k^{(SP)}$ 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 802.16–2004 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 FSL–K93.

The unknown deviations of gain, frequency and time are calculated by an optimum maximum likelihood procedure, which works well even at low signal to noise ratios with the Cramer Rao Bound being reached. After estimation of these parameters, the received signal is fully compensated for the decision of the ideal reference signal $\hat{a}_{l,k}$ and compensated according to the user settings to get the measurement signal $r'_{l,k}$. Then the measurement signal is equalized by the inverse channel transfer function. According to the chosen setting, either the preamble estimation of the channel transfer function or a data aided estimation using the ideal reference signal is used. According to the IEEE 802.16–2004 measurement standard [6], the coarse channel estimation $\hat{H}_k^{(SP)}$ (from the short preamble) has to be used for equalization. Therefore the default setting of the R&S FSL–K93 is equalization from the coarse channel estimate derived from the short preamble.

---

6 Assuming the maximal System Sampling Rate Fs = 32MHz.

In the last block the <u>measurement variables</u> are calculated. The most important variable is the error vector magnitude

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

(33)

of the sub–carrier k of the current packet. Furthermore the packet error vector magnitude

$$EVM = \sqrt{\frac{1}{200} \cdot \sum_{\substack{k=-100 \\ (k \neq 0)}}^{100} EVM_k^2}$$

(34)

is derived by averaging the squared EVM_k versus k. Finally the average error vector magnitude

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

(35)

is calculated by averaging the packet EVM of all $nof\_packets$ detected packets. This parameter is equivalent to the so–called "RMS average of all errors $Error_{RMS}$" of the IEEE 802.16–2004 measurement commandment (see [6], *Chapter 8.3.10.1.2*).

Analysis Steps

Preamble related result	Remark
Rough frequency estimation	In case of subchannelization, a rough frequency estimation is obtained by exploiting the cyclic prefix of the OFDM symbols.
Preamble power	
Preamble EVM	Uses payload channel estimation for equalization.
Frequency error vs. preamble	
Phase error vs. preamble	
Channel estimation	Used for equalizing

Payload related result	Remark
Fine frequency estimation	Estimation on pilots used for phase correction if 'Phase Tracking' is selected. Phase tracking needs at least one pilot.
	In case of subchannelization, the value shown in the result summary table is estimated on pilots and data.
Clock offset estimation	Estimation on pilots used for timing correction if 'Timing Tracking' is selected. Timing tracking needs at least two pilots.
	In case of subchannelization, the value shown in the result summary table is estimated on pilots and data.
IQ Offset	Power at spectral line 0 normalized to the total transmitted power.
Gain Imbalance	Estimation not available in case of subchannelization.
Quadrature Error	Estimation not available in case of subchannelization.
Payload channel estimation	Combined with the preamble channel estimation.

Burst related result	Remark
EVM All carriers EVM Data carriers EVM Pilot carriers	According to standard normalized to the average power of all 200 used carriers.
Burst Power	
Crest Factor	

Subchannelization

Subchannelization can be used in uplink bursts to allocate only a subset of the available OFDM sub carriers. The measurement software can distinguish between downlink bursts, uplink bursts without subchannelization and uplink bursts with a selectable subchannel index. Thus it is possible to analyze the complete WirelessMAN traffic with one capture buffer shot.

Synchronization

The synchronization of uplink bursts using subchannelization is performed after the synchronization on standard downlink and uplink preambles:

1. Synchronization of downlink and uplink bursts without subchannelization.

2. Pre–analysis of the bursts without subchannelization to determine their length.

3. Extraction of TX power areas without already detected bursts.

4. Synchronization of uplink bursts with the selected subchannel index.

In the following sections, the influence of subchannelization on results is discussed.

Channel Results

The standard requires an interpolation of order 0 for the channel estimation on unallocated sub carriers, i.e. the estimated channel coefficient of the nearest allocated sub carrier shall be used for those sub carriers not part of the allocated subchannels.

For the derived channel results like group delay or flatness difference, the unallocated carriers are not taken into account.
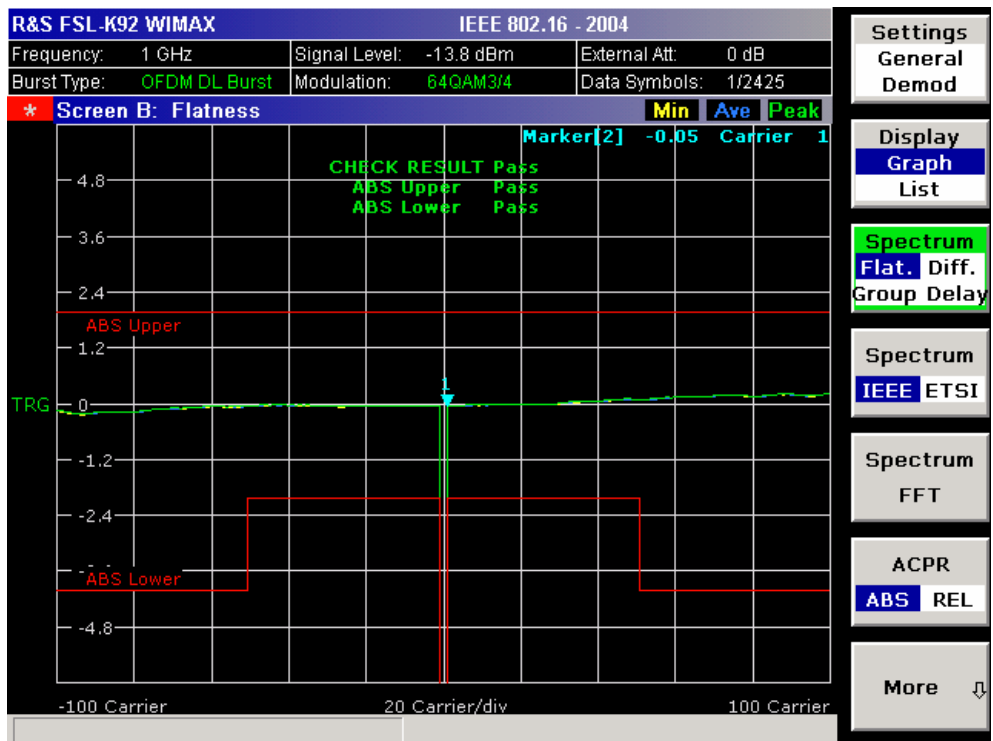
Fig. 2–45   Spectrum Flatness

Frequency and Clock Offset

The measurement software allows selectable compensation of phase, timing and gain errors based on pilot estimations. However, in case of subchannelization the number of pilots is decreased. Bursts with odd subchannel indices do not provide pilots at all. The following table lists the restrictions on the tracking ability for subchannelization:

Tracking	Subchannel Index		
	16 (8 Pilots) 8, 24 (4 Pilots) 4, 12, 20, 28 (2 Pilots)	2, 6, 10, 14, 18, 22, 26, 30 (1 Pilot)	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31 (No Pilot)
Phase	Available	Available	Available, but uses rough frequency offset estimation from the synchronization step only
Timing	Available	Not available	Not available
Gain	Available	Available	Not available

While the tracking functionality has to use pilot based estimates, the actual results for frequency and clock offset in the result summary can be data aided. In case of subchannelization the final estimation of frequency and clock offset is done using the already decided data sequence, which gives stable results even without pilots.

EVM

The error vector magnitude of a single constellation point is defined by

$$
\mathrm{EVM(l,k)} = \sqrt{\frac{\left|r(l,k)-a(l,k)\right|^2}{\dfrac{1}{N_{\mathrm{used}}}\displaystyle\sum_{\substack{k=-N_{\mathrm{used}}/2 \\ k\neq 0}}^{k=N_{\mathrm{used}}/2}\left|a(l,k)\right|^2}}
$$

where $r(l,k)$ is the received constellation point and $a(l,k)$ is the transmitted constellation point at the lth symbol and carrier number k.

In case of subchannelization, it is required by the standard to include the unallocated carriers $k_{unalloc}$ by assuming $a(l,k_{unalloc}) = 0$ in the denominator of the EVM calculation.

Thus the EVM All Carriers result for one burst in the result summary equals

$$
\mathrm{EVM\_All\_Carr} = \sqrt{\frac{\dfrac{1}{L}\displaystyle\sum_{l=1}^{L}\dfrac{1}{N_{\mathrm{used}}}\displaystyle\sum_{\substack{k=-N_{\mathrm{used}}/2 \\ k\neq 0}}^{k=N_{\mathrm{used}}/2}\left|r(l,k)-a(l,k)\right|^2}{\dfrac{1}{L}\displaystyle\sum_{l=1}^{L}\dfrac{1}{N_{\mathrm{used}}}\displaystyle\sum_{\substack{k=-N_{\mathrm{used}}/2 \\ k\neq 0}}^{k=N_{\mathrm{used}}/2}\left|a(l,k)\right|^2}}
$$

where L is the number of symbols in the burst.

This definition is according to the relative constellation error defined in the IEEE 802.16–2004 standard.

Using the equations above, the error power is normalized by the average transmitted power in all 200 carriers. Please notify, that by this definition the same absolute error power leads to different EVM results depending on the number of allocated carriers in case of subchannelization.

IQ Impairments

IQ imbalance in an OFDM transmitter or receiver leads to an interference of the symbols $a_{l,-k}$ with the symbols $a_{l,k}$. In case of subchannelization, the used sub carriers are always situated in such a way, that $a_{l,-k} = 0$, if $a_{l,k} \neq 0$. There is no impact of IQ imbalance on the actually allocated carriers of a subchannelization transmission. The effect can only be seen on the unallocated carriers and yields a pattern around the origin of the constellation diagram.
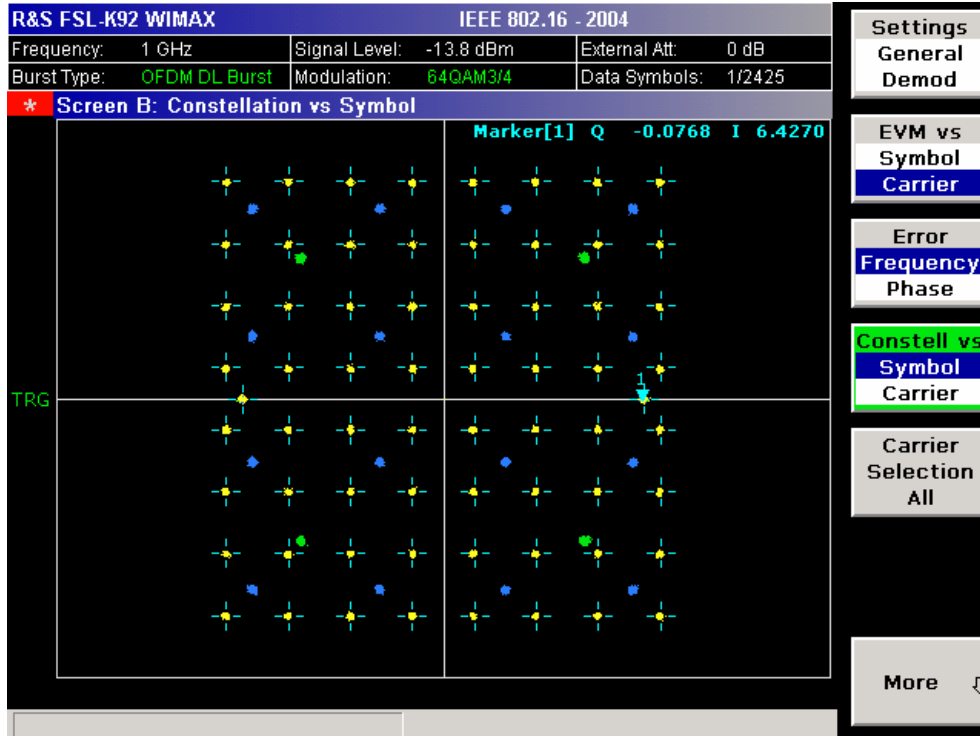
Fig. 2–46   Constellation vs Symbol

The unsymmetrical allocation of the sub carriers prevents a measurement of gain imbalance and quadrature error in case of subchannelization. The influence of the occupied carriers $a_{l,k}$ on the unoccupied carriers $a_{l,-k}$ could be measured, but there is no possibility to distinguish them from an unknown channel coefficient.

RSSI

See [6] section "8.3.9.2 RSSI mean and standard deviation". The Received Signal Strength Indication [RSSI] is basically the preamble power. The result summary provides the RSSI statistics according to the standard. A possible method to compute RSSI[k] at the antenna connector is given in [6] equation (87). RSSI[k] is the RSSI measurement based on the k–th signal/preamble.

The RSSI statistics of the *result summary* is calculated as follows:

1. RSSI row:
    Statistic {min, mean, max} of the R[k]=RSSI[k].
    The mean value is $\hat{\mu}_{RSSI\,dBm}[k]$ according to [6] formula (89).

2. RSSI Standard Deviation row:
    $\hat{\sigma}_{RSSI\,dB}$ according to [6] formula (91).

CINR

See [6] section "8.3.9.3 CINR mean and standard deviation". The result summary provides the Carrier Interference Noise Ratio [CINR] statistics according to the standard. One possible method to estimate the CINR of a single message is to compute the ratio of the sum of signal power and the sum of residual error for each data sample, using equation [6] (92).

$$CINR[k] = \frac{\sum_{n=0}^{N-1}|s[k,n]|^2}{\sum_{n=0}^{N-1}|r[k,n]-s[k,n]|^2}$$

with

    r[k,n]   received/measured sample n within message k

    s[k,n]   corresponding detected/reference sample (with channel state weighting) corresponding to received symbol n

The CINR statistics of the *result summary* is calculated as follows:

1. CINR row:
    Statistic {min, mean, max} of the CINR[k].
    The mean value is $\hat{\mu}_{CINR\,dB}[k]$ according to [6] formula (94).

2. CINR Standard Deviation row
    $\hat{\sigma}_{CINR\,dB}$ according to [6] formula (96).

Literature

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[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 802.16–2004, Part 16: Air Interface for Fixed Broadband Wireless Access Systems; 1 October 2004; Medium Access Control (MAC) and Physical Layer (PHY) specifications

Signal Processing of the IEEE802.16–2005 OFDMA/WiBro Measurement Application

Symbol	Description
$a_{l,k}, \hat{a}_{l,k}$	data symbol (actual, decided)
Δf_{res}	residual carrier frequency offset
$\Delta f, \Delta \hat{f}_{\text{coarse}}$	carrier frequency offset between transmitter and receiver (actual, coarse estimate)
ζ	relative sampling frequency offset
g_l	gain
$H_{l,k}, \hat{H}_{l,k}$	channel transfer function (actual, estimate)
i	time index
$\hat{i}_{\text{coarse}}, \hat{i}_{\text{fine}}$	timing estimate (coarse, fine)
$k, k_{\text{p}}, k_{\text{d}}, k_{\text{ch}\,n}$	subcarrier index (general, pilot, data, subchannel n)
l	OFDM symbol index
N_{FFT}	length of FFT
N_{g}	number of samples in cyclic prefix (guard interval)
N_{s}	number of Nyquist samples
N_{sc}	number of subcarriers
n	subchannel index, subframe index
$n_{l,k}$	noise sample
Φ_l	common phase error
$\Delta Q, \Delta \hat{Q}$	I/Q imbalance (actual, estimate)
$r(i)$	received sample in the time domain
$r_{l,k}, r'_{l,k}, r''_{l,k}, r'''_{l,k}$	received sample (uncompensated, fully compensated, partially compensated, equalized) in the frequency domain
T	useful symbol time
T_{g}	guard time
T_{s}	symbol time

Abbreviation	Description
AWGN	additive white Gaussian noise
BER	bit error rate
CFO	carrier frequency offset
CINR	carrier to interference and noise ratio
CIR	channel impulse response
CP	cyclic prefix (guard interval)
CPE	common phase error
CTF	channel transfer function

DL	downlink
EVM	error vector magnitude
FFT	fast Fourier transformation
IF	intermediate frequency
ISI	intersymbol interference
OFDM	orthogonal frequency division multiplexing
OFDMA	orthogonal frequency division multiple access
PAPR	peak to average power ratio
RSSI	received signal strength indicator
SFO	sampling frequency offset
UL	uplink

Introduction

The following description provides a brief overview of the digital signal processing used in the IEEE 802.16 OFDMA measurement application.

From the received IF signal as the point of origin to the actual analysis results like EVM or CINR, the digital signal processing can be divided into four major groups:

- Data capturing
- Synchronization
- Channel estimation / equalization } OFDMA measurement application
- Analysis

The description of the IEEE802.16–2005 OFDMA/WiBro measurement signal processing is structured accordingly.

Signal Processing Block Diagram
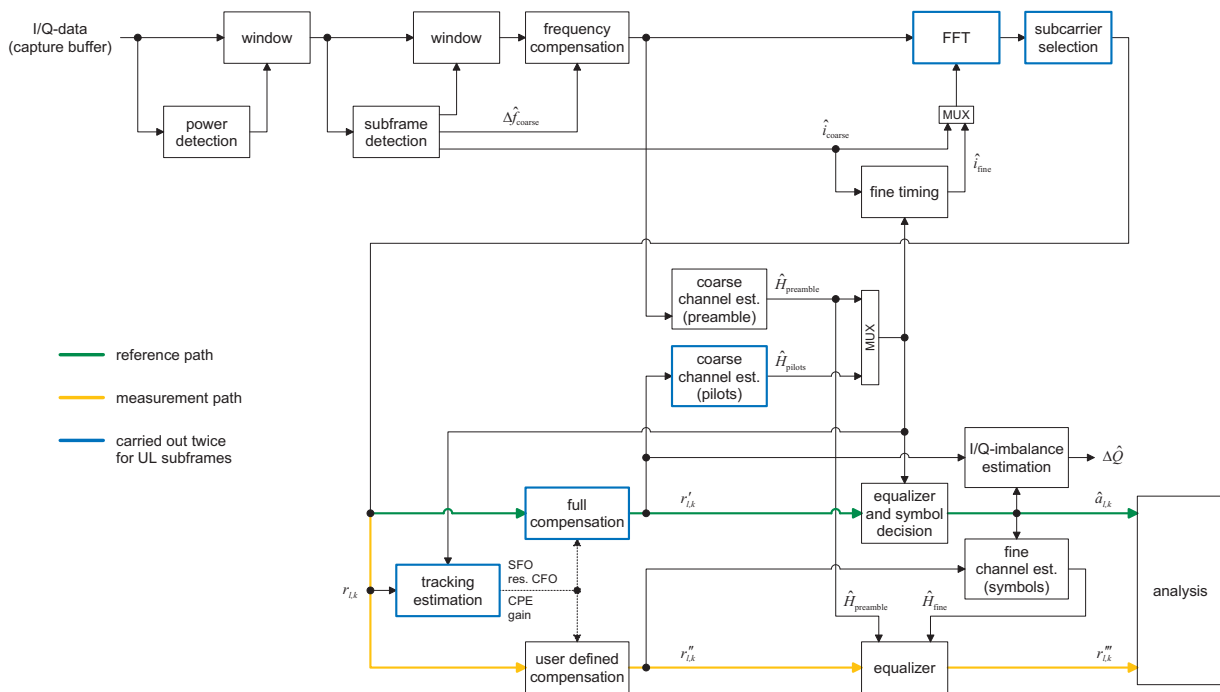
Fig. 2–47   Signal processing of the IEEE 802.16 OFDMA measurement application

The block diagram in Fig. 2–47 shows the OFDMA measurement application from the capture buffer containing the I/Q data to the actual analysis block. Outcome of the fully compensated reference path (green) are the estimates $\hat{a}_{l,k}$ of the transmitted data symbols $a_{l,k}$. Depending on the user defined compensation, the received samples $r'''_{l,k}$ of the measurement path (orange) still contain the transmitted signal impairments of interest. The analysis block reveals these impairments by comparing the reference and the measurement path. Prior to the analysis, diverse synchronization and channel estimation tasks have to be accomplished.

Synchronization

The first of the synchronization tasks is to detect areas of sufficient power within the captured I/Q data stream. The subframe detection block determines the beginning and end of each subframe and coarsely estimates both timing and carrier frequency offset. The fine timing block prior to the FFT allows a timing improvement using a level–based search for the beginning and end of the coarsely estimated channel impulse response. In the DL the coarse estimate of the CIR can be directly obtained from the preamble. Other than that the UL consists only of payload information with scattered pilots in the subcarrier–symbol plane, thus several OFDM symbols have to be observed to get a reliable estimate of the CIR. Since the OFDM symbols need to be phase synchronized prior to the channel estimation, the blue blocks in Fig. 2–47 have to be carried out twice. In the first iteration the timing estimate $\hat{i}_{\text{coarse}}$ is used to position the window of the FFT. Having found the pilot–based estimate of the CIR, the fine timing estimate $\hat{i}_{\text{fine}}$ is used in the second iteration.

After the time to frequency transformation by an FFT of length N_{FFT}, the tracking estimation block is used to estimate the following:

- relative sampling frequency offset ζ
- residual carrier frequency offset Δf_{res}
- common phase error Φ_l
- gain g_l

Corresponding to [3] and [4], the uncompensated samples $r_{l,k}$ can be expressed as

$$r_{l,k} = g_l \cdot a_{l,k} \cdot H_{l,k} \cdot \underbrace{e^{j\Phi_l}}_{\text{CPE}} \cdot \underbrace{e^{j2\pi \cdot N_s/N_{\text{FFT}} \cdot \zeta \cdot k \cdot l}}_{\text{SFO}} \cdot \underbrace{e^{j2\pi \cdot N_s/N_{\text{FFT}} \cdot \Delta f_{\text{res}} \cdot T \cdot l}}_{\text{res. CFO}} + n_{l,k} \quad (36)$$

with

- data symbol $a_{l,k}$ on subcarrier k at OFDM symbol l
- channel transfer function $H_{l,k}$
- number of Nyquist samples N_s within the symbol time T_s
- useful symbol time $T = T_s - T_g$
- independent and Gaussian distributed noise sample $n_{l,k}$

Within one OFDM symbol both the CPE and the residual CFO respectively cause the same phase rotation for each subcarrier, while the rotation due to the SFO linearly depends on the subcarrier index. A linear phase increase in symbol direction can be observed for the residual CFO as well as the SFO.

The results of the tracking estimation block are used to compensate the samples $r_{l,k}$. While a full compensation is performed in the reference path, the signal impairments that are of interest to the user are left uncompensated in the measurement path.

Channel Estimation / Equalization

According to Fig. 2–47, there are two coarse and one fine channel estimation blocks. Which of the two coarse estimation blocks is used depends on the link direction. For DL subframes the coarse channel estimation is based on the preamble and directly follows the coarse frequency compensation block. The pilot–based estimation for UL subframes is tapped behind the full compensation block of the reference path. Both of the coarse estimation blocks use available training symbols to determine initial estimates $\hat{H}_{l,k}$ of the channel transfer function at fixed positions in the subcarrier–symbol plane. Based on these nodes, the missing CTF values are obtained by interpolation in both time and frequency direction. The coarse estimation results are used for the above mentioned fine timing and to equalize the samples $r'_{l,k}$ of the reference path prior to symbol decision. Based on the decided data symbols, a fine channel estimation is performed and then used to equalize the partially compensated samples of the measurement path.

Analysis

The analysis block of the OFDMA measurement application allows to calculate a variety of measurement variables.

EVM

The most important variable is the error vector magnitude (EVM).

$$EVM_{l,k} = \left| \frac{r'''_{l,k} - \hat{a}_{l,k}}{\hat{a}_{l,k}} \right| \quad (37)$$

on subcarrier k at OFDM symbol l. The subsequent average values can be derived from (37).

1. EVM of subchannel n at OFDM symbol l:

$$EVM_{l,\text{subchannel } n} = \sqrt{\frac{1}{N_{\text{sc}}} \sum_{k_{\text{ch } n}} EVM^2_{l,k_{\text{ch } n}}} \quad (38)$$

2. EVM of all pilot subcarriers:

$$EVM_{\text{pilots}} = \sqrt{\frac{1}{N_{\text{sc}}} \sum_l \sum_{k_{\text{p}}} EVM^2_{l,k_{\text{p}}}} \quad (39)$$

3. EVM of all data subcarriers:

$$EVM_{\text{data}} = \sqrt{\frac{1}{N_{\text{sc}}} \sum_l \sum_{k_{\text{d}}} EVM_{l,k_{\text{d}}}^2} \qquad (40)$$

4. EVM of all used subcarriers:

$$EVM_{\text{all}} = \sqrt{\frac{1}{N_{\text{sc}}} \sum_l \left[\sum_{k_{\text{p}}} EVM_{l,k_{\text{p}}}^2 + \sum_{k_{\text{d}}} EVM_{l,k_{\text{d}}}^2 \right]} \quad (41)$$

The number of subcarriers respectively taken into account is denoted by N_{sc}.

CINR

The carrier to interference and noise ratio is determined for each subframe n. The computation is based on the partially compensated samples $r_{l,k}''$, the decided symbols $\hat{a}_{l,k}$, and the channel estimates $\hat{H}_k$ (DL: preamble and fine; UL: fine).

$$CINR(n) = \frac{\sum_l \sum_k |\hat{a}_{l,k} \cdot \hat{H}_k|^2}{\sum_l \sum_k |r_{l,k}'' - \hat{a}_{l,k} \cdot \hat{H}_k|^2} \qquad (42)$$

Further CINR statistics are defined in the standards [5], [6].

$$\hat{\mu}_{\text{CINR}}(n) = \begin{cases} CINR(0) & n = 0 \\ (1 - \alpha_{\text{avg}}) \cdot \hat{\mu}_{\text{CINR}}(n-1) + \alpha_{\text{avg}} \cdot CINR(n) & n > 0 \end{cases}$$

$$\hat{\mu}_{\text{CINR}}^{(\text{dB})}(n) = 10 \cdot \log \hat{\mu}_{\text{CINR}}(n) \, \text{dB}$$

$$(43)$$

$$\hat{x}_{\text{CINR}}^2(n) = \begin{cases} CINR^2(0) & n = 0 \\ (1 - \alpha_{\text{avg}}) \cdot \hat{x}_{\text{CINR}}^2(n-1) + \alpha_{\text{avg}} \cdot CINR^2(n) & n > 0 \end{cases}$$

$$\hat{\sigma}_{\text{CINR}}^{(\text{dB})}(n) = 5 \cdot \log(\hat{x}_{\text{CINR}}^2(n) - \hat{\mu}_{\text{CINR}}^2(n)) \, \text{dB}$$

RSSI

The received signal strength indicator is determined for each subframe n. The computation is based on the time domain samples $r(i)$ extracted by the subframe detection block.

$$RSSI(n) \sim \overline{|r(i)|^2} \qquad (44)$$

Further RSSI statistics are defined in the standard [5], [6].

$$\hat{\mu}_{\text{RSSI}}(n) = \begin{cases} RSSI(0) & n = 0 \\ (1 - \alpha_{\text{avg}}) \cdot \hat{\mu}_{\text{RSSI}}(n-1) + \alpha_{\text{avg}} \cdot RSSI(n) & n > 0 \end{cases}$$

$$\hat{\mu}_{\text{RSSI}}^{(\text{dB})}(n) = 10 \cdot \log \hat{\mu}_{\text{RSSI}}(n) \, \text{dB}$$

$$(45)$$

$$\hat{x}_{\text{RSSI}}^2(n) = \begin{cases} RSSI^2(0) & n = 0 \\ (1 - \alpha_{\text{avg}}) \cdot \hat{x}_{\text{RSSI}}^2(n-1) + \alpha_{\text{avg}} \cdot RSSI^2(n) & n > 0 \end{cases}$$

$$\hat{\sigma}_{\text{RSSI}}^{(\text{dB})}(n) = 5 \cdot \log(\hat{x}_{\text{RSSI}}^2(n) - \hat{\mu}_{\text{RSSI}}^2(n)) \, \text{dB}$$

I/Q Imbalance

The I/Q imbalance estimation block allows to evaluate the

$$modulator\ gain\ balance = |1 + \Delta Q| \qquad (46)$$

and the

$$quadrature\ mismatch = \arg\{1 + \Delta Q\} \qquad (47)$$

respectively based on the block's estimate $\Delta \hat{Q}$.

Other Measurement Variables

Without going into detail, the OFDMA measurement application additionally provides the following results:

- Burst power
- Constellation diagram
- Group delay
- I/Q offset
- PAPR
- Pilot BER
- Spectral flatness

Literature

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[6]   IEEE Std 802.16e™–2005 and IEEE Std 802.16™–2004/Cor1–2005: Air Interface for Fixed and Mobile Broadband Wireless Access Systems (2006)

Contents of Chapter 3

3 Instrument Functions

This chapter describes the analyzer functions of the R&S ZVL-K1 option in detail. For the basic settings functions please refer to the NWA Help System, chapter "GUI Reference".

For every key a table is provided in which all submenus and corresponding commands are listed. The description of the submenus and commands follows the order of the table. The commands for the optional remote control (if any) are indicated for each softkey. The description is divided into the following topics:

- "Measurement Parameters" on page 3.2

    This section describes how to reset the instrument, to set up specific measurements and to set the measurement parameters. Examples of basic operations are provided in the Quick Start Guide, chapter 5 "Basic Measurement Examples". Advanced examples are described in chapter "Advanced Measurement Examples".

- "Measurement Functions" on page 3.41

    This section informs about how to select and configure the measurement functions. Examples are described in chapter "Advanced Measurement Examples".

- "Measurement Modes" on page 3.91

    This section describes the provided measurement modes, the change of measurement modes and the access to the menus of all active measurement modes.

- "Options" on page 3.91

    This section informs about optional functions and their application that are included in the basic unit configuration.

More basic information on operation is given in the introductory chapters of the NWA Help System.

Measurement Parameters

In this section all menus necessary for setting measurement parameters are described. This includes the following topics and keys. For details on changing the mode refer to "Measurement Mode Selection – MODE Key" on page 3.92.

- "Initializing the Configuration – PRESET Key" on page 3.3

- "Selecting the Frequency and Span – CENTER Key" on page 3.5

- "Setting the Frequency Span – SPAN Key" on page 3.10

- "Setting the Level Display and Configuring the RF Input – AMPT Key" on page 3.12

- "Setting the Bandwidths and Sweep Time – PWR BW Key" on page 3.15

- "Configuring the Sweep Mode – SWEEP Key" on page 3.20

- "Triggering the Sweep – TRIG Key" on page 3.23

- "Setting Traces – TRACE Key" on page 3.31

Table 3–1: Sweep range variables

Abbreviation	Definition	R&S FSL3 value	R&S FSL6 value
f_{max}	max. frequency	3 GHz	6 GHz
f_{min}	min. frequency available	0 Hz	0 Hz
$span_{min}$	smallest selectable span > 0 Hz	10 Hz	10 Hz

Initializing the Configuration – PRESET Key

The **PRESET** key resets the instrument to the default setting and therefore provides a defined initial state as a known starting point for measurements.

Note:　*If the **LOCAL LOCKOUT** function is active in the remote control mode, the **PRESET** key is disabled.*

Further information

– "Initial configuration" on page 3.3

Task

– To preset the instrument

To preset the instrument

1. Define the data set for the preset:

    –   To retrieve the originally provided settings file (see Initial configuration), in the file menu, deactivate the **Startup Recall** softkey.

    –   To retrieve a customized settings file, in the file menu, activate the **Startup Recall** softkey, press the **Startup Recall Setup** softkey, and select the corresponding file.

2. Press the **PRESET** key to trigger a preset.

➡   Remote: `*RST` or `SYSTem:PRESet`

Note:　*In order to save the current settings after reboot of the instrument, create a shutdown file by switching the analyzer in the standby mode (press the On/Off key on the FRONT panel and wait until the yellow LED is ON). With the battery pack option, use a USB keyboard and terminate the analyzer firmware with ALT+F4 to create the shutdown file.*

Initial configuration

The initial configuration is selected in a way that the RF input is always protected against overload, provided that the applied signal levels are in the allowed range for the instrument.

The parameter set of the initial configuration can be customized by using the **Startup Recall** softkey in the file menu.

Table 3–2: Initial configuration

Parameter	Settings
mode	Spectrum Analyzer
center frequency	f_{max} / 2
center frequency step size	0.1 * center frequency
span	3 GHz / 6 GHz (R&S FSL3/6)
RF attenuation	auto (0 dB)
reference level	–20 dBm
level range	100 dB log
level unit	dBm
sweep time	auto
resolution bandwidth	auto (3 MHz)
video bandwidth	auto (10 MHz)
FFT filters	off
span / RBW	50
RBW / VBW	0.33
sweep	cont
trigger	free run
trace 1	clr write
trace 2/3/4/5/6	blank
detector	auto peak
frequency offset	0 Hz
reference level offset	0 dB
reference level position	100 %
grid	abs
cal correction	on
noise source	off
input	RF

Selecting the Frequency and Span – CENTER Key

The **CENTER** key is used to specify the frequency axis, and to set the frequency offset and the signal track function. The frequency axis can be specified either by the start and stop frequency or by the center frequency and the span.

To open the frequency menu

➢ Press the **CENTER** key.

The frequency menu is displayed. The **Frequency Center** edit dialog box is displayed.

Menu and softkey description

– "Softkeys of the frequency menu" on page 3.6

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 section "How to use the Help System".

Tasks

– To specify the frequency axis by the start and stop frequency

– To specify the frequency axis by the center frequency and the span

– To specify the step size for the arrow keys and the rotary knob

– To modify the frequency axis by an offset

– To track signals (only possible if span >0)

To specify the frequency axis by the start and stop frequency

1. Press the **Start** softkey and enter a start frequency.

2. Press the **Stop** softkey and enter a stop frequency.

To specify the frequency axis by the center frequency and the span

1. Press the **CENTER** key and enter a center frequency in the **Frequency Center** edit dialog box.

2. Press the **SPAN** key and enter the bandwidth you want to analyze.

Note: *Entering a value of 0 Hz will cause a change to the zero span analysis mode.*

To specify the step size for the arrow keys and the rotary knob

1. Press the **CF Stepsize** softkey.

The softkeys are displayed according to the selected frequency span (zero span or span > 0).

2. To define the step size of the center frequency:

– Only if span > 0: Press **0.1*Span**, **0.5*Span** or **x*Span** to define the step size for the center frequency as percentage of the span.

– Only if span = 0: Press **0.1*RBW**, **0.5*RBW** or **x*RBW** to define the step size for the center frequency as percentage of the resolution bandwidth.

– Press the **=Center** softkey to set the step size to the value of the center frequency and to remove the dependency of the step size to span or resolution bandwidth.

– Press the **=Marker** softkey to set the step size to the value of the marker and to remove the dependency of the step size to span or resolution bandwidth.

– Press the **Manual** softkey and enter a fixed step size for the center frequency.

Note: *The step size assigned to arrow keys corresponds to the selected value; the step size of the rotary knob is $^1/_{10}$ of it.*

To modify the frequency axis by an offset

➢ Press the **Frequency Offset** softkey and enter the offset to shift the displayed frequency span.

To track signals (only possible if span >0)

1. Press the **Signal Track** softkey.

   The softkeys of this submenu are displayed to start and stop signal tracking with specified parameters.

2. Press the **Track On/Off** softkey to switch signal tracking on or off.

3. Press the **Track BW** softkey and enter a bandwidth for signal tracking.

4. Press the **Track Threshold** softkey and enter the threshold for signal tracking.

5. Press the **Select Trace** softkey and select the trace for signal tracking.

Softkeys of the frequency menu

The following table shows all softkeys available in the frequency 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.

Menu / Command	Command
Center	
Start	
Stop	
CF Stepsize ▼	0.1*Span/0.1*RBW
	0.5*Span/0.5*RBW
	x*Span/x*RBW
	=Center
	=Marker
	Manual
Frequency Offset	
Signal Track ▼	Track On/Off
	Track BW
	Track Threshold
	Select Trace

Center

Opens an edit dialog box to enter the center frequency. The allowed range of values for the center frequency depends on the frequency span.

span > 0: span$_{min}$ / 2 $\leq$ f$_{center}$ $\leq$ f$_{max}$ – span$_{min}$ / 2

span = 0: 0 Hz $\leq$ f$_{center}$ $\leq$ f$_{max}$

f$_{max}$ and span$_{min}$ are specified in the data sheet. To help analyze signals located at the end of the frequency range, the f$_{max}$ value is extended by 0.05 GHz for direct entry via the key pad. The preset and full span values remain unchanged.

➡ Remote: `FREQ:CENT 100MHz`

Start

Opens an edit dialog box to define the start frequency. The following range of values is allowed:

f$_{min}$ $\leq$ f$_{start}$ $\leq$ f$_{max}$ – span$_{min}$

f$_{min,}$ f$_{max}$ and span$_{min}$ are specified in the data sheet. To help analyze signals located at the end of the frequency range, the f$_{max}$ value is extended by 0.05 GHz for direct entry via the key pad. The preset and full span values remain unchanged.

➡ Remote: `FREQ:STAR 20MHz`

Stop

Opens an edit dialog box to define the stop frequency. The following range of values for the stop frequency is allowed:

f$_{min}$ + span$_{min}$ $\leq$ f$_{stop}$ $\leq$ f$_{max}$

f$_{min,}$ f$_{max}$ and span$_{min}$ are specified in the data sheet. To help analyze signals located at the end of the frequency range, the f$_{max}$ value is extended by 0.05 GHz for direct entry via the key pad. The preset and full span values remain unchanged.

➡ Remote: `FREQ:STOP 2000MHz`

CF Stepsize

Opens a submenu to set the step size of the center frequency. In addition to the **=Center**, **=Marker** and **Manual** softkeys, the other softkeys are displayed depending on the selected frequency span.

The step size can be coupled to the span (span > 0) or the resolution bandwidth (span = 0) or it can be manually set to a fixed value.

0.1*Span (span > 0)

Sets the step size for the center frequency to 10% of the span.

➡ Remote: `FREQ:CENT:STEP:LINK SPAN`
➡ Remote: `FREQ:CENT:STEP:LINK:FACT 10PCT`

0.1*RBW (zero span)

Sets the step size for the center frequency to 10% of the resolution bandwidth. This is the default setting.

➡ Remote: FREQ:CENT:STEP:LINK RBW

➡ Remote: FREQ:CENT:STEP:LINK:FACT 10PCT

0.5*Span (span > 0)

Sets the step size for the center frequency to 50% of the span.

➡ Remote: FREQ:CENT:STEP:LINK SPAN

➡ Remote: FREQ:CENT:STEP:LINK:FACT 50PCT

0.5*RBW (zero span)

Sets the step size for the center frequency to 50% of the resolution bandwidth.

➡ Remote: FREQ:CENT:STEP:LINK RBW

➡ Remote: FREQ:CENT:STEP:LINK:FACT 50PCT

x*Span (span > 0)

Opens an edit dialog box to set the step size for the center frequency as % of the span.

➡ Remote: FREQ:CENT:STEP:LINK SPAN

➡ Remote: FREQ:CENT:STEP:LINK:FACT 20PCT

x*RBW (zero span)

Opens an edit dialog box to set the step size for the center frequency as % of the resolution bandwidth. Values between 1 and 100% in steps of 1% are allowed. The default setting is 10%.

➡ Remote: FREQ:CENT:STEP:LINK RBW

➡ Remote: FREQ:CENT:STEP:LINK:FACT 20PCT

=Center

Sets the step size to the value of the center frequency and removes the coupling of the step size to span or resolution bandwidth. This function is especially useful during measurements of the signal harmonic content because by entering the center frequency each stroke of the arrow key selects the center frequency of another harmonic.

=Marker

Sets the step size to the value of the current marker and removes the coupling of the step size to span or resolution bandwidth. This function is especially useful during measurements of the signal harmonic content at the marker position because by entering the center frequency each stroke of the arrow key selects the center frequency of another harmonic.

Manual

Opens an edit dialog box to enter a fixed step size for the center frequency.

➡ Remote: `FREQ:CENT:STEP 120MHz`

Frequency Offset

Opens an edit dialog box to enter a frequency offset that shifts the displayed frequency range by the specified offset. The allowed values range from –100 GHz to 100 GHz. The default setting is 0 Hz.

➡ Remote: `FREQ:OFFS 10 MHz`

Signal Track (span > 0)

Opens a submenu to modify the parameters for signal tracking: search bandwidth, threshold value and trace.

The search bandwidth and the threshold value are shown in the diagram by two vertical lines and one horizontal line, which are labeled as **TRK**. After each sweep the center frequency is set to the maximum signal found within the searched bandwidth. If no maximum signal above the set threshold value is found in the searched bandwidth, the track mechanism stops.

➡ Remote: `CALC:MARK:FUNC:STR OFF`

Track On/Off (span > 0)

Switches the signal tracking on or off.

➡ Remote: `CALC:MARK:FUNC:STR OFF`

Track BW (span > 0)

Opens an edit dialog box to set the search bandwidth for signal tracking. The frequency range is calculated as a function of the center frequency.

➡ Remote: `CALC:MARK:FUNC:STR:BAND 1MHZ`

Track Threshold (span > 0)

Opens an edit dialog box to set the threshold value for signal tracking.

➡ Remote: `CALC:MARK:FUNC:STR:THR –70DBM`

Select Trace (span > 0)

Opens an edit dialog box to select the trace on which the signal is tracked.

➡ Remote: `CALC:MARK:FUNC:STR:TRAC 1`

Setting the Frequency Span – SPAN Key

The **SPAN** key is used to set the frequency span to be analyzed.

To open the span menu

➢ Press the **SPAN** key.

The span menu is displayed. For span > 0 an edit dialog box to enter the frequency is displayed. For zero span, an edit dialog box to enter the sweep time is displayed.

Menu and softkey description

– "Softkeys of the span menu" on page 3.10

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 section "How to use the Help System".

Task

– To specify the span (alternatives)

To specify the span (alternatives)

1. To set the span, use the **Span Manual**, **Full Span**, **Zero Span** and **Last Span** softkeys.

2. To define a frequency range, use the **Start** and **Stop** softkeys.

3. For zero span, press the **Sweeptime Manual** softkey and enter a sweep time.

Softkeys of the span menu

The following table shows all softkeys available in the span 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.

Command
Span Manual
Sweeptime Manual
Start
Stop
Full Span
Zero Span
Last Span

Span Manual

Opens an edit dialog box to enter the frequency span. The center frequency is kept constant. The following range is allowed:

span = 0: 0 Hz

span >0: $span_{min} \leq f_{span} \leq f_{max}$

f_{max} and $span_{min}$ are specified in the data sheet. To help analyze signals located at the end of the frequency range, the f_{max} value is extended by 0.05 GHz for direct entry via the key pad. The preset and full span values remain unchanged.

➡ Remote: `FREQ:SPAN 2GHz`

Start

Opens an edit dialog box to enter the start frequency. For details see **Start** softkey in the frequency menu.

➡ Remote: `FREQ:STAR 20MHz`

Stop

Opens an edit dialog box to enter the stop frequency. For details see **Stop** softkey in the frequency menu.

➡ Remote: `FREQ:STOP 2000MHz`

Full Span

Sets the span to the full frequency range of the R&S FSL, useful for overview measurements.

➡ Remote: `FREQ:SPAN:FULL`

Zero Span

Sets the span to 0 Hz (zero span). The x–axis becomes the time axis with the grid lines corresponding to 1/10 of the current sweep time (**SWT**).

➡ Remote: `FREQ:SPAN 0Hz`

Last Span

Sets the span to the previous value. With this function e.g. a fast change between overview measurement and detailed measurement is possible.

Setting the Level Display and Configuring the RF Input – AMPT Key

The **AMPT** key (also called **SCALE** key) is used to set the reference level, the level range and unit, the scaling and the RF attenuation.

To open the amplitude menu

➢ Press the **AMPT** key.

The amplitude menu is displayed. The **Reference Level** dialog box is displayed.

Menu and softkey description

– "Softkeys of the amplitude menu" on page 3.12

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 section "How to use the Help System".

Task

– To specify the amplitude

To specify the amplitude

1. Set the reference level, offset and position, using the **Ref Level**, **Ref Level Offset** and **Ref Level Position** softkeys.

2. Select the level range and the unit for the level axis, using the **Range Log** and **Unit** softkeys.

3. Set the scaling, using the **Range Linear** and/or **Grid Abs / Rel** softkeys.

4. Set the attenuation, using the **RF Atten Manual** or **RF Atten Auto** softkeys.

Softkeys of the amplitude menu

The following table shows all softkeys available in the amplitude 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.

Command
Ref Level
Range Log
Range Linear
Preamp On/Off
RF Atten Manual
RF Atten Auto
More ▼
Ref Level Offset
Ref Level Position
Grid Abs / Rel
Unit
Input 50 Ω / 75 Ω

Ref Level

Opens an edit dialog box to enter the reference level in the currently active unit (dBm, dBµV, etc).

The reference level value is the maximum value the AD converter can handle without distortion of the measured value. Signal levels above this value will not be measured correctly, which is indicated by the **IFOVL** status display.

➡ Remote: `DISP:TRAC:Y:RLEV –60dBm`

Range Log

Opens the **Range Log** dialog box to select a value for the level range.

➡ Remote: `DISP:TRAC:Y:SPAC LOG`

➡ Remote: `DISP:TRAC:Y 120DB`

Range Linear

Opens the **Range Linear** dialog box to select a value for the level range.

➡ Remote: `DISP:TRAC:Y:SPAC LIN | LDB`

Preamp On/Off (option RF Preamplifier, B22)

Switches the preamplifier on or off.

➡ Remote: `INP:GAIN:STAT ON`

RF Atten Manual

Opens an edit dialog box to enter the attenuation, irrespective of the reference level.

The attenuation can be set in 5 dB steps. The range is specified in the data sheet. If the defined reference level cannot be set for the set RF attenuation, the reference level will be adjusted accordingly.

The RF attenuation defines the level at the input mixer according to the formula:

$level_{mixer} = level_{input} - RF\ attenuation$

The maximum mixer level allowed is –10 dBm. Mixer levels above this value may lead to incorrect measurement results, which are indicated by the **OVLD** status display.

➡ Remote: `INP:ATT 30 DB`

RF Atten Auto

Sets the RF attenuation automatically as a function of the selected reference level. This ensures that the optimum RF attenuation is always used. It is the default setting.

➡ Remote: `INP:ATT:AUTO ON`

Ref Level Offset

Opens an edit dialog box to enter the arithmetic level offset. This offset is added to the measured level irrespective of the selected unit. The scaling of the y–axis is changed accordingly. The setting range is ±200 dB in 0.1 dB steps.

➡ Remote: `DISP:WIND:TRAC:Y:RLEV:OFFS -10dB`

Ref Level Position

Opens an edit dialog box to enter the reference level position, i.e. the position of the maximum AD converter value on the level axis. The setting range is from –200 to +200%, 0% corresponding to the lower and 100% to the upper limit of the diagram.

➡ Remote: `DISP:WIND:TRAC:Y:RPOS 100PCT`

Grid Abs / Rel (not available with Range Linear)

Switches between absolute and relative scaling of the level axis.

Absolute scaling	The labeling of the level lines refers to the absolute value of the reference level. Absolute scaling is the default setting.
Relative scaling	The upper line of the grid is always at 0 dB. The scaling is in dB whereas the reference level is always in the set unit (for details on unit settings see **Unit** softkey).

➡ Remote: `DISP:WIND:TRAC:Y:MODE ABS`

Unit

Opens the **Unit** dialog box to select the unit for the level axis. The default setting is dBm. If a transducer is switched on, the softkey is not available.

In general, the spectrum analyzer measures the signal voltage at the RF input. The level display is calibrated in RMS values of an unmodulated sinewave signal. In the default state, the level is displayed at a power of 1 mW (= dBm). Via the known input impedance (50 Ω or 75 Ω), conversion to other units is possible. The units dBm, dBmV, dBµV, V and W are directly convertible.

➡ Remote: `CALC:UNIT:POW DBM`

Input 50 Ω / 75 Ω

Uses 50 Ω or 75 Ω as reference impedance for the measured levels. Default setting is 50 Ω .

➡ Changes the reference impedance for the measured levels

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

All levels specified in this Operating Manual refer to the default setting of the instrument (50 Ω).

➡ Remote: `INP:IMP 50OHM`

Setting the Bandwidths and Sweep Time – PWR BW Key

The **PWR BW** key is used to set the resolution bandwidth, video bandwidth (VBW) and sweep time (SWT). The values available for resolution bandwidth and video bandwidth depend on the selected filter type. For details on channel filters see also "List of available RRC and channel filters" on page 3.16.

To open the bandwidth menu

➢ Press the **PWR BW** key.

The bandwidth menu is displayed.

Menu and softkey description

– "Softkeys of the bandwidth menu" on page 3.17

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 section "How to use the Help System".

Further information

– "List of available RRC and channel filters" on page 3.16

Tasks

– To specify the bandwidth

– To choose the appropriate filter type

To specify the bandwidth

1. Set the resolution bandwidth using the **Res BW Manual** or **Res BW Auto** softkey.

2. Set the video bandwidth using the **Video BW Manual** or **Video BW Auto** softkey.

3. Set the sweep time using the **Sweeptime Manual** or **Sweeptime Auto** softkey.

4. Press the **Filter Type** softkey and select the appropriate filters.

To choose the appropriate filter type

Analog and digital filters are used. All resolution bandwidths up to 3 MHz are realized using digital band–passes. As far as the attenuation characteristic is concerned they behave like analog filters but have a much higher measurement speed than comparable analog filters. This is due to the fact that the transient response can be compensated as a result of an accurately defined filter behavior.

Note: *Due to the LO feedthrough the overload display (***OVLD***) responds for digital filters if the following combinations are set:*
*RBW < 100 kHz and start frequency < 6 * resolution bandwidth, or*
RBW = 100 kHz and start frequency < 3 MHz.

With option Narrow IF Filters, R&S FSL–B7, the range is enlarged (for details refer to the data sheet).

The video filters serve for smoothing the displayed trace. Using video bandwidths that are small compared to the resolution bandwidth, only the signal average is displayed and noise peaks and pulsed signals are repressed. If pulsed signals are to be measured, it is recommended to use a video

bandwidth that is large compared to the resolution bandwidth (VBW * 10 x RBW) for the amplitudes of pulses to be measured correctly.

The following filter types are available:

- Gaussian filters

  The Gaussian filters are set by default. The available bandwidths are specified in the data sheet.

- EMI (6dB) filters

  The available bandwidths are specified in the data sheet.

- FFT filters

  The available bandwidths are specified in the data sheet.

  The FFT algorithm offers considerably higher measurement speeds with all the other settings remaining the same. The reason is that for analog filters the sweep time required for a particular span is proportional to (span/RBW^2). When using the FFT algorithm, however, the sweep time is proportional to (span/RBW).

  FFT filters are particularly suitable for stationary signals (sinusoidal signals or signals that are continuously modulated in time). For burst signals (TDMA) or pulsed signals, normal filters are preferable. When the tracking generator is used as signal source for the DUT, filtering with the FFT algorithm is not useful. The **FFT** option is thus not available if the tracking generator is switched on.

  If the FFT filters are activated, the sweep time display (**SWT**) is replaced by the acquisition time (**AQT**) display. The sweep time is defined by the selected bandwidth and span, and cannot be changed. The video bandwidth is not defined and therefore cannot be set.

  The sample detector and the peak detector are available. If the **Detector Auto Select** softkey in the trace menu is activated, the peak detector is selected.

- channel filters

  details see "List of available RRC and channel filters"

- RRC filters

  details see "List of available RRC and channel filters"

List of available RRC and channel filters

For power measurement a number of especially steep–edged channel filters are available (see the following table).

For filters of type RRC (Root Raised Cosine), the filter bandwidth indicated describes the sampling rate of the filter. For all other filters (CFILter) the filter bandwidth is the 3 dB bandwidth.

Table 3–3: Filter types

Filter Bandwidth	Filter Type	Application
100 Hz (R&S FSL–B7 only)	CFILter	
200 Hz (R&S FSL–B7 only)	CFILter	A0
300 Hz	CFILter	
500 Hz	CFILter	
1 kHz	CFILter	
1.5 kHz	CFILter	
2 kHz	CFILter	
2.4 kHz	CFILter	SSB
2.7 kHz	CFILter	

Filter Bandwidth	Filter Type	Application
3 kHz	CFILter	
3.4 kHz	CFILter	
4 kHz	CFILter	DAB, Satelite
4.5 kHz	CFILter	
5 kHz	CFILter	
6 kHz	CFILter	
8.5 kHz	CFILter	ETS300 113 (12.5 kHz channels)
9 kHz	CFILter	AM Radio
10 kHz	CFILter	
12.5 kHz	CFILter	CDMAone
14 kHz	CFILter	ETS300 113 (20 kHz channels)
15 kHz	CFILter	
16 kHz	CFILter	ETS300 113 (25 kHz channels)
18 kHz, α=0.35	RRC	TETRA
20 kHz	CFILter	
21 kHz	CFILter	PDC
24.3 kHz, α=0.35	RRC	IS 136
25 kHz	CFILter	
30 kHz	CFILter	CDPD, CDMAone
50 kHz	CFILter	
100 kHz	CFILter	
150 kHz	CFILter	FM Radio
192 kHz	CFILter	PHS
200 kHz	CFILter	
300 kHz	CFILter	
500 kHz	CFILter	J.83 (8–VSB DVB, USA)
1 MHz	CFILter	CDMAone
1.228 MHz	CFILter	CDMAone
1.28 MHz	RRC	
1.5 MHz	CFILter	DAB
2 MHz	CFILter	
3 MHz	CFILter	
3.84 MHz, α=0.22	RRC	W–CDMA 3GPP
4.096 MHz, α=0.22	RRC	W–CDMA NTT DOCoMo
5 MHz	CFILter	

Softkeys of the bandwidth menu

The following table shows all softkeys available in the bandwidth 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.

Command
Res BW Manual
Res BW Auto
Video BW Manual
Video BW Auto
Sweeptime Manual

Command
Sweeptime Auto
Filter Type

Res BW Manual

Opens an edit dialog box to enter a value for the resolution bandwidth. The available resolution bandwidths are specified in the data sheet. For details on the correlation between resolution bandwidth and filter type refer to "To choose the appropriate filter type" on page 3.15.

Numeric input is always rounded to the nearest possible bandwidth. For rotary knob or **UP**/**DNARROW** key inputs, the bandwidth is adjusted in steps either upwards or downwards.

The manual input mode of the resolution bandwidth is indicated by a green asterisk (*) at the **RBW** display.

➡ Remote: `BAND:AUTO OFF`

➡ Remote: `BAND 1MHz`

Res BW Auto (span > 0)

Couples the resolution bandwidth to the selected span. If the span is changed, the resolution bandwidth is automatically adjusted.

This setting is recommended, if a favorable setting of the resolution bandwidth in relation to the selected span is desired.

➡ Remote: `BAND:AUTO ON`

Video BW Manual (not available for FFT filter)

Opens an edit dialog box to enter the video bandwidth. The available video bandwidths are specified in the data sheet.

Numeric input is always rounded to the nearest possible bandwidth. For rotary knob or UP/DOWN key inputs, the bandwidth is adjusted in steps either upwards or downwards.

The manual input mode of the video bandwidth is indicated by a green asterisk (*) at the **VBW** display.

➡ Remote: `BAND:VID:AUTO OFF`

➡ Remote: `BAND:VID 10 kHz`

Video BW Auto (not available for FFT filter)

Couples the video bandwidth to the resolution bandwidth. If the resolution bandwidth is changed, the video bandwidth is automatically adjusted.

This setting is recommended, if a minimum sweep time is required for a selected resolution bandwidth. Narrow video bandwidths require longer sweep times due to the longer settling time. Wide bandwidths reduce the signal/noise ratio.

➡ Remote: `BAND:VID:AUTO ON`

Sweeptime Manual (not available for FFT filter)

Opens an edit dialog box to enter the sweep time.

Sweep time		**Option TV Trigger, B6** (available from version 1.10)
absolute max. sweep time value:	16000 s	100 µs (zero span)
absolute min. sweep time value:	1 µs (zero span)	25 µs (zero span)
	2.5 ms (span > 0)	–

Allowed values depend on the ratio of span to RBW and RBW to VBW. For details refer to the data sheet.

Numeric input is always rounded to the nearest possible sweep time. For rotary knob or **UPARROW**/**DNARROW** key inputs, the sweep time is adjusted in steps either downwards or upwards.

The manual input mode of the sweep time is indicated by a green asterisk (*) at the **SWT** display. If the selected sweep time is too short for the selected bandwidth and span, level measurement errors will occur due to a too short settling time for the resolution or video filters. In this case, the R&S FSL displays the error message **UNCAL** and marks the indicated sweep time with a red asterisk (*).

➡ Remote: `SWE:TIME:AUTO OFF`
➡ Remote: `SWE:TIME 10s`

Sweeptime Auto (not available for FFT filter and zero span)

Couples the sweep time to the span, video bandwidth (VBW) and resolution bandwidth (RBW). If the span, resolution bandwidth or video bandwidth are changed, the sweep time is automatically adjusted.

The R&S FSL always selects the shortest sweep time that is possible without falsifying the signal. The maximum level error is < 0.1 dB, compared to using a longer sweep time.

➡ Remote: `SWE:TIME:AUTO ON`

Filter Type

Opens the **Filter Type** dialog box to select the filter type.

For detailed information on filters see "To choose the appropriate filter" on page 3.15 and "List of available RRC and channel filters" on page 3.16.

➡ Remote: `BAND:TYPE NORM`

Configuring the Sweep Mode – SWEEP Key

The **SWEEP** key is used to configure the sweep mode. Continuous sweep or single sweep are possible. The sweep time and the number of measured values are set.

To open the sweep menu

➢ Press the **SWEEP** key.

The sweep menu is displayed.

Menu and softkey description

– "Softkeys of the sweep menu" on page 3.20

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 section "How to use the Help System".

Task

– To specify the sweep settings

To specify the sweep settings

1. Press the **Sweep Count** softkey and enter the sweep count.

2. Set the sweep time by using the **Sweeptime Manual** or **Sweeptime Auto** softkey.

3. Press the **Sweep Points** softkey and enter the number of sweep points.

4. Select the sweep mode using the **Continuous Sweep** or **Single Sweep** softkey.

5. To repeat the single sweep, press the **Continue Single Sweep** softkey.

Softkeys of the sweep menu

The following table shows all softkeys available in the sweep 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.

If the Spectrogram Measurement option (K14) is activated, this menu provides additional functionality. For details refer to "Softkeys of the sweep menu (Spectrogram view)" on page 3.151.

Command
Continuous Sweep
Single Sweep
Continue Single Sweep
Sweeptime Manual
Sweeptime Auto
Sweep Count
Sweep Points

Continuous Sweep

Sets the continuous sweep mode: the sweep takes place continuously according to the trigger settings. This is the default setting. The trace averaging is determined by the sweep count value (see **Sweep Count** softkey).

If the Spectrogram Measurement option (K14) is activated, this softkey provides additional functionality. For details refer to **Continuous Sweep Start/Stop** softkey in the sweep menu of this option.

➡ Remote: INIT:CONT ON

Single Sweep

Sets the single sweep mode: after triggering, starts the number of sweeps that are defined by using the **Sweep Count** softkey. The measurement stops after the defined number of sweeps has been performed.

➡ Remote: INIT:CONT OFF

Continue Single Sweep

Repeats the number of sweeps set by using the **Sweep Count** softkey, without deleting the trace of the last measurement.

This is particularly of interest when using the trace configurations **Average** or **Max Hold** to take previously recorded measurements into account for averaging / maximum search. For details on trace configuration refer to "Setting Traces – TRACE Key" on page 3.31.

➡ Remote: INIT:CONM

Sweeptime Manual

Opens an edit dialog box to enter the sweep time. For details see **Sweeptime Manual** softkey in the bandwidth menu.

➡ Remote: SWE:TIME 10s

Sweeptime Auto

Sets the automatic sweep time mode. For details see **Sweeptime Auto** softkey in the bandwidth menu.

➡ Remote: SWE:TIME:AUTO ON

Sweep Count

Opens an edit dialog box to enter the number of sweeps to be performed in the single sweep mode. Values from 0 to 32767 are allowed. If the values 0 or 1 are set, one sweep is performed. The sweep count is applied to all the traces in a diagram.

The sweep count set in the sweep menu is the same as that in the trace menu (for further details see **Sweep Count** softkey). If the trace configurations **Average**, **Max Hold** or **Min Hold** are set, the sweep count value also determines the number of averaging or maximum search procedures (for details on trace configuration see "Setting Traces – TRACE Key" on page 3.31).

Example:

> **TRACE** key – **Trace Mode** softkey – **Trace Mode** dialog box: select **Max Hold**
> **SWEEP** key – **Sweep Count** softkey – **Average Sweep Count** dialog box: enter 10
> **Single Sweep** softkey: R&S FSL performs the **Max Hold** function over 10 sweeps.

➡ Remote: `SWE:COUN 64`

Sweep Points

Opens an edit dialog box to enter the number of measured values to be collected during one sweep.

The following values are possible: 125, 251, 501 (default), 1001, 2001, 4001, 8001, 16001, 32001. If a value ≠ 501 is set, the auto peak detector will be turned off automatically.

➡ Remote: `SWE:POIN 501`

Triggering the Sweep – TRIG Key

The **TRIG** key (also called **FORMAT** key) is used to set trigger mode, trigger threshold, trigger delay, trigger polarity and for gated sweep the gate configuration.

To open the trigger menu

➢ Press the **TRIG** key.

The trigger menu is displayed.

Menu and softkey description

– "Softkeys of the trigger menu" on page 3.26

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 section "How to use the Help System".

Further information

– "Trigger mode overview" on page 3.26

Tasks

– To specify the trigger settings

– To use gated sweep operation (option Gated Sweep, B8)

– To trigger on TV signals (zero span and option TV Trigger, B6)

To specify the trigger settings

1. Press the **Trg / Gate Source** softkey to select the trigger mode (for details see "Trigger mode overview" on page 3.26).

2. Press the **Trg / Gate Level** softkey to set the trigger level.

3. Press the **Trigger Offset** softkey to set the trigger offset.

4. For details on gated sweep operation, see "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

5. For details on TV signal triggering, see "To trigger on TV signals (zero span and option TV Trigger, B6)".

To use gated sweep operation (option Gated Sweep, B8)

By using a gate in sweep mode and stopping the measurement while the gate signal is inactive, the spectrum for pulsed RF carriers can be displayed without the superposition of frequency components generated during switching. Similarly, the spectrum can also be examined for an inactive carrier. The sweep can be controlled by an external gate or by the internal power trigger.

Gated sweep operation is also possible for span = 0. This enables – e.g. in burst signals – level variations of individual slots to be displayed versus time.

1. Press the Gate **Settings** submenu softkey to define the settings of the gate mode.

   At the center frequency a transition to zero span is made and the time parameters gate delay and gate length are displayed as vertical lines to adjust them easily.

   When quitting the **Gate Settings** submenu, the original span is retrieved so the desired measurement can be performed with the accurately set gate.

2. To set the parameters gate delay and gate length highly accurate, press the **Sweep Time** softkey to alter the x–axis in a way that the signal range concerned (e.g. one full burst) is displayed.

3. Press the **Gate Delay** softkey to set the sampling time in a way that the desired portion of the signal is shown.

4. Press the **Gate Mode Lvl/Edge** softkey to set the gate mode.

5. If the **Edge** gate mode has been selected, press the **Gate Length** softkey to set the sampling duration in a way that the desired portion of the signal is shown.

6. Press the **Trg / Gate Polarity Pos/Neg** softkey to set the polarity of the trigger source.

7. Press the **Gated Trigger** softkey to activate the gated sweep mode.

   To indicate that a gate is used for the sweep, the enhancement label **GAT** is displayed on the screen. This label appears to the right of the window for which the gate is configured.
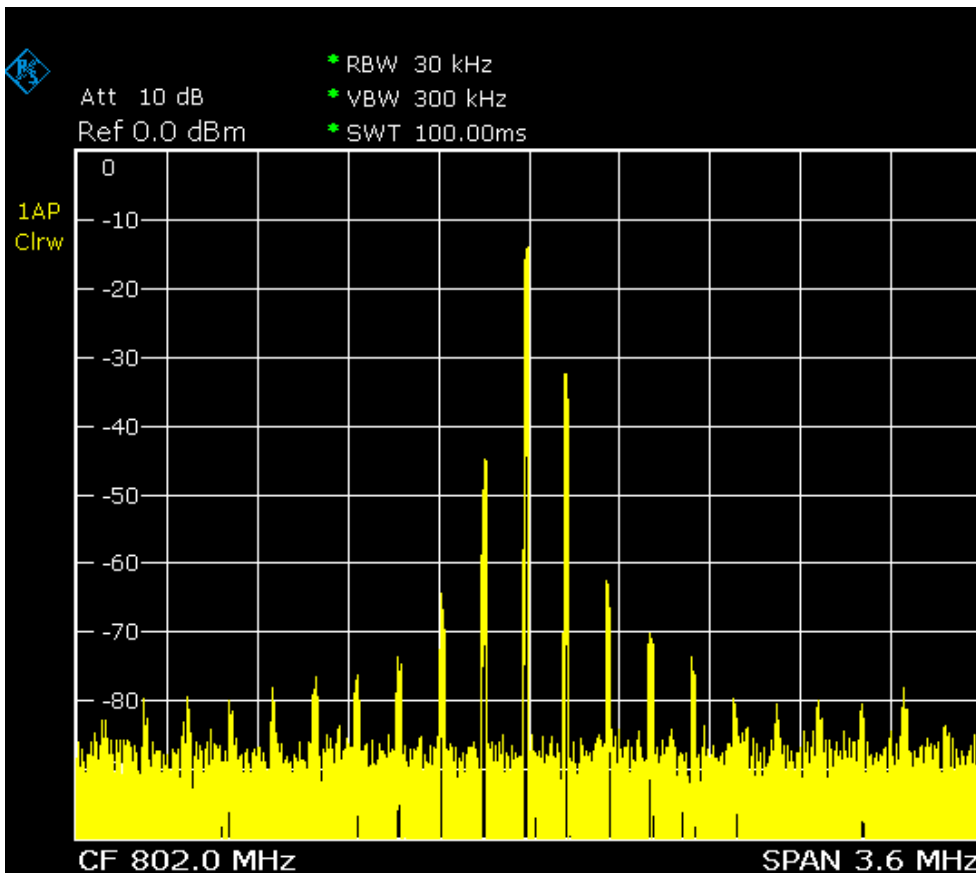
Fig. 3–1: TDMA signal with GATE OFF
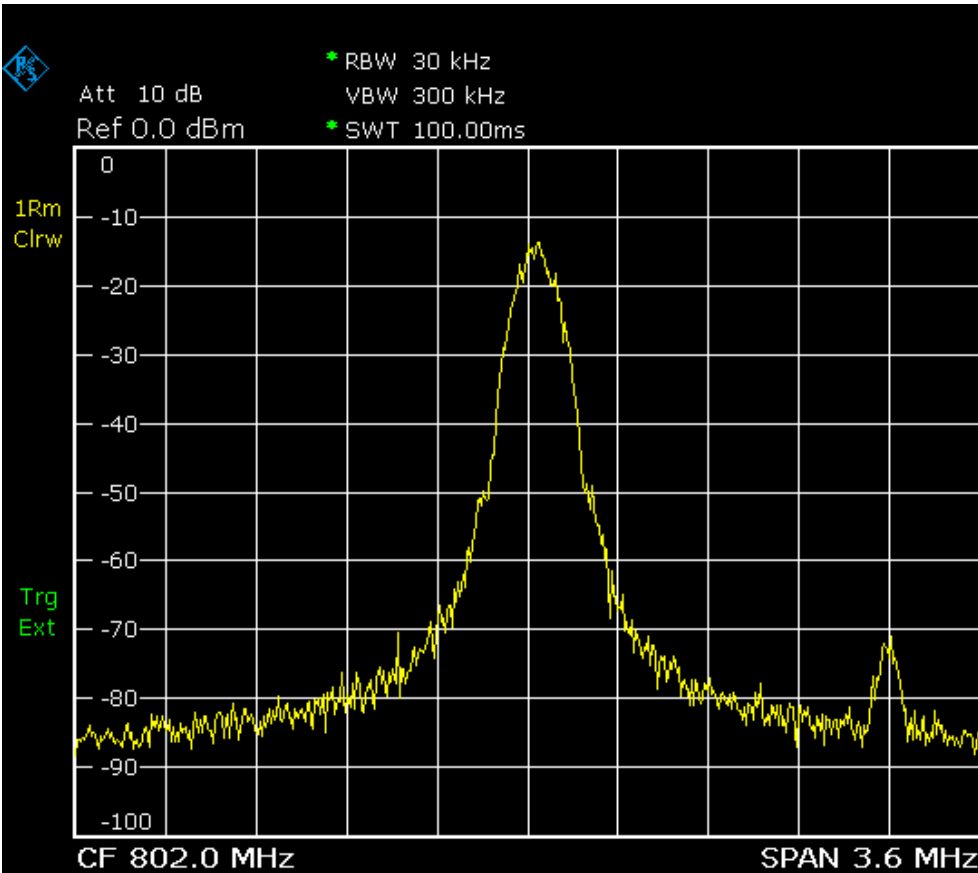
Fig. 3–2: Pulsed signal with GATE ON
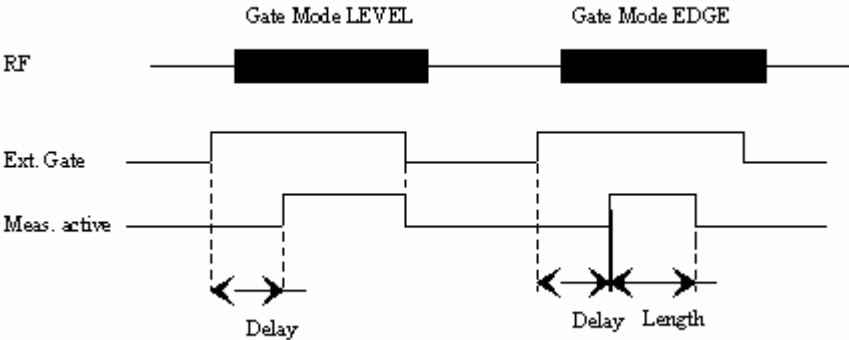
Fig. 3–3: Timing diagram for GATE, GATE DELAY and GATE LENGTH

To trigger on TV signals (zero span and option TV Trigger, B6)

1. Press the **TV Trig Settings** submenu softkey to switch the TV trigger on and define the settings for triggering on TV signal.

2. To configure the TV trigger, press the **Vert Sync**, **Vert Sync Odd Field**, **Vert Sync Even Field** or **Hor Sync** softkey.

3. Press the **Video Pol Pos/Neg** softkey to set the polarity of the video signal.

4. Press the **Lines 625/525** softkey to set the line system to be used.

Trigger mode overview

The R&S FSL offers the following trigger modes:

- **Free Run**

  The start of a sweep is not triggered. Once a measurement is completed, another is started immediately.

- **External**

  Triggering via a TTL signal at the input connector **EXT TRIG / GATE IN** on the rear panel.

- **Video**

  Triggering by the displayed voltage.

  A horizontal trigger line is shown in the diagram. It is used to set the trigger threshold from 0% to 100% of the diagram height.

- **IF Power**

  Triggering of the measurement via signals which are outside the measurement channel.

  For this purpose, the R&S FSL uses a level detector at the second intermediate frequency. Its threshold can be set in a range between –50 dBm and –10 dBm at the input mixer. The resulting trigger level at the RF input is calculated via the following formula:

  $$Mixerlevel_{min} + RFAtt - PreampGain \leq Input\ Signal \leq Mixerlevel_{max} + RFAtt - PreampGain$$

  The bandwidth at the intermediate frequency is 20 MHz. The R&S FSL is triggered as soon as the trigger threshold is exceeded within a 10 MHz range around the selected frequency (= start frequency in the frequency sweep).

  Thus, the measurement of spurious emissions, e.g. for pulsed carriers, is possible even if the carrier lies outside the selected frequency span.

- **TV** (option TV Trigger, B6)

  Triggering of the measurement on TV signals. In this trigger mode, only the **Auto Peak** and the **Sample** detectors are available (for details refer to "Detector overview" on page 3.36).

  In order to display different sections of a TV video signal, the R&S FSL derives several trigger signals from the video signals. This allows triggering as well on the frame repetition as on each line of the TV video signal.

  The filter bandwidth is constant: 4.0 MHz for standards with 525 lines or 5.0 MHz for standards with 625 lines. The position of the filter is determined by the firmware in order to place the 3 dB filter bandwidth on the center frequency, as shown in the diagramm below. For the center frequency, the value of the vision carrier frequency should be set.
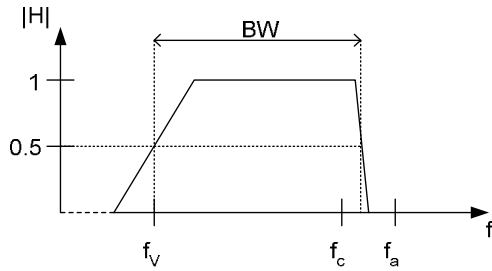
fv = vision carrier frequency   fa = aural carrier frequency

fc = chrominance sub–carrier frequency   BW = –3dB filter bandwidth

Fig. 3–4: 3 dB Filter bandwidth (option TV Trigger, B6)

- **Time Trigger**

  Triggering of the measurement by a time intervall, set via the **Repetition Intervall** softkey.

Softkeys of the trigger menu

The following table shows all softkeys available in the trigger 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.

Menu / Command	Command
Trg / Gate Source	
Trg / Gate Level	
Trg / Gate Polarity Pos/Neg	
Trigger Offset / Repetition Intervall	
Gated Trigger	
Gate Settings ▼	Gate Mode Lvl/Edge
	Gate Delay
	Gate Length
	Trg / Gate Source
	Trg / Gate Level
	Trg / Gate Polarity Pos/Neg
	Sweep Time
More ▼	
IF Power Retrigger Holdoff	
IF Power Retrigger Hysteresis	
TV Trig Settings	Vert Sync
	Vert Sync Odd Field
	Vert Sync Even Field
	Hor Sync
	Video Pol Pos/Neg
	Lines 625/525
	TV Free Run On/Off

Trg / Gate Source

Opens the **Trigger / Gate Source** dialog box to select the trigger / gate mode. For detailed information on trigger modes see "Trigger mode overview" on page 3.26.

The gate–related settings are only available with option Gated Sweep, R&S FSL–B8. As gate modes, all modes apart from the TV Trigger mode (option TV Trigger, B6) are available. For details see also "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

The default setting is **Free Run**. If a trigger mode other than **Free Run** has been set, the enhancement label **TRG** is displayed.

➡ Remote: `TRIG:SOUR IMM | VID | IFP | EXT | TV | TIM` (Free Run, Video, IF Power, Extern, TV Trigger, Time Trigger)

➡ Remote: `SWE:EGAT:SOUR EXT` (Extern)

Trg / Gate Level

Opens an edit dialog box to enter the trigger / gate level. The gate–related settings are only available with option Gated Sweep, R&S FSL–B8. For details see also "Trigger mode overview" on page 3.26 and "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

In the **Time Trigger** mode, this softkey is not available.

➡ Remote: `TRIG:LEV:VID 50PCT`

➡ Remote: `TRIG:LEV:IFP –30DBM`

Trg / Gate Polarity Pos/Neg

Sets the polarity of the trigger / gate source. The gate–related settings are only available with option Gated Sweep, R&S FSL–B8.

The sweep starts after a positive or negative edge of the trigger signal. The default setting is **Pos**. The setting applies to all modes with the exception of the **Free Run** mode.

level triggering	In the setting **Pos** the sweep is stopped by the logic ´0´ signal and restarted by the logical ´1´ signal after the gate delay time has elapsed.
edge triggering	The sweep is continued on a ´0´ to ´1´ transition for the gate length duration after the gate delay time has elapsed.

In the **Time Trigger** mode, this softkey is not available.

For details also see "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

➡ Remote: `TRIG:SLOP POS`

➡ Remote: `SWE:EGAT:POL POS`

Trigger Offset

Opens an edit dialog box to enter the time offset between the trigger signal and the start of the sweep. The time may be entered in multiples of 125 ns in the range –100 s to 100 s (default 0 s).

offset > 0:   start of the sweep is delayed

offset < 0:   sweep starts earlier (pre–trigger)

only possible for span = 0 and gated trigger switched off
not possible if RMS or average detector activated

maximum allowed range and the maximum resolution limited by the sweep time:

$$range_{max} = -499/500 \times sweep\ time$$
$$resolution_{max} = sweep\ time/500$$

Note: *For the option TV Trigger, B6, the allowed offset ranges from –50 µs to +50 µs. If the trigger source is changed to TV trigger and the set trigger offset is out of range, the trigger offset is adopted to the closest value allowed.*

In the **External** or **IF Power** trigger mode, a common input signal is used for both trigger and gate. Therefore changes to the gate delay will affect the trigger delay (trigger offset) as well.

In the **Time Trigger** mode, this softkey is not available.

➡   Remote: `TRIG:HOLD 10US`

Repetition Intervall (Time Trigger mode)

Opens an edit dialog box to enter the time intervall after which the sweep is started. The possible values range from 100 ms to 5000 s.

➡   Remote: `TRIG:TIME:RINT 50`

Gated Trigger (option Gated Sweep, B8)

Switches the sweep mode with gate on or off .

This softkey requires the following trigger mode:

span > 0   **External** or **IF Power**
span = 0   **External** or **IF Power** or **Video**

If a different mode is active, the **IF Power** trigger mode is automatically selected.

If the gate is switched on, a gate signal applied to the rear panel connector EXT TRIGGER/GATE or the internal IF power detector controls the sweep of the analyzer.

In the **Time Trigger** mode, this softkey is not available.

For details also see "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

➡   Remote: `SWE:EGAT ON`
➡   Remote: `SWE:EGAT:SOUR IFP | EXT`

Gate Settings (option Gated Sweep, B8)

Opens a submenu to make all the settings required for gated sweep operation.

In the **Time Trigger** mode, this softkey is not available.

For details also see "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

Gate Mode Lvl/Edge (option Gated Sweep, B8)

Sets the gate mode. As settings level–triggered or edge–triggered gate mode can be selected.

For details also see "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

➡ Remote: `SWE:EGAT:TYPE EDGE`

Gate Delay (option Gated Sweep, B8)

Opens an edit dialog box to enter the gate delay time between the gate signal and the continuation of the sweep. Values between 125 ns and 100 s are allowed. The delay position on the time axis in relation to the sweep is indicated by a line labeled **GD**.

This is useful for e.g. taking into account a delay between the gate signal and the stabilization of an RF carrier.

As a common input signal is used for both trigger and gate when selecting the **External** or **IF Power** trigger mode, changes to the gate delay will affect the trigger delay (trigger offset) as well.

For details also see "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

➡ Remote: `SWE:EGAT:HOLD 1US`

Gate Length (Gate Mode Edge)

Opens an edit dialog box to enter the gate length. Values between 125 ns and 100 s are allowed. The gate length in relation to the sweep is indicated by a line labeled **GL**.

The length of the gate signal defines if the sweep is to be interrupted. Only in the edge–triggered mode the gate length can be set, while in the level–triggered the gate length depends on the length of the gate signal.

For details also see "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

➡ Remote: `SWE:EGAT:LENG 100US`

Sweep Time (option Gated Sweep, B8)

Opens an edit dialog box to change the sweep time in order to obtain a higher resolution for positioning gate delay and gate length. When quitting the **Gate Settings** submenu, the original sweep time is retrieved.

For details also see "To use gated sweep operation (option Gated Sweep, B8)" on page 3.23.

IF Power Retrigger Holdoff (

Opens an edit dialog box to define the value for the IF power trigger holdoff. This softkey is only available if the IF power trigger is selected as the trigger source. The holdoff value in s is the time which must pass since another IF power trigger event may happen. The range of the value is between 150 ns and 10 s in the step width of 10 ns.

➡ Remote: `TRIG:IFP:HOLD 200 ns`

IF Power Retrigger Hysteresis

Opens an edit dialog box to define the value for the IF power trigger hysteresis. This softkey is only available if the IF power trigger is selected as the trigger source. The hysteresis in dB is the

value the input signal must decay below the IF power trigger level in order to allow an IF power trigger starting the measurement. The range of the value is between 3 dB and 50 dB in the step width of 1 dB.

➡ Remote: `TRIG:IFP:HYST 10DB`

TV Trig Settings (zero span and option TV Trigger, B6)

Switches the TV trigger on and opens a submenu to configure the TV signal parameters.

➡ Remote: `TRIG:SOUR TV`

Vert Sync (zero span and option TV Trigger, B6)

Sets the trigger on the vertical sync signal. The R&S FSL triggers on the frame repetition signal without distinction between the two fields.

➡ Remote: `TRIG:VID:FIEL:SEL ALL`

Vert Sync Odd Field (zero span and option TV Trigger, B6)

Sets the trigger on the vertical sync signal of the first field.

➡ Remote: `TRIG:VID:FIEL:SEL ODD`

Vert Sync Even Field (zero span and option TV Trigger, B6)

Sets the trigger on the vertical sync signal of the second field.

➡ Remote: `TRIG:VID:FIEL:SEL EVEN`

Hor Sync (zero span and option TV Trigger, B6)

Sets the trigger on the horizontal sync signal and opens an edit dialog box to enter the corresponding line. Depending on the selected line system (for details see **Lines 625/525** softkey), values from 1 to 525 or 1 to 625 are allowed. If the range is exceeded, the maximum possible line number will be set.

The default setting is 17, which is used to trigger according to CCIR 473–4 on test line 17.

➡ Remote: `TRIG:VID:LINE:NUM 17`

Video Pol Pos/Neg (zero span and option TV Trigger, B6)

Sets the polarity of the video signal. Default setting is **Neg**.

Positive video polarity is to be selected e.g. for standard L signals, negative video polarity for signals according to the standards B/G/I/M (color standard PAL or NTSC).

➡ Remote: `TRIG:VID:SSIG:POL NEG`

Lines 625/525 (zero span and option TV Trigger, B6)

Sets the line system to be used. Default setting is 625 lines.

➡ Remote: `TRIG:VID:FORM:LPFR 625`

TV Free Run On/Off (zero span and option TV Trigger, B6)

Activates or deactivates the free run trigger mode for option TV Trigger, B6. For details on trigger modes refer to "Trigger mode overview" on page 3.26. In this mode, only the trace modes **Clear Write** and **View** are available (see also "Trace mode overview" on page 3.34).

➡   Remote: `TRIG:VID:CONT ON`

Setting Traces – TRACE Key

The **TRACE** key is used to configure the data acquisition for measurement and the analysis of the measurement data.

The R&S FSL is capable of displaying up to four different traces at a time in a diagram. A trace consists of a maximum of 501 measurement points on the horizontal axis (frequency or time). If more measured values than measurement points are available, several measured values are combined in one measurement point.

The trace functions are subdivided as follows:

- Display mode of trace (**Clear Write**, **View** and **Blank**). For details on trace modes see "Trace mode overview" on page 3.34.

- Evaluation of the trace as a whole (**Average**, **Max Hold** and **Min Hold**). For details on trace modes see "Trace mode overview" on page 3.34. For details on averaging see "Description of the averaging method" on page 3.35.

- Evaluation of individual measurement points of a trace. For details on detectors see "Detector overview" on page 3.36.

To open the trace menu

➢ Press the **TRACE** key.

The trace menu is displayed. The **Trace Configuration** dialog box is displayed.

Menu and softkey description

– "Softkeys of the trace menu" on page 3.37

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 section "How to use the Help System".

Further information

– "Trace mode overview" on page 3.34

– "Detector overview" on page 3.36

– "Description of the averaging method" on page 3.35

– "ASCII file export file format" on page 3.40

Task

– To specify the trace settings

To specify the trace settings

1. Press the **Trace 1 2 3 4 5 6** softkey to select the trace.

2. Press the **Trace Mode** softkey to select the trace mode for the selected trace (for details see "Trace mode overview" on page 3.34).

3. Press the **Detector Auto Select** softkey for automatic detector selection or press the **Detector Manual Select** softkey to select a detector (for details see "Detector overview" on page 3.36).

4. To change the sweep count setting, which also determines trace averaging, press the **Sweep Count** softkey.

5. To deactivate the reset of the traces in Min Hold and Max Hold mode after some specific parameter changes, press the **Hold/Cont** softkey.

6. To copy a trace into another trace memory, press the **Copy Trace** softkey.

    Upon copying, the contents of the selected memory are overwritten and the new contents are displayed in the **View** mode.

7. To export the active trace in ASCII format:

    –   Press the **More** softkey.

    –   If necessary, press the **Decim Sep** softkey to change the decimal separator with floating–point numerals.

    –   Press the **ASCII File Export** softkey to enter the ASCII file export name.

        The active trace is saved in ASCII format on a floppy disk.

Trace mode overview

The traces can individually be activated for a measurement or frozen after completion of a measurement. Traces that are not activated are hidden. Each time the trace mode is changed, the selected trace memory is cleared.

The R&S FSL offers 6 different trace modes:

*   **Clear Write**

    Overwrite mode: the trace is overwritten by each sweep. All available detectors can be selected. This is the default setting.

*   **Max Hold**

    The maximum value is determined over several sweeps and displayed. The R&S FSL saves the sweep result in the trace memory only if the new value is greater than the previous one. The detector is automatically set to **Positive Peak**.

    This mode is especially useful with modulated or pulsed signals. The signal spectrum is filled up upon each sweep until all signal components are detected in a kind of envelope.

    This mode is not available for statistics measurements or if the TV trigger is active and the **TV Free Run On/Off** softkey is set to **ON** (option TV Trigger, B6).

*   **Min Hold**

    The minimum value is determined from several measurements and displayed. The R&S FSL saves for each sweep the smallest of the previously stored/currently measured values in the trace memory. The detector is automatically set to **Negative Peak**.

    This mode is useful e.g. for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed whereas a CW signal is recognized by its constant level.

    This mode is not available for statistics measurements or if the TV trigger is active and the **TV Free Run On/Off** softkey is set to **ON** (option TV Trigger, B6).

*   **Average**

    The average is formed over several sweeps. All available detectors can be selected. If the detector is automatically selected, the sample detector is used. For details see also "Description of the averaging method" on page 3.35.

    This mode is not available for statistics measurements or if the TV trigger is active and the **TV Free Run On/Off** softkey is set to **ON** (option TV Trigger, B6).

- **View**

  The current contents of the trace memory is frozen and displayed.

  If a trace is frozen, the instrument settings, apart from level range and reference level (see below), can be changed without impact on the displayed trace. The fact that the trace and the current instrument setting do not correspond any more is indicated by the enhancement label "*" at the left edge of the grid.

  If level range or reference level are changed, the R&S FSL automatically adapts the measured data to the changed display range. This allows an amplitude zoom to be made after the measurement in order to show details of the trace.

- **Blank**

  Hides the selected trace.

Description of the averaging method

Averaging is carried out over the measurement points derived from the measurement samples. Several measured values may be combined in a measurement point. This means that with linear level display the average is formed over linear amplitude values. The settings continuous or single sweep (for details see "Configuring the Sweep Mode – SWEEP Key" on page 3.20) and running averaging apply to the average display analogously.

There are two methods for calculating the average. For a sweep count = 0 , a continuous average is calculated according to the following formula:

$$TRACE = \frac{9 * TRACE + meas. value}{10}$$

Due to the weighting between the new measured value and the trace average, past values have practically no influence on the displayed trace after about ten sweeps. With this setting, signal noise is effectively reduced without need for restarting the averaging process after a change of the signal.

If the sweep count is >1, averaging takes place over the selected number of sweeps. In this case the displayed trace is calculated during averaging according to the following formula:

$$Trace_n = \frac{1}{n}\left[\sum_{i=1}^{n-1}(T_i) + meas. value_n\right]$$

where n is the number of the current sweep. No averaging is carried out for the first sweep but the measured value is stored in the trace memory. With increasing n, the displayed trace is increasingly smoothed since there are more single sweeps for averaging.

After the selected number of sweeps the average trace is saved in the trace memory. Until this number of sweeps is reached, a preliminary average is displayed.

After completion of averaging, i.e. when the averaging length defined by sweep count is attained, continuous averaging is resumed with continuous sweep . The display "Sweep N of N" does not change any more until a new start is triggered. The displayed trace is calculated according to the following formula:

$$Trace = \frac{(N-1)\cdot Trace_{old} + meas. value}{N}$$

with Trace: new; Trace_{old}: old trace; N: sweep count

The same holds true for single sweep operation if the **Continue Single Sweep** softkey is pressed.

In the single sweep mode, a specific number of sweeps is set. The sweeps are stopped when the selected number of sweeps is attained. The number of the current sweep and the total number of sweeps are shown on the display: "Sweep 3 of 200".

Detector overview

The measurement detector for the individual display modes can be selected directly by the user or set automatically by R&S FSL. The detector activated for the specific trace is identified in the respective trace display field in form of an abbreviation (for details see detector list).

The detectors of the R&S FSL are implemented as pure digital devices. They collect signal power data within each measured point during a sweep. The default number of sweep points is 501. The following detectors are available:

Detector	Indicator	Function
auto peak detector (**Auto Peak**)	Ap	determines the maximum and the minimum value within a measurement point
peak detector (**Positive Peak**)	Pk	determines the maximum value within a measurement point
min peak detector (**Negative Peak**)	Mi	determines the minimum value within a measurement point
RMS detector (**RMS**)	Rm	determines the root mean square power within a measurement point
average detector (**Average**)	Av	determines the linear average power within a measurement point
sample detector (**Sample**)	Sa	selects a random value within a measurement point
quasi peak detector (**Quasi Peak**)	QP	determines the quasipeak power within a measurement point for EMI measurements

If the TV trigger is active, only the auto peak and the sample detector are available.

The result obtained from the selected detector within a measurement point is displayed as the power value at this measurement point.

All detectors work in parallel in the background, which means that the measurement speed is independent of the detector combination used for different traces.

Note: During a frequency sweep, R&S FSL increments the 1st local oscillator in steps that are smaller than approximately 1/10 of the bandwidth. This makes sure that the oscillator step speed is conforming to the hardware settling times and does not affect the precision of the measured power.

The number of measured values taken during a sweep is independent of the number of oscillator steps. It is always selected as a multiple or a fraction of 501 (= default number of trace points displayed on the screen). Choosing less then 501 measured values (e.g. 125 or 251) will lead to an interpolated measurement curve, choosing more than 501 points (e.g. 1001, 2001 ...) will result in several measured values being overlaid at the same frequency position.

Softkeys of the trace menu

The following table shows all softkeys available in the trace 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.

Command
Trace 1 2 3 4 5 6
Trace Mode
Detector Auto Select
Detector Manual Select
Sweep Count
Hold/Cont
More ▼
Trace 1 2 3 4 5 6
Copy Trace
ASCII File Export
Decim Sep
Trace Math
Trace Math Position

Trace 1 2 3 4 5 6

Selects the active trace (1, 2, 3, 4, 5, 6). The default setting is trace 1 in the overwrite mode (see **Clear Write** mode), the other traces are switched off (see **Blank** mode).

➡ Remote: (selected via numeric suffix of :TRACe<1...6>)

Trace Mode

Opens the dialog box **Trace Mode** to select the trace mode. For details see "Trace mode overview" on page 3.34.

➡ Remote: DISP:TRAC:MODE WRIT | MAXH | MINH | AVER | VIEW (Clear Write, Max Hold, Min Hold, Average, View)

➡ Remote: DISP:TRAC OFF (Blank)

Detector Auto Select

Selects the optimum detector for the selected trace and filter mode. This is the default setting. For details see also "Detector overview" on page 3.36.

Trace mode	Detector (band–pass filter)	Detector (FFT filter)
Clear/Write	Auto Peak	Max Peak
Average	Sample	Sample
Max Hold	Max Peak	Max Peak
Min Hold	Min Peak	Max Peak

➡ Remote: DET:AUTO ON

Detector Manual Select

Opens the dialog box **Detector** to select the detector. For details see "Detector overview" on page 3.36.

➡ Remote: `DET APE | POS | NEG | RMS | AVER | SAMP | QPE` (Auto Peak, Max Peak, Min Peak, RMS, AVG, Sample, Quasi Peak)

Sweep Count

Opens an edit dialog box to enter the number of sweeps used for averaging. Values from 0 to 32767 are allowed. The default setting is 0. The sweep count is applied to all the traces in a diagram. The sweep count set in the trace menu is the same as that in the sweep menu (for further details see **Sweep Count** softkey).

In the continuous sweep mode, the sweep count value determines the trace averaging:

– sweep count = 0: continuous averaging

– sweep count = 1: no averaging

– sweep count > 1: averaging over the selected number of sweeps; in the continuous sweep mode averaging is performed until the set number of sweeps is attained and is then continued as continuous averaging (see also "Description of the averaging method" on page 3.35).

➡ Remote: `SWE:COUN 64`

Hold/Cont

Switches on or off the reset of the traces in Min Hold, Max Hold and Average mode after some specific parameter changes have been made. The default setting is off.

Normally, the measurement is started anew after parameter changes, before the measurement results are evaluated (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

➡ Remote: `DISP:TRAC:MODE:HCON ON`

Copy Trace

Opens an edit dialog box to enter the number of the trace memory, in which the currently selected trace shall be copied.

➡ Remote: `TRAC:COPY TRACE1,TRACE2`

ASCII File Export

Opens an edit dialog box to enter the ASCII File Export Name and saves the active trace in ASCII format on a floppy disk.

The file consists of the header containing important scaling parameters and a data section containing the trace data. For details on an ASCII file see "ASCII file export file format" on page 3.40.

This format can be processed by spreadsheet calculation programs, e.g. MS–Excel. It is necessary to define ';' as a separator for the data import. Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using the **Decim Sep** softkey.

➡ Remote: `FORM ASC`

Decim Sep

Selects the decimal separator with floating–point numerals for the ASCII file export to support evaluation programs (e.g. MS–Excel) in different languages. The values '.' (decimal point) and ',' (comma) can be set. For details see also **ASCII File Export** softkey.

➡ Remote: `FORM:DEXP:DSEP POIN`

Trace Math

Opens the **Trace Mathematics** dialog box to define which trace is subtracted from trace 1. The result is displayed in trace 1 and refers to the zero point defined with the **Trace Math Position** softkey. The following substractions can be performed:

T1–>T1–T2   Substracts trace 2 from trace 1.

T1–>T1–T3   Substracts trace 3 from trace 1

T1–>T1–T4   Substracts trace 4 from trace 1

T1–>T1–T5   Substracts trace 5 from trace 1

T1–>T1–T6   Substracts trace 6 from trace 1

If the **Trace Math Off** option is activated, the function is switch off (default setting).

➡ Remote: `CALC1:MATH (TRACE1 – TRACE2)`

➡ Remote: `CALC:MATH:STAT ON`

Trace Math Position

Opens an edit dialog box to define the zero point in % of the diagram height. The range of values extends from –100% to +200%.

➡ Remote: `CALC:MATH:POS 50PCT`

ASCII file export file format

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the keyword "Trace <n>" (<n> = number of stored trace), followed by the measured data in one or several columns (depending on measurement) which are also separated by a semicolon.

File contents: header	Description
Type;ZVL;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;ANALYZER;	Instrument mode
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Span;90000;Hz	Frequency range (0 Hz in zero span and statistics measurements)
x–Axis;LIN;	Scaling of x–axis linear (LIN) or logarithmic (LOG)
Start;10000;Hz Stop;100000;Hz	Start/stop of the display range. Unit: Hz for span > 0, s for span = 0, dBm/dB for statistics measurements
Ref Level;–30;dBm	Reference level
Level Offset;0;dB	Level offset
Ref Position;75;%	Position of reference level referred to diagram limits (0% = lower edge)
y–Axis;LOG;	Scaling of y–axis linear (LIN) or logarithmic (LOG)
Level Range;100;dB	Display range in y direction. Unit: dB with x–axis LOG, % with x–axis LIN
Rf Att;20;dB	Input attenuation
RBW;100000;Hz	Resolution bandwidth
VBW;30000;Hz	Video bandwidth
SWT;0.005;s	Sweep time
Trace Mode;AVERAGE;	Display mode of trace: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD
Detector;AUTOPEAK;	Detector set: AUTOPEAK,MAXPEAK,MINPEAK,AVERAGE,RMS,SAMPLE,QUASIPEAK
Sweep Count;20;	Number of sweeps set
File contents: data section of the file	**Description**
Trace 1:;;	Selected trace
x–Unit;Hz;	Unit of x values: Hz with span > 0; s with span = 0; dBm/dB with statistics measurements
y–Unit;dBm;	Unit of y values: dB*/V/A/W depending on the selected unit with y–axis LOG or % with y–axis LIN
Values; 501;	Number of measurement points
10000;–10.3;–15.7 10180;–11.5;–16.9 10360;–12.0;–17.4 ...;...;	Measured values: <x value>, <y1>, <y2>; <y2> being available only with detector AUTOPEAK and containing in this case the smallest of the two measured values for a measurement point.

Measurement Functions

In this section all menus necessary for setting measurement functions are described. This includes the following topics and keys:

Using Markers and Delta Markers – MKR Key

The markers are used for marking points on traces, reading out measurement results and for quickly selecting a display section. The R&S FSL provides four markers per trace.

Marker　　　　　　　Active marker　　　　Temporary marker

M1　　　　　　　　　　M3　　　　　　　　　　T1

▽　　　　　　　　　　▼　　　　　　　　　　▽

△

D2
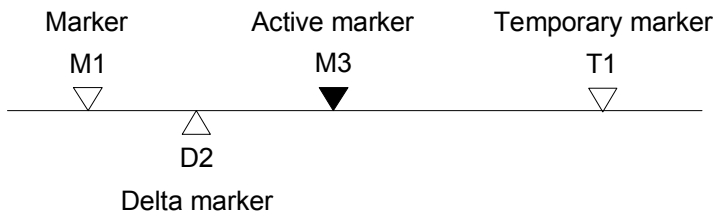
Delta marker

Fig. 3–5: Marker types

All markers can be used either as markers or delta markers. The marker that can be moved by the user is defined in the following as the active marker. Temporary markers are used in addition to the markers and delta markers to evaluate the measurement results. They disappear when the associated function is deactivated.

The measurement results of the active marker (also called marker values) are displayed in the marker field . The marker field is located at the upper right corner of the display and shows the following:

- marker type (M1 in the example)

- trace in square brackets ([1] in the example)

- level (–33.09 dBm in the example)

- marker location (3 GHz in the example)

M1[1]　　　　　　-33.09 dBm

3.000000000 GHz

Fig. 3–6: Marker values

The **MKR** key is used to select and position the absolute and relative measurement markers (markers and delta markers). In addition, the functions for frequency counter, fixed reference point for relative measurement markers and enlargement of the measurement area are assigned to this key.

Also the following measurements can be carried out:

- Noise density (**Noise Meas On/Off** softkey; see also "Measurement of noise density" on page 3.45)

- Frequency measurement (**Sig Count On/Off** softkey; see also "Frequency measurement with the frequency counter" on page 3.44)

- Filter or signal bandwidth (**n dB down** softkey)

- AF demodulation (**Marker Demod** softkey; see also "AF demodulation" on page 3.44)

For further information on markers see also "Changing Settings via Markers – MKR–> Key" on page 3.52.

To open the marker menu

➢ Press the **MKR** key.

The marker menu is displayed. If no marker is active, marker 1 is activated and a peak search on the trace is carried out. Otherwise, the edit dialog box for the last activated marker is opened and the current frequency / time value is displayed.

Menu and softkey description

– "Softkeys of the marker menu" on page 3.46

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 section "How to use the Help System".

Further information

– "AF demodulation" on page 3.44

– "Frequency measurement with the frequency counter" on page 3.44

– "Measurement of noise density" on page 3.45

Tasks

– To define the basic marker settings

– To set a fixed reference point (phase noise measurement)

– To set the demodulation mode and duration

To define the basic marker settings

1. Press the **MKR** key to open the marker menu.

    Marker 1 is activated and positioned on the maximum value of the trace as normal marker. If several traces are being displayed, the marker is set to the maximum value (peak) of the trace which has the lowest number (1 to 3) and is not frozen (View mode). In case a marker is already located there, it will be set to the frequency of the next lowest level (next peak).

2. To change to another trace, press the **Marker to Trace** softkey and enter the number of the trace on which the marker is to be placed.

    The marker changes to selected trace, but remains on the previous frequency or time. If a trace is turned off, the corresponding markers and marker functions are also deactivated.

3. To switch on a delta marker, press the **Marker 2** softkey.

    Marker 2 is switched on as a delta marker. The frequency and level of marker 2 are displayed in relation to marker 1 in the marker field.

4. To change the marker type of marker 2, press the **/Marker Norm/Delta** softkey.

    Marker 2 becomes a normal marker. The frequency and level of marker 2 are displayed as absolute values in the marker field.

5. To switch off marker 2, press the **Marker 2** softkey again.

    Marker 2 is deactivated. Marker 1 becomes the active marker for entry. The frequency and level of marker 1 are displayed in the marker field.

To set a fixed reference point (phase noise measurement)

1. Press the **Phase Noise/Ref Fixed** softkey.

    The submenu with the **Phase Noise On/Off** softkey switched on is displayed. The level and frequency or time values of marker 1 immediately become the reference point.

2. To set the maximum of the selected trace as reference point, press the **Peak Search** softkey.

3. To define the values for the reference point, proceed as follows:

    – Press the **Ref Point Level** softkey and enter a reference level value.

– If span > 0, press the **Ref Point Frequency** softkey and enter a frequency reference value.

– If span = 0, press the **Ref Point Time** softkey and enter a reference time value.

To set the demodulation mode and duration

1. Press the **Marker Demod** softkey.

   The submenu with the **Mkr Demod On/Off** softkey switched on is displayed.

2. To change the demodulation mode, press the **AM** or **FM** softkey.

   For details see "AF demodulation" on page 3.44.

3. To modify the demodulation time for span > 0, press the **Mkr Stop Time** softkey.

4. To change to continuous demodulation for span > 0, press the **Cont Demod** softkey.

5. To tune the volume for acoustic monitoring, press the **Volume** softkey.

AF demodulation

The R&S FSL provides demodulators for AM and FM signals. With these demodulators, a displayed signal can be identified acoustically by using headphones.

> ⚠️ **CAUTION**
> Check the volume setting carefully before putting on the headphones in order to protect your hearing.

For span > 0, the demodulation is not continuous. The frequency at which the demodulation takes place is set by the active marker. If the level of the selected frequency is above the threshold line, the sweep stops for the selected time (stop time) and the RF signal is demodulated. For span = 0, the demodulation is continuously active irrespective of the stop time set.

Frequency measurement with the frequency counter

In order to accurately determine the frequency of a signal, the R&S FSL is equipped with a frequency counter which measures the frequency of the RF signal at the intermediate frequency. Using the measured IF, the R&S FSL calculates the frequency of the RF input signal by applying the known frequency conversion factors.

The frequency measurement uncertainty depends only upon the accuracy of the frequency reference used (external or internal reference). Although the R&S FSL always operates synchronously irrespective of the set span, the frequency counter delivers a more exact result than a measurement performed with a marker. This is due to the following:

- The marker measures only the position of the point on the trace and infers from this value the signal frequency. The trace, however, contains only a limited number of points. Depending upon the selected span, each point may contain many measurement values, which therefore limits the frequency resolution.

- The resolution, with which the frequency can be measured with a marker, is dependant on the selected resolution bandwidth which in return affects the necessary measurement time. For this reason, the bandwidth is normally made as wide as possible and the sweep time as short as possible. This results in a loss of frequency resolution.For the measurement with the frequency counter, the sweep is stopped at the reference marker, the frequency is counted with the desired resolution and then the sweep is allowed to continue.

Measurement of noise density

During noise measurement, the noise power density is measured at the position of the marker. For span = 0, all points of the trace are used to determine the noise power density. For span > 0, two points to the right and left of the marker are used for the measurement to obtain a stable result.

The noise power density is indicated in the marker field. With logarithmic amplitude units (dBm, dBmV, dBmµV, dBµA), the noise power density is output in dBm/Hz, i.e. as level in 1 Hz bandwidth with reference to 1 mW. With linear amplitude units (V, A, W), the noise voltage density is evaluated in µV/Hz, the noise current density in µA/Hz or the noise power density in µW/Hz.

In the default setting, the R&S FSL uses the sample detector for the noise function.

With the sample detector, the trace can additionally be set to AVERAGE to stabilize the measured values. With RMS detector used, trace averaging must not be used since in this case it produces too low noise levels which cannot be corrected. Instead, the sweep time can be increased to obtain stable measurement results.

The following settings have to be made to ensure that the power density measurement yields correct values:

- Detector: Sample or RMS

- Video bandwidth:

    $\leq$ 0.1 resolution bandwidth with sample detector

    $\geq$ 3 x resolution bandwidth with RMS detector

- Trace averaging:

    With the sample detector, the trace can additionally be set to average to stabilize the measured values. With RMS detector used, trace averaging must not be used since in this case it produces too low noise levels which cannot be corrected. Instead, the sweep time can be increased to obtain stable measurement results.

The R&S FSL uses the following correction factors to evaluate the noise density from the marker level:

- Since the noise power is indicated with reference to 1 Hz bandwidth, the bandwidth correction value is deducted from the marker level. It is 10 x lg (1 Hz/BWNoise), where BWNoise is the noise or power bandwidth of the set resolution filter (RBW).

- RMS detector: With the exception of bandwidth correction, no further corrections are required since this detector already indicates the power with every point of the trace.

- Sample detector: As a result of video filter averaging and trace averaging, 1.05 dB is added to the marker level. This is the difference between the average value and the RMS value of white noise. With a logarithmic level axis, 1.45 dB is added additionally. Logarithmic averaging is thus fully taken into account which yields a value that is 1.45 dB lower than that of linear averaging.

- To allow a more stable noise display the adjacent (symmetric to the measurement frequency) points of the trace are averaged.

- For span > 0, the measured values are averaged versus time (after a sweep).

Note: *The R&S FSL noise figure can be calculated from the measured power density level. It is calculated by deducting the set RF attenuation (RF Att) from the displayed noise level and adding 174 to the result.*

Softkeys of the marker menu

The following table shows all softkeys available in the marker 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.

If the Spectrogram Measurement option (K14) is activated, the edit dialog box for markers and delta markers is extended. For details refer to "Markers and marker values" on page 3.150.

Menu / Command	Submenu / Command	Command
Marker 1		
Marker 2		
Marker Norm/Delta		
Noise Meas On/Off		
Phase Noise/Ref Fixed ▼	Phase Noise On/Off	
	Ref Point Level	
	Ref Point Frequency/ Ref Point Time	
	Peak Search	
	Phase Noise 1 2 3 4 ⊿	
	Reference Fixed ▼	Reference Fixed On/Off
		Ref Point Level
		Ref Point Frequency/ Ref Point Time
		Peak Search
Sig Count On/Off		
More ▼		
Marker 3		
Marker 4		
Marker to Trace		
Marker Demod ▼	Mkr Demod On/Off	
	AM	
	FM	
	Mkr Stop Time	
	Cont Demod	
	Volume	
n dB down		
All Marker Off		
More ▼		
Marker Zoom		
Marker Peak List ▼	New Search	
	Sort Mode Freq/Lvl	
	Peak Excursion	
	Left Limit	
	Right Limit	
	Threshold	
	Peak List Off	
Marker Stepsize ▼	Stepsize Standard	

Menu / Command	Submenu / Command	Command
	Stepsize Sweep Points	

Marker 1/Marker 2/Marker 3/Marker 4/Marker Norm/Delta

The **Marker <no>** softkey activates the corresponding marker and opens an edit dialog box to enter a value for the marker to be set to. Pressing the softkey again deactivates the selected marker.

If a marker value is changed using the rotary knob, the step size is defined via the **Stepsize Standard** or **Stepsize Sweep Points** softkeys.

Marker 1 is always the reference marker for relative measurements. If activated, markers 2 to 4 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display by means of the **Marker Norm/Delta** softkey. If marker 1 is the active marker, pressing the **Marker Norm/Delta** softkey switches on an additional delta marker.

➡ Remote: `CALC:MARK ON`

➡ Remote: `CALC:MARK:X <value>`

➡ Remote: `CALC:MARK:Y?`

➡ Remote: `CALC:DELT ON`

➡ Remote: `CALC:DELT:X <value>`

➡ Remote: `CALC:DELT:X:REL?`

➡ Remote: `CALC:DELT:Y?`

Noise Meas On/Off

Switches the noise measurement for the active marker on or off. The corresponding marker becomes the normal marker. For more details on noise measurement see "Measurement of noise density" on page 3.45.

➡ Remote: `CALC:MARK:FUNC:NOIS ON`

➡ Remote: `CALC:MARK:FUNC:NOIS:RES?`

Phase Noise/Ref Fixed

The function of this softkey depends on the setting of the **Noise Meas** softkey:

– **Noise Meas On**: activates phase noise measurements.

– **Noise Meas Off**: freezes the current position of marker 1 as a reference for relative measurements. Additionally it opens a submenu to set all values of a reference point. Instead of using the current values of the reference marker (marker 1) as reference point for the delta markers, level and frequency or time are set to fixed values and used as reference point.

Phase Noise On/Off

Switches the relative measurement to a fixed reference value on or off. The level and frequency or time values of marker 1 immediately become the reference point, but can be altered using the corresponding softkeys (**Ref Point Level**, **Ref Point Frequency**, **Ref Point Time** and **Peak Search**).

➡ Remote: `CALC:DELT2:FUNC:FIX ON`

Ref Point Level

Opens an edit dialog box to enter a reference level value. All relative level values of the delta markers refer to this reference level.

➡ Remote: `CALC:DELT2:FUNC:FIX:RPO:Y –10dBm`

Ref Point Frequency (span > 0) / Ref Point Time (zero span)

Opens an edit dialog box to enter a frequency reference or time value. All relative frequency or time values of the delta markers refer to this frequency reference. For phase noise measurement, input of reference time is not possible..

➡ Remote: `CALC:DELT2:FUNC:FIX:RPO:X 10.7MHz`

➡ Remote: `CALC:DELT2:FUNC:FIX:RPO:X 5MS`

Peak Search

Sets the maximum value of the selected trace as the reference point.

➡ Remote: `CALC:DELT:FUNC:FIX:RPO:MAX`

Phase Noise 1 2 3 4 Δ

Selects the normal marker or the delta markers, activates the marker and opens an edit dialog box to enter a value for the marker to be set to. Δ stands for delta marker 1.

Reference Fixed

Opens a submenu for relative measurement to a fixed reference value.

Reference Fixed On/Off

Switches the relative measurement to a fixed reference value on or off. The level and frequency or time values of marker 1 immediately become the reference point, but can be altered using the corresponding softkeys (**Ref Point Level**, **Ref Point Frequency**, **Ref Point Time** and **Peak Search**).

➡ Remote: `CALC:DELT2:FUNC:FIX ON`

Sig Count On/Off

Switches the frequency counter on/off. The frequency is counted at the position of the reference marker (marker 1). If no marker is activated, marker 1 is switched on and set at the largest signal.

The sweep stops at the reference marker until the frequency counter has delivered a result. The result is displayed in the marker field (see "Fig. 3–6: Marker values" on page 3.42), labeled with [Tx CNT]. For more details see "Frequency measurement with the frequency counter" on page 3.44.

➡ Remote: `CALC:MARK1:COUN ON`

➡ Remote: `CALC:MARK:COUN:FREQ?`

Marker to Trace

Opens an edit dialog box to enter the number of the trace, on which the marker is to be placed.

➡ Remote: `CALC:MARK1:TRAC 1`

➡ Remote: `CALC:DELT:TRAC 1`

Marker Demod

Opens a submenu to set the demodulation mode and duration. For more details see also "AF demodulation" on page 3.44.

Mkr Demod On/Off

Switches the demodulation on/off. For more details see also "AF demodulation" on page 3.44.

➡ Remote: `CALC:MARK1:FUNC:DEM ON`

AM

Sets AM as demodulation mode. This is the default setting. For more details see also "AF demodulation" on page 3.44.

➡ Remote: `CALC:MARK1:FUNC:DEM:SEL AM`

FM

Sets FM as demodulation mode. Default setting is AM. For more details see also "AF demodulation" on page 3.44.

➡ Remote: `CALC:MARK1:FUNC:DEM:SEL FM`

Mkr Stop Time

Opens an edit dialog box to enter the demodulation stop time for span > 0. For more details see also "AF demodulation" on page 3.44.

➡ Remote: `CALC:MARK1:FUNC:DEM:HOLD 3s`

Cont Demod (span > 0)

Switches the continuous demodulation on or off. If the sweep time is long enough, the set frequency range can be monitored acoustically. For more details see also "AF demodulation" on page 3.44.

➡ Remote: `CALC:MARK1:FUNC:DEM:CONT ON`

Volume

Opens an edit dialog box to regulate the volume for acoustic monitoring. For more details see also "AF demodulation" on page 3.44.

➡ Remote: `SYST:SPE:VOL 0.5`

n dB down

Activates the temporary markers T1 and T2, and opens an edit dialog box to enter the value n. If a positive value is entered, the markers T1 and T2 are placed below the active reference marker. If a negative value (e.g. for notch filter measurements) is entered, the markers T1 and T2 are placed above the active reference marker. Marker T1 is placed to the left and marker T2 to the right of the reference marker. The default setting is 3 dB.

Settings	Result displayed in marker field
span > 0	frequency spacing of the two temporary markers
span = 0	pulse width between the two temporary markers
not possible to form the frequency spacing for the n dB value (e.g. because of noise display)	dashes instead of a measured value

➡ Remote: `CALC:MARK1:FUNC:NDBD:STAT ON`

➡ Remote: `CALC:MARK1:FUNC:NDBD 3dB`

➡ Remote: `CALC:MARK1:FUNC:NDBD:RES?`

➡ Remote: `CALC:MARK1:FUNC:NDBD:FREQ?` (span > 0)

➡ Remote: `CALC:MARK1:FUNC:NDBD:TIME?` (span = 0)

All Marker Off

Switches all markers off.

➡ Remote: `CALC:MARK:AOFF`

Marker Zoom (span > 0)

Opens an edit dialog box to enter a display range for the zoom. The area around marker 1 is expanded accordingly and more details of the spectrum can be seen. If no marker is activated, marker 1 is switched on and set on the largest signal..

The following sweep is stopped at the position of the reference marker. The frequency of the signal is counted and the measured frequency becomes the new center frequency. The zoomed display range is then configured and the new settings are used by the R&S FSL for further measurements.

As long as switching to the new frequency display range has not yet taken place, pressing the softkey will abort the procedure. If an instrument setting is changed while using this function, the procedure is aborted.

➡ Remote: `CALC:MARK1:FUNC:ZOOM 1kHz`

Marker Peak List

Opens the **Peak List** dialog box and a submenu to define criterias for the sort order and the contents of the peak list. The number of listed peaks is indicated in the title bar. For all listed peaks the frequency and level values are given. Maximal 50 entries are listed.

➡ Remote: `CALC:MARK:FUNC:FPE:COUN?`

➡ Remote: `CALC:MARK:FUNC:FPE:X?`

➡ Remote: `CALC:MARK:FUNC:FPE:Y?`

New Search

Starts a new peak search and enters the results in the peak list.

➡ Remote: CALC:MARK:FUNC:FPE 3

Sort Mode Freq/Lvl

Defines the criteria for sorting:

Freq   sorting in ascending order of frequency values (span > 0) or time
                  values (span = 0)

Lvl   sorting in ascending order of the level

➡ Remote: CALC:MARK:FUNC:FPE:SORT Y

Peak List Off

Switches the peak list function off.

Marker Stepsize

Opens a submenu to set the step size of all markers and delta markers.

Stepsize Standard

Moves the marker or delta marker from one measurement point to the next, if the marker or
delta marker value is changed via the rotary knob (**Marker 1**/**Marker 2**/**Marker 3**/**Marker 4**
softkeys). If more measured values than measurement points exist, it is not possible to read out
all measured values. In this case, use the **Stepsize Sweep Points** softkey.

➡ Remote: CALC:MARK:X:SSIZ STAN

Stepsize Sweep Points

Moves the marker or delta marker from one measured value to the next, if the marker or delta
marker value is changed via the rotary knob (**Marker 1**/**Marker 2**/**Marker 3**/**Marker 4** softkeys). If
more measured values than measurement points exist, every single measured value is
accessible and its value is displayed in the marker field.

The number of measured values is defined in the sweep menu via the **Sweep Points** softkey.

This functionality is available for all base unit measurements with the exception of statistics
(**APD** and **CCDF** softkeys in the measurement menu).

➡ Remote: CALC:MARK:X:SSIZ POIN

Changing Settings via Markers – MKR–> Key

The **MKR–>** key is used for search functions of measurement markers, assignment of the marker frequency as center frequency, restriction of the search area and characterization of maxima and minima. For details on markers in general, see "Using Markers and Delta Markers – MKR Key" on page 3.42.

To open the marker–> menu

➢ Press the **MKR–>** key.

The marker–> menu is displayed. If no marker is active, marker 1 will be activated and a peak search on the trace carried out. Otherwise, the edit dialog box for the last activated marker is opened and the current frequency / time value is displayed.

Menu and softkey description

– "Softkeys of the marker–> menu" on page 3.55

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 section "How to use the Help System".

Further information

– "Effect of different peak excursion settings (example)" on page 3.54

Tasks

– To search for a maximum

– To search for a minimum

– To specify the search limits

– To specify the search range

– To examine a signal at the center in detail

– To specify the suitable peak excursion

To search for a maximum

1. To search the highest maximum, press the **Peak** softkey.

2. To define the search mode for the next maximum, use the **Next Peak Mode < abs >** softkey.

3. To start the search, press **Next Peak** the softkey.

To search for a minimum

1. To search the minimum, press the **Min** softkey.

2. To define the search mode for the next maximum, use the **Next Min Mode < abs >** softkey.

3. To start the search, press the **Next Min** softkey.

To specify the search limits

1. To define the lower limit, press the **Left Limit** softkey.

2. To define the upper limit, press the **Right Limit** softkey.

3. To define the threshold, press the **Threshold** softkey.

4. To switch the search limits off, press the **Search Lim Off** softkey.

To specify the search range

➢ Press the **Exclude LO** softkey to include the frequency 0 Hz in the marker search functions.

To examine a signal at the center in detail

1. Press the **PRESET** key to set the R&S FSL to the default setting.

2. Press the **MKR–>** key to open the marker–> menu.

3. Marker 1 is activated and set to the largest signal of the trace.

4. Press the **Center =Mkr Freq** softkey to set to the marker frequency.

5. The span is adapted in such a way that the minimum frequency (= 0 Hz) or the maximum frequency is not exceeded.

6. Press the **Ref Lvl =Mkr Lvl** softkey to set the reference level to the measured marker level.

7. Press the **SPAN** key.

8. The edit dialog box to enter a frequency span is displayed.

9. Reduce the span, e.g. using the rotary knob.

To specify the suitable peak excursion

1. If the next peak mode **abs** of softkey **Next Peak Mode < abs >** / **Next Min Mode < abs >** is used, the default value is sufficient, since, in this mode, the next lower maximum or next higher minimum will always be detected.

2. If the next peak mode **<** or **>** of softkey **Next Peak Mode < abs >** / **Next Min Mode < abs >** is used, the 6 dB level change set as a default value may be attained already by the inherent noise of the instrument. To avoid identifying noise peaks as maxima or minima, enter a peak excursion value that is higher than the difference between the highest and the lowest value measured for the displayed inherent noise.

Effect of different peak excursion settings (example)

The following figure shows a trace to be examined.
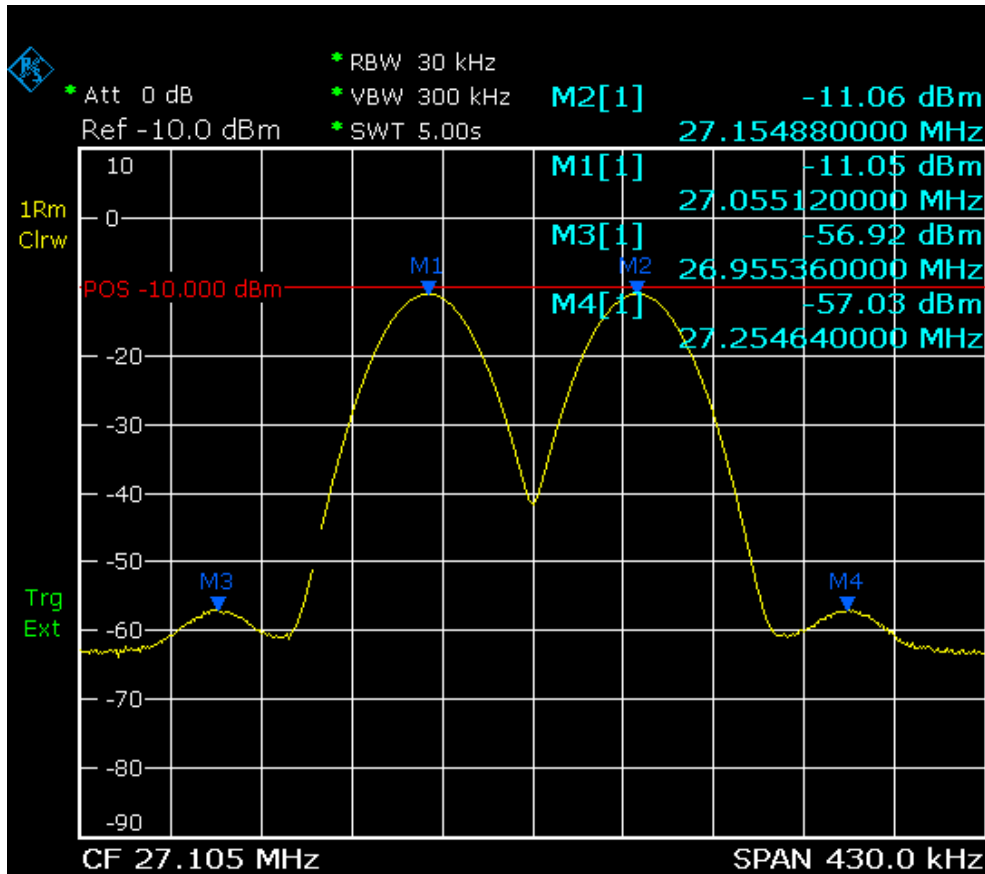
Fig. 3–7: Trace example

The following table lists the signals as indicated by the marker numbers in the diagram above, as well as the minimum of the amplitude decrease to both sides of the signal:

signal #	min. amplitude decrease to both sides of the signal
1	30 dB
2	29.85 dB
3	7 dB
4	7 dB

The detected signals and their order are different depending on the peak excursion setting and the peak search method (whether the next lower maximum or the next relative maximum are searched). The following results are obtained. All tests start with the marker set to signal 1 by pressing the softkey **Peak**.

- 40 dB peak excursion

  Result: With both methods apart from signal 1 no signal is detected, as the signal level does not decrease by more than 30 dB to either side of any signal.

next lower maximum	next relative maximum
next peak mode **abs**: signal 1 (no further signal detected)	next peak mode **<**: signal 1 (no further signal detected)
	next peak mode **>**: signal 1 (no further signal detected)

- 20 dB peak excursion

  Result: With both methods apart from signal 1 signal 2 is detected, as the signal level decreases at least by 29.85 dB to either side of this signal, which is now greater than the peak excursion.

next lower maximum	next relative maximum
next peak mode **abs**: signal 2	next peak mode **<**: signal 1 (no further signal detected)
next peak mode **abs**: signal 2 (no further signal detected)	next peak mode **>**: signal 2
	next peak mode **>**: signal 2 (no further signal detected)

- 6 dB peak excursion

  Result: With both methods all signals are detected.

next lower maximum	next relative maximum
next peak mode **abs**: signal 2	next peak mode **<**: signal 3
next peak mode **abs**: signal 3	next peak mode **>**: signal 1
next peak mode **abs**: signal 4	next peak mode **>**: signal 2
	next peak mode **>**: signal 4

Softkeys of the marker–> menu

The following table shows all softkeys available in the marker–> 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.

If the Spectrogram Measurement option (K14) is activated, this menu provides additional functionality. For details refer to "Softkeys of the marker–> menu (Spectrogram view)" on page 3.153.

Menu / Command	Command
Select 1 2 3 4 ⊿	
Peak	
Next Peak	
Next Peak Mode < abs >	
Center =Mkr Freq	
Ref Lvl =Mkr Lvl	
More ▼	
Select 1 2 3 4 ⊿	
Min	
Next Min	

Menu / Command	Command
Next Min Mode < abs >	
Search Limits ▼	Left Limit
	Right Limit
	Threshold
	Search Lim Off
Peak Excursion	
More ▼	
Exclude LO	
Auto Max Peak/Auto Min Peak	

Select 1 2 3 4 ⊿

Selects the normal marker or the delta markers, activates the marker and opens an edit dialog box to enter a value for the marker to be set to. ⊿ stands for delta marker 1.

If the Spectrogram Measurement option (K14) is activated, the edit dialog box for markers and delta markers is extended. For details refer to "Markers and marker values" on page 3.150.

➡ Remote: `CALC:MARK1 ON`

➡ Remote: `CALC:MARK1:X <value>`

➡ Remote: `CALC:MARK1:Y?`

Peak

Sets the active marker/delta marker to the highest maximum of the trace.

If the Spectrogram Measurement option (K14) is activated, this softkey provides altered functionality. For details refer to **Peak** softkey in the marker–> menu of this option.

➡ Remote: `CALC:MARK:MAX`

➡ Remote: `CALC:DELT:MAX`

Next Peak

Sets the active marker/delta marker to the next maximum of the selected trace according to the mode selected using the **Next Peak Mode < abs >** softkey.

If the Spectrogram Measurement option (K14) is activated, this softkey provides altered functionality. For details refer to **Next Peak** softkey in the marker–> menu of this option.

Next Peak Mode < abs >

Selects the mode of the **Next Peak** softkey. Three settings are available:

<　　Sets the active marker/delta marker to the next maximum left to the marker of the selected trace.

abs　　Sets the active marker/delta marker to the next lower maximum of the selected trace.

>　　Sets the active marker/delta marker to the next maximum right to the marker of the selected trace.

If the Spectrogram Measurement option (K14) is activated, this softkey provides altered functionality. For details refer to **Next Peak X Search < abs >** and **Next Peak Y Search up/abs/dn** softkeys in the marker–> menu of this option.

➡ Remote: `CALC:MARK:MAX:LEFT` (>)

➡ Remote: `CALC:DELT:MAX:LEFT` (<)

➡ Remote: `CALC:MARK:MAX:RIGH` (>)

➡ Remote: `CALC:DELT:MAX:RIGH` (>)

➡ Remote: `CALC:MARK:MAX:NEXT` (abs)

➡ Remote: `CALC:DELT:MAX:NEXT` (abs)

Center =Mkr Freq (span > 0)

Sets the center frequency to the current marker or delta marker frequency. A signal can thus be set to as center frequency, for example to examine it in detail with a smaller span.

Remote: `CALC:MARK:FUNC:CENT`

Ref Lvl =Mkr Lvl

Sets the reference level to the current marker level.

➡ Remote: `CALC:MARK:FUNC:REF`

Min

Sets the active marker/delta marker to the minimum of the selected trace.

If the Spectrogram Measurement option (K14) is activated, this softkey provides altered functionality. For details refer to **Min** softkey in the marker–> menu of this option.

➡ Remote: `CALC:MARK:MIN`

➡ Remote: `CALC:DELT:MIN`

Next Min

Sets the active marker/delta marker to the next minimum of the selected trace according to the mode selected using the **Next Min Mode < abs >** softkey.

If the Spectrogram Measurement option (K14) is activated, this softkey provides altered functionality. For details refer to **Next Min** softkey in the marker–> menu of this option.

➡ Remote: `CALC:MARK:MIN:NEXT`

➡ Remote: `CALC:DELT:MIN:NEXT`

Next Min Mode < abs >

Selects the mode of the **Next Min** softkey. Three settings are available:

<   Sets the active marker/delta marker to the next minimum left to the marker of the selected trace.

abs   Sets the active marker/delta marker to the next higher minimum of the selected trace.

> Sets the active marker/delta marker to the next minimum right to the marker of the selected trace.

If the Spectrogram Measurement option (K14) is activated, this softkey provides altered functionality. For details refer to **Next Min X Search < abs >** and **Next Min Y Search up/abs/dn** softkeys in the marker–> menu of this option.

➡ Remote: CALC:MARK:MAX:LEFT

➡ Remote: CALC:DELT:MAX:LEFT

Search Limits

Opens a submenu to set the limits for maximum or minimum search in the x and y direction.

➡ Remote: CALC:MARK:X:SLIM ON

Left Limit

Opens an edit dialog box to enter a value for the lower limit (left vertical line: S1 for span > 0; T1 for zero span). The search is performed between the lines of the left and right limit (see also **Right Limit** softkey).

➡ Remote: CALC:MARK:X:SLIM:LEFT 1MHZ

Right Limit

Opens an edit dialog box to enter a value for the upper limit (left vertical line: S2 for span > 0; T2 for zero span). The search is performed between the lines of the left and right limit (see also **Left Limit** softkey). If no value is set, the upper limit corresponds to the stop frequency.

➡ Remote: CALC:MARK:X:SLIM:RIGH 10MHZ

Threshold

Opens an edit dialog box to define the threshold line. The threshold line represents the lower level limit for a **Peak** search and the upper level limit for a **Min** search.

Opens an edit dialog box to define the threshold line. The threshold line represents the lower limit of the peak search level range.

➡ Remote: CALC:THR –20dBm

➡ Remote: CALC:THR ON

Search Lim Off

Deactivates all limits of the search range.

➡ Remote: CALC:MARK:X:SLIM OFF

➡ Remote: CALC:THR:STAT OFF

Peak Excursion

Opens – for level measurements – an edit dialog box to enter the minimum level value by which a signal must rise or fall so that it will be identified as a maximum or a minimum by the search

functions. Entries from 0 dB to 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.

For details see also "To specify the suitable peak excursion" on page 3.53 and "Effect of different peak excursion settings (example)" on page 3.54.

➡ Remote: `CALC:MARK:PEXC 10dB`

Exclude LO

Switches the frequency range limit for the marker search functions on or off.

activated   minimum frequency $\geq 6 \times$ resolution bandwidth (RBW)

              Because of the interference by the first local oscillator to the first intermediate frequency at the input mixer, the LO is represented as a signal at 0 Hz. To avoid the marker jumping to the LO at 0 Hz with the peak function when setting the display range, this frequency is excluded.

deactivated   no restriction to the search range. The frequency 0 Hz is included in the marker search functions.

➡ Remote: `CALC:MARK:LOEX ON`

Auto Max Peak / Auto Min Peak

Adds an automatic peak search action for marker 1 at the end of each particular sweep. This function may be used during adjustments of a device under test to keep track of the actual peak marker position and level.

The actual marker search limit settings (**Left Limit**, **Right Limit**, **Threshold**, **Exclude LO** softkeys) are taken into account.

➡ Remote: `CALC:MARK:MIN:AUTO ON`
➡ Remote: `CALC:MARK:MAX:AUTO ON`

Power Measurements – MEAS Key

With its power measurement functions the R&S FSL is able to measure all the necessary parameters with high accuracy in a wide dynamic range.

A modulated carrier is almost always used (except e.g. SSB–AM) for high–frequency transmission of information. Due to the information modulated upon the carrier, the latter covers a spectrum which is defined by the modulation, the transmission data rate and the signal filtering. Within a transmission band each carrier is assigned a channel taking into account these parameters. In order to ensure error–free transmission, each transmitter must be conforming to the specified parameters. These include among others:

- the output power
- the occupied bandwidth, i.e. the bandwidth which must contain a defined percentage of the power
- the power dissipation allowed in the adjacent channels

The **MEAS** key is used for complex measurement functions as power measurements, occupied bandwidth, signal statistic, carrier to noise spacing, AM modulation depth, third–order intercept point, harmonics and spurious emissions. For measurement examples refer to the Operating Manual on CD, chapter "Advanced Measurement Examples" and to the Quick Start Guide, chapter 5, "Basic Measurement Examples".

The following measurements can be performed:

- Power in zero span (**Time Domain Power** softkey; for details see "Power measurement " on page 3.62)
- Channel power and adjacent–channel power with span > 0 and with a single or several carriers (**CP, ACP, MC–ACP** softkey)
- Occupied bandwidth (**OBW** softkey, for details see "Measurement of occupied bandwidth" on page 3.63)
- Carrier–to–noise ratio (**C/N, C/No** softkey)
- Amplitude probability distribution (**APD** and **CCDF** softkeys, for details refer to the Operating Manual on CD, chapter "Advanced Measurement Examples", "Amplitude Distribution Measurement")
- Modulation depth (**AM Mod Depth** softkey)
- 3rd order intercept (**TOI** softkey, for details refer to the Operating Manual on CD, chapter "Advanced Measurement Examples", "Intermodulation Measurements")

To open the power measurement menu

➢ Press the **MEAS** key.

The power measurement menu is displayed.

Menu and softkey description

– "Softkeys of the power measurement menu" on page 3.66

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 section "How to use the Help System".

Further information

Tasks

– To measure the power in zero span

– To set the channel configuration

– To measure the occupied bandwidth

– To measure signal statistics

– To measure the carrier–to–noise ratio

To measure the power in zero span

1. Press the **Time Domain Power** softkey to activate the power measurement.

   The corresponding submenu is displayed.

2. To limit the power evaluation range, switch on the limits (**Limits On/Off** softkey) and enter the limits by using the **Left Limit** and **Right Limit** softkeys.

3. Select the type of power measurement by using the **Mean** or **RMS** softkey. (RMS or mean power), the settings for max hold and averaging as well as the definition of limits.

4. To calculate and display the peak value, press the **Peak** softkey.

5. To calculate and display the standard deviation from the mean value, press the **Std Dev** softkey.

To set the channel configuration

1. Press the **CP, ACP, MC–ACP** softkey to active channel or adjacent–channel power measurement.

   The corresponding submenu is displayed.

2. To use a predefined standard for measurement, press the **CP / ACP Standard** softkey (for details on available standards see).

3. To configure the parameters independently of the predefined standards, press the **CP / ACP Config** softkey (for details see).

4. To enter the sweep time, press the **Sweep Time** softkey.

5. To display the whole diagram, press the **Full Size Diagram** softkey.

6. To adjust the reference level to the measured channel power, press the **Adjust Ref Level** softkey.

To measure the occupied bandwidth

1. Press the **OBW** softkey to activate the measurement of the occupied bandwidth (for details see also).

   The corresponding submenu is displayed.

2. Press the **% Power Bandwidth** softkey to enter the percentage of power.

3. To change the channel bandwidth for the transmission channel, press the **Channel Bandwidth** softkey.

4. To optimize the settings for the selected channel configuration, press the **Adjust Settings** softkey (for details see also "Settings of CP / ACP test parameters" on page 3.64).

5. To adjust the reference level to the measured total power after the first sweep, press the **Adjust Ref Lvl** softkey.

To measure signal statistics

- To activate and configure the measurement of the amplitude probability distribution (APD), press the **APD** softkey (for details refer to the Operating Manual on CD, chapter "Advanced Measurement Examples", "Amplitude Distribution Measurement").

  The corresponding submenu is displayed.

- To activate and configure the measurement of the complementary cumulative distribution (CCDF), press the **CCDF** softkey (for details refer to the Operating Manual on CD, chapter "Advanced Measurement Examples", "Amplitude Distribution Measurement").

  The corresponding submenu is displayed.

To measure the carrier–to–noise ratio

1. Press the **C/N, C/No** softkey to configure the carrier–to–noise ratio measurement.

   The corresponding submenu is displayed.

2. To activate the measurements without reference to the bandwidth, press the **C/N** softkey.

3. To activate the measurements with reference to the bandwidth, press the **C/No** softkey.

4. To change the channel bandwidth for the transmission channel, press the **Channel Bandwidth** softkey.

5. To optimize the settings for the selected channel configuration, press the **Adjust Settings** softkey (for details see also "Settings of CP / ACP test parameters" on page 3.64).

Power measurement in zero span

With the aid of the power measurement function, the R&S FSL determines the power of the signal in zero span by summing up the power at the individual measurement points and dividing the result by the number of measurement points. In this way it is possible to measure for example the power of TDMA signals during transmission or during the muting phase. Both the mean power and the RMS power can be measured by means of the individual power values.

The result is displayed in the marker field. The measured values are updated after each sweep or averaged over a user–defined number of sweeps in order to determine e.g. the mean power over several bursts. For determination of the peak value the maximum value from several sweeps is displayed.

If both the on and off phase of a burst signal are displayed, the measurement range can be limited to the transmission or to the muting phase with the aid of vertical lines. The ratio between signal and noise power of a TDMA signal for instance can be measured by using a measurement as a reference value and after that varying the measurement range.

Upon switching on power measurement the sample detector is activated.

Measurement of occupied bandwidth

An important characteristic of a modulated signal is its occupied bandwidth. In a radio communications system for instance the occupied bandwidth must be limited to enable distortion–free transmission in adjacent channels. The occupied bandwidth is defined as the bandwidth containing a defined percentage of the total transmitted power. A percentage between 10% and 99.9% can be set.

The measurement principle is the following: The bandwidth containing 99% of the signal power is to be determined, for example. The routine first calculates the total power of all displayed points of the trace. In the next step, the points from the right edge of the trace are summed up until 0.5% of the total power is reached. Auxiliary marker 1 is positioned at the corresponding frequency. Then the points from the left edge of the trace are summed up until 0.5% of the power is reached. Auxiliary marker 2 is positioned at this point. 99% of the power is now between the two markers. The distance between the two frequency markers is the occupied bandwidth which is displayed in the marker field.

To ensure correct power measurement, especially for noise signals, and to obtain the correct occupied bandwidth, the following prerequisites and settings are necessary:

- Only the signal to be measured is displayed on the screen. An additional signal would falsify the measurement.

- RBW << occupied bandwidth
  (approx. 1/20 of occupied bandwidth, for voice communication type 300 Hz or 1 kHz)

- VBW $\geq$ 3 x RBW

- RMS detector

- Span $\geq$ 2 to 3 x occupied bandwidth

Some of the measurement specifications (e.g. PDC, RCR STD–27B) require measurement of the occupied bandwidth using a peak detector. The detector setting of the R&S FSL has to be changed accordingly then.

Predefined CP / ACP standards

The test parameters for the channel and adjacent–channel measurements are set according to the mobile radio standard. The available standards are listed below.

- NADC IS136

- TETRA

- PDC

- PHS

- CDPD

- CDMA IS95A FWD

- CDMA IS95A REV

- CDMA IS95C Class 0 FWD

- CDMA IS95C Class 0 REV

- CDMA J–STD008 FWD

- CDMA J–STD008 REV

- CDMA IS95C Class 1 FWD

- CDMA IS95C Class 1 REV

- W–CDMA 4.096 FWD

- W–CDMA 4.096 REV

- W–CDMA 3GPP FWD

- W–CDMA 3GPP REV

- CDMA 2000 DS

- CDMA 2000 MC1

- CDMA 2000 MC3

- TD–SCDMA FWD

- TD–SCDMA REV

- WLAN 802.11A

- WLAN 802.11B

- WiMAX

- WIBRO

Note: *For the R&S FSL, the channel spacing is defined as the distance between the center frequency of the adjacent channel and the center frequency of the transmission channel. The definition of the adjacent–channel spacing in standards IS95 B / C, IS97 B / C, IS98 B / C and CDMA 2000 DS / MC1 / MC3 is different. These standards define the adjacent–channel spacing from the center of the transmission channel to the closest border of the adjacent channel. This definition is also used for the R&S FSL if the standard settings marked with a dagger are selected.*

Settings of CP / ACP test parameters

- **Frequency span**

  The frequency span must at least cover the channels to be measured plus a measurement margin of approx. 10%.

Note: *If the frequency span is large in comparison to the channel bandwidth (or the adjacent–channel bandwidths) being examined, only a few points on the trace are available per channel. This reduces the accuracy of the waveform calculation for the channel filter used, which has a negative effect on the measurement accuracy. It is therefore strongly recommended that the formulas mentioned be taken into consideration when selecting the frequency span.*

For channel power measurements the **Adjust Settings** softkey sets the frequency span as follows:

(No. of transmission channels – 1) x transmission channel spacing + 2 x transmission channel bandwidth + measurement margin

For adjacent–channel power measurements, the **Adjust Settings** softkey sets the frequency span as a function of the number of transmission channels, the transmission channel spacing, the adjacent–channel spacing, and the bandwidth of one of adjacent–channels ADJ, ALT1 or ALT2, whichever is furthest away from the transmission channels:

(No. of transmission channels – 1) x transmission channel spacing + 2 x (adjacent–channel spacing + adjacent–channel bandwidth) + measurement margin

The measurement margin is approx. 10% of the value obtained by adding the channel spacing and the channel bandwidth.

- **Resolution bandwidth (RBW)**

  To ensure both, acceptable measurement speed and required selection (to suppress spectral components outside the channel to be measured, especially of the adjacent channels), the resolution bandwidth must not be selected too small or too large. As a general approach, the resolution bandwidth is to be set to values between 1% and 4% of the channel bandwidth.

  A larger resolution bandwidth can be selected if the spectrum within the channel to be measured and around it has a flat characteristic. In the standard setting, e.g. for standard IS95A REV at an adjacent channel bandwidth of 30 kHz, a resolution bandwidth of 30 kHz is used. This yields correct results since the spectrum in the neighborhood of the adjacent channels normally has a constant level. For standard NADC/IS136 this is not possible for example, since the spectrum of the transmit signal penetrates into the adjacent channels and a too large resolution bandwidth causes a too low selection of the channel filter. The adjacent–channel power would thus be measured too high.

  With the exception of the IS95 CDMA standards, the **Adjust Settings** softkey sets the resolution bandwidth (RBW) as a function of the channel bandwidth:

  > *RBW ≤ 1/40 of channel bandwidth*

  The maximum possible resolution bandwidth (with respect to the requirement RBW ≤ 1/40) resulting from the available RBW steps (1, 3) is selected.

- **Video bandwidth (VBW)**

  For a correct power measurement, the video signal must not be limited in bandwidth. A restricted bandwidth of the logarithmic video signal would cause signal averaging and thus result in a too low indication of the power (–2.51 dB at very low video bandwidths). The video bandwidth should therefore be selected at least three times the resolution bandwidth:

  > *VBW ≥ 3 x RBW*

  The **Adjust Settings** softkey sets the video bandwidth (VBW) as a function of the channel bandwidth (see formula above) and the smallest possible VBW with regard to the available step size will be selected.

- **Detector**

  The **Adjust Settings** softkey selects the RMS detector. This detector is selected since it correctly indicates the power irrespective of the characteristics of the signal to be measured. The whole IF envelope is used to calculate the power for each measurement point. The IF envelope is digitized using a sampling frequency which is at least five times the resolution bandwidth which has been selected. Based on the sample values, the power is calculated for each measurement point using the following formula:

  $$P_{RMS} = \sqrt{\frac{1}{N} \cdot \sum_{i=1}^{N} s_i^2}$$

  s_i = linear digitized video voltage at the output of the A/D converter

  N = number of A/D converter values per measurement point

  P_{RMS} = power represented by a measurement point

When the power has been calculated, the power units are converted into decibels and the value is displayed as a measurement point.

In principle, the sample detector would be possible as well. Due to the limited number of measurement points used to calculate the power in the channel, the sample detector would yield less stable results.

- **Trace averaging**

  The **Adjust Settings** softkey switches off this function. Averaging, which is often performed to stabilize the measurement results, leads to a too low level indication and should therefore be avoided. The reduction in the displayed power depends on the number of averages and the signal characteristics in the channel to be measured.

- **Reference level**

  The **Adjust Settings** softkey does not influence the reference level. It can be separately adjusted using the **Adjust Settings** softkey.

Softkeys of the power measurement menu

The following table shows all softkeys available in the power measurement 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.

Menu / Command	Submenu / Command	Submenu / Command	Command
All Functions Off			
TOI ▼	Marker 1		
	Marker 2		
	Marker 3		
	Marker 4		
	Search Signals		
AM Mod Depth ▼	same contents as TOI menu		
Time Domain Power ▼	Peak		
	RMS		
	Mean		
	Std Dev		
	Limits On/Off		
	Left Limit		
	Right Limit		
C/N, C/No ▼	C/N		
	C/No		
	Channel Bandwidth		
	Adjust Settings		
CP, ACP, MC–ACP ▼	CP / ACP Standard		
	CP / ACP Config ▼	# of TX Chan	
		# of Adj Chan	
		Channel Settings ▼	Channel Bandwidth
			Channel Spacing
			Chan Pwr/Hz
			ACP Ref Settings
			Adjust Ref Level
			Adjust Settings
		Limit Checking ▼	Limit Chk On/Off

Menu / Command	Submenu / Command	Submenu / Command	Command
			Edit ACP Limit
		Power Mode ▼	Clear/Write
			Max Hold
		Select Trace	
		Adjust Settings	
	Sweep Time		
	Fast ACP On/Off		
	ACP Abs/Rel		
	Adjust Ref Level		
More ▼			
All Functions Off			
OBW ▼	% Power Bandwidth		
	Channel Bandwidth		
	Adjust Ref Lvl		
	Adjust Settings		
APD ▼	Percent Marker		
	Res BW		
	# of Samples		
	Scaling ▼	x–Axis Ref Level	
		x–Axis Range	
		y–Axis Max Value	
		y–Axis Min Value	
		Adjust Settings	
		Default Settings	
	Adjust Settings		
	Cont Meas		
	Single Meas		
CCDF ▼	same contents as APD menu		
Harmonic Distortion ▼	Harmonic On/Off		
	No. of Harmonics		
	Harmonic Sweep Time		
	Harmonic RBW Auto		
	Adjust Settings		
Full Size Diagram			

All Functions Off

Switches off all power measurement functions.

➡ Remote: `CALC:MARK:FUNC:<function> OFF`

TOI

Opens a submenu and activates the measurement of the 3rd order intercept point.

A two–tone signal with equal carrier levels is expected at the R&S FSL input. Marker 1 and marker 2 (both normal markers) are set to the maximum of the two signals. Marker 3 and marker 4 (both delta markers) are placed on the intermodulation products. When the function is enabled, the frequency entry is activated for the delta markers. They can be set manually.

The R&S FSL calculates the third order intercept point from the level spacing between normal markers and delta markers and displays it in the marker field.

➡ Remote: `CALC:MARK:FUNC:TOI ON`

➡ Remote: `CALC:MARK:FUNC:TOI:RES?`

Search Signals

Activates all markers.

➡ Remote: `CALC:MARK:FUNC:TOI:RES?`

AM Mod Depth

Opens a submenu and activates the measurement of the AM modulation depth. An AM–modulated carrier is required on the screen for ensuring correct operation.

The level value of marker 1 is taken as the carrier level. When this function is activated, marker 2 and marker 3 are automatically set symmetrically to the carrier on the adjacent peak values of the trace as delta markers and marker 2 is activated for the entry.

When the position of marker 2 (delta) is changed, marker 3 (delta) is moved symmetrically with respect to the reference marker (marker 1).

If the edit dialog box is opened for marker 3, the latter can be moved for fine adjustment irrespective of marker 2.

The R&S FSL calculates the power at the marker positions from the measured levels. The AM modulation depth is calculated from the ratio between the power values at the reference marker and at the delta markers. If the powers of the two AM side bands are unequal, the mean value of the two power values is used for AM modulation depth calculation.

➡ Remote: `CALC:MARK:FUNC:MDEP ON`

➡ Remote: `CALC:MARK:FUNC:MDEP:RES?`

Time Domain Power (zero span)

Activates the power measurement in zero span and opens a submenu to configure the power measurement. For more details see also "Power measurement in zero span" on page 3.62.

➡ Remote: `CALC:MARK:FUNC:SUMM:STAT ON`

Peak (zero span)

Activates the calculation of the peak value from the points of the displayed trace or a segment thereof. For more details see also "Power measurement in zero span" on page 3.62.

➡ Remote: `CALC:MARK:FUNC:SUMM:PPE ON`

➡ Remote: `CALC:MARK:FUNC:SUMM:PPE:RES?`

RMS (zero span)

Activates the calculation of the RMS value from the points of the displayed trace or a segment thereof. For more details see also "Power measurement in zero span" on page 3.62.

➡ Remote: CALC:MARK:FUNC:SUMM:RMS ON

➡ Remote: CALC:MARK:FUNC:SUMM:RMS:RES?

Mean (zero span)

Activates the calculation of the mean value from the points of the displayed trace or a segment thereof. The linear mean value of the equivalent voltages is calculated.

This can be used for instance to measure the mean power during a GSM burst.

For more details see also "Power measurement in zero span" on page 3.62.

➡ Remote: CALC:MARK:FUNC:SUMM:MEAN ON

➡ Remote: CALC:MARK:FUNC:SUMM:MEAN:RES?

Std Dev (zero span)

Activates the calculation of the standard deviation of measurement points from the mean value and displays them as measured value. The measurement of the mean power is automatically switched on at the same time. For more details see also "Power measurement in zero span" on page 3.62.

➡ Remote: CALC:MARK:FUNC:SUMM:SDEV ON

➡ Remote: CALC:MARK:FUNC:SUMM:SDEV:RES?

Limits On/Off (zero span)

Switches the limitation of the evaluation range on or off. Default setting is off.

If switched off, the evaluation range is not limited. If switched on, the evaluation range is defined by the left and right limit. If only one limit is set, it corresponds to the left limit and the right limit is defined by the stop frequency. If the second limit is also set, it defines the right limit.

For more details see also "Power measurement in zero span" on page 3.62.

➡ Remote: CALC:MARK:X:SLIM OFF

Left Limit (zero span)

Opens an edit dialog box to enter a value for line 1. For more details see also "Power measurement in zero span" on page 3.62.

➡ Remote: CALC:MARK:X:SLIM:LEFT <value>

Right Limit (zero span)

Opens an edit dialog box to enter a value for line 2. For more details see also "Power measurement in zero span" on page 3.62.

➡ Remote: CALC:MARK:X:SLIM:RIGH <value>

C/N, C/No (span > 0)

Opens a submenu to configure the carrier/noise ratio measurement. Measurements without (C/N) and measurements with reference to the bandwidth (C/No) are possible.

C/N (span > 0)

Switches the measurement of the carrier/noise ratio on or off. If no marker is active, marker 1 is activated.

The measurement is performed on the trace where marker 1 is located. To shift marker 1 and measure another trace, use the **Marker to Trace** softkey in the marker menu. To determine the maximum value of the current trace, use the **Phase Noise/Ref Fixed** softkey in the marker menu.

➡ Remote: `CALC:MARK:FUNC:POW:SEL CN`

➡ Remote: `CALC:MARK:FUNC:POW:RES? CN`

➡ Remote: `CALC:MARK:FUNC:POW OFF`

C/No (span > 0)

Switches the measurement of the carrier/noise ratio with reference to a 1 Hz bandwidth on or off. If no marker is active, marker 1 is activated.

The measurement is performed on the trace where marker 1 is located. To shift marker 1 and measure another trace, use the **Marker to Trace** softkey in the marker menu. To determine the maximum value of the current trace, use the **Phase Noise/Ref Fixed** softkey in the marker menu.

➡ Remote: `CALC:MARK:FUNC:POW:SEL CN0`

➡ Remote: `CALC:MARK:FUNC:POW:RES? CN0`

➡ Remote: `CALC:MARK:FUNC:POW OFF`

Channel Bandwidth (span > 0)

Opens an edit dialog box to enter the measurement channel bandwidth. The default setting is 14 kHz.

➡ Remote: `POW:ACH:BWID 30kHz`

Adjust Settings (span > 0)

Enables the RMS detector (see also "Detector overview" on page 3.36) and adjusts the span to the selected channel bandwidth according to:

4 x channel bandwidth + measurement margin

The adjustment is performed once; if necessary, the setting can be changed later on.

➡ Remote: `POW:ACH:PRES CN | CN0`

CP, ACP, MC–ACP

Activates the active channel or adjacent–channel power measurement either for a single carrier signal or for several carrier signals, depending on the current measurement configuration, and opens a submenu to configure the channel power measurement. With default settings the measurement is performed by integrating the powers at the display points within the specified channels (IBW method).

If multi–carrier ACP measurement is activated, the number of measured values is increased to ensure that adjacent–channel powers are measured with adequate accuracy.

➡ Remote: `CALC:MARK:FUNC:POW:SEL CPOW|ACP|MCAC`

➡ Remote: `CALC:MARK:FUNC:POW:RES? CPOW|ACP|MCAC`

➡ Remote: `CALC:MARK:FUNC:POW OFF`

CP / ACP Standard

Opens an edit dialog box to select the settings according to predefined standards. For details on the available standards see "Predefined CP / ACP standards" on page 3.63. By default no standard is set.

The selection of the standard influences the following parameters:

– channel spacing and adjacent–channel spacing

– channel bandwidth, adjacent–channel bandwidth, and type of filtering

– resolution bandwidth

– video bandwidth

– detector

– # of adjacent channels

– trace averaging (switched off)

➡ Remote: `CALC:MARK:FUNC:POW:PRES <standard>`

CP / ACP Config

Opens a submenu to configure the channel power and adjacent channel power measurement independently of the predefined standards (for details see also "To set the channel configuration" on page 3.61 and "Settings of CP / ACP test parameters" on page 3.64).

of TX Chan (MC–ACP)

Opens an edit dialog box to enter the number of carrier signals to be taken into account in channel and adjacent–channel power measurements. Values from 1 to 12 are allowed.

➡ Remote: `POW:ACH:TXCH:COUN 4`

# of Adj Chan

Opens an edit dialog box to enter the number of adjacent channels to be considered in the adjacent–channel power measurement. Values from 0 to 12 are allowed.

The following measurements are performed depending on the number of the channels:

0   Only the channel powers are measured.

1   The channel powers and the power of the upper and lower adjacent channel are measured.

2   The channel powers, the power of the upper and lower adjacent channel, and of the next higher and lower channel (alternate channel 1) are measured.

3   The channel power, the power of the upper and lower adjacent channel, the power of the next higher and lower channel (alternate channel 1), and of the next but one higher and lower adjacent channel (alternate channel 2) are measured.

...   ...

12   The channel power, the power of the upper and lower adjacent channel, and the power of the all higher and lower channels (alternate channel 1 to 11) are measured.

➥   Remote: `POW:ACH:ACP 1`

Channel Settings

Opens a submenu to define the channel settings.

Channel Bandwidth

Opens the **TX/ACP Channel Bandwidth** dialog box to enter the channel bandwidths for the transmission channels and the adjacent channels. The entry **TX** is only available for the multi–carrier ACP measurement.

The transmission–channel bandwidth is normally defined by the transmission standard. The correct bandwidth is set automatically for the selected standard (see **CP / ACP Standard** softkey).

Measurements in zero span (see **Fast ACP On/Off** softkey) are performed in the zero span mode. The channel limits are indicated by vertical lines. For measurements requiring channel bandwidths deviating from those defined in the selected standard the IBW method is to be used.

With the IBW method (see **Fast ACP On/Off** softkey), the channel bandwidth limits are marked by two vertical lines right and left of the channel center frequency. It can in this way be visually checked whether the entire power of the signal under test is within the selected channel bandwidth.

If measuring according to the IBW method (**Fast ACP Off**), the bandwidths of the different adjacent channels are to be entered numerically. Since all adjacent channels often have the same bandwidth, the other channels Alt1 and Alt2 are set to the bandwidth of the adjacent channel on entering the adjacent–channel bandwidth (ADJ). Thus only one value needs to be entered in case of equal adjacent channel bandwidths. The same holds true for the ALT2 channels (alternate channels 2) if the bandwidth of the ALT1 channel (alternate channel 1) is entered.

For details on available channel filters see "To choose the appropriate filter" on page 3.15.

➡ Remote: `POW:ACH:BWID 30kHz`

➡ Remote: `POW:ACH:BWID:ACH 30kHz`

➡ Remote: `POW:ACH:BWID:ALT2 30kHz`

Channel Spacing

Opens the **TX/ACP Channel Spacing** dialog box to enter the channel spacings.

The entry **TX** is only available for the multi–carrier ACP measurement.

Since all the adjacent channels often have the same distance to each other, the modification of a channel spacing causes a change in all higher adjacent channel spacings: they are all multiplied by the same factor (new spacing value / old spacing value). Thus only one value needs to be entered in case of equal channel spacing. The lower adjacent channels remain unchanged.

Example:

In the default setting, the adjacent channels have the following spacing: 20 kHz (**ADJ**), 40 kHz (**ALT1**), 60 kHz (**ALT2**), 80 kHz (**ALT3**), 100 kHz (**ALT4**), ...

If the spacing of the first adjacent channel (**ADJ**) is set to 40 kHz, the spacing of all other adjacent channels is multiplied by factor 2 to result in 80 kHz (**ALT1**), 120 kHz (**ALT2**), 160 kHz (**ALT3**), ...

If, starting from the default setting, the spacing of the 5th adjacent channel (**ALT4**) is set to 150 kHz, the spacing of all other adjacent channels is multiplied by factor 1.5 to result in 180 kHz (**ALT5**), 210 kHz (**ALT6**), 240 kHz (**ALT7**), ...

➡ Remote: `POW:ACH:SPAC:CHAN 25kHz`

➡ Remote: `POW:ACH:SPAC 33kHz`

➡ Remote: `POW:ACH:SPAC:ALT1 100kHz`

Chan Pwr/Hz

Switches the display unit for channel power measurements between dBm (total channel power) and Hz (channel power referenced to a 1 Hz bandwidth). The conversion factor is

$$10 \times \lg \frac{1}{channel\,bandwidth}$$

By means of this function it is possible e.g. to measure the signal/noise power density or use the additional functions **ACP Abs/Rel** and **ACP Ref Settings** to obtain the signal to noise ratio.

➡ Remote: `CALC:MARK:FUNC:POW:RES:PHZ ON`

ACP Ref Settings (MC–ACP)

Opens an edit dialog box to select the transmission channel to which the adjacent–channel relative power values should be referenced.

TX Channel 1 – 12	Selection of one of channels 1 to 12.
Min Power TX Channel	The transmission channel with the lowest power is used as a reference channel.
Max Power TX Channel	The transmission channel with the highest power is used as a reference channel.
Lowest & Highest Channel	The outer left–hand transmission channel is the reference channel for the lower adjacent channels, the outer right–hand transmission channel that for the upper adjacent channels.

➡ Remote: `POW:ACH:REF:TXCH:MAN 3`
➡ Remote: `POW:ACH:REF:TXCH:AUTO MAX`

Limit Checking

Opens a submenu to activate and define the limits for the ACP measurement.

Limit Chk On/Off

Activates or deactivates the limit check for the ACP measurement.

➡ Remote: `CALC:LIM:ACP ON`
➡ Remote: `CALC:LIM:ACP:ACH:RES?`
➡ Remote: `CALC:LIM:ACP:ALT:RES?`

Edit ACP Limit

Opens the **ACP Limits** dialog box to define the limits for the ACP measurement.

The following rules apply for the limits:

– A separate limit can be defined for each adjacent channel. The limit applies to both the upper and the lower adjacent channel.

– A relative and/or absolute limit can be defined. The check of both limit values can be activated independently.

– The R&S FSL checks adherence to the limits irrespective of whether the limits are absolute or relative or whether the measurement is carried out with absolute or relative levels. If both limits are active and if the higher of both limit values is exceeded, the measured value is marked by a preceding asterisk.

➡ Remote: `CALC:LIM:ACP ON`

➡ Remote: `CALC:LIM:ACP:<adjacent-channel> 0dB,0dB`

➡ Remote: `CALC:LIM:ACP:<adjacent-channel>:STAT ON`

➡ Remote: `CALC:LIM:ACP:<adjacent-channel>:ABS –10dBm,–10dBm`

➡ Remote: `CALC:LIM:ACP:<adjacent-channel>:ABS:STAT ON`

For details refer to chapter "Remote Control – Commands", section "CALCulate:LIMit:ACPower Subsystem".

Power Mode

Opens a submenu to select the power mode.

Clear/Write

If this mode is activated, the channel power and the adjacent channel powers are calculated directly from the current trace (default mode).

➡ Remote: `CALC:MARK:FUNC:POW:MODE WRIT`

Max Hold

If this mode is activated, the power values are calculated from the current trace and compared with the previous power value using a maximum algorithm. The higher value is retained. If activated, the enhancement label **Pwr Max** is displayed.

➡ Remote: `CALC:MARK:FUNC:POW:MODE MAXH`

Select Trace

Opens an edit dialog box to enter the trace number on which the CP/ACP measurement is to be performed. Only activated traces can be selected (for details on trace modes see "Trace mode overview" on page 3.34).

➡ Remote: `POW:TRAC 2`

Adjust Settings

Optimizes automatically all instrument settings for the selected channel configuration (channel bandwidth, channel spacing) within a specific frequency range (channel bandwidth). The adjustment is carried out only once. If necessary, the instrument settings can be changed later.

For details on the settings of span, resolution bandwidth, video bandwidth, detector and trace averaging see "Settings of CP / ACP test parameters" on page 3.64.

➡ Remote: POW:ACH:PRES ACP

Sweep Time

Opens an edit dialog box to enter the sweep time. With the RMS detector, a longer sweep time increases the stability of the measurement results.

The function of this softkey is identical to the **Sweeptime Manual** softkey in the bandwidth menu.

➡ Remote: SWE:TIM <value>

Fast ACP On/Off

Switches between the IBW method (**Fast ACP Off**) and the zero span method (**Fast ACP On**).

When switched on, the R&S FSL sets the center frequency consecutively to the different channel center frequencies and measures the power with the selected measurement time (= sweep time/number of channels). The RBW filters suitable for the selected standard and frequency offset are automatically used (e.g. root raised cos with IS 136). For details on available channel filters see "To choose the appropriate filter" on page 3.15.

The RMS detector is used for obtaining correct power measurement results. Therefore this requires no software correction factors.

Measured values are output as a list. The powers of the transmission channels are output in dBm, the powers of the adjacent channels in dBm.

The sweep time is selected depending on the desired reproducibility of results. Reproducibility increases with sweep time since power measurement is then performed over a longer time period. As a general approach, it can be assumed that approx. 500 non–correlated measured values are required for a reproducibility of 0.5 dB (99% of the measurements are within 0.5 dB of the true measured value). This holds true for white noise. The measured values are considered as non–correlated if their time interval corresponds to the reciprocal of the measured bandwidth.

With IS 136 the measurement bandwidth is approx. 25 kHz, i.e. measured values at an interval of 40 µs are considered as non–correlated. A measurement time of 40 ms is thus required per channel for 1000 measured values. This is the default sweep time which the R&S FSL sets in coupled mode. Approx. 5000 measured values are required for a reproducibility of 0.1 dB (99%), i.e. the measurement time is to be increased to 200 ms.

➡ Remote: POW:HSP ON

ACP Abs/Rel

Switches between absolute and relative power measurement in the adjacent channels.

Abs   The absolute power in the adjacent channels is displayed in the unit of the y–axis, e.g. in dBm, dBµV.

Rel   The level of the adjacent channels is displayed relative to the level of the transmission channel in dBc.

➡ Remote: `POW:ACH:MODE REL`

Adjust Ref Level

Adjusts the reference level to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSL or limiting the dynamic range by a too small S/N ratio. For details on manual settings see "Settings of CP / ACP test parameters" on page 3.64.

The reference level is not influenced by the selection of a standard. To achieve an optimum dynamic range, the reference level has to be set in a way that places the signal maximum close to the reference level without forcing an overload message. Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is still significantly below the reference level.

➡ Remote: `POW:ACH:PRES:RLEV`

OBW (span > 0)

Activates measurement of the occupied bandwidth according to the current configuration and opens a submenu to configure the measurement. The occupied bandwidth is displayed in the marker display field and marked on the trace by temporary markers. For details see also "Measurement of occupied bandwidth" on page 3.63.

The measurement is performed on the trace with marker 1. In order to evaluate another trace, marker 1 must be placed on another trace (see **Marker to Trace** softkey in the marker menu).

➡ Remote: `CALC:MARK:FUNC:POW:SEL OBW`
➡ Remote: `CALC:MARK:FUNC:POW:RES? OBW`
➡ Remote: `CALC:MARK:FUNC:POW OFF`

% Power Bandwidth (span > 0)

Opens an edit dialog box to enter the percentage of total power in the displayed frequency range which defines the occupied bandwidth. Values from 10% to 99.9% are allowed.

➡ Remote: `POW:BWID 95PCT`

Channel Bandwidth (span > 0)

Opens an edit dialog box to enter the channel bandwidth for the transmission channel. The specified channel bandwidth is used for optimization of the test parameters (for details see "Settings of CP / ACP test parameters" on page 3.64). The default setting is 14 kHz.

For measurements in line with a specific transmission standard, the bandwidth specified by the standard for the transmission channel must be entered.

➡ Remote: `POW:ACH:BWID 30kHz`

Adjust Ref Lvl (span > 0)

Adjusts the reference level to the measured total power of the signal. The softkey is activated after the first sweep with active measurement of the occupied bandwidth has been completed and the total power of the signal is thus known.

Adjusting the reference level ensures that the signal path will not be overloaded and the dynamic range not limited by too low a reference level. Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is distinctly below the reference level. If the measured channel power is equal to the reference level, the signal path cannot be overloaded.

➡ Remote: `POW:ACH:PRES:RLEV`

APD

Activates the function to measure the amplitude probability density (APD) and opens a submenu.

➡ Remote: `CALC:STAT:APD ON`

Percent Marker

Opens an edit dialog box to enter a probability value and to position marker 1. Thus, the power which is exceeded with a given probability can be determined very easily. If marker 1 is deactivated, it will be switched on automatically.

➡ Remote: `CALC:MARK:Y:PERC 0...100%`

Res BW

Opens an edit dialog box to set the resolution bandwidth directly. The function of this softkey is identical to the **Res BW Manual** softkey in the bandwidth menu.

For correct measurement of the signal statistics the resolution bandwidth has to be wider than the signal bandwidth in order to measure the actual peaks of the signal amplitude correctly. In order not to influence the peak amplitudes the video bandwidth is automatically set to 10 MHz. The sample detector is used for detecting the video voltage.

➡ Remote: `BAND 3 MHz`

# of Samples

Opens an edit dialog box to set the number of power measurements that are taken into account for the statistics.

Apart from the number of measurements the overall measurement time depends also on the set resolution bandwidth as the resolution bandwidth directly influences the sampling rate.

➡ Remote: `CALC:STAT:NSAM <value>`

Scaling

Opens a submenu to change the scaling parameters of x– and y–axis.

x–Axis Ref Level

Opens an edit dialog box to enter the reference level in the currently active unit (dBm, dBμV, etc). The function of this softkey is identical to the **Ref Level** softkey in the amplitude menu.

For the APD function this value is mapped to the right diagram border. For the CCDF function there is no direct representation of this value on the diagram as the x–axis is scaled relatively to the measured mean power.

➡ Remote: `CALC:STAT:SCAL:X:RLEV <value>`

x–Axis Range

Opens the **Range Log** dialog box to select a value for the level range to be covered by the statistics measurement selected. The function is identical to the **Range Log** softkey in amplitude menu.

➡ Remote: `CALC:STAT:SCAL:X:RANG <value>`

y–Axis Max Value

Opens an edit dialog box to define the upper limit of the displayed probability range. Values on the y–axis are normalized which means that the maximum value is 1.0. As the y–axis scaling has a logarithmic axis the distance between max and min value must be at least one decade.

➡ Remote: `CALC:STAT:SCAL:Y:UPP <value>`

y–Axis Min Value

Opens an edit dialog box to define the lower limit of the displayed probability range. As the y–axis scaling has a logarithmic axis the distance between max and min value must be at least one decade. Values in the range 0 < value < 1 are allowed.

➡ Remote: `CALC:STAT:SCAL:Y:LOW <value>`

Default Settings

Resets the x– and y–axis scalings to their preset values.

x–axis ref level:	–20 dBm
x–axis range APD:	100 dB
x–axis range CCDF:	20 dB
y–axis upper limit:	1.0
y–axis lower limit:	1E–6

➡ Remote: `CALC:STAT:PRES`

Adjust Settings

Adjusts the level settings according to the measured difference between peak and minimum power for APD measurement or peak and mean power for CCDF measurement in order to obtain maximum power resolution. Adapts the probability scale to the selected number of samples. Adjusts the reference level to the current input signal. For details see also **Adjust Ref Level** softkey.

➡ Remote: `CALC:STAT:SCAL:AUTO ONCE`

Cont Meas

Starts to collect a new sequence of sample data and to calculate the APD or CCDF curve depending on the selected measurement. The next measurement is started automatically as soon as the indicated number of samples has been reached ("CONTinuous MEASurement").

➡ Remote: `INIT:CONT ON`

➡ Remote: `INIT:IMM`

Single Meas

Starts to collect a new sequence of sample data and to calculate the APD or CCDF curve depending on the selected measurement. At the beginning of the measurement previously obtained measurement results are discarded.

➡ Remote: `INIT:CONT OFF`

➡ Remote: `INIT:IMM`

CCDF

Activates the function to measure the complementary cumulative distribution function (CCDF) and opens a submenu.

➡ Remote: `CALC:STAT:CCDF ON`

Harmonic Distortion

Opens a submenu to determine the settings for harmonics measurement and activates the harmonic distortion measurement. With this measurement it is possible to measure easily the harmonics e.g. from a VCO. In addition the THD (total harmonic distortion) is calculated in % and dB.

With span > 0 Hz, an automatic search for the first harmonic is carried out within the set frequency range. Also the level is adjusted. In zero span, the center frequency is unchanged.

In the upper pane, the zero span sweeps on all harmonics are shown, separated by display lines. This provides a very good overview about the measurement. In the lower pane, the mean RMS results are displayed in numerical values. The THD values are displayed in the marker field.

➡ Remote: `CALC:MARK:FUNC:HARM:STAT ON`

➡ Remote: `CALC:MARK:FUNC:HARM:DIST? TOT`

➡ Remote: `CALC:MARK:FUNC:HARM:LIST?`

Harmonic On/Off

Activates/deactivates the harmonic distortion measurement.

➡ Remote: `CALC:MARK:FUNC:HARM:STAT ON`

No. of Harmonics

Sets the number of harmonics that shall be measured. The range is from 1 to 26.

➡ Remote: `CALC:MARK:FUNC:HARM:NHAR 2`

Harmonic Sweep Time

For details refer to the **Sweeptime Manual** softkey in the bandwidth menu.

Harmonic RBW Auto

Enables/disables the automatic adjustment of the resolution bandwidth. The automatic adjustment is carried out according to:

$RBWn = RBW_1 * n$

If RBW_n is not available, the next higher value is used.

➡ Remote: `CALC:MARK:FUNC:HARM:BAND:AUTO OFF`

Adjust Settings

Activates the frequency search in the frequency range that was set before starting the harmonic measurement (if harmonic measurement was with span > 0) and adjusts the level.

➡ Remote: `CALC:MARK:FUNC:HARM:PRES`

Full Size Diagram (span > 0)

Displays the diagram in full screen size.

➡ Remote: `DISP:SIZE LARG|SMAL`

Using Limit Lines and Display Lines – LINES Key

The **LINES** key is used to configure limit and display lines.

To open the lines menu

➢ Press the **LINES** key.

The lines menu and the **Select Limit Line** dialog box are displayed. For details on the **Select Limit Line** dialog box refer to "To select a limit line" on page 3.83.

Menu and softkey description

– "Softkeys of the lines menu" on page 3.87

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 section "How to use the Help System".

Further information

– "Display Lines" on page 3.86

– "Limit Lines" on page 3.86

Task

– To work with display lines

– To select a limit line

– To create a new limit line

– To edit an existing limit line

– To create a new limit line based upon an existing limit line

– To activate/deactivate a limit line

To work with display lines

Initial situation: The line is switched on (softkey with highlighted background) or off (softkey without highlighted background), for example the Display Line 1.

1. Press the **Display Lines** softkey.

2. Press the **Display Line 1** softkey for the first time.

   An edit dialog box is opened to enter the position of the display line (by rotary knob, step keys or numerical entry). If the line was switched off, it is switched on. If it was switched on, it remains switched on.

3. If another softkey is pressed, the edit dialog box for the **Display Line 1** softkey is closed, but the line remains switched on (softkey with highlighted background).

4. Press the **Display Line 1** softkey for the second time.

   The edit dialog box for the display line will be opened again.

5. Press the **Display Line 1** softkey again.

   The line is switched off (softkey without highlighted background).

To select a limit line

1. To display the **Select Limit Line** dialog box, press the **LINES** key or go to the main limit line menu.
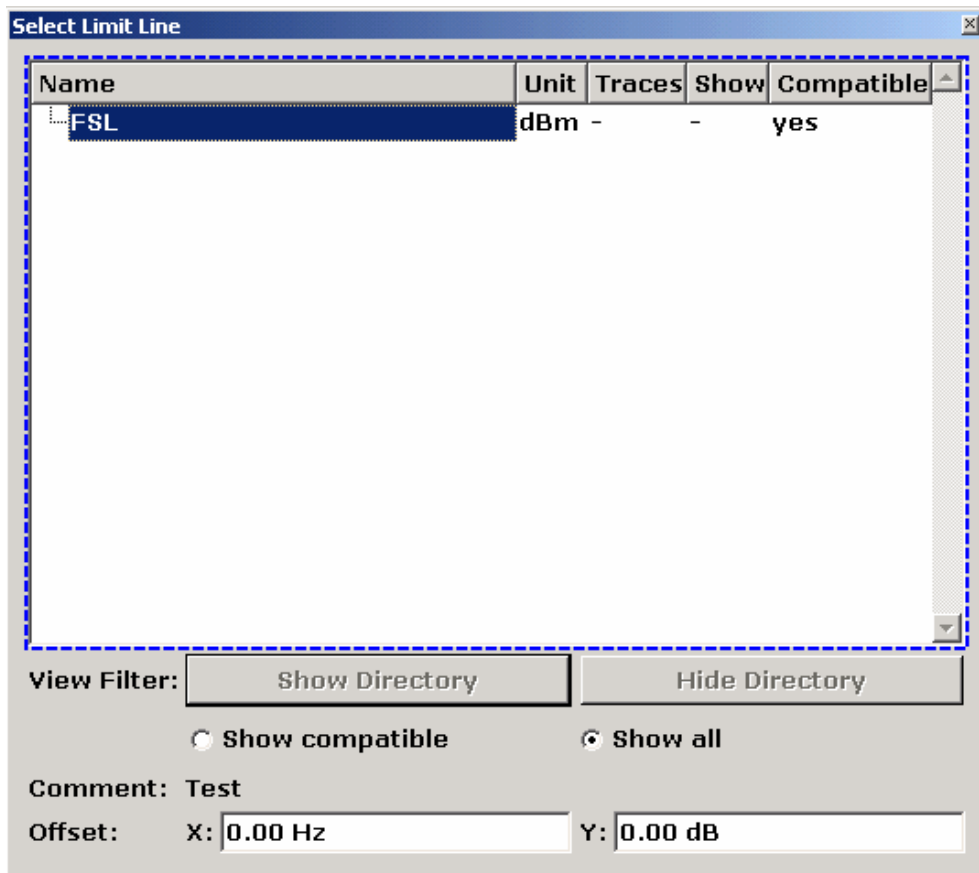
All limit lines, saved in the default directory, and all subdirectories are displayed. For each limit line, the following information is given:

Unit   unit of the y–axis

Traces   selected traces to check

Show   limit line displayed in the measurement diagram or hidden

Compatible   compatibility of the limit line to the current measurement settings

2. To display only the limit lines that are compatible, activate the **Show compatible** option. For details on compatibility refer to "Limit Lines" on page 3.86.

3. To navigate into a subdirectory, use the **Show Directory** and **Hide Directory** buttons.

To create a new limit line

1. Press the **New** softkey to define a new limit line.

   The **Edit Limit Line** dialog box is displayed. For more details on limit lines refer also to "Limit Lines" on page 3.86.

2. Press the **Edit Name** softkey and enter a name, if you want to save the limit line in the main directory. To save the limit line in an existing subdirectory, enter the relative path. A new subdirectory can only be created using the **FILE** key.

3. To change the span setting, set the focus in the **X–Axis** field and change the unit via the rotary knob: **Hz** for span > 0 Hz or **s** for zero span.

4. To change between absolute and relative scale mode for the x–axis, set the focus on the **abs** or **rel** option next to the **X–Axis** field and press the **CHECKMARK** key. Relative scaling is always suitable, if masks for bursts are to be defined in zero span, or if masks for modulated signals are required for span > 0 Hz.

    absolute: The frequencies or times are interpreted as absolute physical units.

    relative: In the data point table, the frequencies are referred to the currently set center frequency. In the zero span mode, the left boundary of the diagram constitutes the reference.

5. To change the scaling of the y–axis, set the focus in the **Y–Axis** field and change the unit using the rotary knob.

6. To change between absolute and relative units for the y–axis, set the focus on the **abs** or **rel** option next to the **Y–Axis** field and press the **CHECKMARK** key.

    absolute: The limit values refer to absolute levels or voltages.

    relative: The limit values refer to the reference level (Ref Level). Limit values with the unit dB are always relative values.

7. To define the limit line as upper or lower limit line, set the focus on the **Upper** or **Lower** option and press the **CHECKMARK** key.

8. To change between linear or logarithmic scale of the x–axis, set the focus on the **lin** or **log** option and press the **CHECKMARK** key.

9. If the scaling of the y–axis is relative, you can define an absolute threshold value that works as a lower limit for the relative limit values (see figure below). Set the focus in the **Threshold** field and enter a value.

    The function is especially useful for mobile radio applications provided the limit values are defined in relation to the carrier power as long as they are above an absolute limit value.
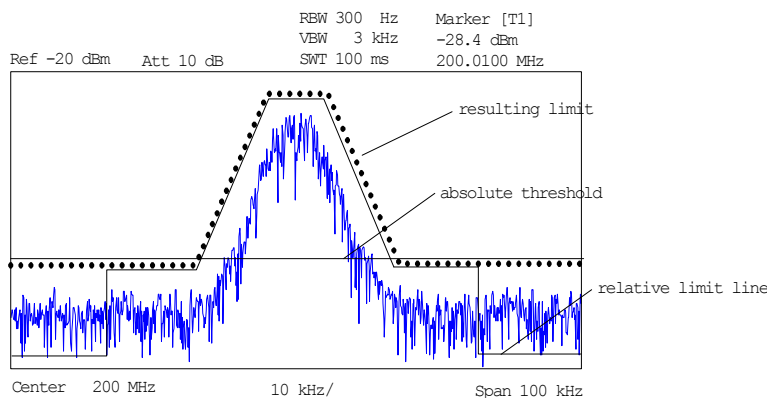
10. To define a signal–level distance to the limit line, press the **Edit Margin** softkey and enter a value.

    If the limit line is defined as an upper limit, the margin means that the level is below the limit line. If the limit line is defined as a lower limit, the margin means that the level is above the limit line.

11. To enter a comment, press the **Edit Comment** and enter a comment, e.g. a description of the application.

12. To enter a new data point:

    – Press the **Insert Value Above** softkey.

    – Enter the new x and y value in the successive displayed edit dialog boxes.

13. To change a data point:

    – Set the focus on the x and y value to be changed and press the **Value** softkey.

– Enter the new x or y value in the displayed edit dialog box.

14. To delete a data point, select the corresponding entry and press the **Delete Value** softkey.

15. To shift the complete limit line parallel in the horizontal direction, select the **Shift x** button and enter a x shift value.

16. To shift the complete limit line parallel in the vertical direction, select the **Shift y** button and and enter an y shift value.

17. Press the **Save Limit Line** softkey.

If an existing name is used, a message box is displayed. You have to confirm before the limit line is overwritten.

To edit an existing limit line

1. In the **Select Limit Line** dialog box, select the limit line you want to alter. For details see also "To select a limit line" on page 3.83.

2. Press the **Edit** softkey.

3. Edit the data as described in "To select a limit line" on page 3.83.

4. Save the limit line (**Save Limit Line** softkey).

To create a new limit line based upon an existing limit line

1. In the **Select Limit Line** dialog box, select the limit line you want to use as a basis for a new limit line. For details see also "To select a limit line" on page 3.83.

2. Press the **Copy to** softkey to transfer the data of the limit line into the **Edit Limit Line** dialog box.

3. Press the **Edit Name** softkey and enter a new name.

4. To shift the complete limit line parallel in the horizontal direction, select the **Shift x** button and enter an x shift value. In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally.

5. To shift the complete limit line parallel in the vertical direction, select the **Shift y** button and enter a y shift value. In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted in Y direction

6. If required, edit the data as described in "To select a limit line" on page 3.83.

7. Save the limit line (**Save Limit Line** softkey).

To activate/deactivate a limit line

Prerequisites:

- The x– and y–units of limit line and current measurement setting have to be compatible. For details refer to "Limit Lines" on page 3.86.

- The limit line has to consist of 2 or more data points.

1. In the **Select Limit Line** dialog box, select the limit line you want to activate/deactivate. For details see also "To select a limit line" on page 3.83.

2. To activate or deactivate a limit line for a trace, press the **Select Traces to check** softkey and select or deselect the trace(s) to which this limit line applies.

3. To deactivate the limit line for all traces, press the **Deselect All** softkey.

Display Lines

Display lines help to evaluate a trace – as do markers. The function of a display line is comparable to that of a ruler that can be shifted on the trace in order to mark absolute values. They are exclusively used to optically mark relevant frequencies or points in time (span = 0) as well as constant level values. It is not possible to check automatically whether the points are below or above the marked level values.

The softkeys for setting and switching the display lines on/off work like triple switches. For details see "To work with display lines" on page 3.82.

Two different types of display lines are provided:

- Two horizontal level lines for marking levels – Display Line 1 and 2

  The level lines are continuous horizontal lines across the entire width of a diagram and can be shifted in y direction.

- Two vertical frequency or time lines for marking frequencies or points in time – Frequency/Time Line 1 and 2

  The frequency or time lines are continuous vertical lines across the entire height of the diagram and can be shifted in x direction.

Each line is identified by one of the following abbreviations:

- D1: Display Line 1

- D2: Display Line 2

- F1: Frequency Line 1

- F2: Frequency Line 2

- T1: Time Line 1

- T2: Time Line 2

Limit Lines

Limit lines are used to define amplitude curves or spectral distribution boundaries on the display screen which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are allowed from a device under test (DUT). For transmission of information in TDMA systems (e.g. GSM), the amplitude of the bursts in a timeslot must adhere to a curve that falls within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then, the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).

The instrument supports limit lines with a maximum of 50 data points. 8 of the limit lines stored in the instrument can be activated simultaneously. The number of limit lines stored in the instrument is only limited by the capacity of the flash disk used. For details see also "To select a limit line" on page 3.83.

Limit lines are compatible with the current measurement settings, if the following applies:

- The x unit of the limit line has to be identical to the current setting.

- The y unit of the limit line has to be identical to the current setting with the exception of dB based units; all dB based units are compatible with each other.

At the time of entry, the R&S FSL immediately checks that all limit lines are in accordance with the following guidelines:

- The frequencies/times for each data point must be entered in ascending order, however, for any single frequency/time, two data points may be entered (vertical segment of a limit line).

- The data points are allocated in order of ascending frequency/time. Gaps are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.

- The entered frequencies/times need not necessarily be selectable in R&S FSL. A limit line may also exceed the specified frequency or time range. The minimum frequency for a data point is –200 GHz, the maximum frequency is 200 GHz. For the time range representation, negative times may also be entered. The allowed range is –1000 s to +1000 s.

Softkeys of the lines menu

The following table shows all softkeys available in the lines 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.

Menu / Command	Command
Select Traces to check	
Deselect All	
New ▼	Edit Name
	Edit Comment
	Edit Margin
	Value
	Insert Value Above
	Delete Value
	Save Limit Line
Edit ▼	same contents as New Limit Line menu
Copy to ▼	same contents as New Limit Line menu
Delete	
Display Lines ▼	Display Line 1
	Display Line 2
	Frequency Line 1
	Frequency Line 2
	Time Line 1
	Time Line 2

Select Traces to check

Opens the **Select Traces to Check** dialog box to activate the selected limit line for a trace. One limit line can be activated for several traces simultaneously. For details see also "To activate/deactivate a limit line" on page 3.85 .

➡ Remote: `CALC:LIM2:TRAC 3`

➡ Remote: `CALC:LIM:STAT ON`

Deselect All

Deactivates the selected limit line for all assigned traces. For details see also "To activate/deactivate a limit line" on page 3.85 .

➡ Remote: `CALC:LIM:STAT OFF`

New

Opens the **Edit Limit Line** dialog box and a submenu to define a new limit line. For details see also "Limit Lines" on page 3.86 and "To select a limit line" on page 3.83.

Edit Name

Sets the focus on the **Name** field to enter or change the limit line name. A maximum of 8 characters is permitted for each name. All names must be compatible with the Windows XP conventions for file names. The limit line data are stored under this name. The instrument stores all limit lines with LIM as extension.

➡ Remote: `CALC:LIM3:NAME "GSM1`

Edit Comment

Sets the focus on the **Comment** field to enter or change a comment for the limit line. The text must not exceed 40 characters.

➡ Remote: `CALC:LIM5:COMM 'Upper limit for spectrum'`

Edit Margin

Sets the focus on the **Margin** field to enter or change a margin for the limit line. The default setting is 0 dB (i.e. no margin).

Value

Opens an edit dialog box to change an existing x or y value, depending on the selected column. The softkey is only available if an existing value is selected.

The desired data points are entered in ascending order (two repeated frequencies/time values are permitted).

➡ Remote: `CALC:LIM3:CONT:DATA 1MHz,3MHz,30MHz`

➡ Remote: `CALC:LIM3:UPP:DATA -10,0,0`

➡ Remote: `CALC:LIM3:LOW:DATA -30,-40,-40`

Insert Value Above

Creates an empty line above the selected data point to enter a new data point. This softkey corresponds to the **Insert** button in the dialog box.

It is also possible to add a data point at the end of the list, if the focus is set below the last entry line of the list.

The data points are entered in ascending order (two repeated frequencies/time values are permitted). If the entered values are not in accordance with the ascending order rule, an error message is displayed and the values are discarded.

Delete Value

Deletes the selected data point (x and y value). All succeeding data points are shifted up accordingly. This softkey corresponds to the **Delete** button in the dialog box.

The softkey is only available if an existing value is selected.

Save Limit Line

Saves the currently edited limit line under the name defined in the **Name** field.

Edit

Opens a submenu to edit limit lines. For details see also "Limit Lines" on page 3.86 and "To edit an existing limit line" on page 3.85.

➡   Remote: For details refer to chapter "Remote Control – Commands", section "Definition of the limit line".

Copy to

Copies the data of the selected limit line and displays it in the **Edit Limit Line** dialog box. If the limit line is edited and saved under a new name, a new limit line can be easily generated by parallel translation or editing of an existing limit line.

For details see also "Limit Lines" on page 3.86 and "To create a new limit line based upon an existing limit line" on page 3.85.

➡   Remote: CALC:LIM3:COPY 2

Delete

Deletes the selected limit line.

➡   Remote: CALC:LIM3:DEL

Display Lines

Opens a submenu to enable, disable and set display lines. Which softkeys are available depends on the display mode (frequency or time range). For details see also "Display Lines" on page 3.86 and "To work with display lines" on page 3.82.

Display Line 1 and Display Line 2

Enable or disable the level lines 1/2 and open an edit dialog box to enter the position of the lines. For details see also "Display Lines" on page 3.86 and "To work with display lines" on page 3.82.

➡   Remote: CALC:DLIN:STAT ON
➡   Remote: CALC:DLIN –20dBm

Frequency Line 1 and Frequency Line 2 (span > 0)

Enable or disable the frequency lines 1/2 and open an edit dialog box to enter the position of the lines. For details see also "Display Lines" on page 3.86 and "To work with display lines" on page 3.82.

➡ Remote: `CALC:FLIN:STAT ON`

➡ Remote: `CALC:FLIN 120MHz`

Time Line 1 and Time Line 2 (zero span)

Enable or disable the time lines 1/2 and open an edit dialog box to enter the position of the lines. For details see also "Display Lines" on page 3.86 and "To work with display lines" on page 3.82.

➡ Remote: `CALC:TLIN:STAT ON`

➡ Remote: `CALC:TLIN 10ms`

Measurement Modes

This section describes the provided measurement modes, the change of measurement modes and the access to the menus of all active measurement modes. For details refer to the following sections:

- "Measurement Mode Selection – MODE Key" on page 3.92

- "Measurement Mode Menus – MENU Key" on page 3.94

Measurement Mode Selection – MODE Key

The **MODE** key provides a quick access to the menu of the current measurement mode and a fast change of the measurement mode. You can choose from the following measurement modes:

- Select a measurement mode.
- ➡ Remote: `INST SAN`
- Spectrum Analyzer mode
- Analog Demodulation mode (Analog Demodulation option, K7)
- Bluetooth mode (Bluetooth Measurements option, K8)
- Noise mode (Noise Figure Measurements option, K30)
- 3G FDD BTS mode (3GPP Base Station Measurements option, K72)
- WLAN mode (WLAN TX Measurements option, K91)
- WiMAX mode (WiMAX IEEE 802.16 OFDM, OFDMA Measurements option, K93)

To change the measurement mode

1. Press the **MODE** key.

    The menu of the current measurement mode is displayed and the **Measurement Modes** dialog box is opened.

2. Select a measurement mode.

➡ Remote: `INST SAN`

Spectrum Analyzer mode

In the **Spectrum Analyzer** mode the functions provided correspond to those of a conventional spectrum analyzer. The analyzer measures the frequency spectrum of the test signal over the selected frequency range with the selected resolution and sweep time, or, for a fixed frequency, displays the waveform of the video signal. This mode is set in the initial configuration.

Analog Demodulation mode (Analog Demodulation option, K7)

The **Analog Demodulation** mode requires an instrument equipped with the corresponding optional software. This mode provides measurement functions for demodulating AM, FM, or PM signals. For details refer to "Analog Demodulation (Option K7)" on page 3.96.

Bluetooth mode (Bluetooth Measurements option, K8)

The **Bluetooth** mode requires an instrument equipped with the corresponding optional software. This mode provides measurements to test the conformity of signal sources to the Bluetooth RF Test Specifications. For details refer to "Bluetooth Measurements (Option K8)" on page 3.114.

Noise mode (Noise Figure Measurements option, K30)

The **Noise** mode requires an instrument equipped with the corresponding optional software. This mode provides accurate and flexible noise measurement functions. For details refer to "Noise Figure Measurements Option (K30)" on page 3.159.

3G FDD BTS mode (3GPP Base Station Measurements option, K72)

The **3G FDD BTS** mode requires an instrument equipped with the corresponding optional software. This mode provides test measurements for WCDMA downlink signals (base station signals) according to the test specification. For details refer to "3GPP Base Station Measurements (Option K72)" on page 3.183.

WLAN mode (WLAN TX Measurements option, K91)

The **WLAN** mode requires an instrument equipped with the corresponding optional software. This mode provides Wireless LAN TX measurement functions according to IEEE 802.11 a, b, g and j standards. For details refer to "WLAN TX Measurements (Option K91)" on page 3.208.

WiMAX mode (WiMAX IEEE 802.16 OFDM, OFDMA Measurements option, K93)

The **WiMAX** mode requires an instrument equipped with the WiMAX IEEE 802.16 OFDM, OFDMA Measurements option (R&S FSL–K93). This mode provides WiMAX and WiBro measurement functions according to IEEE standards 802.16–2004 OFDM and 802.16e–2005 OFDMA/WiBro. It includes the WiMAX 802.16 OFDM Measurements option (R&S FSL–K92). For details refer to "WiMAX, WiBro Measurements (Option K93)" on page 3.245.

Measurement Mode Menus – MENU Key

The **MENU** key provides a quick access to the menu of the current measurement mode. For details on measurement modes refer to "Measurement Mode Selection – MODE Key" on page 3.92.

To access the main menu of an active measurement mode

➢ Press the **MENU** key.

The menu of the current measurement mode is displayed.

If the tracking generator, the power meter, and the spectrogram are available in the current measurement mode, softkeys for these functions are also provided In the **Spectrum Analyzer** mode with active acoustic monitoring, the softkey **Marker Demod Volume** to control the volume control for acoustic monitoring is displayed.

Menu and softkey description

– "Optional softkeys of the menu menu" on page 3.94

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 section "How to use the Help System".

Optional softkeys of the menu menu

Apart from the softkeys of the current measurement mode, the following optional softkeys are available in the menu menu. It is possible that the basic unit does not provide all these softkeys. If a softkey is only available with a special option, model or (measurement) mode, this information is delivered in the corresponding softkey description.

Menu / Command
Power Meter
Spectrogram
Marker Demod Volume

Power Meter (Power Sensor Support option, K9)

Displays the menu of the **Power Meter** measurement mode. For details refer to "Power Meter (Option K9)" on page 3.144.

Spectrogram (Spectrogram Measurement option, K14)

Displays the menu of the Spectrogram Measurement option. For details refer to "Spectrogram Measurement (Option K14)" on page 3.148.

Marker Demod Volume (Spectrum Analyzer mode)

Opens a dialog box to regulate the volume for acoustic monitoring.

Options

This section describes firmware options that are not included in the basic unit configuration. If hardware options are controlled via the firmware, the provided softkeys are described in the corresponding menu section. The information, with which special option these softkeys are supplied, is delivered in the corresponding softkey description.

A list of all available hardware and firmware options is provided on CD. To check the options your instrument provides, refer to the Quick Start Guide, chapter 2 "Preparing for Use". For details on models and firmware options refer to the following sections:

Analog Demodulation (Option K7)

The digital signal processing in the R&S FSL, used in the analyzer mode for digital IF filters, is also ideally suited for demodulating AM, FM, or PM signals. The firmware option FSL–K7 provides the necessary measurement functions.

The R&S FSL is equipped with a demodulator that is capable of performing AM, FM, and PM demodulation at a time. Additionally maximum, minimum and average or current values can be obtained parallelly over a selected number of measurements. In order to make it suitable for bursted signals, the demodulator can be configured in terms of pretrigger time, sample rate and record length.

By sampling (digitization) already at the IF and digital down–conversion to the baseband (I/Q), the demodulator achieves maximum accuracy and temperature stability. There is no evidence of typical errors of an analog down–conversion and demodulation like AM to FM conversion and vice versa, deviation error, frequency response or frequency drift at DC coupling.

To open the analog demodulation menu

➢ If the **Analog Demodulation** mode is not the active measurement mode, press the **MODE** key and activate the **Analog Demodulation** option.

➢ If the **Analog Demodulation** mode is already active, press the **MENU** key.

   The analog demodulation menu is displayed. If the power meter (option Power Sensor Support, K9) is available, softkeys for these functions are also provided.

Menu and softkey description

Apart from the power measurement menu that is not available in the **Analog Demodulation** mode, all other menus are provided as described for the base unit. For details refer to the corresponding menu descriptions.

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 section "How to use the Help System".

Further information

Circuit description – block diagrams

The software demodulator runs on the main processor of the analyzer. The demodulation process is shown in Fig. 3–8: Block diagram of software demodulatorthe figure below. All calculations are performed simultaneously with the same I/Q data set. Magnitude (= amplitude) and phase of the complex I/Q pairs are determined. The frequency result is obtained from the differential phase.

For details on the analyzer signal processing refer to chapter "Remote Control – Commands", section "TRACe:IQ Subsystem".
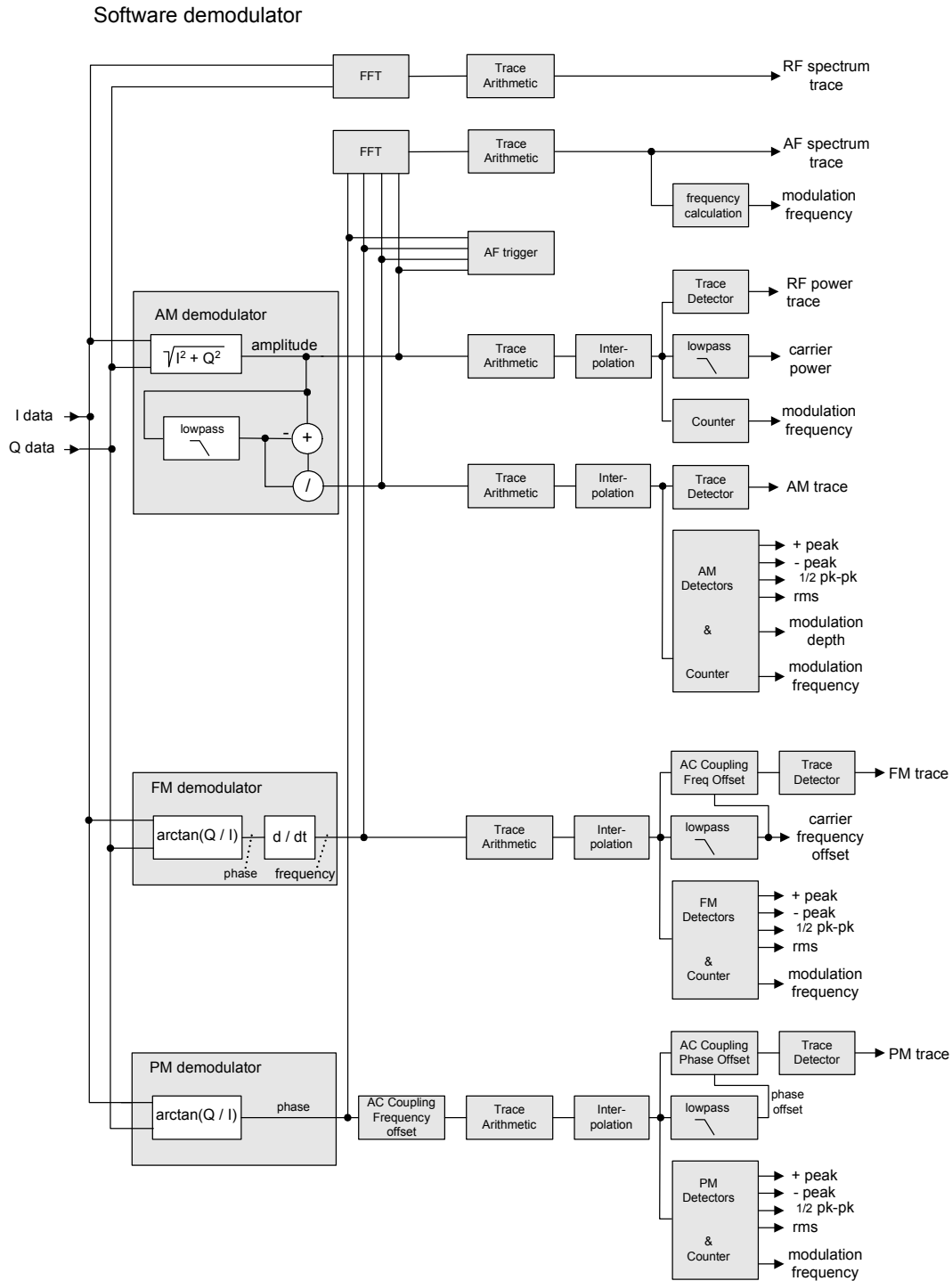
Fig. 3–8: Block diagram of software demodulator

The AM DC, FM DC and PM DC raw data of the demodulators is fed into the *Trace Arithmetic* block that combines consecutive data sets. Possible trace modes are: Clear Write, Max Hold, Min Hold and Average (for details refer to section "Trace mode overview" on page 3.34). The output data of the *Trace Arithmetic* block can be read via remote control.

The collected measured values are evaluated by the selected detector (for details refer to chapter "Instrument Functions", section "Detector overview". The result is displayed on the screen and can be read out via remote control.

In addition, important parameters are calculated:

- A counter determines the modulation frequency for AM, FM, and PM.

- A low pass filter suppresses the modulation frequency; the result is:
  average power = carrier power (RF power)
  average frequency = carrier frequency offset (FM)
  The deviation from the selected center frequency is displayed.

- AC coupling is possible with FM and PM display. The carrier frequency offset is subtracted from the FM DC data, and the frequency deviation is determined from the trace data. +Peak, –Peak, ½ Peak–Peak and RMS are displayed.

Demodulation bandwidth

The demodulation bandwidth is not the 3 dB bandwidth but the useful bandwidth which is distortion–free with regard to phase and amplitude.

Therefore the following formulas apply:

- AM: demodulation bandwidth $\geq$ 2 x modulation frequency

- FM: demodulation bandwidth $\geq$ 2 x (frequency deviation + modulation frequency)

- PM: demodulation bandwidth $\geq$ 2 x modulation frequency x (1 + phase deviation)

Note: *If the center frequency of the analyzer is not set exactly to the signal frequency, the demodulation bandwidth must be selected larger by the carrier offset, in addition to the requirement described above. This also applies if FM or PM AC coupling has been selected.*

In general, the demodulation bandwidth should be as narrow as possible to improve the S/N ratio. The residual FM caused by noise floor and phase noise increases dramatically with the bandwidth, especially with FM.

AF trigger

The analog demodulation option allows triggering to the demodulated signal. The display is stable if a minimum of five modulation periods are within the recording time.

Triggering is always DC–coupled. Therefore triggering is possible directly to the point where a specific carrier level, phase or frequency is exceeded or not attained.

Stability of measurement results

Despite amplitude and frequency modulation, the display of carrier power and carrier frequency offset is stable.

This is achieved by a digital filter which sufficiently suppresses the modulation, provided, however, that the measurement time is $\geq$ 3 x 1 / modulation frequency, i.e. that at least three periods of the AF signal are recorded.

The mean carrier power for calculating the AM is also calculated with a digital filter that returns stable results after a measurement time of $\geq$ 3 x 1 / modulation frequency, i.e. at least three cycles of the AF signal must be recorded before a stable AM can be shown.

Sample rate, measurement time and trigger offset

Depending on the sample rate, the maximum demodulation bandwidths listed in the table can be obtained during the measurement. The permissible value range of the measurement time and trigger offset depends on the selected demodulation bandwidth. If the AF filter or the AF trigger are not active, the measurement time enlarges by 20%.

Demod. bandwidth	Sample rate	Measurement time			Trigger offset	
		Min.	Max. with AF filter or AF trigger active	Max. with AF filter and AF trigger deactive	Min.	Max.
18 MHz	32 MHz	31.25 ns	12.5 ms	15 ms	−12.5 ms	507.9 ms
10 MHz	32 MHz	31.25 ns	12.5 ms	15 ms	−12.5 ms	507.9 ms
8 MHz	16 MHz	62.5 ns	25 ms	30 ms	−25 ms	1.015 s
5 MHz	8 MHz	125 ns	50 ms	60 ms	−50 ms	2.031 s
3 MHz	4 MHz	250 ns	100 ms	120 ms	−100 ms	4.063 s
1.6 MHz	2 MHz	500 ns	200 ms	240 ms	−200 ms	8.126 s
800 kHz	1 MHz	1 μs	400 ms	480 ms	−400 ms	16.25 s
400 kHz	500 kHz	2 μs	800 ms	960 ms	−800 ms	32.50 s
200 kHz	250 kHz	4 μs	1.6 s	1.92 s	−1.6 s	65.00 s
100 kHz	125 kHz	8 μs	3.2 s	3.84 s	−3.2 s	130.0 s
50 kHz	62.5 kHz	16 μs	6.4 s	7.68 s	−6.4 s	260.0 s
25 kHz	31.25 kHz	32 μs	12.8 s	15.36 s	−12.8 s	520.0 s
12.5 kHz	15.625 kHz	64 μs	25.6 s	30.72 s	−25.6 s	1040 s
6.4 kHz	7,8125 kHz	128 μs	51.2 s	61.44 s	−51.2 s	2080 s
3.2 kHz	3,90625 kHz	256 μs	102.4 s	122.88 s	−102.4 s	4160 s
1.6 kHz	1,953125 kHz	512 μs	204.8 s	245.76 s	−204.8 s	8321 s
800 Hz	976,5625 Hz	1.024 ms	409.6 s	491.52 s	−409.6 s	16643 s
400 Hz	488,28125 Hz	2.048 ms	819.2 s	983.04 s	−819.2 s	33287 s
200 Hz	244,140625 Hz	4.096 ms	1638.4 s	1966.08 s	−1638.4 s	66574 s
100 Hz	122,0703125 Hz	8.192 ms	3276.8 s	3932.16 s	−3276.8 s	133148 s

Softkeys of the analog demodulation menu

The following table shows all softkeys available in the analog demodulation 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.

Menu / Command	Submenu / Command	Command
Modulation AM/FM/PM		
Result Display	AF Time Domain	
	AF Spectrum	
	RF Time Domain	
	RF Spectrum	
	Select Trace	
	Diagram Full Size	
Demod BW		
Meas Time		
AF Range ▼	Dev per Division/dB per Division	
	Reference Position	
	Reference Value	
	Deviation Lin/Log	
Demod Settings ▼	AF Coupling AC/DC	
	AF Filter ▼	Low Pass AF Filter
		High Pass AF Filter
		Deemphasis
	Zero Phase Reference Point	
	Phase Wrap On/Off	
	Phase Unit Rad/Deg	
More ▼		
Zoom		

Modulation AM/FM/PM

Selects the display of demodulated AM, FM, or PM signal. In single sweep mode, the data is determined from the current I/Q data set, i.e. a change to AM/FM/PM does not trigger a new measurement.

If FM is selected, the average value of the demodulated signal is mapped depending on the **AF Coupling AC/DC** softkey setting.

➡ Remote: `CALC:FEED 'XTIM:FM'`

Result Display

Opens a submenu to select the measurement result to be displayed. The RF or AF signal in the zero span or the RF or AF frequency spectrum determined via FFT can be selected for display.

In order to display the measurement results, the screen is divided in two halves. In the upper half, the measurement results are displayed as a trace. In the lower half the results of additional evaluation functions are shown.

All displays are determined from the I/Q data set recorded for the measurement. In single sweep mode, the single data set recorded can be evaluated in all displays simply by switching the result display.

AF Time Domain

Selects the AF display in zero span, calculated from the AM, FM, or PM signal.

➡   Remote: `CALC:FEED 'XTIM:FM'`

AF Spectrum

Selects the display of the AF spectrum. The AF spectrum can be calculated from the AM, FM, or PM signal in zero span.

➡   Remote: `CALC:FEED 'XTIM:FM:AFSP'`

RF Time Domain

Selects the display of the RF signal in zero span. In contrast to normal analyzer operation, the level values are determined from the recorded I/Q data set as root–mean–square values.

The softkey is not available if the RF spectrum display is selected.

➡   Remote: `CALC:FEED 'XTIM:RFP'`

RF Spectrum

Selects the display of the RF signal in span > 0. In contrast to normal spectrum analyzer operation, the measured values are determined using FFT from the recorded I/Q data set.

➡   Remote: `CALC:FEED 'XTIM:SPECTRUM'`

Select Trace

Opens an edit dialog box to enter the number of the trace for which the data is to be displayed in the lower half of the screen. Only activated traces can be selected.

Diagram Full Size

Switches the diagram to full screen size.

➡   Remote: `DISP:SIZE LARG`

Demod BW

Opens an edit dialog box to enter the demodulation bandwidth of the analog demodulation. The demodulation bandwidth determines the sampling rate for recording the signal to be analyzed. For details on the relation between demodulation bandwidth and sampling rate refer to "Sample rate, measurement time and trigger offset" on page 3.99.

➡   Remote: `BAND:DEM 1MHz`

Meas Time

Opens an editor for entering the measurement time of the analog demodulation. For details on the measurement time values refer to "Sample rate, measurement time and trigger offset" on page 3.99.

➡ Remote: `ADEM:MTIM 62.5US`

➡ Remote: `SWE:TIME 10s`

AF Range

Opens a submenu for determining the diagram scaling for AF displays.

The range for RF displays is set via the amplitude menu. For details refer to "Setting the Level Display and Configuring the RF Input – AMPT Key" on page 3.12.

Dev per Division

Opens an edit dialog box to set the modulation depth or the phase or frequency deviation per division:

AM display: 0.0001% to 1000%

FM display: 1 Hz/div to 1 MHz/div

PM display: 0.0001 rad/div to 1000 rad/div

The softkey is not available if logarithmic display is set (**Deviation Lin/Log** softkey).

➡ Remote: `DISP:WIND:TRAC:Y:PDIV 50kHz`

dB per Division

Opens an edit dialog box to set the modulation depth or the FM or PM deviation to be displayed in the range 0.1 dB/div to 20 dB/div.

The softkey is not available if linear display is set (**Deviation Lin/Log** softkey).

➡ Remote: `DISP:TRAC:Y:PDIV 5DB`

Reference Position

Determines the position of the reference line for the modulation depth or the phase or frequency deviation on the y–axis of the diagram. By default, this line is set to 0.

The position is entered as a percentage of the diagram height with 100 % corresponding to the upper diagram border. The default setting is 50 % (diagram center) for the display of the AM, FM, or PM signal, and 100% (upper diagram border) for the AF spectrum display of the AM, FM, or PM signal.

➡ Remote: `DISP:TRAC:Y:RPOS 50PCT`

Reference Value

Determines the modulation depth or the frequency or phase deviation at the reference line of the y–axis. The reference value is set separately for each display of the AM, FM, and PM signal and the AF spectrum of the AM, FM, and PM signal.

– AM/FM/PM signal display

The trace display takes individual frequency/phase offsets into account (in contrast, the **AF Coupling AC/DC** softkey permits automatic correction by the average frequency/phase offset of the signal, and can therefore not be activated simultaneously).

Possible values: 0 and $\pm$ 10000% (AM), 0 and $\pm$ 10 MHz (FM), 0 and $\pm$ 10000 rad (PM).

– AF spectrum display of the AM/FM/PM signal

In the default setting, the reference value defines the modulation depth or the FM/PM deviation at the upper diagram border.

Possible values: 0 and 10000% (AM), 0 and 10 MHz (FM), 0 and 10000 rad (PM).

➡ Remote: `DISP:TRAC:Y:RVAL 0HZ`

Deviation Lin/Log

Switches between logarithmic and linear display of the modulation depth or the frequency or phase deviation.

➡ Remote: `DISP:TRAC:Y:SPAC LOG`

Demod Settings

Opens a submenu for the demodulation settings.

AF Coupling AC/DC

Controls the automatic correction of the frequency offset and phase offset of the input signal:

– FM signal display

If DC is selected, the absolute frequency is displayed, i.e. an input signal with an offset relative to the center frequency is not displayed symmetrically with respect to the zero line.

If AC is selected, the frequency offset is automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

– PM signal display

If DC is selected, the phase runs according to the existing frequency offset. In addition, the DC signal contains a phase offset of $\pm\pi$.

If AC is selected, the frequency offset and phase offset are automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

The softkey is not available with the AF spectrum display of the FM or PM signal.

➡ Remote: `ADEM:AF:COUP DC`

AF Filter

Opens a submenu to select the appropriate filters. The bandwidth of the demodulated signal can be reduced by high pass or low pass filters and also a de–emphasis can be switched on. The selected filters are used for AM, FM and PM demodulation in common. Individual settings are not possible.

Low Pass AF Filter

Opens the **Low Pass AF Filter** dialog box to select the filter type. Relative and absolute low pass filter are available.

– Relative low pass filters:

The filters (3 dB) can be selected in % of the demodulation bandwidth. The filters are designed as 5th–order Butterworth filter (30 dB/octave) and active for all demodulation bandwidths.

– Absolute low pass filters:

The filter are indicated by the 3 dB cutoff frequency. The 3 kHz and 15 kHz filters are designed as 5th–order Butterworth filter (30 dB/octave). The 150 kHz filter is designed as 8th–order Butterworth filter (48 dB/octave).

The absolute low pass filters are active in the following demodulation bandwidth range:

  3 kHz: 6.4 kHz $\leq$ demodulation bandwidth $\leq$ 4 MHz

  15 kHz: 50 kHz $\leq$ demodulation bandwidth $\leq$ 16 MHz

  150 kHz: 400 kHz $\leq$ demodulation bandwidth $\leq$ 16 MHz

➡ Remote: `FILT:LPAS ON`

➡ Remote: `FILT:LPAS:FREQ 150kHz`

➡ Remote: `FILT:LPAS:FREQ 25PCT`

High Pass AF Filter

Opens the **High Pass AF Filter** dialog box to switch on a high pass filter with the given limit to separate the DC component. The filters are indicated by the 3 dB cutoff frequency. The filters are designed as 2nd–order Butterworth filter (12 dB/octave).

The high pass filters are active in the following demodulation bandwidth range:

50 Hz: 200 Hz $\leq$ demodulation bandwidth $\leq$ 4 MHz

300 Hz: 800 Hz $\leq$ demodulation bandwidth $\leq$ 16 MHz

➡ Remote: `FILT:HPAS ON`

➡ Remote: `FILT:HPAS:FREQ 300Hz`

Deemphasis

Opens the **Deemphasis** dialog box to switch on a deemphasis with the given time constant.

The deemphasis is active in the following demodulation bandwidth range:

25 µs: 25 kHz ≤ demodulation bandwidth ≤ 18 MHz

50 µs: 6.4 kHz ≤ demodulation bandwidth ≤ 18 MHz

75 µs: 6.4 kHz ≤ demodulation bandwidth ≤ 18 MHz

750 µs: 800 Hz ≤ demodulation bandwidth ≤ 4 MHz

The following table shows the required demodulation bandwidth for an error less than 0.5 dB up to a maximum AF frequency.

deemphasis	25 µs	50 µs	75 µs	750 µs
max. AF frequency	25 kHz	12 kHz	8 kHz	800 Hz
required demodulation bandwidth	≥ 200 kHz	≥ 100 kHz	≥ 50 kHz	≥ 6.4 kHz

For higher AF frequencies the demodulation bandwidth must be increased.

➡ Remote: `FILT:DEMP ON`

➡ Remote: `FILT:DEMP:TCON 750us`

Zero Phase Reference Point

Defines the position at which the phase of the PM–demodulated signal is set to 0 rad. The entry is made with respect to time. In the default setting, the first measured value is set to 0 rad.

This softkey is only available in the PM display with DC coupling.

➡ Remote: `ADEM:PM:RPO 500us`

Phase Wrap On/Off

Activates/deactivates the phase wrap.

On   The phase will be displayed in the range ±180° ($\pm\Pi$). For example, if the phase exceeds +180°, 360° is subtracted from the phase value, with the display thus showing >–180°.

Off   The phase will not be wrapped.

This softkey in available in the PM signal displays.

➡ Remote: `CALC:FORM PHAS`

Phase Unit Rad/Deg

Sets the phase unit to rad or deg for displaying PM signals.

➡ Remote: `UNIT:ANGL RAD`

Zoom

Activates or deactivates the zoom function. The zoom function is not available if the number of measurement points falls below 501.

activated: A 1–to–1 allocation is selected, i.e. each measurement point corresponds to a measured value. The start of the zoom window can be determined in the associated field by entering the time.

deactivated: If more measured values than measurement points are available, several measured values are combined in one measurement point according to the method of the selected trace detector. For details on detectors refer to "Detector overview" on page 3.36.

➡ Remote: ADEM:ZOOM ON

➡ Remote: ADEM:ZOOM:STARt 30US

Softkeys of the frequency menu (Analog Demodulation mode)

The following table shows all softkeys available in the frequency menu in **Analog Demodulation** mode (**CENTER** 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.

Menu / Command	Command
Center	
CF Stepsize ▼	0.1*Span/0.1*Demod BW
	0.5*Span/0.5*Demod BW
	x*Span/x*Demod BW
	=Center
	Manual
AF Center	
AF Start	
AF Stop	

Center

For details refer to the **Center** softkey in the frequency menu of the base unit.

CF Stepsize

For details refer to the **CF Stepsize** softkey in the frequency menu of the base unit.

0.1*Span (RF Spectrum)

For details refer to the **0.1*Span** softkey in the frequency menu of the base unit.

0.1*Demod BW (AF/RF Time Domain, AF Spectrum)

For details see **0.1*RBW** softkey in the frequency menu of the base unit.

0.5*Span (RF Spectrum)

For details refer to the **0.5*Span** softkey in the frequency menu of the base unit.

0.5*Demod BW (AF/RF Time Domain, AF Spectrum)

For details see **0.5*RBW** softkey in the frequency menu of the base unit.

x*Span (RF Spectrum)

For details refer to the **x*Span** softkey in the frequency menu of the base unit.

x*Demod BW (AF/RF Time Domain, AF Spectrum)

For details see **x*RBW** softkey in the frequency menu of the base unit.

=Center

For details refer to the **=Center** softkey in the frequency menu of the base unit.

Manual

For details refer to the **Manual** softkey in the frequency menu of the base unit.

AF Center (AF Spectrum)

Opens an edit box to enter the center frequency within the AF spectrum.

➥ Remote: `ADEM:AF:CENT 1MHZ`

AF Start

Opens an edit box to define the start frequency within the AF spectrum.

➥ Remote: `ADEM:AF:STAR 0HZ`

AF Stop

Opens an edit box to define the stop frequency within the AF spectrum.

The maximum AF stop frequency corresponds to half the demodulation bandwidth.

➥ Remote: `ADEM:AF:STOP 2MHZ`

Softkeys of the span menu (Analog Demodulation mode)

The following table shows all softkeys available in the span menu in **Analog Demodulation** mode (**SPAN** 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.

Command
Span Manual/AF Span Manual
Demod Bandwidth
Full Span/AF Full Span

Span Manual (RF Spectrum)

If the RF spectrum display is active, values between the sampling rate/200 and the demodulation bandwidth/2 are allowed.

For further details refer to the **Span Manual** softkey in the span menu of the base unit.

➡ Remote: `ADEM:SPEC:SPAN:ZOOM 5 MHz`

AF Span Manual (AF Spectrum)

Opens an edit dialog box to enter the frequency range for the AF spectrum display. Values between the sampling rate/1000 and the demodulation bandwidth/2 are allowed.

➡ Remote: `ADEM:AF:SPAN 2.5 MHz`

Demod Bandwidth

For details see **Demod BW** softkey in the analog demodulation menu.

Full Span (RF Spectrum)

If the RF spectrum display is active, the full frequency range corresponds to the demodulation bandwidth.

For further details refer to the **Full Span** softkey in the span menu of the base unit.

➡ Remote: `ADEM:SPEC:SPAN:ZOOM MAX`

AF Full Span (AF Spectrum)

Sets the span to the maximum frequency range for the AF spectrum display. The maximum frequency range corresponds to the demodulation bandwidth.

➡ Remote: `ADEM:AF:SPAN:FULL`

Softkeys of the amplitude menu (Analog Demodulation mode)

The following table shows all softkeys available in the amplitude menu in **Analog Demodulation** mode (**AMPT** 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.

Menu / Command	Command
Ref Level	
Range Log/Range Linear	
AF Range▼	Dev per Division/dB per Division
	Reference Position
	Reference Value
	Deviation Lin/Log
Preamp On/Off	
RF Atten Manual	
RF Atten Auto	
More ▼	
Ref Level Offset	
Ref Level Position	
Grid Abs / Rel	
Unit	
Input 50 Ω / 75 Ω	

Ref Level

For details refer to the **Ref Level** softkey in the amplitude menu of the base unit.

Range Log (RF result display)

This softkey is only available for the RF result display. For the RF result display, the **AF Range** softkey is used.

For details refer to the **Range Log** softkey in the amplitude menu of the base unit.

Range Linear (RF result display)

This softkey is only available for the RF result display. For the RF result display, the **AF Range** softkey is used.

For details refer to the **Range Linear** softkey in the amplitude menu of the base unit.

AF Range (AF result display)

For details refer to the **AF Range** softkey in the analog demodulation menu.

Dev per Division

For details refer to the **Dev per Division** softkey in the analog demodulation menu.

dB per Division

For details refer to the **dB per Division** softkey in the analog demodulation menu.

Reference Position

For details refer to the **Reference Position** softkey in the analog demodulation menu.

Reference Value

For details refer to the **Reference Value** softkey in the analog demodulation menu.

Deviation Lin/Log

For details refer to the **Deviation Lin/Log** softkey in the analog demodulation menu.

Preamp On/Off (option RF Preamplifier, B22)

For details refer to the **Preamp On/Off** softkey in the amplitude menu of the base unit.

RF Atten Manual

For details refer to the **RF Atten Manual** softkey in the amplitude menu of the base unit.

RF Atten Auto

For details refer to the **RF Atten Auto** softkey in the amplitude menu of the base unit.

Ref Level Offset

For details refer to the **Ref Level Offset** softkey in the amplitude menu of the base unit.

Ref Level Position

For details refer to the **Ref Level Position** softkey in the amplitude menu of the base unit.

Grid Abs / Rel (not available with Range Linear)

For details refer to the **Grid Abs / Rel** softkey in the amplitude menu of the base unit.

Unit (PM AF result display)

For details refer to the **Unit** softkey in the amplitude menu of the base unit.

Input 50 Ω / 75 Ω

For details refer to the **Input 50 Ω / 75 Ω** softkey in the amplitude menu of the base unit.

Softkeys of the bandwidth menu (Analog Demodulation mode)

The following table shows all softkeys available in the bandwidth menu in **Analog Demodulation** mode (**PWR BW** 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.

Command
Res BW
Demod BW
Meas Time

Res BW (span > 0)

Opens an edit dialog box to enter a value for the resolution bandwidth. The range is specified in the data sheet.

➡   Remote: ADEM:SPEC:BAND 10 kHz

Demod BW

For details refer to the **Demod BW** softkey in the in the analog demodulation menu.

Meas Time

For details refer to the **Meas Time** softkey in the in the analog demodulation menu.

Softkeys of the sweep menu (Analog Demodulation mode)

The following table shows all softkeys available in the sweep menu in **Analog Demodulation** mode (**SWEEP** 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.

Command
Continuous Sweep
Single Sweep
Continue Sgl Sweep
Meas Time
Sweep Count

Continuous Sweep

For details refer to the **Continuous Sweep** softkey in the in the sweep menu of the base unit.

Single Sweep

For details refer to the **Single Sweep** softkey in the in the sweep menu of the base unit.

Continue Sgl Sweep

For details refer to the **Continue Single Sweep** softkey in the in the sweep menu of the base unit.

Meas Time

For details refer to the **Meas Time** softkey in the in the analog demodulation menu.

Sweep Count

For details refer to the **Sweep Count** softkey in the in the sweep menu of the base unit.

Softkeys of the trigger menu (Analog Demodulation mode)

The following table shows all softkeys available in the trigger menu in **Analog Demodulation** mode (**TRIG** 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.

Command
Trigger Source
Trigger Level
Trigger Polarity Pos/Neg
Trigger Offset

Trigger Source

Opens the **Trigger** dialog box to select the trigger mode. Additional to the trigger modes described in section "Trigger mode overview" on page 3.26, the following trigger modes are available:

Selected option	Specified threshold
AM (Offline)	modulation depth of the AM signal
FM (Offline)	frequency of the FM signal
PM (Offline)	phase of the PM signal
RF (Offline)	level of the RF signal

In **Analog Demodulation** mode, the next measurement is triggered if the selected input signal exceeds the threshold specified using the **Trg / Gate Level** softkey. A periodic signal modulated onto the carrier frequency can be displayed in this way. It is recommended that the measurement time covers at least five periods of the audio signal.

For further details refer to the **Trg / Gate Source** softkey in the trigger menu.

➡ Remote: `TRIG:SOUR IMM | IFP | EXT | FM | PM | AM | RF` (Free Run, IF Power, Extern, FM (Offline), PM (Offline), AM (Offline), RF (Offline))

Trigger Level

For details refer to the **Trg / Gate Level** softkey in the in the trigger menu of the base unit.

Trigger Polarity Pos/Neg

For details refer to the **Trg / Gate Polarity Pos/Neg** softkey in the in the trigger menu of the base unit.

Trigger Offset

For details on the relation between demodulation bandwidth (option Analog Demodulation, R&S FSL–K7) and trigger offset refer to "Sample rate, measurement time and trigger offset" on page 3.99.

For details refer to the **Trigger Offset** softkey in the in the trigger menu of the base unit.

Bluetooth Measurements (Option K8)

This option provides measurements to test the conformity of signal sources to the Bluetooth RF Test Specification (Bluetooth SIG). For background information on Bluetooth measurements refer to the Operating Manual on CD, chapter "Advanced Measurement Examples".

To open the Bluetooth menu

➢ If the **Bluetooth** mode is not the active measurement mode, press the **MODE** key and activate the **Bluetooth** option.

➢ If the **Bluetooth** mode is already active, press the **MENU** key.

   The Bluetooth menu is displayed. .

Menu and softkey description

– "Softkeys of the Bluetooth menu" on page 3.126

– "Softkeys of the frequency menu (Bluetooth mode)" on page 3.130

– "Softkeys of the amplitude menu (Bluetooth mode)" on page 3.131

– "Softkeys of the bandwidth menu (Bluetooth mode)" on page 3.133

– "Softkeys of the sweep menu (Bluetooth mode)" on page 3.135

– "Softkeys of the trigger menu (Bluetooth mode)" on page 3.139

– "Softkeys of the measurement menu (Bluetooth mode)" on page 3.139

The span menu is not available in the **Bluetooth** mode. All other menus are provided as described for the base unit. For details refer to the corresponding menu descriptions.

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 section "How to use the Help System".

Further information

– "Position of a Bluetooth burst" on page 3.116

– "Labels used in the measurement displays" on page 3.116

Tasks

– To adapt the settings to the characteristics of the DUT

Measurements overview

The Bluetooth Measurements option provides the following measurement types:

– "Output Power" on page 3.117

– "Adjacent Channel Power" on page 3.118

– "Modulation Characteristics" on page 3.119

– "Initial Carrier Frequency Tolerance" on page 3.120

– "Carrier Frequency Drift" on page 3.121

– "Relative Transmit Power (EDR)" on page 3.122

– "In–band Spurious Emissions (EDR)" on page 3.123

–   "Carrier Frequency Stability and Modulation Accuracy (EDR)" on page 3.124

–   "Differential Phase Encoding (EDR)" on page 3.125

The basic parameter settings are described in section "To adapt the settings to the characteristics of the DUT" on page 3.115. The settings that can be configured individually for each measurement are the following:

- RBW (the IF bandwidth set up for modulation measurements is valid for all measurements)

- VBW

- RBW auto mode

- VBW auto mode

- trace mode

- detector

- sweep count

- sweep time auto mode

- sweep time

They are available in the corresponding menus as soon as the corresponding measurement is selected. Changes to these settings are always related to the selected measurement. The settings defined in the RF Test Specification can thus be modified individually for development or production. By using the start recall function, the individual configuration of the various tests can be preserved over a preset.

To adapt the settings to the characteristics of the DUT

1. Set the spectrum analyzer to its default state.

   –   Press **PRESET**.

       The R&S FSL is set to its default state.

2. Select the Bluetooth operating mode.

   –   Press **MODE** key.

   –   In the **Measurement Modes** dialog box, select **Bluetooth**.

       The **Bluetooth** mode is activated and the main menu of the option is displayed.

3. Select the transmit channel.

   –   Press **Channel** softkey and enter the desired channel number.

4. Select the packet length.

   –   Press **Packet Type** softkey.

       The list of available packet type is displayed.

   –   Select the desired packet length and confirm the selection with **ENTER**.

5. Select the power class of the DUT.

   –   Press **Power Class** softkey and enter the power class.

6. Configure the sync settings (LAP).

   –   Press **Find Sync** softkey.

       The submenu menu for configuration of the sync information is displayed.

   –   Press **LAP** softkey and enter the lower address part of the Bluetooth device address of the DUT. The sync word used for the sync search will be calculated.

7. Select a measurement.

    –   Press the **MEAS** key and select the desired measurement in the softkey menu.

    –   Configure measurement time, measurement control and the number of measurement cycles by pressing the corresponding softkeys. For further information refer to section "Softkeys of the measurement menu (Bluetooth mode)" on page 3.139.

Further information

This section provides background information on measurements and displayed information.

Position of a Bluetooth burst

The RF Test Specification allows different methods to determine the position of a Bluetooth burst:

*   The burst is defined by the p0 bit and the automatically determined packet length (**Find Sync On**).

*   The burst is defined by the two 3dB points (**Find Sync Off** and **Find Burst On**). The search of the 3dB points is defined in the RF Test Specification as the alternative method compared with the p0 bit method.
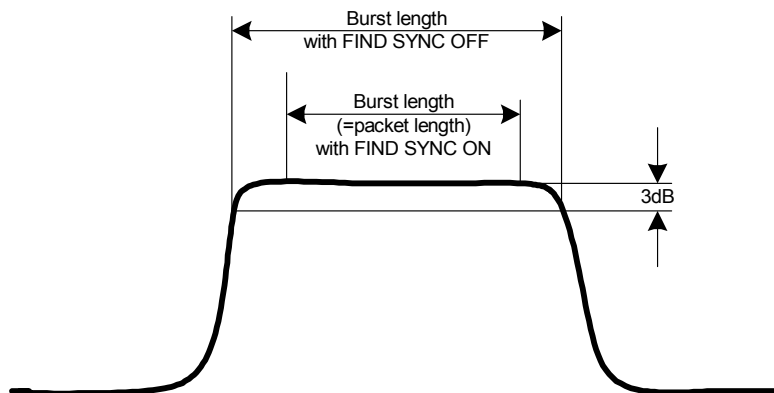
Fig. 3–10 Definition of a Bluetooth burst

Labels used in the measurement displays

*   Enhancement label **TDF**

Offset values, set with the **Antenna Gain** softkey that are larger or smaller than 0 dB will activate the enhancement label **TDF** at the right diagram border.

Measurements

In this section, every measurement type is introduced by a short description.

Output Power measurement

The Output Power measurement (**Output Power** softkey) determines the maximum and average output power during a burst of the equipment under test (EUT). For this purpose a complete packet is recorded in the zero span.
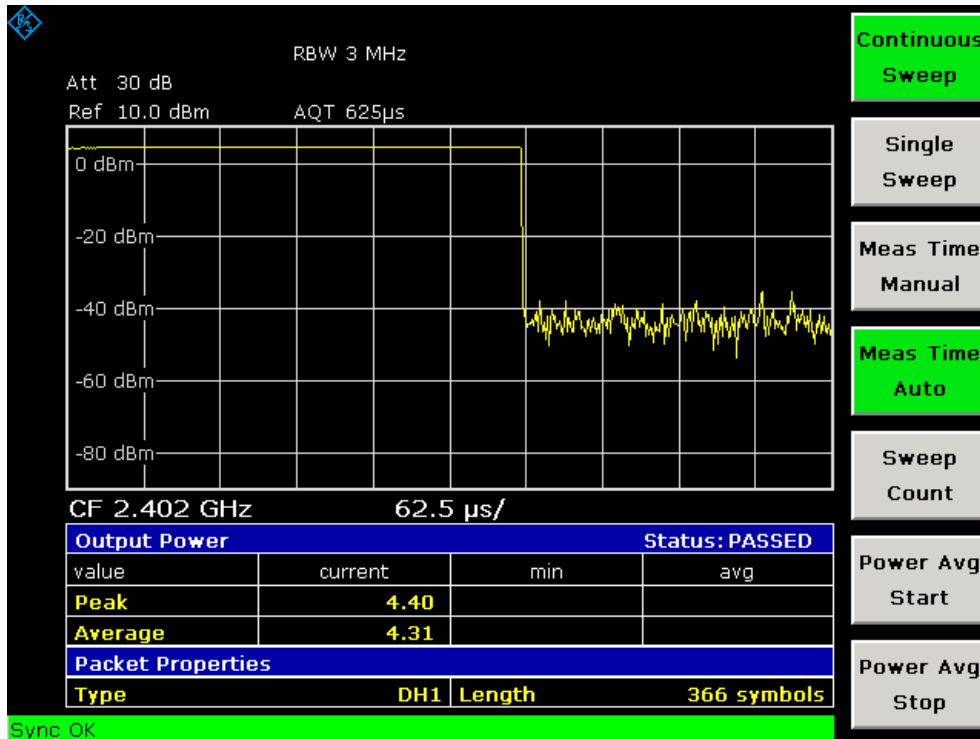
Fig. 3–11 Output power measurement

The peak value is determined from the complete contents of the measurement curve, whereas the average power is calculated from an area of at least 20% to 80% of the burst.

During the Output Power measurement the Bluetooth demodulator is active in order to determine the sync word within the signal, which is later–on used as the trigger basis. The Bluetooth demodulator is placed in a signal path without video filter. This is why the video filter cannot be activated with the Output Power measurement.

The EUT (equipment under test) must keep the following limits according to the RF Test Specification:

- P_{AV} < 100 mW (20 dBm) EIRP

- P_{PK} < 200 mW (23 dBm) EIRP

- If the EUT is conforming to power class 1: P_{AV} > 1 mW (0 dBm)

- If the EUT is conforming to power class 2: 0.25 mW (–6 dBm) < P_{AV} < 2.5 mW (4 dBm)

- If the EUT is conforming to power class 3: P_{AV} < 1 mW (0 dBm)

A violation of these limits is marked on the screen in red color.

Adjacent Channel Power measurement

The measurement of the TX Output Spectrum – Adjacent Channel Power measurement (**TX Spec ACP** softkey) measures the power of all adjacent channels.
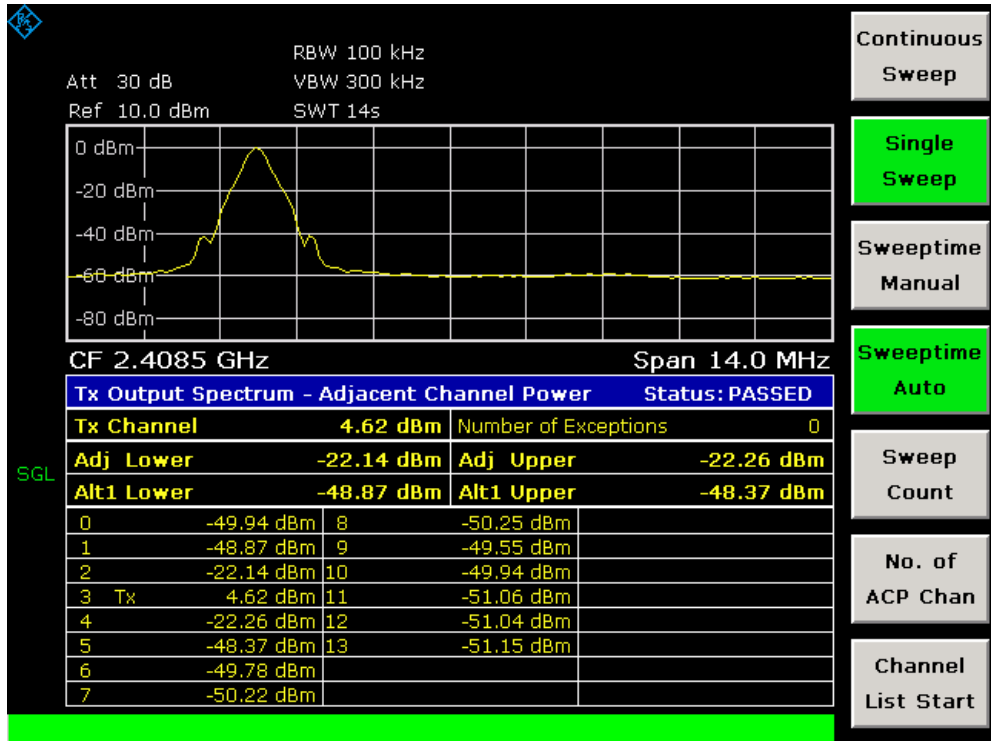
Fig. 3–12 TX Spectrum ACP measurement

The following limits are given by the RF Test Specification:

- P_{TX} (f) $\leq$ –20 dBm for |M–N| = 2

- P_{TX} (f) $\leq$ –40 dBm for |M–N| $\geq$ 3

with M = Transmit channel of the equipment under test, N = adjacent channel to be measured

A violation of these limits will be marked by red color and an asterisk (*).

Modulation Characteristics measurement

The measurement of the modulation characteristics (**Modulation Char** softkey) determines the maximum frequency deviation of all 8 bit sequences of the payload.

Additionally the average value of the maximum frequency deviation of a packet will be calculated. For this purpose the equipment under test is configured in a way that packets with bit pattern "11110000" and "10101010" are transmitted alternately. According to the RF Test Specification this sequence has to be repeated 10 times.
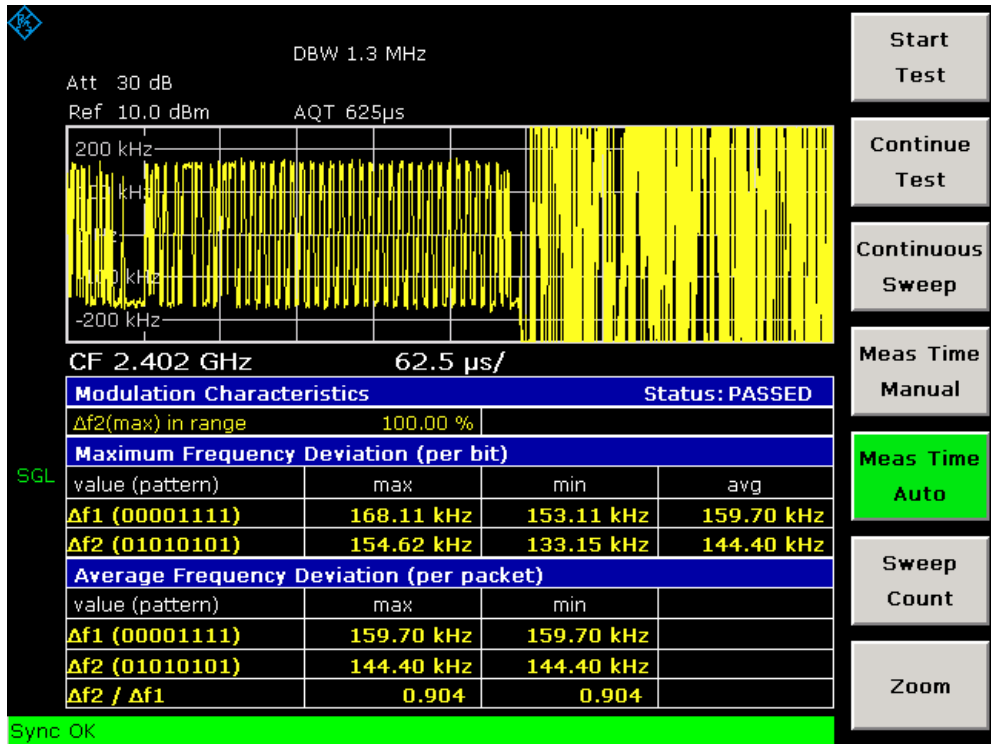
Fig. 3–13 Modulation Characteristics measurement

Initial Carrier Frequency Tolerance measurement

The measurement of the Initial Carrier Frequency Tolerance (**Init Carr Freq Tol** softkey) determines the carrier offset of the four preamble bits. According to the RF Test Specification the calculation of the carrier offset is performed from the middle of the first preamble bit to the middle of the bit following the preamble.

With **Clear/Write** trace mode and single sweep operation the selected number of sweeps will be processed and according to the RF Test Specification the results of all sweeps will be compared with the defined tolerance. If a different trace mode is selected, the analyzer can alternatively combine several traces and determine the measurement results from the resulting trace.
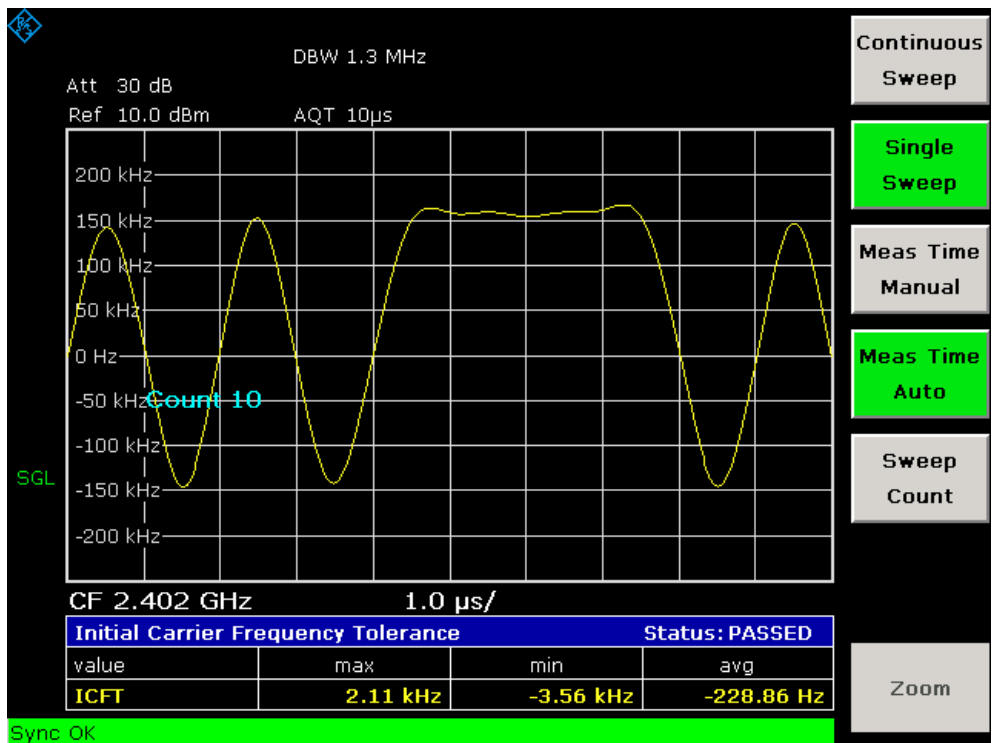
Fig. 3–14 Initial Carrier Frequency Tolerance measurement

Carrier Frequency Drift measurement

The measurement of the Carrier Frequency Drift (**Carr Freq Drift** softkey) determines the maximum frequency drift between the average value of the preamble bits and any 10 bit group of the payload. Additionally the maximum drift rate between all 10 bit groups in the payload is determined every 50μs.

With **Clear/Write** trace mode and single sweep operation the selected number of sweeps will be processed and according to the RF Test Specification the results of all sweeps will be compared with the defined tolerance. If a different trace mode is selected, the analyzer can alternatively combine several traces and determine the measurement results from the resulting trace.
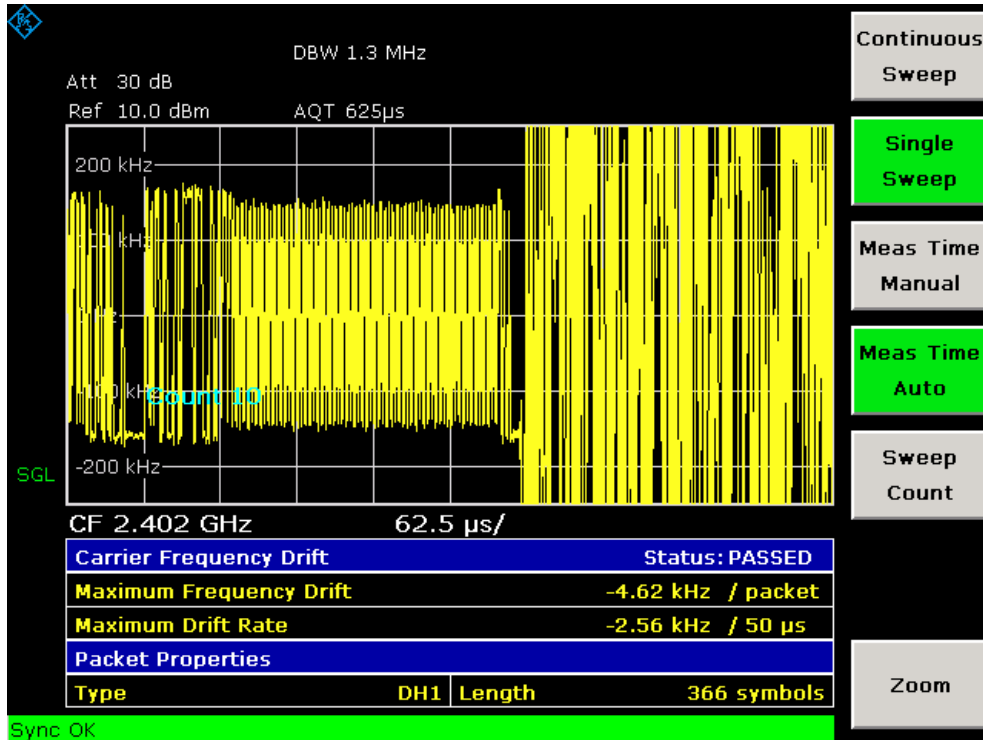
Fig. 3–15 Carrier Frequency Drift measurement

Relative Transmit Power (EDR) measurement

The measurement of the Relative Transmit Power (**Rel TX Power** softkey) is an enhanced data rate measurement (EDR). It determines the average transmission power of the GFSK and DPSK modulated parts of the signal and calculates the ratio of those values.

The measurement results must conform to the requirement:

- $(P_{GFSK} - 4dB) < P_{DPSK} < (P_{GFSK} + 1dB)$
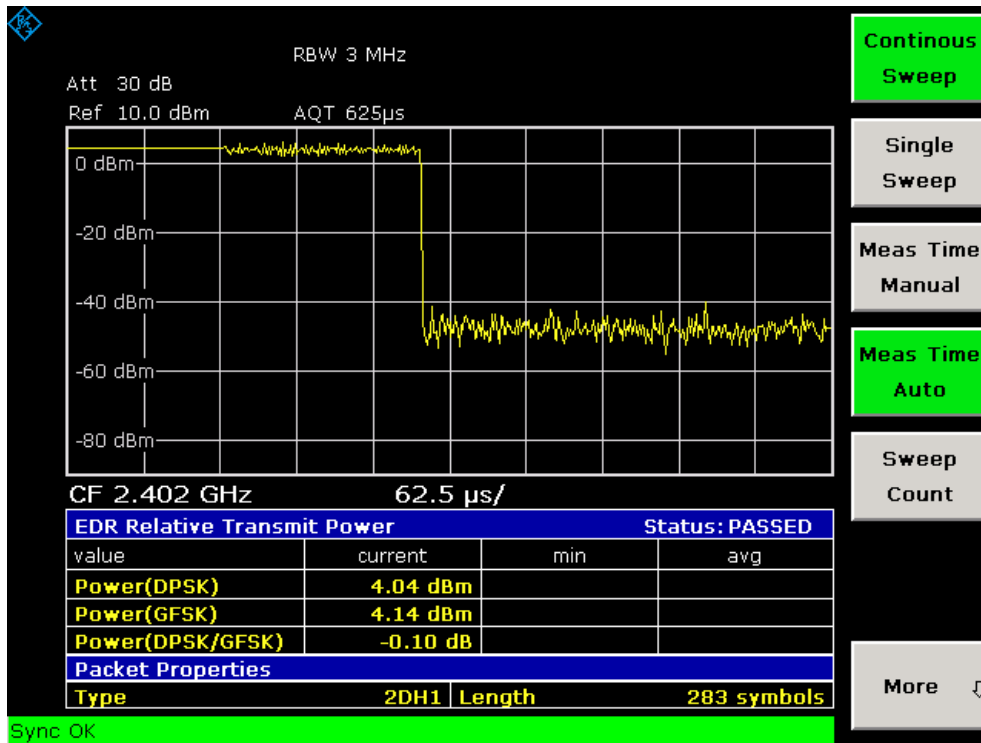
Fig. 3–16 Relative Transmit Power (EDR) measurement

In–band Spurious Emissions (EDR) measurement

The measurement of the In–band Spurious Emissions (**Spurious Emissions** softkey) is an enhanced data rate measurement (EDR). It verifies whether the level of unwanted signals within the used frequency band lies below the required level. The analyzer records the signal only in those parts of the signal in which the device transmits DPSK–modulated data.

The signal must meet the following conditions:

- P_{TX} (f) $\leq$ –20 dBm for |M–N| = 2

- P_{TX} (f) $\leq$ –40 dBm for |M–N| $\geq$ 3

    with M = transmit channel of the equipment under test, N = adjacent channel to be measured

- The adjacent channel power between 1 MHz and 1.5 MHz from the carrier (Adj500kHz Low/Upp) shall be at least 26 dB below the maximum power of the carrier (TX Channel (Ref)).
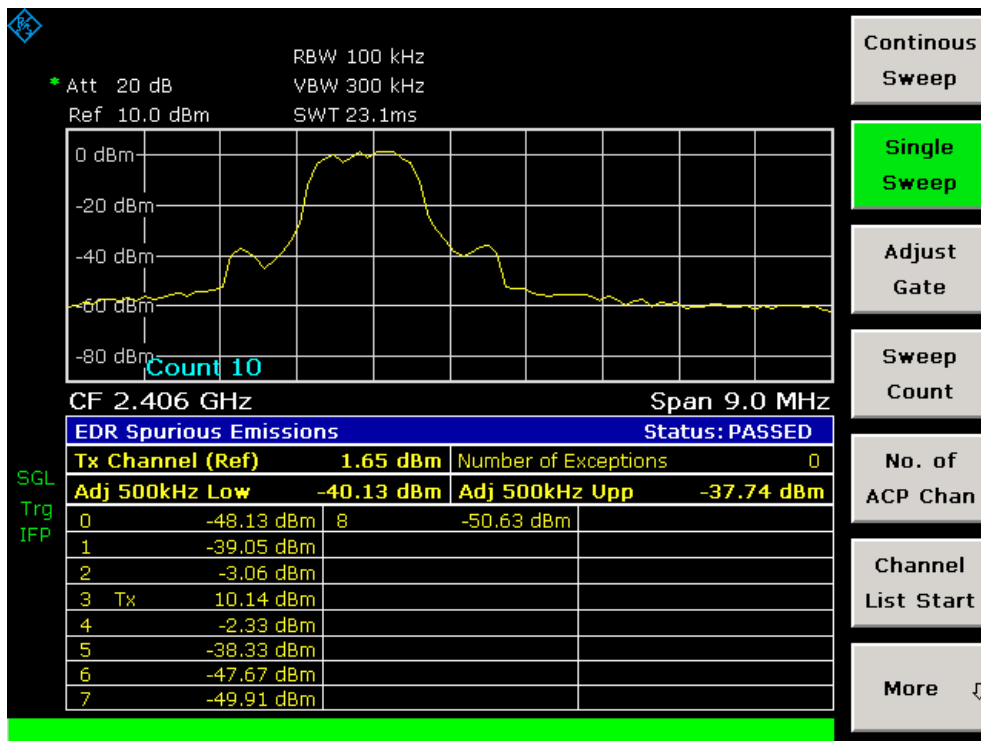
Fig. 3–17 In–band Spurious Emissions (EDR) measurement

Carrier Frequency Stability and Modulation Accuracy (EDR) measurement

The measurement of the Carrier Frequency Stability and Modulation Accuracy (**Carr Freq Stability** softkey) is an enhanced data rate measurement (EDR). It verifies that the modulation accuracy and the frequency stability are working within the required limits. According to the RF Test Specification, the software records 200 blocks, each with a length of 50 µs for the evaluation. The number of blocks to be recorded can be changed by the softkey **Block Count**.
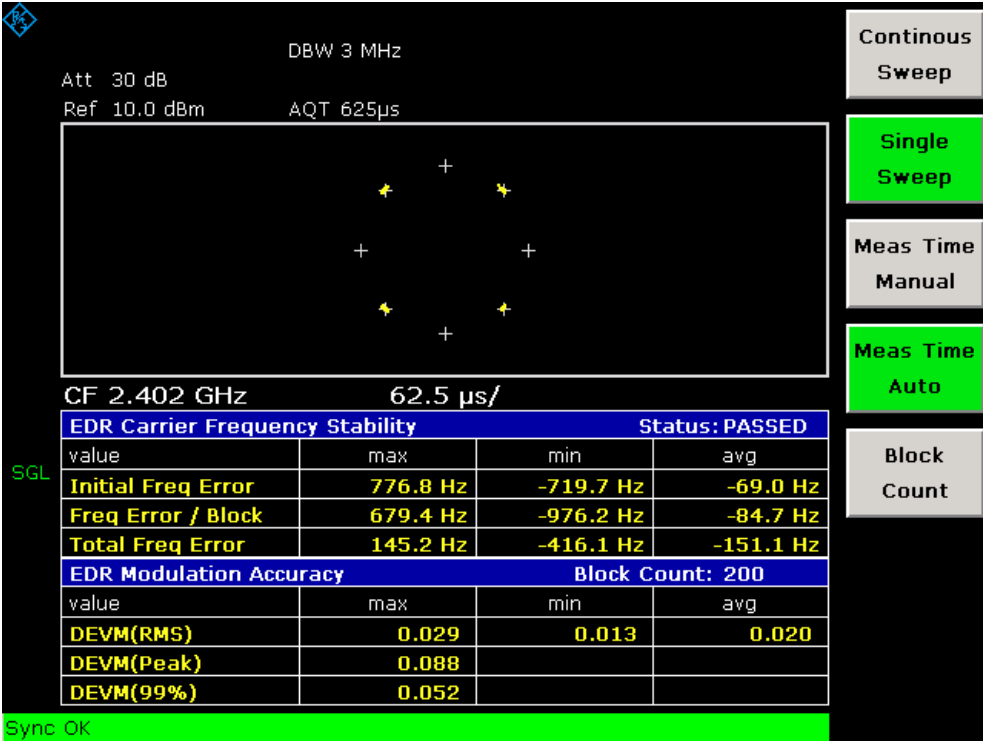
Fig. 3–18 Carrier Frequency Stability and Modulation Accuracy (EDR) measurement

Differential Phase Encoding (EDR) measurement

The measurement of the Differential Phase Encoding (**Diff Phase** softkey) is an enhanced data rate measurement (EDR). It checks in the time range of the DPSK modulation whether the device modulates the data correctly.
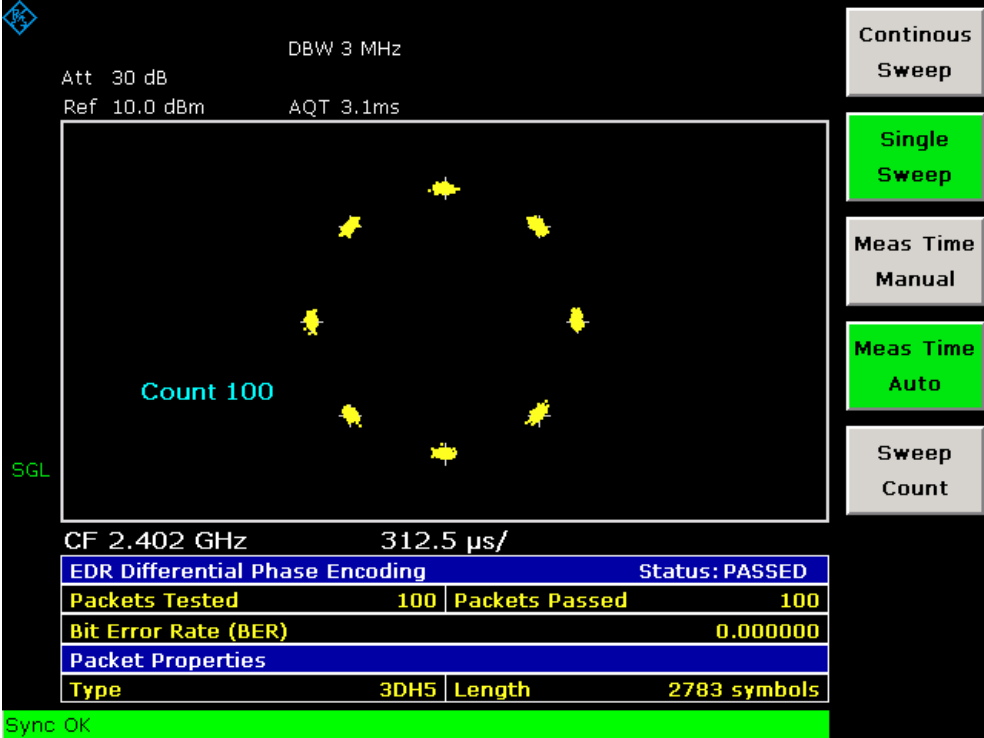
Fig. 3–19 Differential Phase Encoding (EDR) measurement

Softkeys of the Bluetooth menu

This menu provides the softkeys for the basic settings, which are common to all tests. The following table shows all softkeys available in the Bluetooth 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.

Menu / Command	Command
Channel	
Packet Type	
Packet Bytes SCO	
Power Class	
Antenna Gain	
Find Sync ▼	Find Sync On/Off
	LAP
	Sync Offset
	Find Burst On/Off
	Burst Offset
	Search Len Auto
	Search Len Manual
More ▼	
Select Trace	
Points / Symbol	

Channel

Opens an edit dialog box to enter the transmission channel number. From the number of the channel the center frequency is calculated in accordance to the RF Test Specification. The default setting is channel number 0.

Setting the channel number is in principle equal to changing the center frequency. The major difference is that the center frequency is not limited to available frequency band values, i.e. values outside the frequency band and between the discrete channels can be selected (see also **Center** softkey in the frequency menu).

➡ Remote: CONF:BTO:CHAN 20

Packet Type

Opens a dialog box to select the number of occupied slots in the sent packet. The **AUTO** value is identical to **5 Slot Packet**. The default value is packet type **1 Slot Packet**.

The number of occupied slots is used for the automatic calculation of the sweep time (**Sweeptime Auto** softkey) and the search length of the sync word (**Search Len Auto** softkey).

The actually transmitted packet type is determined automatically by the Bluetooth demodulator (which means that the selected packet type need not necessarily correspond to the really transmitted packet type; it will only affect the settings for sweep time and search length as described above).

➡ Remote: CONF:BTO:PTYP DH5

Packet Bytes SCO

Opens an edit dialog box to set the number of payload bytes that are transmitted in a packet. For SCO packets, the payload length must be adjusted because those packets have no payload header.

➡   Remote: `CONF:BTO:PBSC 50`

Power Class (Output Power)

Opens an edit dialog box to set one the Bluetooth power classes (1 to 3). The selection of the power class determines the limits. The default setting is power class 1 (100 mW).

➡   Remote: `CONF:BTO:PCL 3`

Antenna Gain

Opens an edit dialog box to enter a level offset in order to take the gain of an antenna into account for displaying power values. The default setting is 0 dB (see also Labels used in the measurement displays).

➡   Remote: `CORR:EGA:INP 10DB`

Find Sync

Opens a submenu to set the signal processing functions of the analyzer in order to determine the position of the first preamble bit p0 by correlation with the sync word. For this purpose a sufficient record length of the FM demodulated signal is necessary.

For further information refer to "Position of a Bluetooth burst" on page 3.116.

Find Sync On/Off

Activates or deactivates the search of the sync word. The default setting is activated.

The results of the modulation measurements Modulation Characteristics, Initial Carrier Frequency Tolerance, Carrier Frequency Drift can only be calculated if the softkey is activated. The measurement of the Output Power can be performed with either this softkey or the **Find Burst On/Off** softkey activated. If both softkeys are activated, the search area for the sync word will be limited to the area of the detected burst. If the **Find Burst On/Off** softkey is not activated or no burst is identified, the total record length (search length) is investigated.

For further information refer to "Position of a Bluetooth burst" on page 3.116.

➡   Remote: `DDEM:SEAR:SYNC ON`

LAP

Opens an edit dialog box to enter the lower 24 bit (Lower Address Part, LAP)of the Bluetooth Device Address (BD_ADDR) of the equipment under test (EUT).

The LAP is used to calculate the 64–bit sync word. The sync word in return is used to determine the start of a packet by correlation and to determine the position of the first preamble bit p0 using the method described in the RF Test Specification.

The values for the lower address part range from 000000h to FFFFFFh. The default setting is 0000000h.

➡ Remote: `DDEM:SEAR:SYNC:LAP #HA3F45B`

Sync Offset

Opens an edit dialog box to define the number of bits to be displayed in front of the of the first preamble bit p0. If the sync word is identified, but the selected measurement time cannot be displayed due to the selected sync offset, the message **SYNC OFFSET INVALID** is displayed.

The value range depends on the search length and the upper limit of symbols (400001 points / symbol). The default setting for the sync offset is 0.

This softkey is only available if the **Find Sync On/Off** softkey is activated.
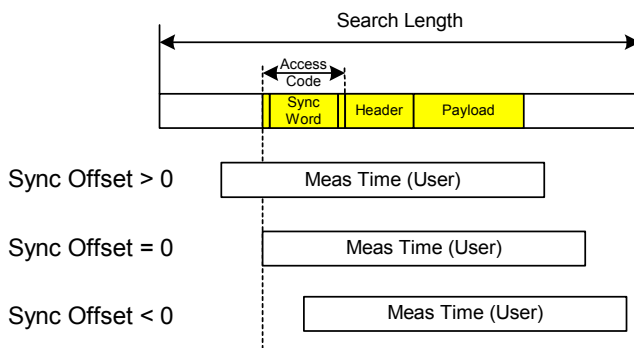
➡ Remote: `DDEM:SEAR:SYNC:OFFS 10`

Find Burst On/Off (Output Power)

Activates the burst search if the **Find Sync On/Off** softkey is deactivated. Beside the synchronization on the sync word, the Output Power measurement can perform a burst search to evaluate the signal according to the standard.

If the **Find Sync On/Off** softkey is not activated and no burst is identified, the message **BURST NOT FOUND** is displayed, and the corresponding bit in the STATus:QUEStionable:SYNC register is set during remote operation.

For further information refer to "Position of a Bluetooth burst" on page 3.116.

➡ Remote: `DDEM:SEAR:PULS OFF`

Burst Offset

Opens an edit dialog box to define the time to be displayed before the identified burst. The values range from –10 ms to + 10 ms, with negative values moving the burst to the left, positive values to the right. The default setting for the burst offset is 0.

If the burst is identified, but the selected measurement time cannot be displayed due to the selected burst offset, the message **BURST OFFSET INVALID** is displayed.

This softkey is only available if the **Find Sync On/Off** softkey is deactivated and the **Find Burst On/Off** softkey is activated.
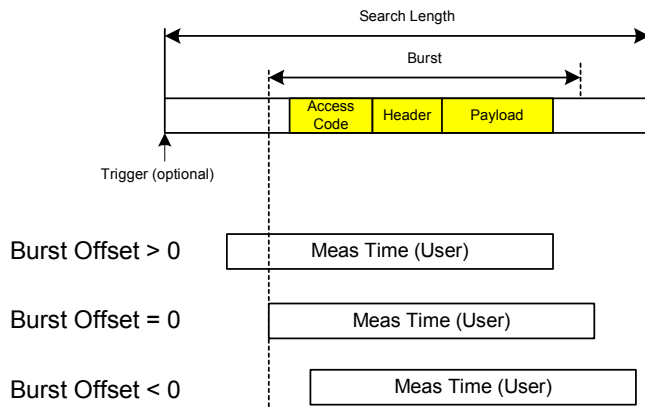
➡ Remote: `DDEM:SEAR:PULS:OFFS 1MS`

Search Len Auto

Activates or deactivates the automatic selection of the search length for the search of the sync word or the burst, depending on the selected packet type. The automatic search length is determined as follows:

Trigger free run:

*search length = 3 * packet length + | sync offset or burst offset |*

All other trigger modes:

*search length = 1 * packet length + 1 Slot + | sync offset or burst offset |*

If the selected measurement time is higher than the packet length, the following difference is added to the search length:

measurement time – packet length

In the default setting, the automatic calculation of the search length is activated.

➡ Remote: `DDEM:SEAR:TIME:AUTO OFF`

Search Len Manual

Opens an edit dialog box to enter the search length used for determining the sync word or the burst. The unit of the search length is seconds; the values range from 100 μs to (400001 / points per symbol) μs. The default setting is 1825 μs.

The selected number of points / symbol and the maximum search length is listed in the table below.

Points per symbol	Max. search length (number of slots)
2	104.4
4	52.2
8	26.1
16	13.1
32	6.5

For information on the correlation of trigger and record length refer to the **Search Len Auto** softkey.

➡ Remote: `DDEM:SEAR:TIME 100US`

Select Trace

Opens an edit dialog box to select the measurement curve whose numeric results will be displayed in the lower half of the screen. The default curve selected is trace 1.

➡ Remote: `CONF:BTO:TRAC2:SEL`

Points / Symbol
(Output Power, TX Spec ACP, Modulation Char, Init Carr Freq Tol, Carr Freq Drift)

Opens an edit dialog box to change the number of measurement samples per symbol. For Basic Rate measurements, the possible values are 2, 4, 8, 16, 32. The default value is 4. For EDR measurements, the default value is set and cannot be changed.

The RF Test Specification requests an oversampling factor of at least 4. With this oversampling factor a **5 Slot Packet** corresponds to 12500 measurement samples (= 2500 samples / slot).

➡ Remote: `CONF:BTO:PRAT 16`

Softkeys of the frequency menu (Bluetooth mode)

The following table shows all softkeys available in the frequency menu in **Bluetooth** mode (**CENTER** 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.

Menu / Command	Command
Center	
CF–Stepsize ▼	0.1*Chan Spacing
	= Chan Spacing

Center

Opens an edit dialog box to change the center frequency.

If the frequency channel has been set via the **Channel** softkey, a change of the center frequency is possible, but the relation to the frequency channel will be lost, which means that the value range for the center frequency is not limited to frequencies within valid frequency channels.

The return to the fixed relation between center frequency and Bluetooth frequency channels is performed when **Channel** softkey is pressed or when another measurement is selected. The center frequency will be rounded to the nearest frequency channel.

➡ Remote: `FREQ:CENT 100MHz`

CF–Stepsize

Opens a submenu to set the step size of the center frequency.

0.1*Chan Spacing

Sets the step size of the center frequency to 1/10 of the channel spacing.

= Chan Spacing

Sets the step size of the center frequency to the size of the channel spacing.

Softkeys of the amplitude menu (Bluetooth mode)

The following table shows all softkeys available in the amplitude menu in **Bluetooth** mode (**AMPT** 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.

Menu / Command	Command
Ref Level	
Range ▼	Range
	Reference Position
	Reference Value
	Zoom
Range Log	
Range Linear	
RF Atten Manual	
RF Atten Auto	
More ▼	
Ref Level Offset	
Ref Level Position	
Input 50 Ω / 75 Ω	

Ref Level

The maximum input power of the A/D converter (defined by this value) must be equal or higher than the maximum power of the signal under test.

For details refer to the **Ref Level** softkey in the amplitude menu of the base unit.

Range (Modulation Char, Init Carr Freq Tol, Carr Freq Drift)

Opens a submenu for scaling the x– and y–axis.

Range (Modulation Char, Init Carr Freq Tol, Carr Freq Drift)

Opens an edit dialog box to enter the range for the frequency deviation.

➡ Remote: `DISP:TRAC:Y 110dB`

Reference Position (Modulation Char, Init Carr Freq Tol, Carr Freq Drift)

Opens an edit dialog box to enter the position of the reference line for the frequency deviation on the y–axis of the diagram. The unit is % of the diagram height, with 100% corresponding to the upper diagram border.

➡ Remote: `DISP:WIND:TRAC:Y:RPOS 50PCT`

Reference Value (Modulation Char, Init Carr Freq Tol, Carr Freq Drift)

Opens an edit dialog box to enter the FM deviation at the reference line on the y–axis. This allows individual frequency offsets to be taken into account for the display of the measurement curves. The valid value range is 0 to $\pm$ 1 MHz; the default setting is 0 Hz.

➡ Remote: `DISP:TRAC:Y:RVAL 0`

Range Log
(Output Power, TX Spec ACP, Rel TX Power, Spurious Emissions, Carr Freq Stability, Diff Phase)

For details refer to the **Range Log** softkey in the amplitude menu of the base unit.

Range Linear
(Output Power, TX Spec ACP, Rel TX Power, Spurious Emissions, Carr Freq Stability, Diff Phase)

For details refer to the **Range Linear** softkey in the amplitude menu of the base unit.

RF Atten Manual

For details refer to the **RF Atten Manual** softkey in the amplitude menu of the base unit.

RF Atten Auto

For details refer to the **RF Atten Auto** softkey in the amplitude menu of the base unit.

Ref Level Offset

For details refer to the **Ref Level Offset** softkey in the amplitude menu of the base unit.

Ref Level Position

For details refer to the **Ref Level Position** softkey in the amplitude menu of the base unit.

Input 50 Ω / 75 Ω

For details refer to the **Input 50 Ω / 75 Ω** softkey in the amplitude menu of the base unit.

Softkeys of the bandwidth menu (Bluetooth mode)

The following table shows all softkeys available in the bandwidth menu in **Bluetooth** mode (**PWR BW** 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.

Command
Meas Time Manual
Meas Time Auto
Sweeptime Manual
Sweeptime Auto
Res BW Manual
Res BW Auto
Video BW Manual
Video BW Auto
Filter Type
Meas Filter

Meas Time Manual
(Output Power, Modulation Char, Init Carr Freq Tol, Carr Freq Drift, Rel TX Power, Carr Freq Stability, Diff Phase)

Opens an edit dialog box to enter the measurement time. The valid value range is 1 μs to (400001 / points per symbol) μs.

➡ Remote: `CONF:BTO:SWE:TIME 10MS`

Meas Time Auto
(Output Power, Modulation Char, Init Carr Freq Tol, Carr Freq Drift, Rel TX Power, Carr Freq Stability, Diff Phase)

Activates the automatic calculation of the measurement time. The automatic sweep time corresponds to the settings defined in the RF Test Specification. By default, the automatic sweep time calculation is activated.

➡ Remote: `CONF:BTO:SWE:TIME:AUTO ON`

Sweeptime Manual (TX Spec ACP)

Opens an edit dialog box to enter the sweep time. The valid value range is 10 μs (minimum measurement time for one channel) to 16000 s. The default setting is 79 s.

➡ Remote: `CONF:BTO:SWE:TIME 10MS`

Sweeptime Auto (TX Spec ACP)

Activates the automatic calculation of the sweep time. The automatic sweep time corresponds to the settings defined in the RF Test Specification. By default, it is activated.

➡ Remote: `CONF:BTO:SWE:TIME:AUTO ON`

Res BW Manual (Output Power, Rel TX Power)

Opens an edit dialog box to enter the resolution bandwidth. The values range from 1 MHz to 3 MHz. The default value is 3 MHz.

➡ Remote: `CONF:BTO:BAND 1KHZ`

Res BW Auto (Output Power, TX Spec ACP, Rel TX Power, Spurious Emissions)

Sets the bandwidth according to the values defined in the RF Test Specification.

➡ Remote: `CONF:BTO:BAND:AUTO ON`

Video BW Manual (TX Spec ACP)

The default value is 300 kHz, according to the values defined in the RF Test Specification.

For further details refer to the **Video BW Manual** softkey in the bandwidth menu of the base unit.

➡ Remote: `CONF:BTO:BAND:VID 100HZ`

Video BW Auto (TX Spec ACP, Spurious Emissions)

Sets the video bandwidth according to the values defined in the RF Test Specification. In the In–band Spurious Emissions measurement, the video bandwidth is always adjusted automatically. Therefore the softkey is activated by default and its state cannot be changed.

➡ Remote: `CONF:BTO:BAND:VID:AUTO ON`

Filter Type (Output Power, TX Spec ACP, Spurious Emissions, Rel TX Power)

Opens the **Filter Type** dialog box to select the filter type. For the measurements Output Power and Rel TX Power, a Gaussian or a channel filter can be selected. For the measurements TX Spec ACP and Spurious Emissions, the filter type is a Gaussian filter.

➡ Remote: `BAND:TYPE NORM`

Meas Filter (Modulation Char, Init Carr Freq Tol, Carr Freq Drift)

Activates or deactivates a filter that limits the bandwidth for the modulation measurements. Since the RF Test Specification Rev 2.0.E.3 it is required to use this filter and therefore it is activated by default.

The filter is flat within 1.04 MHz (ripple: only 0.02 dB) and has steep slopes outside this area. The filter has the following characteristics:

– passband ripple up to $\pm$ 550 kHz < 0.5 dB (peak to peak)

– minimum attenuation in the transition band

$\pm$ 650 kHz:	$\geq$ 3 dB
$\pm$ 1 MHz:	$\geq$ 14 dB
$\pm$ 2 MHz:	$\geq$ 44 dB

➡ Remote: `DDEM:FILT:MEAS BTO`

Softkeys of the sweep menu (Bluetooth mode)

The following table shows all softkeys available in the sweep menu in **Bluetooth** mode (**SWEEP** key). In the **Bluetooth** mode, the sweep menu is used for direct entry into the measurement menu of the currently selected measurement. 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.

Command
Start Test
Continue Test
Continuous Sweep
Single Sweep
Meas Time Manual
Meas Time Auto
Sweeptime Manual
Sweeptime Auto
Block Count
Adjust Gate
Sweep Count
Power Avg Start
Power Avg Stop
Zoom
No. of ACP Chan
Channel List Start
More ▼
Gate Delay
Gate Length
GFSK Start
GFSK Stop
DPSK Start
DPSK Stop

Start Test (Modulation Char)

Initiates a new measurement. All frequency deviation values obtained earlier are discarded.

The bit pattern in the payload is detected automatically. The frequency deviation of a packet is determined according to the procedure defined in the RF Test Specification.

➡ Remote: `INIT;*WAI`

Continue Test (Modulation Char)

Measures the frequency deviation of further packets after the bit pattern has been changed at the EUT, just like the **Start Test** softkey did for the first bit pattern type. The results of the preceding measurement are preserved and are taken into account for the new measurements.

➡ Remote: `INIT:CONM;*WAI`

Continuous Sweep

Selects the continuous measurement operation. This is the default setting of the instrument.

➡ Remote: `INIT:CONT ON;*WAI`

Single Sweep
(Output Power, TX Spec ACP, Init Carr Freq Tol, Carr Freq Drift, Rel TX Power, Spurious Emissions, Carr Freq Stability, Diff Phase)

Selects the single measurement operation and starts a measurement cycle.

➡ Remote: `INIT:CONT OFF;*WAI`

Block Count (Carr Freq Stability)

Opens an edit dialog box to enter the number of blocks to be measured. Every block has the length of 50 µs. The default value is 200 blocks.

This softkey is only available in single sweep operation.

➡ Remote: `CONF:BTO:CFST:BCO 1000`

Adjust Gate (Spurious Emissions)

Adjusts the gate settings according to the pre–measurement results.

➡ Remote: `CONF:BTO:IBS:GATE:AUTO ONCE`

Sweep Count
(Output Power, TX Spec ACP, Modulation Char, Init Carr Freq Tol, Carr Freq Drift, Rel TX Power, Spurious Emissions, Diff Phase)

Opens an edit dialog box to enter the number of sweeps to be initiated by **Single Sweep** softkey. The valid value range is 0 to 32767.

➡ Remote: `CONF:BTO:SWE:COUN 20`

Power Avg Start (Output Power)

Opens an edit dialog box to enter the start position of the evaluation area for the average burst power. The values range from 0 to 100%, the default setting is 20%.

For further information refer to "Position of a Bluetooth burst" on page 3.116.

➡ Remote: `CONF:BTO:POW:AVER:STAR 10PCT`

Power Avg Stop (Output Power)

Opens an edit dialog box to enter the stop position of the evaluation area for the average burst power. The values range from 0 to 100%, the default setting is 80%.

For further information refer to "Position of a Bluetooth burst" on page 3.116.

➡ Remote: `CONF:BTO:POW:AVER:STAR 90PCT`

Zoom (Modulation Char, Init Carr Freq Tol, Carr Freq Drift)

Activates or deactivates the zoom function. Opens an edit dialog box to enter the zoom start position. The valid value range for the zoom start position is 0 to (measurement time – 500 / sampling rate). The default setting for the zoom function is 0s (off).

With active zoom function, an area of only 501 samples is displayed.

➡ Remote: `ADEM:ZOOM ON`
➡ Remote: `ADEM:ZOOM:STAR 500us`

No. of ACP Chan (TX Spec ACP, Spurious Emissions)

Opens an edit dialog box to enter the number of adjacent channels, for which the power is to be measured. The values range from 0 to 78. A minimum value of 3 is recommended. The default setting is 78 (all channels).

As with the ACP measurement of the basic instrument firmware this value refers to the number of adjacent channels on one side of the TX channel. This means that with a selected value of 10 the analyzer will measure in total 21 channels (10 lower channels + TX channel + 10 upper channels).

The frequency range required for the measurement is set up automatically. The center frequency will also be adapted automatically dependent on the selected TX channel.

The measurement of the adjacent channels is limited to the available Bluetooth frequency band, which means that at maximum 79 channels (23 channels in France) will be measured.

➡ Remote: `CONF:BTO:ACLR:ACP 10` (TX Spec ACP)
➡ Remote: `CONF:BTO:IBS:ACP 20` (Spurious Emissions)

Channel List Start (TX Spec ACP, Spurious Emissions)

Opens an edit dialog box to enter the channel with which the result display table starts. Because of the multiplicity of the measurements results not all channels can be displayed simultaneously.

Gate Delay (Spurious Emissions)

Opens an edit dialog box to enter the time between trigger event and start of the DPSK packet. That is the measurement start time.

➡ Remote: `SWE:EGAT:HOLD 100us`

Gate Length (Spurious Emissions)

Opens an edit dialog box to enter the sweep time in seconds. Usually, this is the length of the DPSK section.

➡ Remote: `SWE:EGAT:LENG 10ms`

GFSK Start (Rel TX Power)

Opens an edit dialog box to enter the start time for the power measurement of the GFSK sections of the packet. The default value is 10%.

The abbreviation GFSK stands for Gaussian Frequency Shift Keying.

➡ Remote: `CONF:BTO:RTP:GAV:STAR 20`

GFSK Stop (Rel TX Power)

Opens an edit dialog box to enter the stop time for the power measurement of the GFSK sections of the packet. The default value is 90%.

The abbreviation GFSK stands for Gaussian Frequency Shift Keying.

➡ Remote: `CONF:BTO:RTP:GAV:STOP 80`

DPSK Start (Rel TX Power)

Opens an edit dialog box to enter the start time for the power measurement of the DPSK sections of the packet. The default value is 10%.

The abbreviation DPSK stands for Differential Phase Shift Keying.

➡ Remote: `CONF:BTO:RTP:DAV:STAR 20`

DPSK Stop (Rel TX Power)

Opens an edit dialog box to enter the stop time for the power measurement of the DPSK sections of the packet. The default value is 90%.

The abbreviation DPSK stands for Differential Phase Shift Keying.

➡ Remote: `CONF:BTO:RTP:DAV:STOP 80`

Softkeys of the trigger menu (Bluetooth mode)

The following table shows all softkeys available in the trigger menu in **Bluetooth** mode (**CENTER** 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.

Command
Trigger Source
Trg/Gate Level
Trigger Polarity
Trigger Offset

Trigger Source

Opens the **Trigger** dialog box to select one of the following trigger sources: **Free Run**, **External**, **IF Power**.

For further details refer to the **Trg / Gate Source** softkey in the trigger menu of the base unit.

Trg/Gate Level

Opens an edit dialog box to enter the trigger / gate level. This softkey is not available, if the trigger source **Free Run** is selected.

For further details refer to the **Trg / Gate Level** softkey in the trigger menu of the base unit.

Trigger Polarity

For details refer to the **Trg / Gate Polarity Pos/Neg** softkey in the trigger menu of the base unit.

Trigger Offset

For details refer to the **Trigger Offset** softkey in the trigger menu of the base unit.

Softkeys of the measurement menu (Bluetooth mode)

The following table shows all softkeys available in the measurement menu in **Bluetooth** mode (**MEAS** 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.

In the **Bluetooth** mode, the sweep menu is used for direct entry into the measurement menu of the currently selected measurement. Therefore only the softkeys to select a measurement are described in this section. All other softkeys are linked to the description in section Softkeys of the sweep menu (Bluetooth mode) or Softkeys of the bandwidth menu (Bluetooth mode).

Menu / Command	Submenu / Command	Command
Output Power	Continuous Sweep	
	Single Sweep	
	Meas Time Manual	
	Meas Time Auto	
	Sweep Count	
	Power Avg Start	
	Power Avg Stop	
TX Spec ACP ▼	Continuous Sweep	
	Single Sweep	
	Sweeptime Manual	
	Sweeptime Auto	
	Sweep Count	
	No. of ACP Chan	
	Channel List Start	
Modulation Char ▼	Start Test	
	Continue Test	
	Continuous Sweep	
	Meas Time Manual	
	Meas Time Auto	
	Sweep Count	
	Zoom	
Init Carr Freq Tol ▼	Continuous Sweep	
	Single Sweep	
	Meas Time Manual	
	Meas Time Auto	
	Sweep Count	
	Zoom	
Carr Freq Drift ▼	see contents of the Init Carr Freq Tol submenu	
EDR ▼	Rel TX Power ▼	Continuous Sweep
		Single Sweep
		Meas Time Manual
		Meas Time Auto
		Sweep Count
		More ▼
		GFSK Start
		GFSK Stop
		DPSK Start
		DPSK Stop
	Spurious Emissions ▼	Continuous Sweep
		Single Sweep
		Adjust Gate
		Sweep Count

Menu / Command	Submenu / Command	Command
		No. of ACP Chan
		Channel List Start
		More ▼
		Gate Delay
		Gate Length
	Carr Freq Stability ▼	Continuous Sweep
		Single Sweep
		Meas Time Manual
		Meas Time Auto
		Block Count
	Diff Phase ▼	Continuous Sweep
		Single Sweep
		Meas Time Manual
		Meas Time Auto
		Sweep Count

Output Power

Opens a submenu to configure the Output Power measurement. For further details refer to "Output Power measurement" on page 3.117.

➡ Remote: `CONF:BTO:MEAS OPOW`

➡ Remote: `CALC:BTO:OPOW?`

➡ Remote: `CALC:BTO:OPOW:AVER? MAX`

TX Spec ACP

Opens a submenu to configure the TX Spec ACP measurement. For further details refer to "Adjacent Channel Power measurement" on page 3.118.

➡ Remote: `CONF:BTO:MEAS ACLR`

➡ Remote: `CALC:BTO:ACLR?`

➡ Remote: `CALC:BTO:ACLR:EXC?`

Modulation Char

Opens a submenu to configure the Modulation Char measurement. For further details refer to "Modulation Characteristics measurement" on page 3.119.

➡ Remote: `CONF:BTO:MEAS MCH`

➡ Remote: `CALC:BTO:MCH:DF1:AVER? MIN`

➡ Remote: `CALC:BTO:MCH:DF1:MAX? MIN`

➡ Remote: `CALC:BTO:MCH:DF2:PERC?`

➡ Remote: `CALC:BTO:MCH:RAT? MIN`

Init Carr Freq Tol

Opens a submenu to configure the Init Carr Freq Tol measurement. For further details refer to "Initial Carrier Frequency Tolerance measurement" on page 3.120.

➡ Remote: CONF:BTO:MEAS IFCT

➡ Remote: CALC:BTO:ICFT? AVER

Carr Freq Drift

Opens a submenu to configure the Carr Freq Drift measurement. For further details refer to "Carrier Frequency Drift measurement" on page 3.121.

➡ Remote: CALC:BTO:CFDR?

➡ Remote: CALC:BTO:CFDR:RATE?

EDR

Opens a submenu with all available enhanced data rate measurements.

Rel TX Power

Opens a submenu to configure the Rel TX Power measurement. For further details refer to "Relative Transmit Power (EDR) measurement" on page 3.122.

➡ Remote: CONF:BTO:MEAS RTP

➡ Remote: CALC:BTO:RTP? MIN

➡ Remote: CALC:BTO:RTP:GFSK? MIN

➡ Remote: CALC:BTO:RTP:RAT? MIN

Spurious Emissions

Opens a submenu to configure the Spurious Emissions measurement. For further details refer to "In–band Spurious Emissions (EDR) measurement" on page 3.123.

➡ Remote: CONF:BTO:MEAS IBS

➡ Remote: CALC:BTO:IBS?

➡ Remote: CALC:BTO:IBS:EXC?

➡ Remote: CALC:BTO:IBS:HADJ? LOW

Carr Freq Stability

Opens a submenu to configure the Carr Freq Stability measurement. For further details refer to "Carrier Frequency Stability and Modulation Accuracy (EDR) measurement" on page 3.124.

➡ Remote: `CONF:BTO:MEAS CFST`

➡ Remote: `CALC:BTO:CFST:FERR? MIN`

➡ Remote: `CALC:BTO:CFST:FERR:BLOC? AVER`

➡ Remote: `CALC:BTO:CFST:FERR:INIT? MAX`

➡ Remote: `CALC:BTO:CFST:DEVM? AVER`

➡ Remote: `CALC:BTO:CFST:DEVM:PEAK?`

➡ Remote: `CALC:BTO:CFST:DEVM:D99Pct?`

➡ Remote: `CALC:BTO:CFST:COUNt?`

Diff Phase

Opens a submenu to configure the Diff Phase measurement. For further details refer to "Differential Phase Encoding (EDR) measurement" on page 3.125.

➡ Remote: `CONF:BTO:MEAS DPEN`

➡ Remote: `CALC:BTO:DPEN:NERR?`

➡ Remote: `CALC:BTO:DPEN?`

➡ Remote: `CALC:BTO:DPEN:BER?`

Power Meter (Option K9)

For precise power measurement a power sensor is connected to the instrument via the front panel (USB connector) or the rear panel (power sensor, option R&S FSL–B5). The Power Sensor Support firmware option provides the power measurement functions for this test setup (see figure below Fig. 3–20: Power sensor support – standard test setup). Both manual operation and remote control are supported. The functions of this firmware option are described in this section. For details on the connectors and compatible power sensors refer to the Quick Start Guide, chapter 1, "Front and Rear Panel".
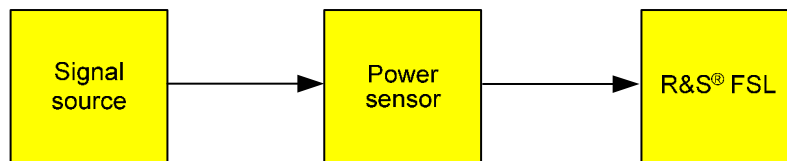
Fig. 3–20: Power sensor support – standard test setup

To open the power meter menu

1. Press the **MENU** key.

2. Press the **Power Meter** softkey.

   The power meter menu is displayed.

Menu and softkey description

– "Softkeys of the power meter menu" on page 3.145

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 section "How to use the Help System".

Tasks

– To zero the power meter

– To use the power meter

To zero the power meter

1. Press the **Zero** softkey.

   A dialog box is displayed that prompts you to disconnect all signals from the input of the power sensor.

2. Disconnect all signals from the input of the power sensor and press **ENTER** to continue.

3. Wait until zeroing is complete.

   A corresponding message is displayed.

To use the power meter

1. Press the **Frequency Coupling** softkey to select the coupling option.

2. If you have selected the **Manual** coupling option, press the **Frequency Manual** softkey to enter the frequency of the signal which power you want to measure.

3. Press the **Unit/Scale** softkey to set the unit for the power result display.

4. If you have selected dB or % as units (relative display), define a reference value:

   – To set the currently measured power as a reference value, press the **Meas–>Ref** softkey.

   – To enter a reference value, press the **Reference Value** softkey.

5. Press the **Meas Time/Average** softkey to select the measurement time. For recommendations refer to the **Meas Time/Average** softkey description.

Softkeys of the power meter menu

The following table shows all softkeys available in the power meter 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.

For the description of the other main softkeys refer to "Optional softkeys of the menu menu" on page 3.94.

Command
Power Meter On/Off
Frequency Manual
Frequency Coupling
Unit/Scale
Zero
Meas Time/Average
More ▼
Meas–>Ref
Reference Value
Use Ref Lev Offset
Number of Readings

Power Meter On/Off

Switches the power measurement on or off.

➡ Remote: `PMET ON`

Frequency Manual

Opens an edit dialog box to enter the frequency of the signal to be measured. The power sensor has a memory with frequency–dependent correction factors. This allows extreme accuracy for signals of a known frequency.

➡ Remote: `PMET:FREQ 1GHZ`

Frequency Coupling

Opens the **Frequency Coupling** dialog box to select the coupling option. The frequency can be coupled automatically to the center frequency of the instrument or to the frequency of marker 1, or manually to a set frequency (see **Frequency Manual** softkey).

➡ Remote: `PMET:FREQ:LINK CENT`

Unit/Scale

Opens the **Unit/Scale** dialog box to select the unit with which the measured power is to be displayed.

If dB or % is selected, the display is relative to a reference value that is defined with either the Meas–>Ref softkey or the **Reference Value** softkey.

➡ Remote: `UNIT:PMET:POW DBM`

➡ Remote: `UNIT:PMET:POW:RAT DB`

Zero

Starts zeroing of the power sensor. For details on the zeroing process refer to "To zero the power meter" on page 3.144.

➡ Remote: `CAL:PMET:ZERO:AUTO ONCE;*WAI`

Meas Time/Average

Opens the **Meas Time** dialog box to select the measurement time or to switch to manual averaging mode. In general, results are more precise with longer measurement times. The following settings are recommended for different signal types to obtain stable and precise results:

Short	Stationary signals with high power (> –40dBm), because they require only a short measurement time and short measurement time provides the highest repetition rates.
Normal	Signals with lower power or of modulated signals
Long	Signals at the lower end of the measurement range (<–50 dBm) or signals with lower power to minimize the influence of noise.
Manual	Switches to manual averaging mode. The average count is set with the **Number of Readings** softkey.

➡ Remote: `PMET:MTIM SHOR`

➡ Remote: `PMET:MTIM:AVER ON`

Meas–>Ref

Sets the currently measured power as a reference value for the relative display. The reference value can also be set manually via the **Reference Value** softkey.

➡ Remote: `CALC:PMET:REL:AUTO ONCE`

Reference Value

Opens an edit dialog box to enter a reference value for relative measurements in the unit dBm.

➡ Remote: `CALC:PMET:REL –30DBM`

Use Ref Lev Offset

If activated, takes the reference level offset set for the analyzer (**Ref Level Offset** softkey) into account for the measured power. If deactivated, takes no offset into account.

➡ Remote: `PMET:ROFF OFF`

Number of Readings

Opens an edit dialog box to enter the number of readings (averagings) to be performed after a single sweep has been started. This softkey is only available if manual averaging is selected (**Meas Time/Average** softkey).

The values for the average count range from 0 to 256 in binary steps (1, 2, 4, 8,…). For average count = 0 or 1, one reading is performed. The averaging and sweep count of the trace menu are independent from this setting.

Results become more stable with extended average, particularly if signals with low power are measured. This setting can be used to minimize the influence of noise in the power meter measurement.

➡ Remote: `PMET:MTIM:AVER:COUN 8`

Spectrogram Measurement (Option K14)

The Spectrogram Measurement option provides a graphical view of frequency and amplitude changes over a time interval. For display details refer to "Spectrogram view" on page 3.148.

Not all measurement types can be displayed in the Spectrogram view. If the Spectrogram Measurement option is active and a measurement cannot be displayed in form of a spectrogram, the softkey of the corresponding measurement is disabled.

If the Spectrogram view is active, all parameter settings set in the **Spectrum Analyzer** mode are kept, and vice versa.

To open the spectrogram menu

1. Press the **MENU** key.

2. Press the **Spectrogram** softkey.

   The spectrogram menu is displayed.

Menu and softkey description

– "Softkeys of the spectrogram menu" on page 3.150

– "Softkeys of the sweep menu (Spectrogram view)" on page 3.151

– "Softkeys of the marker menu (Spectrogram view)" on page 3.153

– "Softkeys of the marker–> menu (Spectrogram view)" on page 3.153

All other menus are provided as described for the base unit. For details refer to the corresponding menu descriptions.

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 section "How to use the Help System".

Further information

– "Spectrogram view" on page 3.148

– "Markers and marker values" on page 3.150

– "Maximum number of frames" on page 3.150

Spectrogram view

The Spectrogram view is divided into two panes: the spectrum analyzer result display (upper pane) and the spectrogram result display (lower pane).

- spectrum analyzer result display

   As in **Spectrum Analyzer** mode, all traces are displayed and available. For trace 1, the **View** and **Blank** trace modes are not available.

   During the measurement, always the current trace is displayed.
   If no measurement is running, the trace to be displayed is selected via:

   – the **Select Frame** softkey

   – the edit dialog box for markers and delta markers (**MKR** key, **Marker 1/2/3/4** softkeys or **MKR–> ** key, **Select 1 2 3 4** $\triangle$ softkey)

The selected trace is displayed with its corresponding, activated markers (D2 in the example). The position of the markers activated for other traces is only displayed in the marker field (M1 in the example).

* spectrogram result display

   In a Cartesian diagram, the chronological power distribution (y–axis) over a frequency or time range (x–axis) is displayed. The different levels are displayed in different colors.

   Only the data of trace 1 is displayed in the spectrogram. The result display is build up by horizontal lines so–called frames, each representing a trace. The frames are sorted in chronological order: Starting from the current trace (frame 0) at the y–axis value zero, the last trace (frame –1), the trace before the last trace (frame –2), and so on, are displayed with increasing y–axis value. The maximum number of frames to be recorded is defined by the **History Depth** softkey.

   A frame consists of a maximum of 501 measurement points. If more measured values than measurement points are available (set via the **Sweep Points** softkey), several measured values are combined in one measurement point using the selected detector (**Auto Peak** detector not available, for details on detectors refer to "Detector overview" on page 3.36).
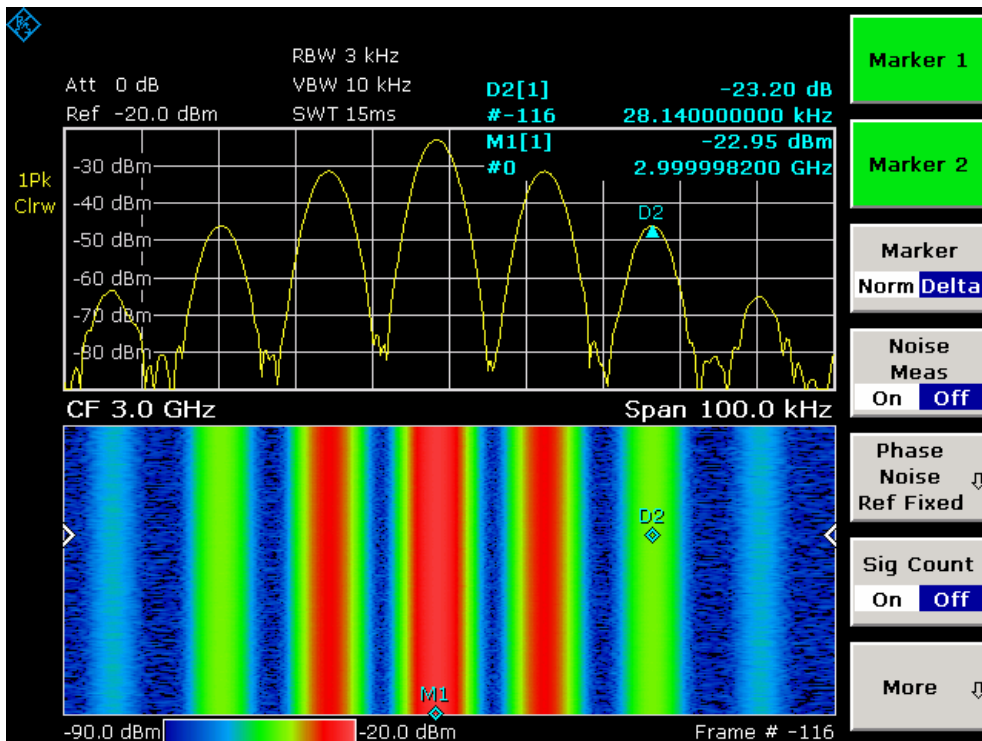
Fig. 3–21 Spectrogram (example)

A color map below the spectrogram shows the level and color assignment: the minimum level on the left (–101.0 dBm in the example), the maximum level on the right (–1.0 dBm in the example). The used colors are defined via the **Color** softkey. The level and color assignment is derived automatically from the levels.

Below the right corner of the spectrogram, the frame number is displayed (# 0 in the example). If the time stamp is activated, the time stamp instead of the frame number is displayed (for details refer to the **Time Stamp On/Off** softkey).

The position of a marker (rhomb symbol) is displayed in the spectrogram result display only if the marker is located in the visible area. If the marker is located outside the visible area, only its values are displayed in the marker field.

Markers and marker values

In the spectrum analyzer result display, the marker information of all activated markers is displayed in the marker field. Additional to the marker values of the base unit (for details see "Using Markers and Delta Markers – MKR Key" on page 3.42), the frame number is given (# 0 in the example).

```
M1[1]              -26.12 dBm
#0            2.083200000 GHz
D2[1]              -70.65 dB
#0            904.800000000 MHz
```

In the spectrogram result display, in maximum 4 markers and delta markers can be activated for different frames at the same time. To assign a marker to a frame, the edit marker dialog box is extended. Additionally to the marker value, the frame number must be defined.

```
Marker 1                    Frame Number        ⨯
2.0 GHz                     0
```
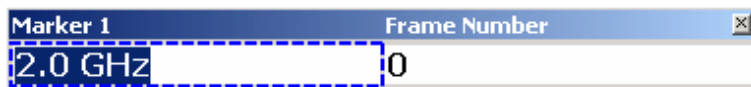
When the marker edit dialog box is opened, the **Marker 1** field is in edit mode. To change to the frame number field, use the **FIELD RIGHT** key.

If a marker is activated when the measurement is halted (**Continuous Sweep Start/Stop** softkey), the marker is set and visible in both result displays (provided that it is located in the visible area of the spectrogram result display). If the marker value or the frame number is altered, the new position is reflected in both result displays.

Maximum number of frames

The following table shows the correlation between the number of measurement points and the maximum number of frames stored in the history buffer:

Measurement points	Max. number of frames
≤ 501	20,000
1,001	12,488
2,001	6,247
4,001	3,124
8,001	1,562
16,001	781
32,001	391

Softkeys of the spectrogram menu

The following table shows all softkeys available in the spectrogram menu (**MENU** 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.

For the description of the other main softkeys refer to "Optional softkeys of the menu menu" on page 3.94.

Command
Spectrogram On/Off
History Depth
Color
Maximize Size
Time Stamp On/Off

Spectrogram On/Off

Activates or deactivates the Spectrogram Measurement option.

➡ Remote: `CALC:SPEC ON`

History Depth

Opens an edit dialog box to enter the number of frames to be stored in the history buffer. The maximum number of frames depends on the number of sweep points (**Sweep Points** softkey) and is determined according to "Maximum number of frames" on page 3.150.

If the history buffer is full, the oldest frame results are overwritten by the new ones.

➡ Remote: `CALC:SPEC:HDEP 1000`

Color

Opens the **Frame Color** dialog box to select the frame color setting.

Color	RGB colors
Radar	black – green – white
Grayscale	black and white

➡ Remote: `CALC:SPEC:COL RAD`

Maximize Size

Changes the screen layout.

Activated	Enlarges the spectrogram result display and scales down the spectrum analyzer result display.
Deactivated	Divides the screen in two equally sized panes.

➡ Remote: `CALC:SPEC:SIZE LARG`

Time Stamp On/Off

Defines the displayed item in the right lower corner.

On	The time stamp (system time of the sweep start) is displayed instead of the frame number.
Off	The frame number is displayed.

➡ Remote: `CALC:SPEC:TST ON`

Softkeys of the sweep menu (Spectrogram view)

The following table shows all softkeys available in the sweep menu of the Spectrogram Measurement option (**SWEEP** 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.

Command
Continuous Sweep Start/Stop
Single Sweep
Select Frame
Sweeptime Manual
Sweeptime Auto
Sweep Count
More ▼
Sweep Points
Continue Frame On/Off
Frame Count
Spectrogram Clear

Continuous Sweep Start/Stop

➡ Stops or continues the measurement in continuous sweep mode. The trace averaging is determined by the sweep count value (for details refer to the **Sweep Count** softkey in the trace menu of the base unit).

Continuous Sweep Start	The measurement is stopped. Press the softkey to continue the measurement.
Continuous Sweep Stop	The measurement is running. Press the softkey to stop the measurement.

➡ Remote: `INIT:CONT ON`

Single Sweep

For details refer to the **Single Sweep** softkey in the sweep menu of the base unit.

Select Frame

Opens an edit dialog box to select the frame if no measurement is running. If the active marker value is altered, the value of the selected frame is updated accordingly.

During a measurement, the value is fixed to 0 and this softkey is not available.

➡ Remote: `CALC:SPEC:FRAM:SEL -10`

Sweeptime Manual

For details refer to the **Sweeptime Manual** softkey in the sweep menu of the base unit.

Sweeptime Auto

For details refer to the **Sweeptime Auto** softkey in the sweep menu of the base unit.

Sweep Count

For details refer to the **Sweep Count** softkey in the sweep menu of the base unit.

Sweep Points

For details refer to the **Sweep Points** softkey in the sweep menu of the base unit.

Continue Frame On/Off

Determines whether the results of the last measurement are deleted before starting a new measurement.

On   Repeats the single sweep measurement without deleting the spectrogram results of the last measurement. One of the following trace modes is to be used: **Max Hold**, **Min Hold**, **Average**.

Off   Deletes the last measurement results before performing a single sweep measurement.

This softkey takes effect in single sweep mode only.

➡   Remote: `CALC:SPEC:CONT ON`

Frame Count

Opens an edit dialog box to enter the number of frames to be recorded in a single sweep measurement, whereas the **Sweep Count** entry determines how many sweeps are combined according to the selected trace mode (**Max Hold** or **Min Hold**) in one trace (frame). The maximum number of frames is determined according to "Maximum number of frames" on page 3.150.

This softkey takes effect in single sweep mode only.

➡   Remote: `CALC:SPEC:FRAM:COUN 200`

Spectrogram Clear

Deletes the spectrogram result display and the history buffer.

➡   Remote: `CALC:SPEC:CLE`

Softkeys of the marker menu (Spectrogram view)

Additional to the functionality of the base unit (for details refer to "Softkeys of the marker menu" on page 3.46), the edit dialog box for markers and delta markers is extended. For details refer to "Markers and marker values" on page 3.150.

Softkeys of the marker–> menu (Spectrogram view)

The following table shows all softkeys available in the marker–> menu of the Spectrogram Measurement option (**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.

Menu / Command	Command
Select 1 2 3 4 ⊿	
Peak	
Next Peak	
Search Mode ▼	Next Peak X Search < abs >
	Next Peak Y Search up/abs/dn
	Next Min X Search < abs >
	Next Min Y Search up/abs/dn
	Marker Search Type
	Select Search Area
Center =Mkr Freq	
Ref Lvl =Mkr Lvl	
More ▼	
Select 1 2 3 4 ⊿	
Min	
Next Min	
Search Mode ▼	identical to Search Mode menu above
Search Limits ▼	Left Limit
	Right Limit
	Threshold
	Search Lim Off
Peak Excursion	
Exclude LO	

Select 1 2 3 4 ⊿

The edit dialog box for markers and delta markers is extended as described in "Markers and marker values" on page 3.150.

For further details refer to the **Select 1 2 3 4 ⊿** softkey in the marker–> menu of the base unit.

➡ Remote: `CALC:MARK2:SPEC:FRAM –20`

➡ Remote: `CALC:DELT3:SPEC:FRAM –50`

Peak

Sets the active marker/delta marker to the highest maximum according to the selected search type (**Marker Search Type** softkey).

➡ Remote: `CALC:MARK:MAX` (in x direction)

➡ Remote: `CALC:DELT:MAX` (in x direction)

➡ Remote: `CALC:MARK:SPEC:Y:MAX` (y direction)

➡ Remote: `CALC:DELT4:SPEC:Y:MAX` (y direction)

➡ Remote: `CALC:MARK2:SPEC:XY:MAX` (xy direction)

➡ Remote: `CALC:DELT2:SPEC:XY:MAX` (xy direction)

Next Peak

Sets the active marker/delta marker to the next maximum according to the mode selected using the **Search Mode** softkey. For the **XY Search** (**Marker Search Type** softkey), this softkey is not available.

➡ Remote: for search in x direction see **Next Peak X Search < abs >** softkey
➡ Remote: for search in y direction see **Next Peak Y Search up/abs/dn** softkey

Search Mode

Displays a submenu to define the search mode for the **Next Peak** and **Next Min** softkeys.

Next Peak X Search < abs >

Selects the mode of the **Next Peak** softkey, if the X Search is selected (**Marker Search Type** softkey). Three settings are available:

<   Sets the active marker/delta marker to the next maximum left to the marker of the selected frame.

abs   Sets the active marker/delta marker to the next lower maximum of the selected frame.

>   Sets the active marker/delta marker to the next maximum right to the marker of the selected frame.

➡ Remote: `CALC:MARK2:MAX:LEFT` (<)
➡ Remote: `CALC:DELT:MAX:LEFT` (<)
➡ Remote: `CALC:MARK:MAX:RIGH` (>)
➡ Remote: `CALC:DELT:MAX:RIGH` (>)
➡ Remote: `CALC:MARK2:MAX:NEXT` (abs)
➡ Remote: `CALC:DELT2:MAX:NEXT` (abs)

Next Peak Y Search up/abs/dn

Selects the mode of the **Next Peak** softkey, if the Y Search is selected (**Marker Search Type** softkey). Three settings are available:

up   Sets the active marker/delta marker to the next maximum above the current marker position (constant x–axis value).

abs   Sets the active marker/delta marker to the next lower maximum in y–axis direction (constant x–axis value).

dn   Sets the active marker/delta marker to the next maximum below the current marker position (constant x–axis value).

➡ Remote: `CALC:MARK2:SPEC:Y:MAX:ABOV` (up)
➡ Remote: `CALC:DELT2:SPEC:Y:MAX:ABOV` (up)
➡ Remote: `CALC:MARK:SPEC:Y:MAX:NEXT` (abs)
➡ Remote: `CALC:DELT4:SPEC:Y:MAX:NEXT` (abs)
➡ Remote: `CALC:MARK3:SPEC:Y:MAX:BEL` (dn)
➡ Remote: `CALC:DELT3:SPEC:Y:MAX:BEL` (dn)

Next Min X Search < abs >

Selects the mode of the **Next Min** softkey, if the X Search is selected (**Marker Search Type** softkey). Three settings are available:

<   Sets the active marker/delta marker to the next minimum left to the marker of the selected frame.

abs   Sets the active marker/delta marker to the next higher minimum of the selected frame.

>   Sets the active marker/delta marker to the next minimum right to the marker of the selected frame.

➡ Remote: `CALC:MARK2:MIN:LEFT` (<)
➡ Remote: `CALC:DELT:MIN:LEFT` (<)
➡ Remote: `CALC:MARK:MIN:RIGH` (>)
➡ Remote: `CALC:DELT:MIN:RIGH` (>)
➡ Remote: `CALC:MARK2:MIN:NEXT` (abs)
➡ Remote: `CALC:DELT2:MIN:NEXT` (abs)

Next Min Y Search up/abs/dn

Selects the mode of the **Next Min** softkey, if the Y Search is selected (**Marker Search Type** softkey). Three settings are available:

up   Sets the active marker/delta marker to the next minimum above the current marker position (constant x–axis value).

abs   Sets the active marker/delta marker to the next higher minimum in y–axis direction (constant x–axis value).

dn   Sets the active marker/delta marker to the next minimum below the current marker position (constant x–axis value).

➡ Remote: `CALC:MARK2:SPEC:Y:MIN:ABOV` (up)
➡ Remote: `CALC:DELT2:SPEC:Y:MIN:ABOV` (up)
➡ Remote: `CALC:MARK:SPEC:Y:MIN:NEXT` (abs)
➡ Remote: `CALC:DELT4:SPEC:Y:MIN:NEXT` (abs)
➡ Remote: `CALC:MARK3:SPEC:Y:MIN:BEL` (dn)
➡ Remote: `CALC:DELT3:SPEC:Y:MIN:BEL` (dn)

Marker Search Type

Displays the **Marker Search Type** dialog box to select the search direction:

X Search   The selected frame is searched for peaks (**Next Peak X Search < abs >** softkey) or minima (**Next Min X Search < abs >** softkey).

Y Search   The frames are searched with constant x–axis value for peaks (**Next Peak Y Search up/abs/dn** softkey) or minima (**Next Min Y Search up/abs/dn** softkey).

XY Search   All frames are searched in x and y–axis direction for peaks or minima. Only the absolute search mode is available.

Select Search Area

Displays the **Marker Search Area** dialog box to select the search area:

Visible   The search takes only place in the area displayed in the Spectrogram view.

Memory   The search takes place in the whole data range stored in the history buffer.

➡ Remote: `CALC:MARK2:SPEC:SAR MEM`
➡ Remote: `CALC:DELT2:SPEC:SAR MEM`

Center =Mkr Freq (span > 0)

For details refer to the **Center =Mkr Freq** softkey in the marker–> menu of the base unit.

Ref Lvl =Mkr Lvl

For details refer to the **Ref Lvl =Mkr Lvl** softkey in the marker–> menu of the base unit.

Min

Sets the active marker/delta marker to the highest minimum according to the selected search type (**Marker Search Type** softkey).

For further details refer to the **Min** softkey in the marker–> menu of the base unit.

➡ Remote: `CALC:MARK:MIN` (in x direction)
➡ Remote: `CALC:DELT:MIN` (in x direction)
➡ Remote: `CALC:MARK:SPEC:Y:MIN` (y direction)
➡ Remote: `CALC:DELT4:SPEC:Y:MIN` (y direction)
➡ Remote: `CALC:MARK3:SPEC:XY:MIN` (xy direction)
➡ Remote: `CALC:DELT3:SPEC:XY:MIN` (xy direction)

Next Min

Sets the active marker/delta marker to the next minimum according to the mode selected using the **Search Mode** softkey. For the **XY Search** (**Marker Search Type** softkey), this softkey is not available.

➡ Remote: for search in x direction see **Next Min X Search < abs >** softkey
➡ Remote: for search in y direction see **Next Min Y Search up/abs/dn** softkey

Search Limits

For details refer to the **Search Limits** softkey in the marker–> menu of the base unit.

Left Limit

For details refer to the **Left Limit** softkey in the marker–> menu of the base unit.

Right Limit

For details refer to the **Right Limit** softkey in the marker–> menu of the base unit.

Threshold

For details refer to the **Threshold** softkey in the marker–> menu of the base unit.

Search Lim Off

For details refer to the **Search Lim Off** softkey in the marker–> menu of the base unit.

Peak Excursion

For details refer to the **Peak Excursion** softkey in the marker–> menu of the base unit.

Exclude LO

For details refer to the **Exclude LO** softkey in the marker–> menu of the base unit.

Noise Figure Measurements Option (K30)

The Noise Figure Measurements option provides noise figure measurements. Using this option, the noise figure of a Device Under Test, e.g. low–noise FET amplifier circuits, with noise figures of less than 1 dB can be measured. **To open the noise figure measurements menu**

➢ If the **Noise** mode is not the active measurement mode, press the **MODE** key and activate the **Noise** option.

➢ If the **Noise** mode is already active, press the **MENU** key or the **MEAS** key.

   The noise figure measurements menu is displayed. .

Menu and softkey description

– "Softkeys of the noise figure measurements menu (Noise mode)" on page 3.165

– "Softkeys of the sweep menu (Noise mode)" on page 3.177

– "Softkeys of the trace menu (Noise mode)" on page 3.178

– "Softkeys of the marker menu (Noise mode)" on page 3.179

– "Softkeys of the marker–> menu (Noise mode)" on page 3.180

– "Softkeys of the lines menu (Noise mode)" on page 3.180

The span and trigger menus are not available in the **Noise** mode. All other menus are provided as described for the base unit. For details refer to the corresponding menu descriptions.

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 section "How to use the Help System".

Further information

– "Measurement modes of the noise figure measurement" on page 3.160

– "Calibration" on page 3.160

– "Measurement forms" on page 3.161

– "Measurement settings" on page 3.161

– "Result displays" on page 3.161

– "Status bar information" on page 3.164

Tasks

– To edit tables

– To work with limit lines

To edit tables

1. Select the table header using the rotary knob or arrow keys and press rotary knob or the **ENTER** key to enter into the edit mode.

2. Focus the field you want to edit using the arrow keys or the rotary knob.

3. Enter the values (for details refer to the Quick Start Guide, chapter 4, "Basic Operations").

4. To insert a new row above the currently selected row, press the **Insert** softkey.

5. To delete the currently selected row, press the **Delete** softkey.

6. Only available for the **Frequency Table**:
    To update the table according to the **Frequency Settings**, press the **Build Tbl** softkey.

7. Press the **Exit** softkey to leave the edit mode.

To work with limit lines

1. Press the **LINES** key.

    The **Limit Lines** dialog box is displayed. It contains information on name, limit, status, and a comment.

2. To activate limit lines, select the limit line you want to activate and press the **Enable/Disable** softkey.

3. To define a new limit line, press the **New** softkey and enter the limit line characteristics.

4. To modify a limit line, select the limit line you want to edit and press the **Edit** softkey.

5. To save a limit line, press the **Exit** softkey.

    If data are missing or if some data are invalid, an error message is displayed.

6. To delete a limit line, select the limit line you want to edit and press the **Delete** softkey.

Further information

This section provides background information on measurements and displayed information.

Measurement modes of the noise figure measurement

Noise measurements are performed on many different types of device under test (DUT). The type of DUT to be measured determines the test setup and also how the frequency list is to be generated. To support these different types of DUT, two different noise figure measurement types are available:

- Direct measurement

- Frequency–converting measurement

  – Fixed LO, IF = RF + LO

  – Fixed LO, IF = abs(RF – LO)

The setup for the different measurement types is described with the **Schematic** softkey. The measurement mode is set in the **Frequency Settings** dialog box, **Mode** field.

Calibration

The calibration measures the noise introduced to a signal by the spectrum analyzer itself to compensate it in measurements on a device under test. This compensation is called 2nd stage correction, because the spectrum analyzer is the second stage of the test setup, the DUT being the first stage.

If the second stage correction is activated (**Measurement Settings** dialog box, **2nd Stage Correction** option), a separate calibration measurement is performed before the main measurement (for details on the measurement setup refer to the Operating Manual on CD, chapter "Advanced Measurement Examples"). The data measured in the calibration measurement are used for compensation in the main measurement.

It is strongly recommended to perform calibration before running measurements (**Cal** softkey). It is possible to run measurements in an uncalibrated status, but the measurement results will not be corrected for any noise introduced by the spectrum analyzer itself.

If the list of receive frequencies (RF) is changed, at which the measurements are performed, calibration is necessary again to ensure that calibration data are available for every measurement step. For details on frequency settings refer to the **Freq Settings** softkey.

Measurement forms

Two forms of measurements are possible:

- frequency list measurement

  A measurement is performed at each of the frequencies listed in the frequency list (**Freq Settings** softkey). The noise figure of the DUT across a user–specified range of frequencies is measured. In single sweep mode, each frequency point is measured once and complete. In continuous sweep mode, one frequency point after the other is measured in turn until the measurement is aborted.

- fixed frequency measurement

  A continuous measurement is performed at the single frequency currently selected in the **Frequency List Results**. This individual frequency from the frequency list measurement is investigated in more detail, for example to see the effect of dynamic changes to the noise figure of the DUT at a particular frequency (see also **Fix Freq** softkey).

Measurement settings

The overall measurement settings used to obtain the current measurement results are displayed below the title bar (see figure belowFig. 3–22). The following settings are listed:

Setting	Defined in
RBW	**Measurement Settings** dialog box, **RBW** field
Average	**Measurement Settings** dialog box, **Average** field
RF Attenuation	**Measurement Settings** dialog box, **RF Attenuation** field
Auto Ref Level	**Measurement Settings** dialog box, **Automatic Ref Level** field
2nd Stage Corr	**Measurement Settings** dialog box, **2nd Stage Correction** field
Image Rej	**Frequency Settings** dialog box, **Image Rej** field

Fig. 3–22 Measurement settings for the noise figure measurement (example)

Result displays

The result displays consist of two panes:

- **Current Value** pane

  In the title bar of this pane, the current measurement mode of the noise figure measurement (on the left) and the calibration status of the noise figure measurement (on the right, if the second stage correction is switched on) are displayed.

  Below, the settings and measurement results for the currently selected measurement point in the frequency list are displayed:

Parameter	Description
RF	Receive frequency at the DUT at which the current values were measured (Hz).

Parameter	Description
LO	Local oscillator frequency (Hz), only displayed for frequency–converting measurements
IF	Intermediate frequency (Hz), only displayed for frequency–converting measurements
ENR	ENR value (dB), refers to the receive frequency (RF)
Loss In	Loss at the input of the DUT (dB), refers to the receive frequency (RF)
Loss Out	Loss at the output of the DUT (dB) frequency–converting measurements: refers to the intermediate frequency (IF) direct measurements: refers to the receive frequency (RF)
NF	Noise figure measured (dB)
Noise Temp	Noise temperature (K), derived from measured noise figure
Gain	Gain measured (dB)

Fixed LO,IF=RF+LO		Current Value			CALIBRATED
RF:	554 MHz	ENR:	15 dB	NF:	17.13 dB
LO:	0 Hz	Loss In:	0 dB	Noise Temp:	14674.41 K
IF:	554 MHz	Loss Out:	0 dB	Gain:	0.35 dB

Fig. 3–23 Current Value pane (example)

- **Frequency List Result** or graph (frequency list results only)

The measurement results are represented according to the measurement form (see "Measurement forms").

- frequency list results

  The measurement results for all frequencies defined in the **Frequency Table** are displayed in form of a graph (see Fig. Graphical result display (example)) or a table (**Frequency List Results**, see Fig. Tabular result display (example)), depending on the currently selected result display (see **Display List/Graph** softkey). The measurement results are updated as the measurement is in progress. Under **Current Value**, the details of the currently selected frequency in the **Frequency List Results** are displayed.

Fig. 3–24 Graphical result display (example)

Fig. 3–25 Tabular result display (example)

- fixed frequency results

  Under **Current Value**, the measurement results for the fixed frequency are displayed and continuously updated. The **Frequency List Results** do not change – these are the results of the last frequency list measurement.

Status bar information

The status bar displays the following information:

- parameter values

  If a parameter in a settings dialog box is selected, the minimum and maximum values for the selected parameter are displayed.

  If a Boolean or an enumarated parameter in a dialog box is selected, the minimum and maximum values are displayed as N/A for not applicable.

- measurement status

  During the measurement, the current measurement status along with detailed information about the progress is displayed.

- error messages (with red background)

- warning messages (with yellow background)

Softkeys of the noise figure measurements menu (Noise mode)

The following table shows all softkeys available in the noise figure measurements 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.

Command
Freq Settings
Display List/Graph
Display Settings
ENR Settings
Loss Settings
Meas Settings
Schematic
Table edit mode
Build Tbl
Exit
Insert
Delete

Freq Settings

Opens the **Frequency Settings** dialog box. Alternatively, this dialog box is opened by pressing the **CENTER** key (with focus on the **Start Freq** field).
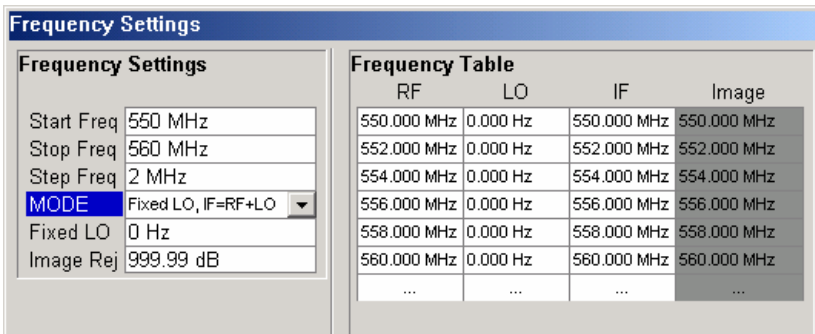
The **Frequency Settings** dialog box contains the following elements:

Frequency Settings	Start Freq
	Stop Freq
	Step Freq
	Mode
	Fixed LO
	Image Rej
Frequency Table	

Under **Frequency Settings**, the frequency settings and the measurement mode are set.

Under **Frequency Table**, the individual measurement steps are listed that will be performed exactly in the order of the table. They are generated from the start frequency, the stop frequency, and the step size on basis of the selected mode. If the start frequency is smaller than the stop frequency, the RF values are generated into a list of ascending frequencies. If the start

frequency is larger, the list is descending. Not more than 100 measurement steps are possible. If the gap between start and stop frequency is too large, increase the step frequency.

Depending on the measurement type, the **Frequency Table** contains the following columns:

Measurement type	Column	Description
Direct measurement Frequency–converting measurement	RF	receive frequency, generated from the **Start Freq**, the **Stop Freq**, and the **Step Freq** field entries
Frequency–converting measurement	LO	constant LO frequency, defined via the **Fixed LO** field
	IF	IF frequency, calculated according to the **Mode** field
	Image	image frequency, shows whether image frequency filters are required and for which frequency range the image rejection of the DUT is needed (**Image Rej** field)

It is possible to customize the **Frequency Table** by editing, deleting, and inserting measurement steps. This might be useful in order to insert extra measurement steps near to a specific frequency of interest in order to get more detailed results. If the start, stop, or step frequency is changed, the **Frequency Table** is generated afresh and all manual modifications are overwritten. To customize this table, proceed according to "To edit tables" on page 3.159.

➡ Remote: `FREQ:LIST:DATA 550MHz,300MHz,900MHz` (Frequency Table)

Start Freq

Specifies the start frequency. This is the first receive frequency (RF) entry in the **Frequency Table** and the **Frequency List Results** (result display).

If the start frequency is changed, the **Frequency Table** is updated accordingly.

➡ Remote: `FREQ:STAR 500MHZ`

Stop Freq

Specifies the stop frequency. This is the last receive frequency (RF) entry in the **Frequency Table** and the **Frequency List Results** (result display).

If the stop frequency is changed, the **Frequency Table** is updated accordingly.

➡ Remote: `FREQ:STOP 700MHZ`

Step Freq

Specifies the step size between the single measurement steps. If the step frequency is larger than the difference between the start frequency and the stop frequency, the **Frequency Table** and the **Frequency List Results** (result display) just contain the start and stop frequency.

If the step frequency is changed, the **Frequency Table** is updated accordingly.

➡ Remote: `FREQ:STEP 10MHZ`

Mode

Specifies the measurement mode. For details on modes refer to "Measurement modes of the noise figure measurement" on page 3.160.

If the mode is changed, the **Frequency Table** is updated accordingly.

➡ Remote: `SENS:CONF:MODE:DUT DOWN`

Fixed LO

Specifies the fixed local oscillator frequency. This field is only available if a frequency–converting measurement mode is selected (**Mode** field). For details on modes refer to Measurement modes of the noise figure measurement.

If the fixed LO is changed, the **Frequency Table** is updated accordingly.

➡ Remote: SENS:CONF:MODE:SYST:LOSC:FREQ 1MHZ

Image Rej

Specifies the suppression applied to the second sideband. This field is only available if a frequency–converting measurement mode is selected. For details on modes refer to "Measurement modes of the noise figure measurement" on page 3.160.

The value entered is applied across the complete frequency range. A value of 999.99 dB corresponds to the generally used single–sideband measurement (SSB), where the second sideband does not noticeably affect the measurement result. This is the default value. A value of 0 dB corresponds to the double–sideband measurement (DSB), where both sidebands are converted to the same extent.

➡ Remote: CORR:IREJ 100

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. For further details refer to "Result displays" on page 3.161.

➡ Remote: DISP:TABL ON

Display Settings

Opens the **Graphic** dialog box to modify the graphical results display.
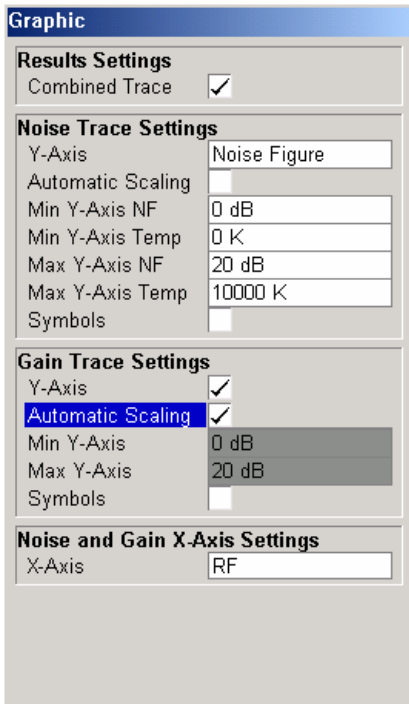
Under **Results Settings**, the settings that affect the overall results display are defined. Under **Noise Trace Settings**, the settings related to the graphical display of noise results are defined. Under **Gain Trace Settings**, the settings related to the graphical display of gain results are defined.

The **Graphic** dialog box contains the following elements:

Results Settings	Combined Trace Display
Noise Trace Settings	Y–Axis
	Automatic Scaling
	Min Y–Axis NF
	Min Y–Axis Temp
	Max Y–Axis NF
	Max Y–Axis Temp
	Symbols
Gain Trace Settings	Y–Axis
	Automatic Scaling
	Min Y–Axis
	Max Y–Axis
	Symbols
Noise and Gain X–Axis Settings	X–Axis

Combined Trace Display

Activates or deactivates the combined trace display of noise and gain results.

On   The noise and gain traces are displayed in the same trace display in different colors.

Off   The noise and gain traces are displayed in different trace displays.

➡ Remote: `DISP:FORM SING`

Y–Axis

Specifies the type of noise result that is to be displayed graphically:

– **Noise Figure**

– **Noise Temperature**

– **Off** (no noise results are displayed graphically)

➡ Remote: `DISP:DATA:TRAC1 NFIG|TEFF`

➡ Remote: `DISP:TRAC OFF`

Automatic Scaling

Activates or deactivates the automatic scaling of the Y–axis.

On   The y–axis is scaled automatically. The automatic scaling algorithm provides the
      optimal display of the complete range of results.

Off   The automatic scaling of the y–axis is switched off, and the scale has to be specified
      manually:
      for noise results via the **Min Y–Axis NF/Min Y–Axis Temp/Max Y–Axis NF/Max Y–
      Axis Temp** fields,

      for gain results via the **Min Y–Axis/Max Y–Axis** fields.

➡ Remote: `DISP:TRAC:Y:AUTO ON`

Min Y–Axis NF/Max Y–Axis NF

Specifies the minimum/maximum noise figure result that can be displayed graphically. It is only
possible to enter a value, if the automatic scaling is deactivated (see **Automatic Scaling**
option), and the y–axis is set to **Noise Figure** (see **Y–Axis** field).

➡ Remote: `DISP:TRAC:Y:BOTT -30`

➡ Remote: `DISP:TRAC:Y:TOP 30`

Min Y–Axis Temp/Max Y–Axis Temp

Specifies the minimum/maximum noise temperature result that can be displayed graphically. It is
only possible to enter a value, if the automatic scaling is deactivated (see **Automatic Scaling**
option), and the y–axis is set to **Noise Figure** (see **Y–Axis** field).

➡ Remote: `DISP:TRAC:Y:BOTT -30`

➡ Remote: `DISP:TRAC:Y:TOP 30`

Symbols

Activates or deactivates the symbol representation. If activated, each measured value is marked by a symbol. This helps to distinguish result types in a monochrome printout.

➥ Remote: `DISP:TRAC:SYMB ON`

Y–Axis

Activates or deactivates the graphical display of gain results.

➥ Remote: `DISP:TRAC2 OFF`

Min Y–Axis/Max Y–Axis

Specifies the minimum/maximum gain result that can be displayed graphically. It is only possible to enter a value, if the automatic scaling is deactivated (see **Automatic Scaling** option), and the y–axis is activated (see **Y–Axis** field).

➥ Remote: `DISP:TRAC2:Y:BOTT 1`
➥ Remote: `DISP:TRAC2:Y:TOP 10`

X–Axis

Specifies the scaling of the x–axis. This parameter is only editable in a frequency–converting measurement mode.

➥ Remote: `DISP:TRAC:X IF`

ENR Settings

Opens the **ENR** dialog box.

ENR Settings		ENR Table	
		RF	ENR
Selection	Constant	550 MHz	5 dB
ENR Constant	15 dB	560 MHz	10 dB
Room Temperature	293 K	570 MHz	20 dB
		…	…
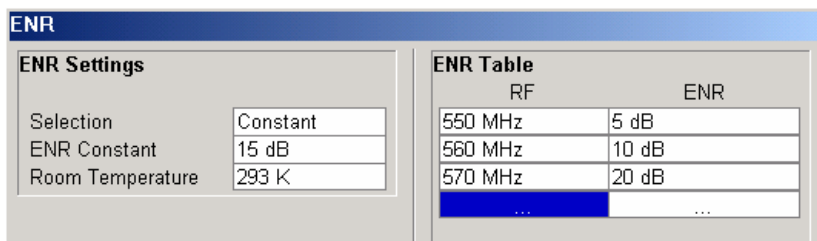
The abbreviation ENR stands for excess noise ratio. Correct ENR values for the noise source are essential to perform accurate measurements. They are used to calculate the effective noise temperature of the noise source that in turn is used for calculation of measurement results.

Under **ENR Settings**, the default ENR value is 15 dB as a constant value that is valid for all frequencies.

Under **ENR Table**, the frequency–dependent ENR values are listed. The list can contain up to 100 RF/ENR pairs. The order of the RF values in the list is not important. To modify this table, proceed as described in "To edit tables" on page 3.159. ENR tables can be saved and recalled at any time via the **FILE** key. Additionally to the data saved by the basic unit, all data entered in the **ENR Settings** dialog box are saved.

The **ENR Settings** dialog box contains the following elements:

ENR Settings	Selection
	ENR Constant
	Room Temperature
ENR Table	

➡ Remote: `CORR:ENR:MEAS:TABL:DATA 1MHZ,10,2MHZ,12` (ENR Table)

Selection

Defines the used ENR values.

Constant   The value specified in the **ENR Constant** field is used for all frequencies. The entries of the **ENR Table** are ignored.

Table   The entries of the **ENR Table** provide the basis for the ENR values. Between these values the R&S FSL uses interpolated values.

➡ Remote: `CORR:ENR:MODE SPOT`

ENR Constant

Specifies the constant ENR value of the noise source that is used throughout the entire frequency range. This parameter is only editable if, in the **Selection** list, **Constant** is selected.

➡ Remote: `CORR:ENR:SPOT 30`

Room Temperature

Specifies the current room temperature as an absolute value in Kelvin. This value is used in the calculation of the noise results.

➡ Remote: `CORR:TEMP 291.50`

Loss Settings

Opens the **LOSS** dialog box to take additional losses due to cables or attenuators into account that are not considered in the calibration.

LOSS

Loss Input Settings		Loss Output Settings	
Selection	Constant	Selection	Table
Loss Input Constant	1 dB	Loss Output Constant	0 dB

Loss Input Table		Loss Output Table	
RF	Loss Input	RF	Loss Output
550 MHz	0 dB	550 MHz	1 dB
560 MHz	2 dB	560 MHz	2 dB
...	...	...	...
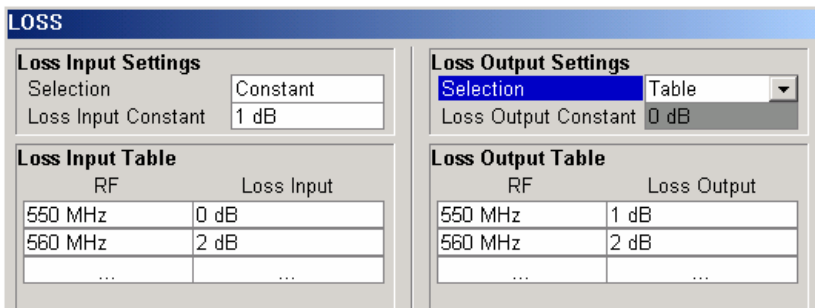
Under **Loss Input Settings**, the additional loss between the noise source and the DUT is defined. Under **Loss Output Settings**, the additional loss between the DUT and the analyzer is defined.

Under **Loss Input Table** or **Loss Output Table**, the list can contain up to 100 RF/ENR pairs. The order of the RF values in the list is not important. To modify this table, proceed as described

Loss tables can be saved and recalled at any time via the **FILE** key. Additionally to the data saved by the basic unit, all loss input & output data entered in the **Loss Settings** dialog box are saved.

The **Loss Settings** dialog box contains the following elements:

Loss Input Settings	Selection
	Loss Input Constant
Loss Input Table	
Loss Output Settings	Selection
	Loss Output Constant
Loss Output Table	

➡ Remote: `CORR:LOSS:INP:TABL 1MHz,10,2MHz,12` (Loss Input Table)

➡ Remote: `CORR:LOSS:OUTP:TABL 1MHz,10,2MHz,12` (Loss Output Table)

Selection

Defines the used Loss values.

Constant   The values specified in the **Loss Input Constant/Loss Output Constant** fields are used for all frequencies. The entries of the **Loss Input/Output Table** are ignored.

Table   The entries of the **Loss Input/Output Table** provide the basis for the Loss values. Between these values the R&S FSL uses interpolated values.

➡ Remote: `CORR:LOSS:INP:MODE SPOT`

➡ Remote: `CORR:LOSS:OUTP:MODE SPOT`

Loss Input Constant/Loss Output Constant

Specifies the constant loss value that is used across the entire frequency range. This parameter is only editable if, in the **Selection** list, **Constant** is selected.

➡ Remote: `CORR:LOSS:INP:SPOT 10`

➡ Remote: `CORR:LOSS:OUTP:SPOT 10`

Meas Settings

Opens the **Measurement Settings** dialog box to modify all settings related to the overall measurement.

Alternatively, the **Measurement Settings** dialog box is opened as follows:

– **AMPT** key, with focus on the **RF Attenuation** field

– **PWR BW** key, with focus on the **RBW** field
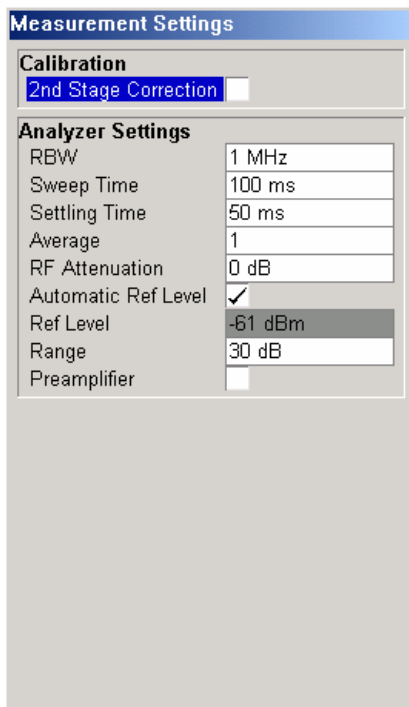
Under **Calibration**, the second stage correction can be activated or deactivated. For details refer also to "Calibration" on page 3.160.

Under **Analyzer Settings**, the general settings for the spectrum analyzer concerning the level, attenuation and bandwidth of the signal to be measured are defined.

The **Measurement Settings** dialog box contains the following elements:

Calibration	2nd Stage Correction
Analyzer Settings	RBW
	Sweep Time
	Settling Time
	Average
	RF Attenuation
	Automatic Ref Level
	Ref Level
	Range
	Preamplifier

2nd Stage Correction

Activates or deactivates the second stage correction.

On   The calibration data recorded via the **Cal** softkey are used to correct the measurement results. The calibration data are stored independent of the state of the option.

Off   No correction is applied to the measurement results.

For details refer also to "Calibration" on page 3.160.

➡ Remote: CORR ON

RBW

Specifies the resolution bandwidth for the measurement.

A large value improves the averaging of the display considerably, reduces the influence of external sources of interference, and permits the fastest measurement time possible.

A low value should only be used across a very small frequency range. For measurements at low frequencies, the RBW must be reduced to prevent the LO frequency of the analyzer from invalidating the measurement. At receive frequencies of 100 kHz, the RBW must not exceed 10 kHz.

➡ Remote: `BAND 1MHz`

Sweep Time

Specifies the time one complete measurement sweep takes. Two sweeps are performed for each measurement step (once with noise source on, once with noise source off).

For narrow bandwidths, the sweep time should be increased in order to give accurate measurement results.

➡ Remote: `SWE:TIME 10s`

Settling Time

Specifies the time the DUT takes to settle after a noise source has been turned on or off.

Most noise sources generate an interfering DC component in addition to the noise spectrum. If the noise source is switched on or off, low–frequency DUTs may require this settling time for coupling capacitors to be charged or discharged.

➡ Remote: `SYST:CONF:DUT:STIM 1000MS`

Average

Specifies the number of measurement sweeps over which the average is taken to produce the displayed measurement results.

The higher the number of sweeps, the more accurate the measurement results, but the measurement time is significantly longer.

An average value of 1 means that each displayed result is produced from one measurement sweep. This is sufficient for most cases.

➡ Remote: `SWE:COUN 10`

RF Attenuation

Specifies the attenuation that is applied to the received RF signal.

To obtain a low noise figure for the analyzer and hence more accurate noise measurements, 0 dB should be set. For high DUT power levels or critical matching, a higher setting is also possible. A setting of 10 dB will give a much better VSWR (voltage standing wave ratio) of the analyzer, but will result in a worse noise figure of the analyzer.

➡ Remote: `INP:ATT 30 DB`

Automatic Ref Level

Activates or deactivates the automatic reference level setting.

Off   Specify a reference level manually (see **Ref Level** softkey).

On   The reference level is measured automatically. The total measurement time increases.

The automatic reference level measurement is performed as follows:

– 2nd stage correction activated:

At the beginning of the calibration measurement, several measurements are performed at the first frequency test point and the reference level is calculated from these results taking into account the maximum gain of the DUT (see **Range** softkey).

– 2nd stage correction deactivated:

At the beginning of the main measurement, several measurements are performed at the first frequency test point and the reference level is calculated from these results. The range setting is not significant.

➡   Remote: `DISP:TRAC:Y:RLEV:AUTO ON`

Ref Level

Specifies the reference level. It is only possible to enter a reference level manually, if the automatic reference level is deactivated (see **Automatic Ref Level** softkey).

The reference level should be about 5 to 15 dB above the noise display that occurs with the DUT connected and the noise source activated.

Even for DUTs with a high–ripple frequency response it can be useful to enter the reference level manually, because an automatic reference level setting may not always result in optimal settings.

➡   Remote: `DISP:TRAC:Y:RLEV 0`

Range

Specifies the maximum gain expected from the DUT.

If the **2nd Stage Correction** is activated, this value is used to calculate the automatic reference level to ensure that the expected power of the measured signal will be within the optimum operating range of the spectrum analyzer (see **Automatic Ref Level** softkey).

To ensure accurate measurement results, the range should not exceed the actual gain of the DUT by more than a margin of 10 dB.

➡   Remote: `SYST:CONF:DUT:GAIN 10`

Preamplifier

Activates or deactivates the preamplifier of the R&S FSL.

➡   Remote: `INP:GAIN:STAT ON`

Schematic

Displays the schematic diagram of the test setup for the selected measurement type and the specified frequency ranges. If the frequency ranges are changed, the schematic diagram is updated accordingly.

– Direct measurement

The direct measurement mode is designed for DUTs without frequency–conversion, e.g. amplifiers.

The schematic display for the direct measurement mode is shown in

Fig. 3–26Fig. Schematic diagram for direct measurements. The upper part of the figure shows the setup for calibration. The lower part of the figure shows the test setup for the measurement.
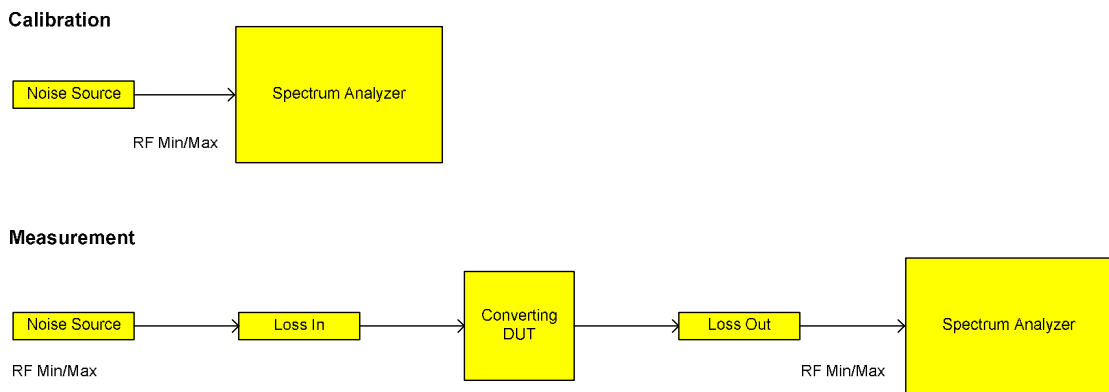
Fig. 3–26 Schematic diagram for direct measurements

– Frequency–converting measurement

The frequency–converting measurement mode is designed for frequency–converting DUTs that have a fixed Local Oscillator (LO) frequency, for example, satellite converters with a fixed LO frequency. .

The schematic display for the frequency–converting measurement mode is shown in Fig. 3–27Fig. Schematic diagram for frequency converting measurements. The upper part of the figure shows the setup for calibration. The lower part of the figure shows the test setup for the measurement.
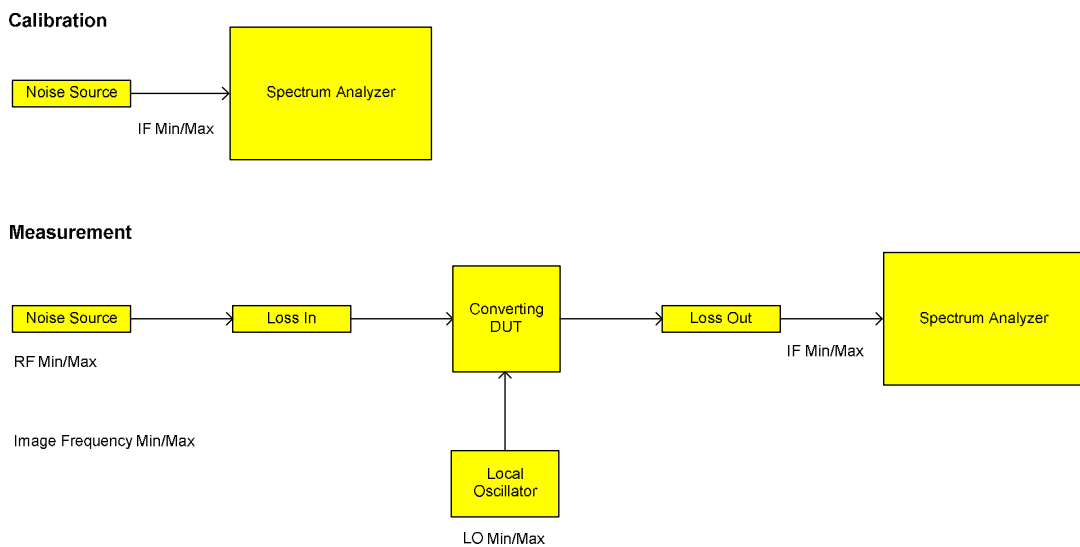
Fig. 3–27 Schematic diagram for frequency converting measurements

Build Tbl

Updates the table according to the **Frequency Settings** (**Freq Settings** softkey).

Exit

Exits the edit mode of a table.

Insert

Inserts a row above the currently selected row and sets the focus on the first field of the new row.

This softkey is only available if the **Frequency Table** contains less than 100 measurement steps.

Delete

Deletes the currently selected row. This action requires no confirmation.

Softkeys of the sweep menu (Noise mode)

The following table shows all softkeys available in the sweep menu in **Noise** mode (**SWEEP** 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.

Command
Sweep Single/Cont
Cal
Fix Freq

Sweep Single/Cont

Selects the sweep mode.

Single	single sweep mode
Cont	continuous sweep mode

If a measurement is started while another measurement is in progress, the first measurement will be aborted and the new measurement started immediately.

For further details refer to "Measurement forms" on page 3.161.

➡ Remote: `CONF:LIST:CONT`
➡ Remote: `CONF:LIST:SING`

Cal

Performs a calibration. The calibration status of the noise figure measurement is displayed in the title bar. For further details refer to "Calibration" on page 3.160.

This softkey is only available, if the **2nd Stage Correction** option in the Measurement Settings dialog box is activated.

➡ Remote: CONF:CORR

Fix Freq

Starts a fixed frequency measurement for the frequency that is currently selected in the **Frequency List Results**. For further details refer to "Measurement forms" on page 3.161 and "Result displays" on page 3.161.

This softkey is only available after a frequency list measurement has been completed and the measurement results are displayed in list form (**Display List/Graph** softkey).

➡ Remote: CONF:SING

➡ Remote: FREQ 10MHz

Softkeys of the trace menu (Noise mode)

Using the trace memory facility, you can save graphical display results (max. 3 trace sets) for comparison with subsequent measurements. This facility is recommended in order to compare and to document the effects of small changes on the DUT.

The following table shows all softkeys available in the trace menu in **Noise** 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.

Command
Display Graph/List
ASCII File Export
Decim Sep
More ⬇
Data –> Mem1
Data –> Mem2
Data –> Mem3
Data On/Off
Mem1 On/Off
Mem2 On/Off
Mem3 On/Off

Display Graph/List

For details refer to the **Display List/Graph** softkey in the noise figure measurements menu.

ASCII File Export

For details refer to the **ASCII File Export** softkey in the trace menu of the base unit.

Decim Sep

For details refer to the **Decim Sep** softkey in the trace menu of the base unit.

Data –> Mem1/Data –> Mem2/Data –> Mem3

Saves the current trace results to trace memory <n>. If a trace memory <n> contains data, the corresponding softkey has a green background. The content of the trace memory <n> is displayed via the **Mem1 On/Off/Mem2 On/Off/Mem3 On/Off** softkeys.

If data is transferred to a trace memory that already contains trace data, the new trace data overwrite the current trace data in the memory.

➡ Remote: CONF:ARR:MEM2 ONCE

➡ Remote: FETC:ARR:MEM2:NOIS:FIG?

➡ Remote: FETC:ARR:MEM2:NOIS:GAIN?

➡ Remote: FETC:ARR:MEM2:NOIS:TEMP?

Data On/Off

Switches the display of the current measurement results on or off. The display of trace memory results is not affected if this softkey is pressed. If a new frequency list measurement is started, the display of the current result trace is switched on automatically.

➡ Remote: DISP:CURR:DATA OFF

Mem1 On/Off / Mem2 On/Off / Mem3 On/Off

Switches the display of trace memory <n> on or off. This softkey is not available if no data is held in the selected trace memory.

➡ Remote: DISP:ARR:MEM2 ON

Softkeys of the marker menu (Noise mode)

The following table shows all softkeys available in the marker menu in **Noise** 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.

Command
Marker 1
Marker to Trace
All Marker Off

Marker 1

Activates marker 1 and opens an edit dialog box to enter a value for marker 1 to be set to. Pressing the softkey again deactivates the marker 1. This softkey is only available if measurement results are displayed.

➡ Remote: `CALC:MARK ON`

➡ Remote: `CALC:MARK:X 550 MHZ`

➡ Remote: `CALC:MARK:Y?`

Marker to Trace

Opens a dialog box to select the trace (noise figure or gain), on which the marker is to be placed. This softkey is only available if measurement results are displayed.

➡ Remote: `CALC:MARK:TRAC GAIN`

All Marker Off

Switches off the active marker. This softkey is only available if measurement results are displayed.

➡ Remote: `CALC:MARK:AOFF`

Softkeys of the marker–> menu (Noise mode)

The following table shows all softkeys available in the marker–> menu in **Noise** 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.

Command
Peak
Min

Peak

Activates marker 1 and sets it to the highest maximum of the trace.

➡ Remote: `CALC:MARK:MAX`

Min

Activates marker 1 and sets it to the minimum of the selected trace.

➡ Remote: `CALC:MARK:MIN`

Softkeys of the lines menu (Noise mode)

The following table shows all softkeys available in the lines menu in **Noise** 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.

Menu / Command	Command
New ▼	Exit
	Insert
	Delete
Edit ▼	same contents as New menu
Enable/Disable	
Delete	

New

Displays the **Limit Line** dialog box in edit mode with all fields necessary to define a new limit line. For further details see "To work with limit lines" on page 3.160.

In the edit mode, the **Limit Line** dialog box contains the following elements:

Name
Limit
Comment
Frequency
Limit

Name

Specifies the name of the limit line to uniquely identify every limit line. Any combination of alphanumeric characters is allowed. If the entered name already exists, an error message is displayed with the request to alter the name.

➡ Remote: `CALC:LIM1:NAME FM1`

Limit

Specifies the result type (noise or gain) and the limit type (upper or lower) for the limit line.

➡ Remote: `CALC:LIM2:TRAC NFIG`

Comment

Specifies a description for the limit line. Any combination of alphanumeric characters is allowed.

➡ Remote: `CALC:LIM5:COMM 'Upper limit for spectrum'`

Frequency

Specifies the receive frequencies.

➡ Remote: `CALC:LIM2:CONT 1MHz,30MHz,100MHz,300MHz,1GHz`

Limit

Specifies the limits for the receive frequencies.

➡ Remote: CALC:LIM2:LOW -30,-40,-10,-40,-30 (lower limit line)

➡ Remote: CALC:LIM2:UPP -10,0,0,-10,-5 (upper limit line)

Exit

Exits the edit mode of a table.

Insert

Inserts a row above the currently selected row and sets the focus on the first field of the new row.

Delete

Deletes the currently selected row. This action requires no confirmation.

Edit

Displays the **Limit Line** dialog box in edit mode with all data of the selected limit line. For further details refer to the **New** softkey.

Enable/Disable

Enables or disables the selected limit line. Limit checking is only performed for activated limit lines. Only one limit line of each type can be active at a given time.

➡ Remote: CALC:LIM:STAT ON

➡ Remote: CALC:LIM4:LOW:STAT ON

➡ Remote: CALC:LIM4:UPP:STAT ON

Delete

Deletes the selected limit line.

➡ Remote: CALC:LIM1:DEL

3GPP Base Station Measurements (Option K72)

The R&S FSL equipped with the 3GPP Base Station Measurements option performs code domain power measurements on downlink signals according to the 3GPP standard (Third Generation Partnership Project, FDD mode). Signals that meet the conditions for channel configuration of 3GPP standard test models 1 to 5 can be measured, including HSDPA and HSUPA signals (test model 5). In addition to the code domain power measurements specified by the 3GPP standard, the 3GPP Base Station Measurements option offers measurements with predefined settings in the frequency domain, e.g. power measurements.

To open the settings menu

➢ If the **3G FDD BTS** mode is not the active measurement mode, press the **MODE** key and activate the **3G FDD BTS** option.

➢ If the **3G FDD BTS** mode is already active, press the **MENU** key.

   The settings menu is displayed. .

Menu and softkey description

– "Softkeys of the settings menu (3G FDD BTS mode)" on page 3.187

– "Softkeys of the frequency menu (3G FDD BTS mode)" on page 3.191

– "Softkeys of the amplitude menu (3G FDD BTS mode)" on page 3.192

– "Softkeys of the trigger menu (3G FDD BTS mode)" on page 3.193

– "Softkeys of the marker menu (3G FDD BTS mode)" on page 3.193

– "Softkeys of the marker–> menu (3G FDD BTS mode)" on page 3.194

– "Softkeys of the measurement menu (3G FDD BTS mode)" on page 3.195

The span, bandwidth, and lines menus are not available in the **3G FDD BTS** mode. All other menus are provided as described for the base unit. For details refer to the corresponding menu descriptions.

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 section "How to use the Help System".

Further information

– "Short list of abbreviations" on page 3.185

– "Channels of the Code Domain Channel Table and their usage" on page 3.185

– "Marker values" on page 3.187

Measurements and result displays

The 3GPP Base Station Measurements option provides the following test measurement types and result displays: (K72)

- code domain power measurements

  – Code Domain Power Diagram (see **Code Dom Power Diagram** softkey)

  – Code Domain Channel Table (see **Code Dom Channel Table** softkey)

  – Code Domain Result Summary (see **Code Dom Result Summary** softkey)

The code domain power measurements are performed as specified by the 3GPP standards. A signal section of approx. 20 ms is recorded for analysis and then searched through to find the start of a 3GPP FDD frame. If a frame start is found in the signal, the code domain power analysis is performed for a complete frame starting from slot 0. The different result displays are calculated from the recorded IQ data set. Therefore it is not necessary to start a new measurement in order to change the result display. Common settings for these measurements are performed via the settings menu (**MENU** key). For details refer to "Softkeys of the settings menu (3G FDD BTS mode)" on page 3.187.

The measurement settings are listed below the title bar:

```
CF 3.0 GHz  Result Summary

                    Channel    0.256
        Att  0 dB   CPICH Slot    0
        Ref -20.0 dBm   Chan Slot    0
```

Parameter in example	Description
CF 3.0 GHz	center frequency
Result Summary	Code Domain Result Summary result display
Att 0 dB	attenuation
Ref –20.0 dBm	reference level
Channel 0.256	channel number and spreading code
CPICH Slot	common pilot channel slot number
Chan Slot	channel slot number

- RF measurements

  – Signal Channel Power (see **Power** softkey)

  – Adjacent–Channel Power (see **ACP** softkey)

  – Spectrum Emission Mask (see **Spectrum Emission Mask** softkey)

All these measurements are accessed via the **MEAS** key (measurement menu). Some parameters are set automatically according to the 3GPP standard. A list of these parameters is given with each measurement type. A set of parameters is passed on from the 3GPP Base Station Measurements option to the base unit and vice versa in order to provide a quick swap (see the following table).

Transferred parameters
center frequency
reference level
attenuation
reference level offset
center frequency step size
trigger source
trigger offset

For a detailed description refer also to the Operating Manual on CD, chapter "Advanced Measurement Examples".

Short list of abbreviations

Term or abbreviation	Description
BTS	base transmission station
CPICH	common pilot channel
DPCH	dedicated physical channel, data channel
FDD	frequency division duplexing
PCCPCH	primary common control physical channel
PICH	paging indication channel.
SCH	synchronization channel, divided into P–SCH (primary synchronization channel) and S–SCH (secondary synchronization channel)

Channels of the Code Domain Channel Table and their usage

The channel assignment table contains the following (data) channels:

- CPICH

   The common pilot channel is used to synchronize the signal in the case of CPICH synchronization. It is expected at code class 8 and code number 0.

- PSCH

   The primary synchronization channel is used to synchronize the signal in the case of SCH synchronization. It is a non–orthogonal channel. Only the power of this channel is determined.

- SSCH

   The secondary synchronization channel is a non–orthogonal channel. Only the power of this channel is determined.

- PCCPCH

   The primary common control physical channel is used to synchronize the signal in the case of SCH synchronization. It is expected at code class 8 and code number 1.

- SCCPCH

   The secondary common control physical channel is a QPSK–modulated channel without any pilot symbols. In the 3GPP test models, this channel can be found in code class 8 and code number 3. However, the code class and code number need not to be fixed and can vary. For this reason, the following rules are used to indicate SCCPCH.

HSDPA/HSUPA On/Off softkey set to **Off**

–   Only one QPSK–modulated channel without pilot symbols is detected and displayed as the SCCPCH. Any further QPSK–modulated channels without pilot symbols are not detected as active channels.

–   If the signal contains more than one channel without pilot symbols, the channel that is received in the highest code class and with the lowest code number is displayed as the SCCPCH. It is expected that only one channel of this type is included in the received signal. According to this assumption, this channel is probably the SCCPCH.

HSDPA/HSUPA On/Off softkey set to **On**

–   All QPSK–modulated channels without pilot symbols are detected. If one of these channels is received at code class 8 and code number 3, it is displayed as the SCCPCH. QPSK–modulated channels without pilot symbols and a code class higher than or equal to 7 are marked with the channel type CHAN. QPSK–modulated channels without pilot symbols and a code class lower than 7 are marked with channel type HSPDSCH.

- PICH

  The paging indication channel is expected at code class 8 and code number 16.

- DPCH

  The dedicated physical channel is a data channel that contains pilot symbols. The displayed channel type is DPCH. The status is **inactive** (channel is not active), **active** (channel is active and all pilot symbols are correct), or **pilotf** (channel is active but it contains incorrect pilot symbols).

- HS–PDSCH (HSDPA)

  The high speed physical downlink shared channel does not contain any pilot symbols. It is a channel type that is expected in code classes equal to or higher than 7: HSPDSCH(QPSK)_ (QPSK–modulated slot of an HS–PDSCH channel), HSPDSCH(16QAM)_ (16QAM–modulated slot of an HS–PDSCH channel), HSPDSCH(NONE)_ (slot without power of an HS–PDSCH channel). The modulation type of these channels can be varied depending on the selected slot. The status is **inactive** (channel is not active) or **active** (channel is active and all pilot symbols are correct).

- HS–SSCH (HSDPA)

  The high speed shared control channel does not contain any pilot symbols. It is a channel type that is expected in code classes equal to or higher than 7. The modulation type should always be QPSK. The channel does not contain any pilot symbols. The status is **inactive** (channel is not active) or **active** (channel is active and all pilot symbols are correct).

- CHAN

  Any arbitrary channel that does not carry a valid pilot symbol sequence is displayed as an arbitrary channel. It is not possible to decide which channel type is transmitted. The only prerequisite is that the channel carries symbols of a sufficient signal to noise ratio.

  –   Chan Type: CHAN (QPSK–modulated channel without any pilot symbols)

  –   Status: inactive if the channel is not active; active if the channel is active

- E–HICH

  Enhanced HARQ hybrid acknowledgement indicator channel
  Carries hybrid ARQ ACK/NACK

- E–RGCH

  Enhanced relative grant channel
  Carries relative grant allocation for a UE

- E–AGCH

  Enhanced absolute grant channel
  Carries absolute grant allocation for a UE

Marker values

Additional to the marker values of the base unit, displayed in the marker field (for details see "Using Markers and Delta Markers – MKR Key" on page 3.42), the symbol rate of the channel (for unassigned codes 7.5 ksps, see example) is given.

```
M1[1]              -2.35 dB
222.512        SR 7.5 Ksps
```

Softkeys of the settings menu (3G FDD BTS mode)

The following table shows all softkeys available in the main menu of the 3GPP Base Station Measurements option (**MENU** 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.

Menu / Command	Command
Select Channel	
Select CPICH Slot	
Code Power Abs/Rel	
Power Ref TOT/CPICH	
Scrambling Code ▼	Scrambling Code
	Scrambling Code Autosearch
	Show List
	Format Hex/Dec
Adjust Ref Level	
More ▼	
Invert Q On/Off	
Normalize On/Off	
Antenna Diversity On/Off	
Antenna Number 1/2	
Inactive Channel Threshold	
HSDPA/HSUPA On/Off	
Sync Type CPICH/SCH	

Select Channel

Opens an edit dialog box to enter the channel number and spreading factor, separated by a decimal point. The chosen channel is marked red in the Code Domain Power Diagram and this channel is used for channel–based evaluations in the Code Domain Result Summary.

Example:

entry 5.128

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

➡ Remote: `CDP:CODE 30`

Select CPICH Slot

Opens an edit dialog box to enter the slot number. The chosen slot is evaluated in the Code Domain Power Diagram and is used for slot–based evaluations in the Code Domain Result Summary.

The slot number is defined on the basis of the CPICH (i.e. calculated in steps of 2560 chips starting from the beginning of the frame). The desired slot of the selected channel is converted according to its timing offset.

Example:

Slot 0 of the CPICH is set. The selected channel has a timing offset of 2816 chips, i.e. slot 0 of the channel is delayed by 2816 chips with respect to the frame start. Slot 0 of the CPICH therefore corresponds to slot 14 of the last frame of the channel.

➡ Remote: `CDP:SLOT 3`

Code Power Abs/Rel (Code Domain Power Diagram)

Sets the scaling of the result display.

Abs   absolute power in dB

Rel   power relative to the reference chosen via the **Power Ref TOT/CPICH** softkey in dBm (default setting)

➡ Remote: `CALC:FEED 'XPOW:CDP'`

Power Ref TOT/CPICH (Code Domain Power Diagram)

Sets the power reference for the relative power displays (see also **Code Power Abs/Rel** softkey):

TOT   total power

CPICH   power of the common pilot channel (default setting)

In contrast to the variable total power, the power of the CPICH is the same in all slots so that it can form the constant reference for the display.

➡ Remote: `CDP:PREF TOT`

Scrambling Code

Opens the scrambling code menu.

Scrambling Code

Opens an edit dialog box to enter the scrambling code. The scrambling codes are used to distinguish between different base stations. Each base station has her own scrambling code. The scrambling code range in hexadecimal format is [0x0 … 0x5FFF]

The scrambling codes are divided into 512 sets, each consisting of a primary scrambling code and 15 secondary scrambling codes.
The range of the primary scrambling codes is described by n=16*i
with k=0, i $\in$ [0 ... 511] = [0 ... 1FF].
The range of the secondary scrambling codes is described by j=16*i+k,
with k $\in$ [1 ... 15] = [1 ... F].

Example:

To enter the primary scrambling code number '1', the digits '10' need to be entered. (i = 1, k = 0).

The entered scrambling code has to coincide with that of the signal. Otherwise, a code domain power measurement of the signal is not possible.

➡ Remote: `CDP:LCOD #H2`

Scrambling Code Autosearch

Searches automatically the scrambling code that leads to the highest signal power and stores it as new scrambling code for further measurements. All scrambling codes of the recorded signal are taken into account. As a prerequisite, the center frequency and level settings have to be correct.

The scrambling code search automatically determines the primary scrambling code number. The secondary scrambling code number is expected to be 0. Other scrambling codes can not be detected. Therefore, the range for detection is 0x000<u>0</u> – 0x1FF<u>0</u>h, where the last digit is always 0.

➡ Remote: `CDP:LCOD:SEAR`

Show List

Displays a result list of the automatic search sequence containing the highest power values calculated and the corresponding scrambling codes. The power shown is a coarse value for the CPICH power.

This softkey is only available after a scrambling code auto search has been performed (see **Scrambling Code Autosearch** softkey).

➡ Remote: `CDP:LCOD:SEAR:LIST?`

Format Hex/Dec

Selects the display format of the scrambling codes:

Hex　　hexadecimal

Dec　　decimal

The default setting is hexadecimal.

➡ Remote: `CDP:LCOD #H2`
➡ Remote: `CDP:LCOD:DVAL 3`

Adjust Ref Level

Adjusts the reference level to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSL or limiting the dynamic range by an S/N ratio that is too small.

➡ Remote: `CDP:LEV:ADJ`

Invert Q On/Off

Switches the Q inversion on or off:

ON   The sign of the Q–component of the signal is inverted.

OFF   The sign of the Q–component of the signal remains unchanged (default setting).

➡ Remote: `CDP:QINV ON`

Normalize On/Off

Activates and deactivates the elimination of the I/Q offset.

➡ Remote: `CDP:NORM ON`

Antenna Diversity On/Off

Activates or deactivates the antenna diversity mode for the code domain power analysis. The default setting of this softkey is **OFF**. The diversity antennas are selected via the **Antenna Number** softkey.

➡ Remote: `CDP:ANT 1`

Antenna Number 1/2

Switches between antenna set 1 or 2. The default setting of this softkey is **1**. This softkey is only available if the **Antenna Diversity On/Off** softkey is activated.

➡ Remote: `CDP:ANT 1`

Inactive Channel Threshold

Opens an edit dialog box to set the minimum power theshold for a single channel (channel power compared to total signal power). Only channels with a signal power above this value are recognized as active channels. Channels with a signal power below this value are considered to be not active (irrespective of whether they contain pilot symbols or not).

The default value is –60 dB.

➡ Remote: `CDP:ICTR -10dB`

HSDPA/HSUPA On/Off

Activates or deactivates the HSUPA/DPA channel detection and the display of the HSUPA/DPA channels in the channel table.

ON   The high speed channels can be detected (default settings).

The modulation type (QPSK /16QAM) is detected.

OFF   The high speed channel can not be detected.

Pilot symbols are detected.

➡   Remote: `CDP:HSDP OFF`

Sync Type CPICH/SCH

Defines the synchronization. The default setting of this softkey is **CPICH**.

CPICH   A synchronization to the CPICH control channel is performed. As a prerequisite, the CPICH control channel must be present in the signal.

SCH   A synchronization without assuming the presence of a CPICH channel is performed.

While this setting can also be used with other channel configurations, but the probability of synchronization failure increases with the number of data channels.

➡   Remote: `CDP:STYP SCH`

Softkeys of the frequency menu (3G FDD BTS mode)

The following table shows all softkeys available in the frequency menu in **3G FDD BTS** mode. 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.

Command
Center
Stepsize Manual
Frequency Offset

Center

For details refer to the **Center** softkey in the frequency menu of the base unit.

Stepsize Manual

For details refer to the **Manual** softkey in the frequency menu of the base unit.

Frequency Offset

For details refer to the **Frequency Offset** softkey in the frequency menu of the base unit.

Softkeys of the amplitude menu (3G FDD BTS mode)

The following table shows all softkeys available in the amplitude menu in **3G FDD BTS** mode. 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.

Command
Ref Level
Adjust Ref Level
Ref Level Offset
dB per Division
Reference Position
RF Atten Manual
RF Atten Auto

Ref Level

For details refer to the **Ref Level** softkey in the amplitude menu of the base unit.

Adjust Ref Level

For details refer to the **Adjust Ref Level** softkey in the settings menu.

Ref Level Offset

For details refer to the **Ref Level Offset** softkey in the amplitude menu of the base unit.

dB per Division

Opens an edit dialog box to set the scaling of the y–axis in dB.

➡ Remote: `DISP:TRAC:Y:PDIV +10dB`

Reference Position

For details refer to the **Ref Level Position** softkey in the amplitude menu of the base unit.

RF Atten Manual

For details refer to the **RF Atten Manual** softkey in the amplitude menu of the base unit.

RF Atten Auto

For details refer to the **RF Atten Auto** softkey in the amplitude menu of the base unit.

Softkeys of the trigger menu (3G FDD BTS mode)

The following table shows all softkeys available in the trigger menu in **3G FDD BTS** mode. 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.

Command
Trigger Source
Trigger Polarity Pos/Neg
Trigger Offset

Trigger Source

Opens the **Trigger Source** dialog box. In the 3GPP Base Station Measurements option, only the following trigger sources are available:

–   **Free Run**, **External**, **IF Power**

For further details refer to the **Trg / Gate Source** softkey in the trigger menu of the base unit.

Trigger Polarity Pos/Neg

For details refer to the **Trg / Gate Polarity Pos/Neg** softkey in the trigger menu of the base unit.

Trigger Offset

For details refer to the **Trigger Offset** softkey in the trigger menu of the base unit.

Softkeys of the marker menu (3G FDD BTS mode)

The following table shows all softkeys available in the marker menu in **3G FDD BTS** mode. 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.

Command
Marker 1
Marker 2
Marker 3
Marker 4
Marker Norm/Delta
Marker Zoom
All Marker Off

Marker 1/Marker 2/Marker 3/Marker 4/Marker Norm/Delta

For details refer to the **Marker 1**, **Marker 2**, **Marker 3**, **Marker 4**, **Marker Norm/Delta** softkeys in the trigger menu of the base unit.

Marker Zoom

Opens an edit dialog box to set the number of channels.

All Marker Off

For details refer to the **All Marker Off** softkey in the trigger menu of the base unit.

Softkeys of the marker–> menu (3G FDD BTS mode)

The following table shows all softkeys available in the marker–> menu in **3G FDD BTS** mode. 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.

Command
Select 1 2 3 4 ⊿
Peak
Next Peak
Next Peak Mode < abs >
CPICH
PCCPCH
More ▼
Select 1 2 3 4 ⊿
Min
Next Min
Next Min Mode < abs >
CPICH
PCCPCH

Select 1 2 3 4 ⊿

For further details refer to the **Select 1 2 3 4 ⊿** softkey in the marker–> menu of the base unit.

Peak

For further details refer to the **Peak** softkey in the marker–> menu of the base unit.

Next Peak

For further details refer to the **Next Peak** softkey in the marker–> menu of the base unit.

Next Peak Mode < abs >

For further details refer to the **Next Peak Mode < abs >** softkey in the marker–> menu of the base unit.

CPICH

Sets the active marker/delta marker on the common pilot channel (code number 0 for spreading factor 256; corresponds to displayed code numbers 0 and 1 of the x–axis).

➡ Remote: `CALC:MARK1:FUNC:CPIC`

➡ Remote: `CALC:MARK1:Y?`

➡ Remote: `CALC:DELT1:FUNC:CPIC`

➡ Remote: `CALC:DELT1:Y?`

PCCPCH

Sets the active marker/delta marker on the primary common control physical channel (code number 1 for spreading factor 256; corresponds to displayed code numbers 2 and 3 of the x–axis).

➡ Remote: `CALC:MARK1:FUNC:PCCP`

➡ Remote: `CALC:MARK1:Y?`

➡ Remote: `CALC:DELT1:FUNC:PCCP`

➡ Remote: `CALC:DELT1:Y?`

Min

For further details refer to the **Min** softkey in the marker–> menu of the base unit.

Next Min

For further details refer to the **Next Min** softkey in the marker–> menu of the base unit.

Next Min Mode < abs >

For further details refer to the **Next Min Mode < abs >** softkey in the marker–> menu of the base unit.

Softkeys of the measurement menu (3G FDD BTS mode)

The following table shows all softkeys available in the measurement menu in **3G FDD BTS** mode. 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.

Menu / Command	Submenu / Command	Submenu / Command	Command
Auto Level&Code			
Code Dom Channel Table			
Code Dom Power Diagram			
Code Dom Result Summary ▼	Select Channel		
	Result Summary Normal		
	Result Summary Extended		
Power ▼	CP / ACP Config ▼	# of TX Chan	

Menu / Command	Submenu / Command	Submenu / Command	Command
		# of Adj Chan	
		Channel Settings ▼	Channel Bandwidth
			Channel Spacing
			Chan Pwr/Hz
			ACP Ref Settings
			Adjust Ref Lvl
			Adjust Settings
		Limit Checking ▼	Limit Chk On/Off
			Edit ACP Limit
		Power Mode ▼	Clear/Write
			Max Hold
		Select Trace	
		Adjust Settings	
	Sweep Time		
	Fast ACP On/Off		
	ACP Abs/Rel		
	Adjust Ref Lvl		
ACP ▼	same contents as Power menu		
Spectrum Emission Mask ▼	Limit Line Auto		
	Limit Line Manual		
	Limit Line User ▼		
	Restore Std Lines		
	30kHz/1MHz Transition		
	Adjust Ref Level		

Auto Level&Code

Starts a sequence performing the following steps:

– Auto adjust the reference level.

– Search and select scrambling code with the highest power.

– Start measurement.

– Select Code Domain Result Summary result display.

➡ Remote: `CDP:ASEQ`

Code Dom Channel Table

Selects the Code Domain Channel Table result display. This channel assignment table can contain up to 512 entries, corresponding to the 512 codes that can be assigned within the class of spreading factor 512. For detailed description of the channels refer to "Channels of the Code Domain Channel Table" on page 3.185.

CF 2.1175 GHz Code Domain Channel Table

	Offs 30.0 dB		Channel	0.256				
	Att 20 dB		CPICH Slot	0				
	Ref 30.0 dBm		Chan Slot	0				

	Chan Type	SymRate [ksps]	Chan	Status	PilotL [Bits]	PwrAbs [dBm]	PwrRel [dB]	T Offs [Chips]
1 Clrw	CPICH	15	0	act.	0	18.62	0.00	0
	PSCH	-----	-----	act.	0	15.65	-2.97	0
	SSCH	-----	-----	act.	0	15.65	-2.97	0
	PCCPCH	15	1	act.	0	18.62	0.00	0
	SCCPCH	15	3	act.	0	15.62	-3.00	0
	PICH	15	16	act.	0	10.63	-7.99	30720
	DPCH	30	2	act.	8	15.62	-3.00	22016
	DPCH	30	7	act.	8	8.60	-10.01	21248
	DPCH	30	11	act.	8	15.63	-2.98	34304
	DPCH	30	13	act.	8	10.59	-8.03	6400
	DPCH	30	17	act.	8	14.59	-4.02	13312
	DPCH	30	20	act.	8	14.63	-3.98	26368
	DPCH	30	23	act.	8	13.63	-4.99	11520

Sync OK

Menu buttons: Auto Level&Code · Code Dom Channel Table · Code Dom Power Diagram · Code Dom Result Summary · Power · ACP · Spectrum Emission Mask

In the upper part of the Code Domain Channel Table, all channels that have to be present in the signal to be analyzed are listed. In the lower part of the table, all data channels contained in the signal are listed. A data channel is any channel that does not have a predefined channel number and symbol rate.

The channels are listed in descending order according to symbol rates and, within a symbol rate, in ascending order according to the channel numbers. Therefore, the unassigned codes are always to be found at the end of the table.

The following parameters of these channels are determined by the code domain power measurement:

– **Chan Type**

type of channel (active channels only)

If the modulation type of a channel can vary (HS–PDSCH), the value of the measured modulation type is appended to the channel type. Data channels without a type fully recognized are characterized as CHAN.

– **SymRate [ksps]**

symbol rate at which the channel is transmitted (7.5 ksps to 960 ksps).

– **Chan**

number of the channel spreading code (0 to [spreading factor–1]).

- **Status**

   Unassigned codes are considered to be inactive. A data channel is considered to be active if the required pilot symbols (see 3GPP specification, exception: PICH) are to be found at the end of each slot. In addition, the channel should have minimum power (see **Inactive Channel Threshold** softkey).

- **PilotL [Bits]**

   number of pilot bits of the channel

- **PwrAbs [dBm]/ PwrRel [dB]**

   indication of the absolute and relative channel power (referenced to the CPICH or the total power of the signal)

- **T Offs [Chips]**

   timing offset = offset between the start of the first slot of the channel and the start of the analyzed 3GPP FDD frame

➡ Remote: `CALC:FEED 'XTIM:CDP:ERR:CTAB'`

➡ Remote: `TRAC? CTAB`

Code Dom Power Diagram

Selects the Code Domain Power Diagram result display. Common settings for code domain power measurements are performed via the settings menu (**MENU** key). For details refer to "Softkeys of the settings menu (3G FDD BTS mode)" on page 3.187.

This result display shows the power of all occupied code channels in a bar graph. The x–axis is scaled for the highest code class or the highest spreading factor (512). Code channels with a lower spreading factor occupy correspondingly more channels of the highest code class. The power of a code channel is always measured according to its symbol rate. Unused code channels are assumed to belong to the highest code class and displayed accordingly. The displayed power of an unused code channel therefore corresponds to the power of a channel with the spreading factor 512 at the respective code position.

The measured power always refers to one slot. The time reference for the start of a slot is the CIPCH slot. If the signal contains channels with timing offsets, the start of a slot of the channel may be different from the CPICH slot start. This leads to the power of the bar graphs normally being averaged over two adjacent slots in such cases. The power shown in the bar graphs thus does not necessarily correspond to the slot power of the channel the bar graph belongs to.
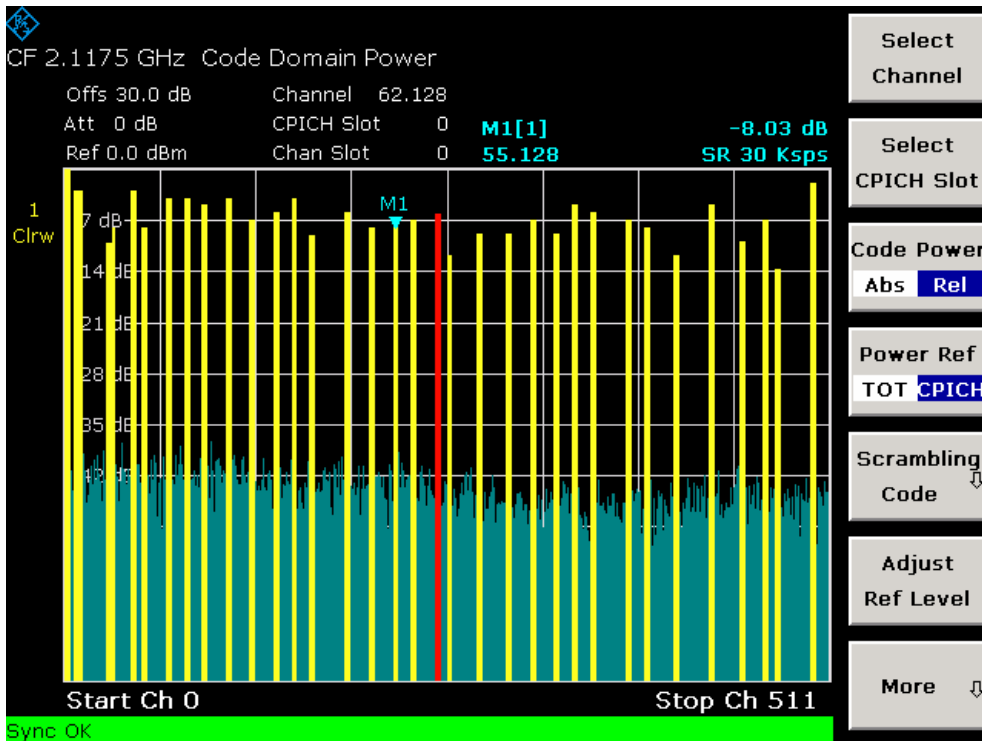
Detected channels are displayed in yellow color.
The codes where no channel could be detected (non–active channels) are displayed in blue color. These channel should be checked for their pilot symbols.
The channel that is adjusted via the **Select Channel** softkey is marked red. If it is an assigned channel, the entire channel is marked red. If it is an unassigned code, only the entered code is marked.

If the **HSDPA/HSUPA On/Off** softkey is activated, the detection of channels does not depend on pilot sequences. An active channel merely has to exceed the minimum power (see **Inactive Channel Threshold** softkey). Therefore channels of the type HS–PDSCH are recognized as active (see also **Code Dom Channel Table** softkey).

➡ Remote: `CALC:FEED 'XPOW:CDP'`

➡ Remote: `TRAC? TRACE1`

Code Dom Result Summary

Opens a submenu to display the Result Summary.

Result Summary Normal

Selects the mormal Code Domain Result Summary result display.

This result display shows the most important measurement results in one table with big letters. Via the **Result Summary Extended** softkey you can switch to the extended Code Dom Result Summary result display.

– **Total Power**

total signal power (average power of total evaluated 3GPP FDD frame).

– **Carrier Frequency Error**

frequency error relative to the center frequency of the R&S FSL

The absolute frequency error is the sum of the R&S FSL and DUT frequency error. The specified value is averaged via one slot; the frequency offset of the selected slot applies (via **Select CPICH Slot** softkey). The maximum frequency error that can be compensated is specified in the table below as a function of the sync mode. Transmitter and receiver should be synchronized as far as possible (see Operating Manual on CD, chapter 2).

Sync Type	Antenna diversity	Max. Freq. Offset
CPICH	X	5.0 kHz
SCH	OFF	1.6 kHz
SCH	ANT 1	330 Hz
SCH	ANT 2	330 Hz

– **Composite EVM**

difference between the test signal and the ideal reference signal

– **Peak Code Domain Error**

projection of the difference between the test signal and the ideal reference signal onto the selected spreading factor

– **No of Active Channels**

number of active channels detected in the signal (Both the detected data channels and the control channels are considered active channels.)

➤ Remote: `CALC:FEED 'XTIM:CDP:ERR:SUMM'`

➤ Remote: `CALC:MARK:FUNC:WCDP:RES? CDP`

➤ Remote: `TRAC? TRACE1`

Result Summary Extended

Extends the number of results shown in the normal Code Dom Result Summary result display (**Result Summary Normal** softkey) by the results listed below.

This result display consists of two panes. The **Global Results** (upper pane) contains the results for the total signal. The **Channel Results** (lower pane) lists the measurement results of the selected channel (marked red in the Code Domain Power Diagram).

– **Chip Rate Error**

chip rate error in ppm

As a result of a high chip rate error, symbol errors arise and the code domain power measurement is possibly not synchronized to the 3GPP FDD signal. The result is valid even if synchronization of the R&S FSL and signal failed.

– **Trigger to Frame**

time difference between the beginning of the recorded signal section to the start of the analyzed 3GPP FDD frame

In the case of triggered data collection, this difference is identical with the time difference of frame trigger (+ trigger offset) – frame start. If synchronization of the R&S FSL and W–CDMA signal fails, the **Trigger to Frame** value is not significant.

- **IQ Offset**

  DC offset of signals in %

- **IQ Imbalance**

  I/Q imbalance of signal in %

- **CPICH Slot No**

  number of the CPICH slot at which the measurement is performed (selected via the **Select CPICH Slot** softkey).

- **CPICH Power**

  power of the common pilot channel

- **Symbol Rate**

  symbol rate at which the channel is transmitted

- **RHO**

  quality parameter for every slot

- **Channel Code**

  number of the spreading code of the selected channel

- **Timing Offset**

  offset between the start of the first slot in the channel and the start of the analyzed 3GPP FDD frame

- **No of Pilot Bits**

  number of pilot bits of the selected channel

- **Channel Slot No**

  channel slot number, obtained by combining the value of the **Select CPICH Slot** softkey and the channel's timing offset

- **Channel Power Rel / Abs**

  channel power, relative (see **Power Ref TOT/CPICH** softkey) and absolute.

- **Symbol EVM**

  Peak (%Pk) or average (%rms) of the results of the error vector magnitude

- **Modulation Type**

  modulation type of an HSDPA channel (QPSK or 16QAM modulation)

➡ Remote: `CDP:RSUM EXT`

Power

Activates the measurement of the 3GPP FDD signal channel power and opens a submenu. This measurement is identical to the ACP measurement (see **ACP** softkey), the default settings are in accordance with the 3GPP specifications:

Parameter	Default setting
CP / ACP Standard	W–CDMA 3GPP FWD
# of Adj Chan	0 (all adjacent channels deactivated)

The R&S FSL measures the unweighted RF signal power in a bandwidth of

$$f_{BW} = 5\,MHz \geq (1 + \alpha) \cdot 3.84\,MHz \quad | \quad \alpha = 0.22$$

The power is measured in zero span using a digital channel filter of 5 MHz in bandwidth. According to the 3GPP standard, the measurement bandwidth (5 MHz) is slightly larger than the minimum required bandwidth of 4.7 MHz.
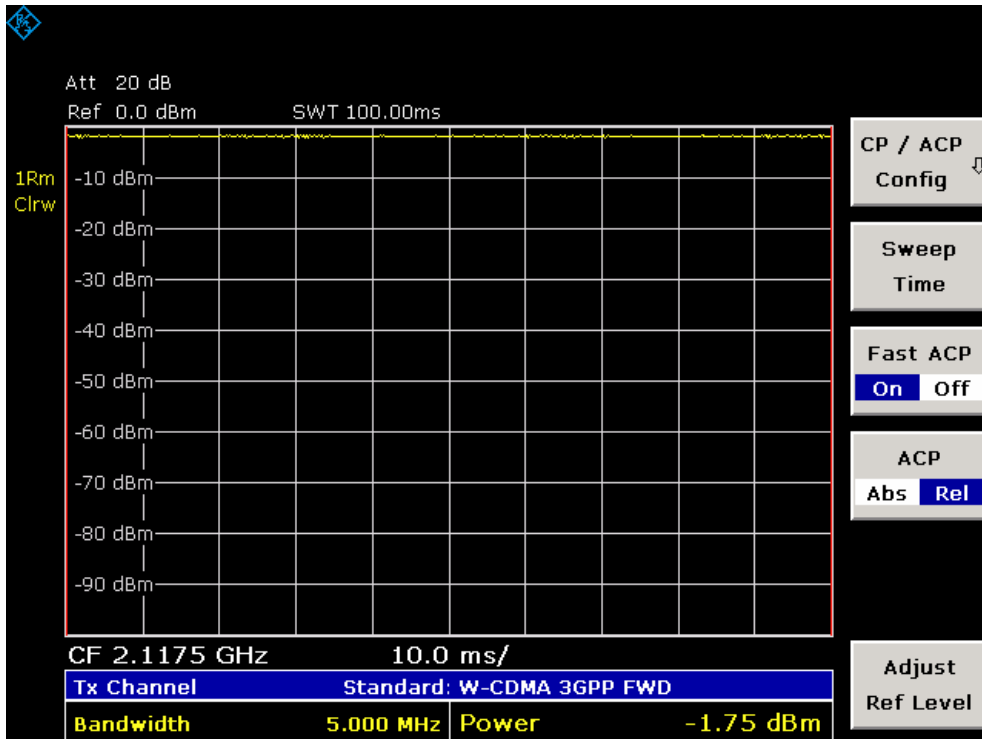
→   Remote: `CONF:WCDP:MEAS POW`

→   Remote: `CALC:MARK:FUNC:POW:RES? CPOW`

→   Remote: `TRAC? TRACE1`

CP / ACP Config

For further details refer to the **CP / ACP Config** softkey in the power measurement menu of the base unit.

# of TX Chan

For further details refer to the **# of TX Chan** softkey in the power measurement menu of the base unit.

# of Adj Chan

For further details refer to the **# of Adj Chan** softkey in the power measurement menu of the base unit.

Channel Settings

For further details refer to the **Channel Settings** softkey in the power measurement menu of the base unit.

Channel Bandwidth

For further details refer to the **Channel Bandwidth** softkey in the power measurement menu of the base unit.

Channel Spacing

For further details refer to the **Channel Spacing** softkey in the power measurement menu of the base unit.

Chan Pwr/Hz

For further details refer to the **Chan Pwr/Hz** softkey in the power measurement menu of the base unit.

ACP Ref Settings

For further details refer to the **ACP Ref Settings** softkey in the power measurement menu of the base unit.

Limit Checking

For further details refer to the **Limit Checking** softkey in the power measurement menu of the base unit.

Limit Chk On/Off

For further details refer to the **Limit Chk On/Off** softkey in the power measurement menu of the base unit.

Edit ACP Limit

For further details refer to the **Edit ACP Limit** softkey in the power measurement menu of the base unit.

Power Mode

For further details refer to the **Power Mode** softkey in the power measurement menu of the base unit.

Clear/Write

For further details refer to the **Clear/Write** softkey in the power measurement menu of the base unit.

Max Hold

For further details refer to the **Max Hold** softkey in the power measurement menu of the base unit.

Select Trace

For further details refer to the **Select Trace** softkey in the power measurement menu of the base unit.

Adjust Settings

For further details refer to the **Adjust Settings** softkey in the power measurement menu of the base unit.

Sweep Time

For further details refer to the **Sweep Time** softkey in the power measurement menu of the base unit.

Fast ACP On/Off

For further details refer to the **Fast ACP On/Off** softkey in the power measurement menu of the base unit.

ACP Abs/Rel

For further details refer to the **ACP Abs/Rel** softkey in the power measurement menu of the base unit.

Adjust Ref Lvl

For further details refer to the **Adjust Ref Level** softkey in the power measurement menu of the base unit.

ACP

Activates the Adjacent–Channel Power measurement and opens a submenu for configuration. This measurement is identical to the ACP measurement of the base unit (see **CP, ACP, MC–ACP** softkey in the measurement menu of the base unit), but the default settings are in accordance with the 3GPP specifications:

Parameter	Default setting
CP / ACP Standard	W–CDMA 3GPP FWD

Parameter	Default setting
# of Adj Chan	2
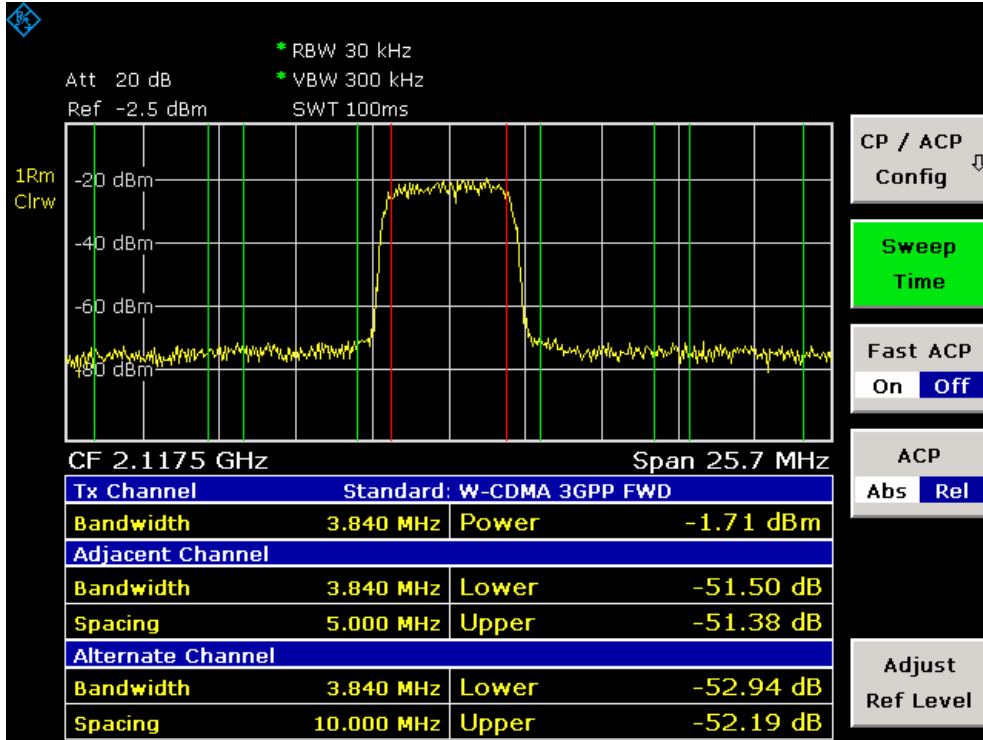
The R&S FSL measures the channel power and the relative power of the adjacent channels/alternate channels. The results are displayed below the screen.

➡ Remote: `CONF:WCDP:MEAS ALCR`

➡ Remote: `CALC:MARK:FUNC:POWer:RES? ACP`

Spectrum Emission Mask

Activates the Spectrum Emission Mask measurement and opens a submenu. This measurement compares the signal power in defined carrier offset ranges with the maximum values specified by 3GPP.

The following default settings are used in accordance with the 3GPP specifications:

Parameter	Default setting
CP / ACP Standard	W–CDMA 3GPP REV
# of Adj Chan	0
Span	25.5 MHz
BW	50 ms

Additional to the graphical result display, the peak list displays the peaks of the frequency ranges specified by the 3GPP specification. The table contains the following information:

Tx Power	power of the transmission channel
Tx Bandwidth	bandwidth used to measure the Tx power
Range	upper and lower frequency of the evaluated range relative to the center frequency
RBW	bandwidth used to measure the evaluated range
Frequency	exact frequency where the peak was detected
Level	absolute level of the peak
Pwr Rel	peak level relative to the Tx power
Delta	level relative to the limit. Positive Values show that the peak exceeds the limit from the specification. The values Level, Pwr Rel and Delta therefore change their color to red and an asterisk appears beside the Delta values.

➡ Remote: `CONF:WCDP:MEAS ESP`

➡ Remote: `TRAC? TRACE1`

Limit Line Auto

If activated, sets the limit line automatically according to the power determined in the useful channel. If the measurement is carried out in continuous sweep mode and the channel power changes from sweep to sweep, this can result in the limit line being continuously redrawn. This softkey is activated by default.

If deactivated, the limit line settings are defined via the **Limit Line Manual** softkey.

➡ Remote: `CALC:LIM:ESP:MODE AUTO`

Limit Line Manual

Opens the **Manual Power** dialog box to select one of the following predefined limit lines according to the expected power range:

P $\geq$ 43 dBm
39 dBm $\leq$ P < 43 dBm
31 dBm $\leq$ P < 39 dBm
P < 31 dBm

The power at the different frequency offsets is compared with the selected limit line.

➡ Remote: `CALC:LIM:ESP:MODE MAN`

➡ Remote: `CALC:LIM:ESP:VAL 39`

Limit Line User

Opens the lines menu of the base unit and switches to the standard limit line handling of the base unit. For details refer to section "Softkeys of the lines menu" on page 3.87 of the base unit.

➡ Remote: `CALC:LIM:ESP:MODE USER`

Restore Std Lines

Restores the limit lines defined according to the standard to their factory–set values.

➡ Remote: `CALC:LIM:ESP:REST`

30kHz/1MHz Transition

Defines the offset frequency at which the resolution bandwidth is changed in the range from 30 kHz to 1 MHz. The default value is 4.0 MHz.

➡ Remote: `CALC:LIM:ESP:TRAN 5MHZ`

Adjust Ref Level

Adjusts the reference level to the total signal power measured. This softkey becomes active after the occupied bandwidth has been measured in the first sweep and therefore the total signal power is known.

This ensures that the signal path is not overdriven and that the dynamic range is not limited by a reference level that is too low.

➡ Remote: `POW:ACH:PRES:RLEV`

WLAN TX Measurements (Option K91)

The WLAN TX Measurements option extends the functionality of the R&S FSL spectrum analyzer to enable Wireless LAN TX measurements according to IEEE standards 802.11 a, b, g and j.

TX measurement of wireless LAN Device Under Test (DUT) according to the standards specified for the device can be performed:

- Modulation formats:
  - IEEE 802.11a, j, g (OFDM): BPSK, QPSK, 16 QAM, 64 QAM
  - IEEE 802.11b, g (single carrier): DBPSK, DQPSK, CCK (5.5 & 11 Mbps), PBCC (5.5, 11 & 22 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 up to 15 ms (dependent on selected standard), multiple sweeps possible for large number of bursts (10922).

To open the WLAN menu

➢ If the **WLAN** mode is not the active measurement mode, press the **MODE** key and activate the **WLAN** option.

➢ If the **WLAN** mode is already active, press the **MENU** or **MEAS** key.

   The WLAN menu is displayed. .

➢ To exit the **WLAN** measurement mode, select another option. For details refer also to section "Measurement Mode Selection – MODE Key" on page 3.92.

Menu and softkey description

The file, setup, and print menus are provided as described for the base unit. For details refer to the corresponding menu descriptions. The span and bandwidth 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** 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 section "How to use the Help System".

Further information topics

– "Measurements and result displays" on page 3.209

– "Rise / fall time measurement" on page 3.212

– "Title bar information" on page 3.213

– "Status bar information" on page 3.213

Measurements and result displays

The WLAN option provides two main measurement types:

- IQ measurements (based on captured IQ data)

  – Power vs Time (see **PVT** softkey)

  – EVM vs Symbol, EVM vs Carrier (see **EVM vs Symbol/Carrier** softkey)

  – Phase vs Preamble, Frequency vs Preamble (see **Error Frequency/Phase** softkey)

  – Spectrum Flatness (see **Spectrum Flatness** softkey)

  – Spectrum FFT (see **Spectrum FFT** softkey)

  – Constellation vs Symbol, Constellation vs Carrier (see **Constell vs Symbol/Carrier** softkey)

  – Conditional Cumulative Distribution Function (see **CCDF** softkey)

  – Bit Stream (see **Bitstream** softkey)

  – Signal Field (see **Signal Field** softkey)

- frequency sweep measurements

  – Spectrum mask (see **Spectrum Mask** or **Spectrum IEEE/ETSI** softkeys)

  – Spectrum ACP/ACPR (see **Spectrum ACPR** or **ACP Rel/Abs** softkey)

The measurement result display is divided into two panes:

- Measurement settings

- Result displays

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

  – "Result summary list" on page 3.210

  – "Result display graph" on page 3.211

Measurement settings

The overall measurement settings used to obtain the current measurement results are displayed below the title bar (see Fig. 3–28). The following settings are listed:

Setting	Description	Restrictions
Frequency	The frequency of the measured input signal.	
Preamble Type	The type of preamble of analyzed bursts.	
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 spectrum analyzer), e.g.: External Att = 10 dB means that before the RF connector of the R&S FSL a 10 dB attenuator is used External Att = –20 dB means that before the RF connector of the R&S FSL a amplifier with 20 dB gain is used	
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. 3–28 Measurement settings (example)

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 (**LINES** key).

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.

IEEE 802.11g								Settings
Frequency:	1 GHz		Ref Level:	11.1 dBm		External Att:	0 dB	General
Premable Type:	OFDM		Modulation:	54 Mbps 64 QAM		PSDU Len:	1/1366	Demod
*				**Result Summary**				
Bursts:	3	Min	Mean	Limit	Max	Limit	Unit	Display
EVM All Carr.		0.78	0.83	5.62	0.88	5.62	%	Graph
		- 42.14	- 41.59	- 25.00	- 41.12	- 25.00	dB	List
EVM Data Carr.		0.78	0.84	5.62	0.89	5.62	%	
		- 42.11	- 41.50	- 25.00	- 41.00	- 25.00	dB	PVT
EVM Pilot Carr.		0.67	0.72	39.81	0.75	39.81	%	
		- 43.44	- 42.88	- 8.00	- 42.45	- 8.00	dB	EVM
IQ Offset		- 47.53	- 46.87	- 15.00	- 46.17	- 15.00	dB	Constell
Gain Imbalance		- 0.16	- 0.10		- 0.06		%	
		- 0.01	- 0.01		- 0.01		dB	Spectrum
Quadrature Err		- 0.08	- 0.06		- 0.05		%	
Freq. Err		- 461.36	- 471.38	± 25000	- 480.19	± 25000	Hz	Statistics
Symb Clock Err		- 0.60	- 0.96	± 25	- 1.64	± 25	ppm	
Burst Power		1.30	1.30		1.30		dBm	
Crest Factor		8.93	8.93		8.94		dB	
Running ...								

Fig. 3–29 Result summary list (example)

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.
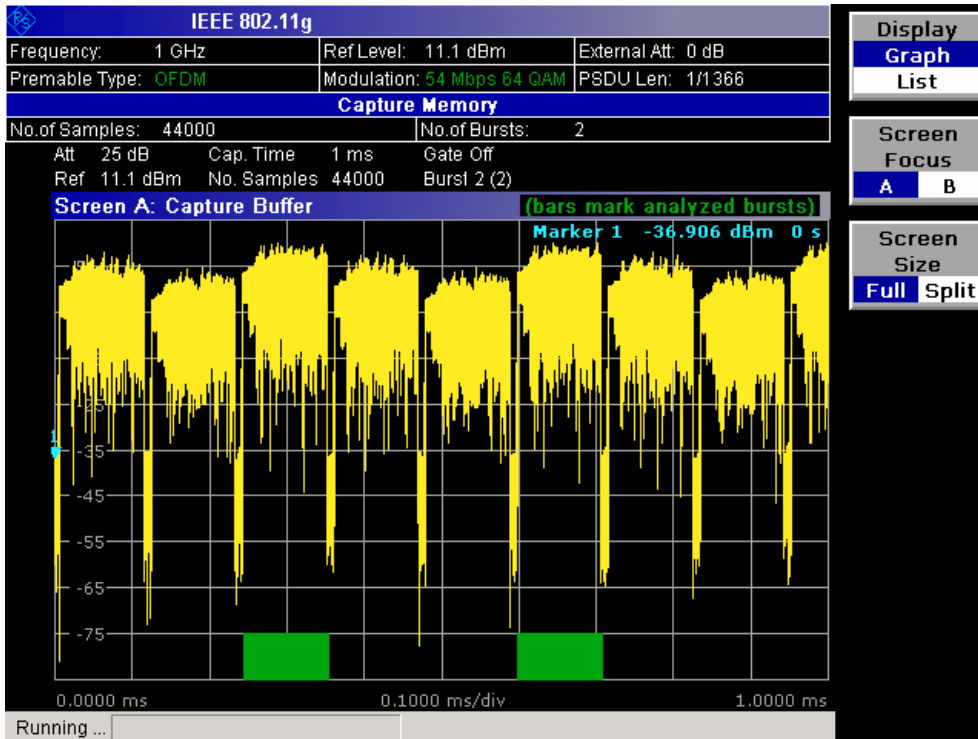
Fig. 3–30 Magnitude capture buffer results (example)

- 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.

Further information

This section provides background information on measurements and displayed information. For details on signal processing refer to chapter "Advanced Measurement Examples", section "Measurement Examples of the WLAN TX Measurements Option (K91)".

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 P_{max} over the whole burst. Set $P_{ref}=P_{max}$

- If **Ref Pow Mean** is set: Calculate mean power P_{mean} of the whole burst. Set $P_{ref}=P_{mean}$
- Rise time
  - Search the first crossing of $0.5 \times P_{ref}$ from the left.
  - Search backwards for the 10% crossing $0.1 \times P_{ref}$ and note t_{10}.
  - Search forward for the 90% crossing $0.9 \times P_{ref}$ and note t_{90}.
  - Return $T_{rise}=t_{90}-t_{10}$.
- Fall time
  - Search the first crossing of $0.5 \times P_{ref}$ from the right.
  - search forwards for the 10% crossing $0.1 \times P_{ref}$ and note t_{10}.
  - search backwards for the 90% crossing $0.9 \times P_{ref}$ and note t_{90}.
  - Return $T_{fall}=t_{10}-t_{90}$.

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 FSL–K91 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.

Title bar information

The title bar displays the following information:

- wireless LAN standard applicable to the current measurement (in the middle)

Status bar information

The status bar displays the following information:

- parameter values

  If a parameter in a settings dialog box is selected, the minimum and maximum values for the selected parameter are displayed.

  If a Boolean parameter in a dialog box is selected, the minimum and maximum values are displayed as N/A for not applicable.

- measurement status

  During the measurement, the current measurement status along with detailed information about the progress is displayed.

- error messages (with red background)

- warning messages (with yellow background)

Softkeys of the WLAN menu

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.

Menu / Command	Command
Settings General/Demod	
Display List/Graph	
PVT ▼	Settings General/Demod
	Display List/Graph
	Full Burst
	Rising & Falling
	Ramp Up/Down/Up & Down
	Ref Pow Max/Mean
	Average Length
	More ▼
	Gating Settings On/Off
	Import
	Export
	R&S Support
EVM Constell ▼	Settings General/Demod
	Display List/Graph
	EVM vs Symbol/Carrier
	Error Frequency/Phase
	Constell vs Symbol/Carrier
	Carrier Selection
	More ▼
	Gating Settings On/Off
	Import
	Export
	Y–Axis/Div
	R&S Support
Spectrum ▼	Settings General/Demod
	Display List/Graph
	Spectrum Flatness
	Spectrum Mask / Spectrum IEEE/ETSI
	Spectrum FFT
	Spectrum ACPR / Spectrum ACP / ACP Rel/Abs
	More ▼
	same contents as PVT side menu
Statistics ▼	Settings General/Demod
	Display List/Graph
	CCDF
	Bitstream
	Signal Field / PLCP Header

Menu / Command	Command
	More ▼
	same contents as PVT side menu

Settings General/Demod

Opens the **General Settings** or the **Demod Settings** dialog box. Screenshots of the dialog boxes are provided in chapter "Advanced Measurement Examples", section "Measurement Examples of the WLAN TX Measurements Option (K91)".

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

– **CENTER** 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

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:

Signal Characteristics	Standard
	Frequency
	Channel No
Level Settings	Signal Level
	Auto Lvl
	Ext Att
Data Capture Settings	Capture Time
	Burst Count
	Analyze Bursts
	Sweep Count
Trigger Settings	Trigger Mode
	Trigger Offset
	Power Level
	Auto Lvl
IQ Settings	Swap IQ
Advanced Settings	Auto Level Time
	Ref Level
	Attenuation
	Sample Rate

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.

Burst to Analyze	Signal Field Content
	Use Header Content
	Burst Type
	Preamble Type
	Auto Demodulation
	Analyze PSDU Mod
	Demodulator
	Equal Burst Length
	Data Symbols
	Min Data Symbols
	Max Data Symbols
	Channel Estimation
	Payload Length
	Min Payload Length
	Max Payload Length
Tracking	Phase
	Timing
	Level

Standard (General Settings dialog box)

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.

➡ Remote: CONF:STAN 0

Frequency (General Settings dialog box)

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

➡ Remote: FREQ:CENT 100MHz

Channel No (General Settings dialog box)

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

➡ Remote: CONF:CHAN 9

Signal Level (General Settings dialog box)

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).

➡ Remote: CONF:POW:EXP:RF 9

Auto Lvl (General Settings dialog box)

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. For details about automatic level detection refer to the Operating Manual on CD, chapter "Advanced Measurement Examples".

Off   The reference level is defined manually in the **Signal Level** field.

➡ Remote: CONF:POW:AUTO 1
➡ Remote: CONF:POW:AUTO:SWE:TIME 200MS

Ext Att (General Settings dialog box)

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.

➡ Remote: INP:ATT 30dB

Capture Time (General Settings dialog box)

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

➡ Remote: SWE:TIME 10ms

Burst Count (General Settings dialog box)

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.

➡ Remote: BURS:COUN:STAT ON

Analyze Bursts (General Settings dialog box)

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

➡ Remote: BURS:COUN 16

Sweep Count (General Settings dialog box)

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

➡ Remote: `SWEep:COUNt 64`

Trigger Mode (General Settings dialog box)

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**.

➡ Remote: `TRIG:MODE IMM`

Trigger Offset (General Settings dialog box)

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.

➡ Remote: `TRIG:HOLD 500us`

Power Level (General Settings dialog box)

Specifies the trigger level if the **Power** trigger mode is set.

➡ Remote: `TRIG:LEV:POW 10 DBM`

Auto Lvl (General Settings dialog box)

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** field.

➡ Remote: `TRIG:LEV:POW:AUTO ON`

Swap IQ (General Settings dialog box)

Activates or deactivates the inverted I/Q modulation.

On   I and Q signals are interchanged.

Off   Normal I/Q modulation.

➡ Remote: `SWAP ON`

Auto Level Time (General Settings dialog box)

Specifies the sweep time used for the automatic level measurements.

➡ Remote: `CONF:POW:AUTO:SWE:TIME 200MS`

Ref Level (General Settings dialog box)

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.

➡ Remote: `DISP:TRAC:Y:RLEV?`

Attenuation (General Settings dialog box)

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.

➡ Remote: `INP:ATT 30dB`

Sample Rate (General Settings dialog box)

Specifies the sample rate used for IQ measurements.

➡ Remote: `TRACE:IQ:SRAT 20000`

Signal Field Content (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

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** field.

Off   The data is demodulated according to the modulation scheme specified in the **Demodulator** field. If any of the analyzed data has a modulation different to that specified the results will be of limited use.

➡ Remote: `DEM:FORM:SIGS ON`

Use Header Content (Demod Settings dialog box, 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** field.

Off   The data is demodulated according to the modulation scheme specified in the **Demodulator** field. If any of the analyzed data has a modulation different to that specified the results will be of limited use.

➡ Remote: `DEM:FORM:AUT ON`

Burst Type (Demod Settings dialog box, IEEE 802.11a, g (OFDM, Single Carrier), j)

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
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

➡ Remote: DEM:FORM:BAN:BTYPe 'DIRECT'

Preamble Type (Demod Settings dialog box, 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.

➡ Remote: DEM:FORM:BAN:BTYPe 'SHORT'

Auto Demodulation (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

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.

➡ Remote: DEM:FORM:AUT ON

Analyze PSDU Mod (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

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.

➡ Remote: DEM:FORM:AUT ON

Demodulator (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

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.

➡ Remote: DEM:FORM:BAN 'QAM16'

Equal Burst Length (Demod Settings dialog box)

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	On	Only bursts with exactly the number of symbols specified in the **Data Symbols** field are considered for measurement analysis.
	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.
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.
	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.
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.
	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.

➡ Remote: `DEM:FORM:BAN:SYMB:EQU ON`

➡ Remote: `DEM:FORM:BAN:DBYTes:EQU ON`

➡ Remote: `DEM:BAN:DUR:EQU ON` (PVT)

Data Symbols (Demod Settings dialog box, IEEE 802.11a, j)

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.

➡ Remote: `DEM:FORM:BAN:SYMB:MIN 16`

Min Data Symbols (Demod Settings dialog box, IEEE 802.11a, j)

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.

➡ Remote: `DEM:FORM:BAN:SYMB:MIN 16`

Max Data Symbols (Demod Settings dialog box, IEEE 802.11a, j)

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.

➡ Remote: `DEM:FORM:BAN:SYMB:MAX 1300`

Channel Estimation (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

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.

➡ Remote: `DEM:CEST ON`

Payload Length (Demod Settings dialog box, 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.

➡ Remote: `DEM:FORM:BAN:DBYTes:MIN 16`

➡ Remote: `DEM:BAN:DUR:MIN 45`

Min Payload Length (Demod Settings dialog box, 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.

➡ Remote: `DEM:FORM:BAN:DBYTes:MIN 16`

➡ Remote: `DEM:BAN:DUR:MIN 45`

Max Payload Length (Demod Settings dialog box, 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.

➡ Remote: `DEM:FORM:BAN:DBYTes:MAX 1300`

➡ Remote: `DEM:BAN:DUR:MAX 1300`

Phase (Demod Settings dialog box)

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

➡ Remote: `TRAC:PHAS 1`

Timing (Demod Settings dialog box)

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

➡ Remote: `TRAC:TIME ON`

Level (Demod Settings dialog box)

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

➡   Remote: `TRAC:LEV ON`

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.

➡   Remote: `DISP:WIND1:TABL ON`

➡   Remote: for result queries see chapter "Remote Control – Commands", section FETCh Subsystem

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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 "Rise / fall time measurement" on page 3.212.

➡   Remote: `CONF:BURS:PVT`

Full Burst (IEEE 802.11a, g, j – OFDM)

Displays the PVT results in a single graph with all burst data being displayed.
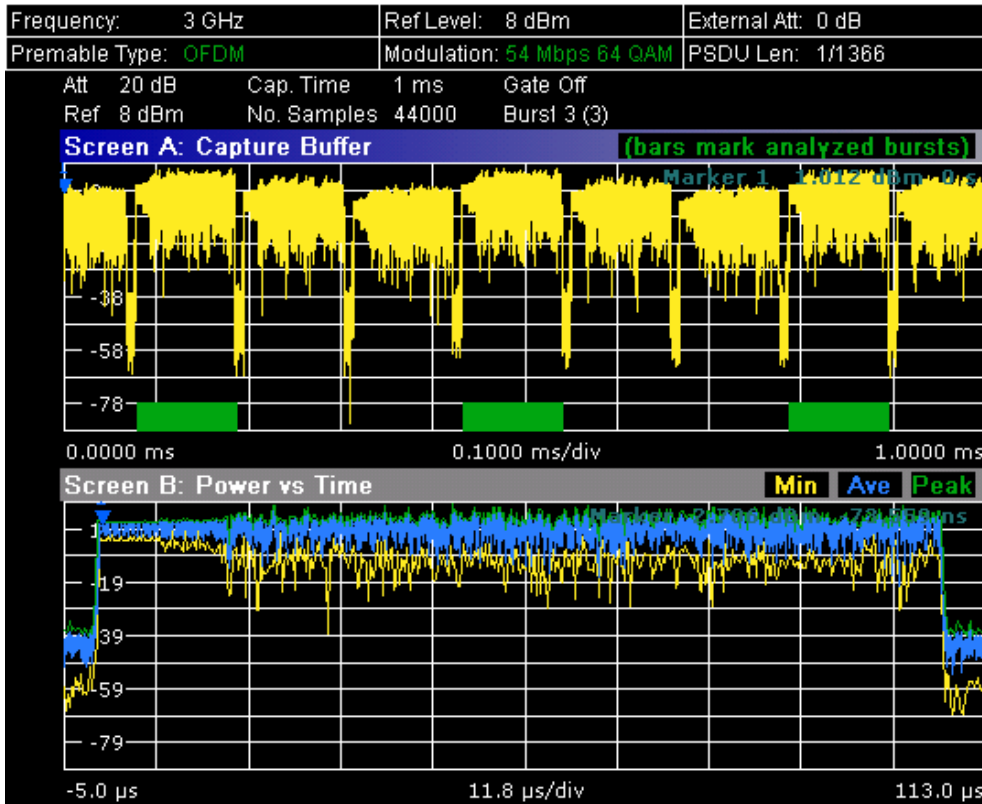
For further details refer to the PVT softkey.

➡ Remote: `CONF:BURS:PVT:SEL FULL`

Rising & Falling (IEEE 802.11a, g, j – OFDM)

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.

➡ Remote: `CONF:BURS:PVT:SEL EDGE`

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

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.
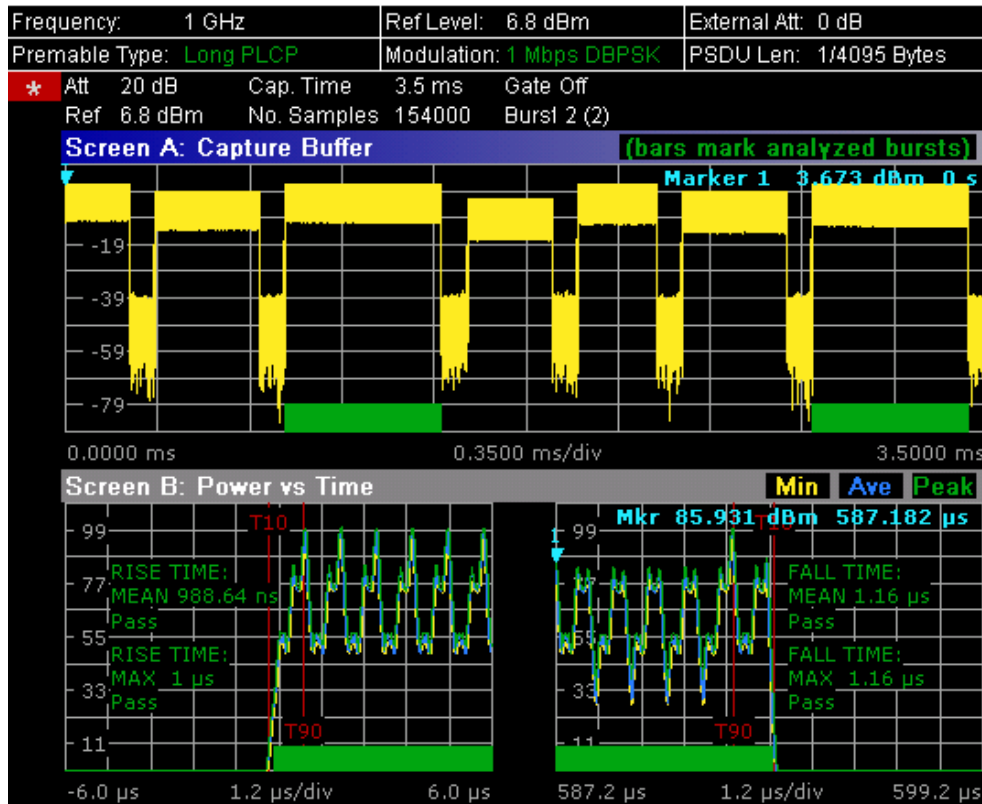
For further details refer to the PVT softkey.

➡ Remote: `CONF:BURS:PVT:SEL RISE`

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

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

For further details refer to the PVT softkey.

➡ Remote: `CONF:BURS:PVT:RPOW MEAN`

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

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 softkey.

➡ Remote: `CONF:BURS:PVT:AVER 31`

Gating Settings On/Off

Activates or deactivates gating, or 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.

➡ Remote: `SWE:EGAT ON`

➡ Remote: `SWE:EGAT:HOLD 125us, SWE:EGAT:HOLD:SAMP 2500` (Delay)

➡ Remote: `SWE:EGAT:LENG 20ms, SWE:EGAT:LENG:SAMP 200000` (Length)

➡ Remote: `SWE:EGAT:LINK ON` (Link Gate and Mark)

Import

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.

➡ Remote: `MMEM:LOAD:IQ:STAT`

Export

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.

➡ Remote: `MMEM:STOR:IQ:STAT`

R&S Support

Creates files that help identifying the current problem. They are stored under C:\R_S\Instr\user\Support. 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.

Y–Axis/Div

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.

➡ Remote: `DISP:WIND2:TRAC:Y:SCAL:AUTO ON`
➡ Remote: `DISP:WIND2:TRAC:Y:SCAL:DPIV 2`

EVM Constell

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

EVM vs Symbol/Carrier

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) 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.
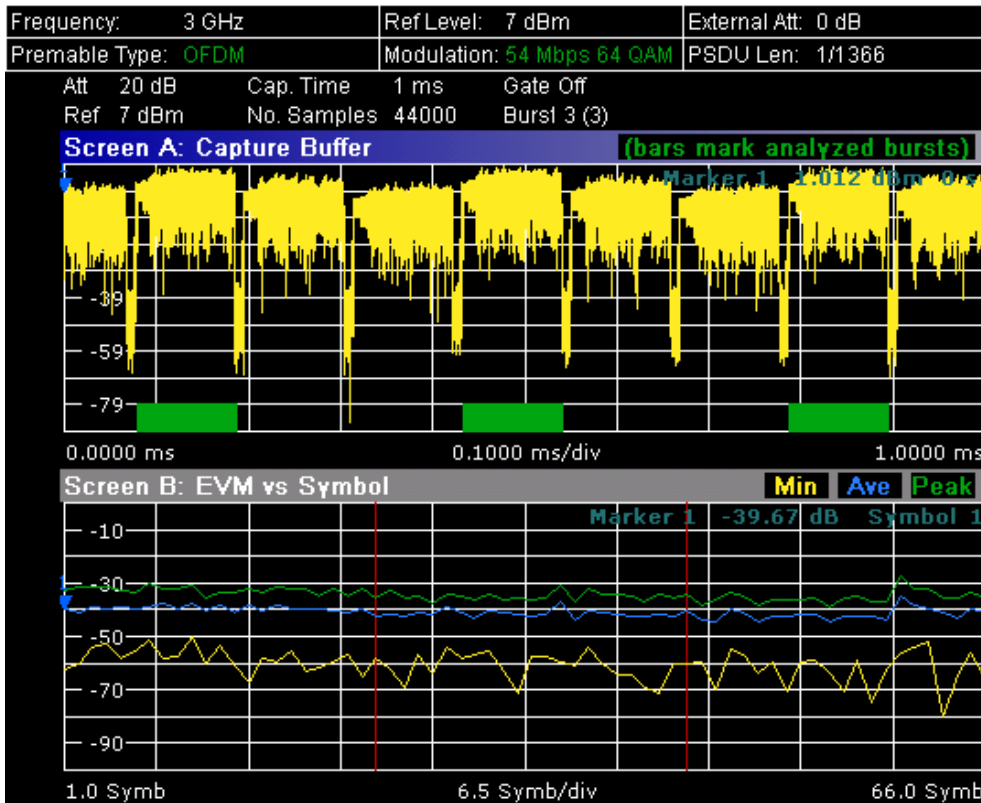
– EVM vs Carrier (IEEE 802.11a, g, j – OFDM)

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.
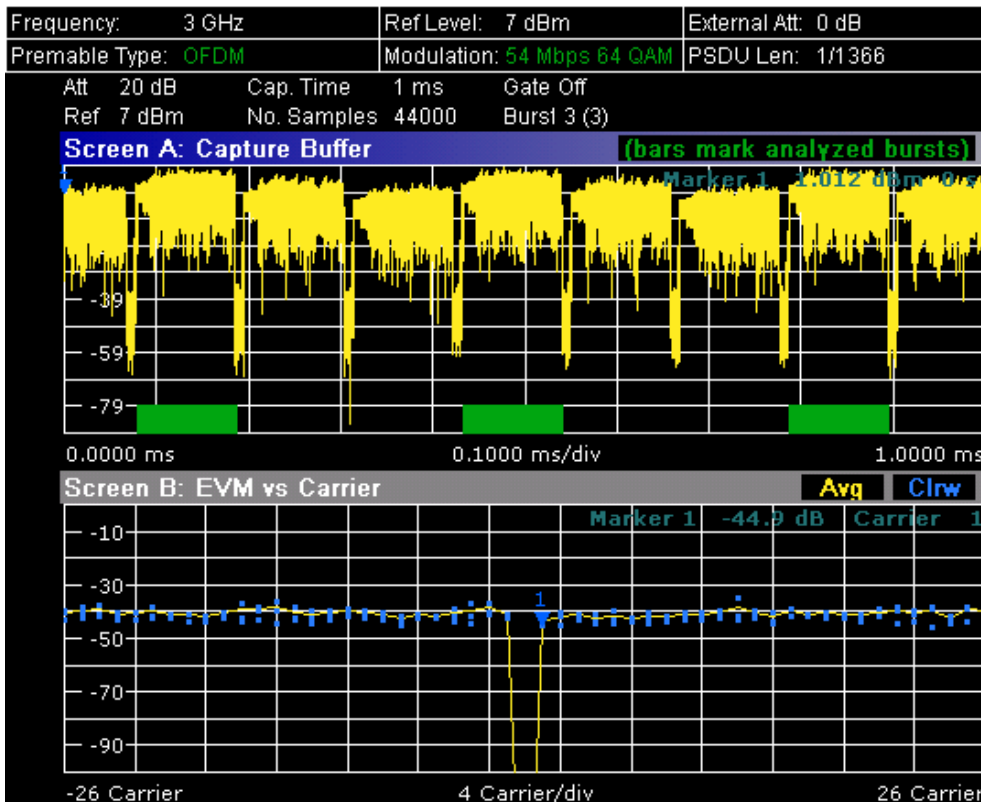
➡ Remote: `CONF:BURS:EVM:ESYM` (EVM vs Symbol)

➡ Remote: `CONF:BURS:EVM:ECAR` (EVM vs Carrier)

Error Frequency/Phase

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.
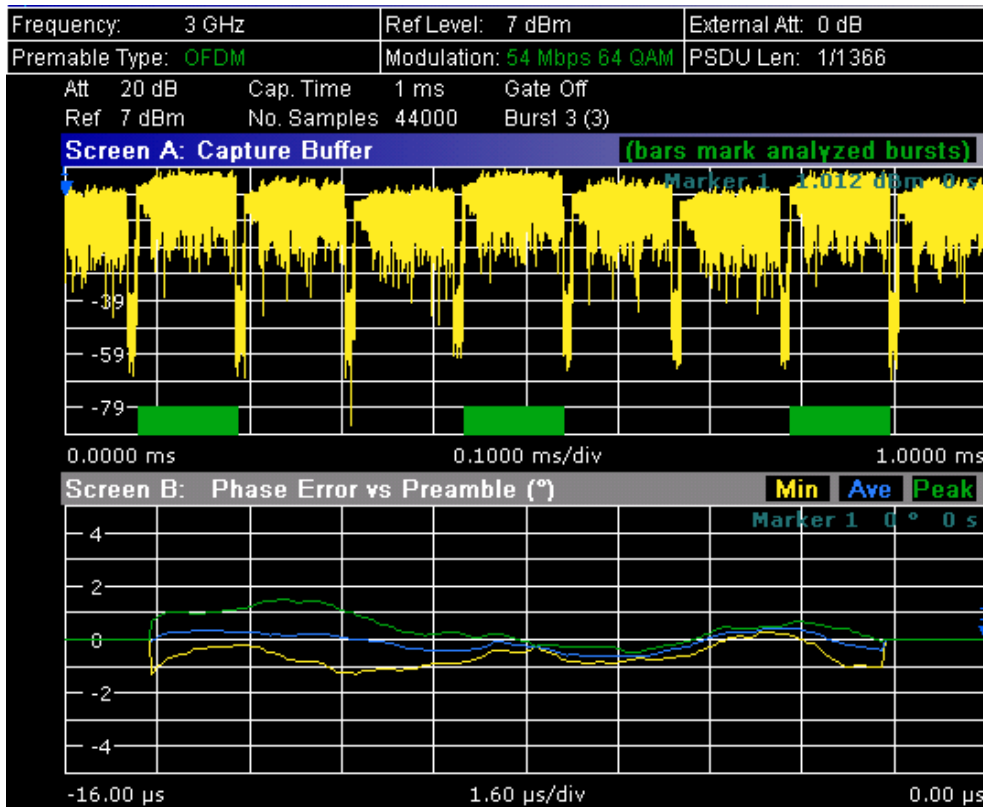
➡ Remote: `CONF:BURS:PRE`

➡ Remote: `CONF:BURS:PRE:SEL FREQ` (Frequency Error vs Preamble)

➡ Remote: `CONF:BURS:PRE:SEL PHAS` (Phase Error vs Preamble)

Constell vs Symbol/Carrier

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** softkey).

– Constellation vs Carrier (IEEE 802.11a, g, j – OFDM)

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).

➥ Remote: `CONF:BURS:CONS:CSYM` (Constellation vs Symbol)

➥ Remote: `CONF:BURS:CONS:CCAR` (Constellation vs Carrier)

Carrier Selection (IEEE 802.11a, g, j – OFDM)

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

➥ Remote: `CONF:BURS:CONS:CARR:SEL –26`

Spectrum

Opens a submenu for frequency measurements.

Spectrum Flatness (IEEE 802.11a, g, j – OFDM)

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.
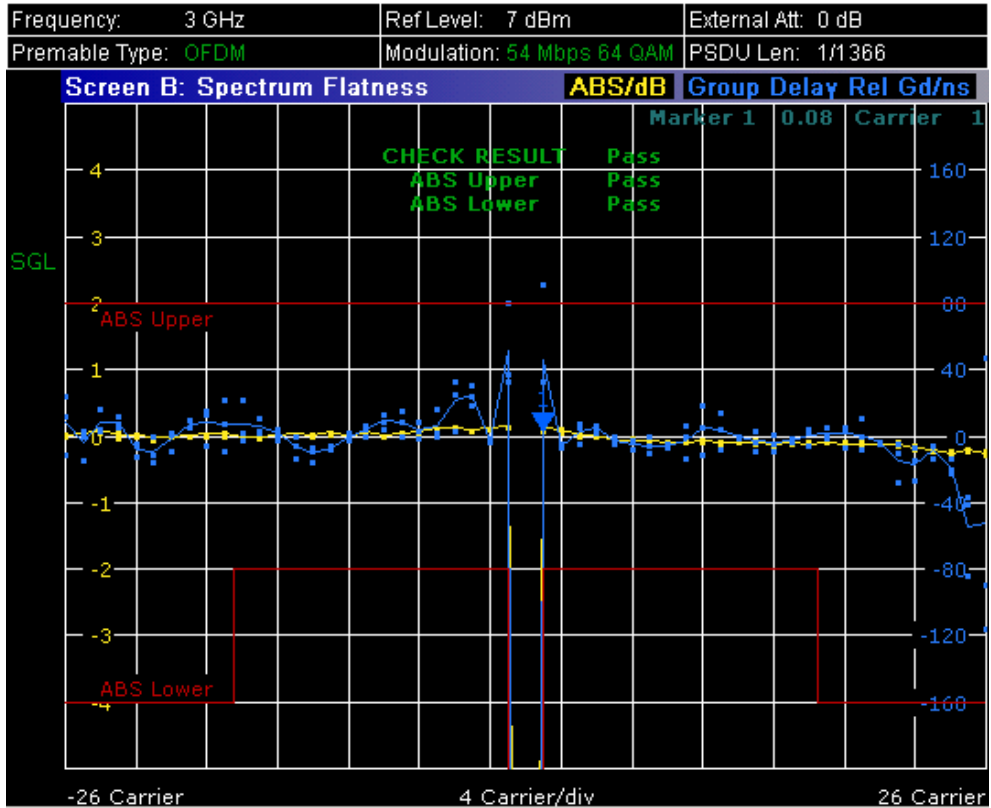
➡   Remote: CONF:BURS:SPEC:FLAT

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

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.
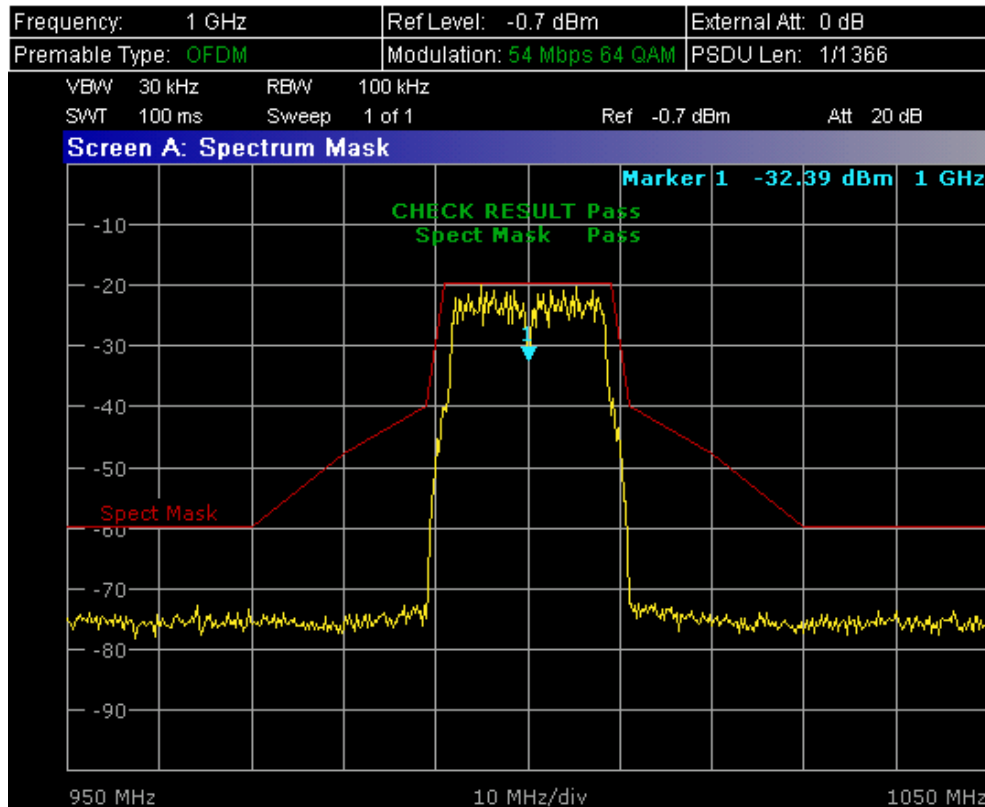
➡ Remote: `CONF:BURS:SPEC:MASK`
➡ Remote: `CONF:BURS:SPEC:MASK:SEL ETSI`

Spectrum FFT

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.
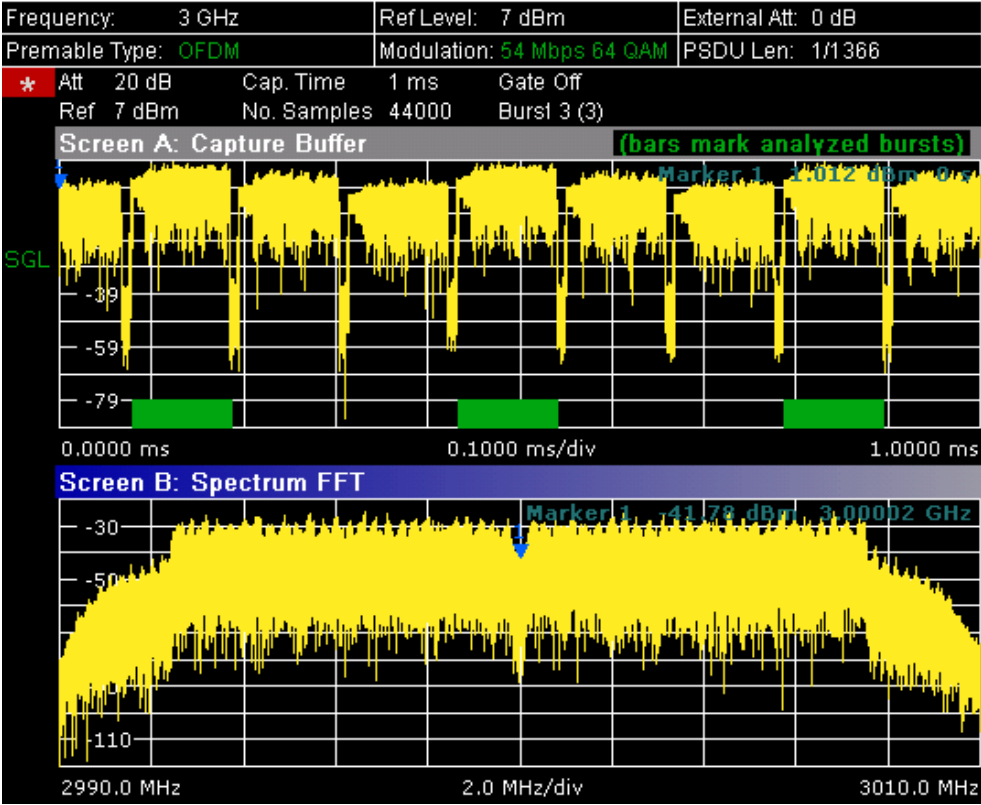
➡ Remote: `CONF:BURS:SPEC:FFT`

Spectrum ACPR (IEEE 802.11a, b)
Spectrum ACP (IEEE 802.11b)
ACP Rel/Abs (IEEE 802.11j)

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 spectrum 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.
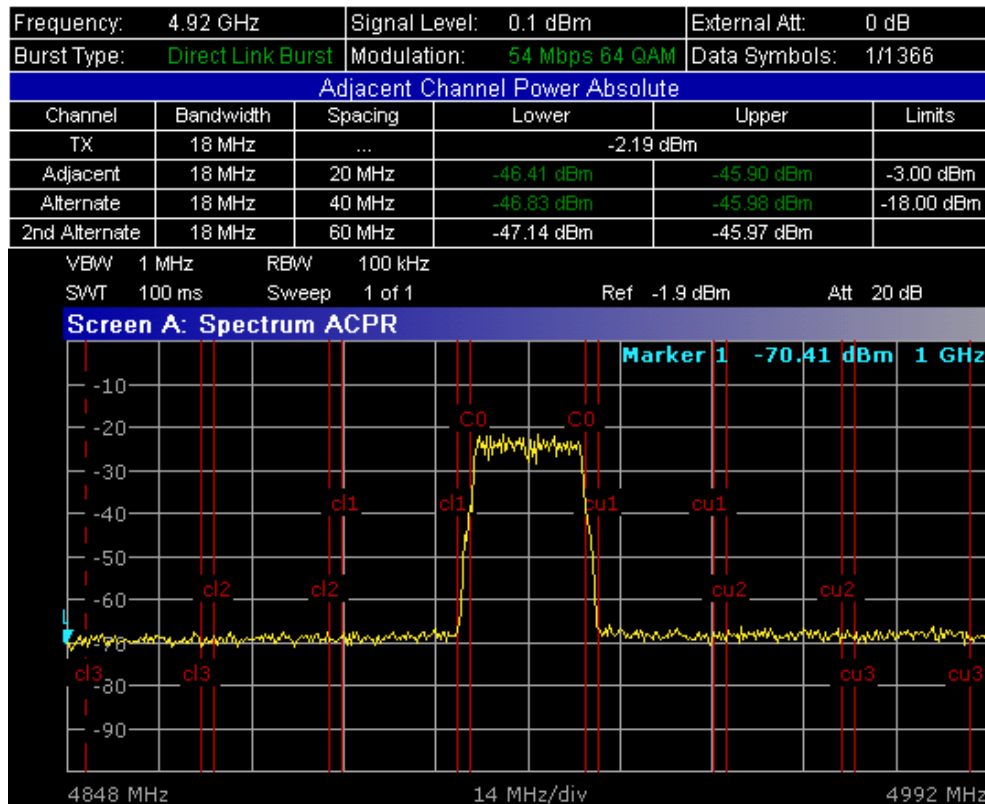
➡ Remote: `CONF:BURS:SPEC:ACPR`

➡ Remote: `CALC:MARK:FUNC:POW:RES?` (result query)

➡ Remote: `CALC:MARK:FUNC:POW:RES:MAXH?` (result query)

Statistics

Opens a submenu to display statistics measurement results.

CCDF

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.
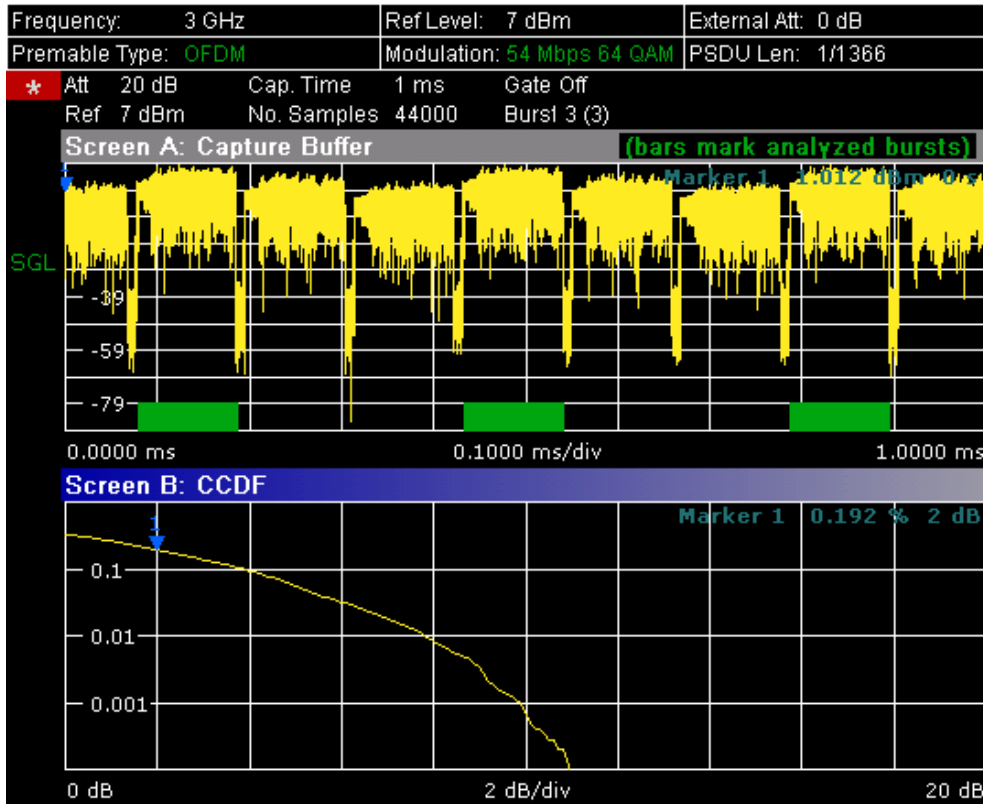
➡ Remote: `CONF:BURS:STAT:CCDF`

Bitstream

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

– IEEE 802.11a, j, g (OFDM):

The results are grouped by symbol and carrier.

Frequency:	3 GHz		Ref Level: 7 dBm	External Att: 0 dB
Premable Type: OFDM			Modulation: 54 Mbps 64 QAM	PSDU Len: 1/1366

```
Att    20 dB       Cap. Time    1 ms      Gate Off
Ref    7 dBm       No. Samples  44000     Burst 3 (3)
```

Screen A: Capture Buffer   (bars mark analyzed bursts)

Marker 1   1.012 dBm   0 s

```
SGL

  -39

  -59

  -79
0.0000 ms              0.1000 ms/div              1.0000 ms
```

Screen B: Bitstream

Carrier	Symbol 1					
-26	010101	100011	010010	110110	110110	1
-20	001001	110001	100000	001111	111001	011111
-14	100000	010100	101010	010011	001011	101011
-8	010011	1	110100	011100	011011	111100
-2	100011	101101	001110	111000	110011	101011
5	101111	100001	1	110001	111101	011110
11	100010	010011	110100	000101	001001	101100
17	001000	001100	010011	111010	0	111010
23	000100	100110	111101	011100		

–   IEEE 802.11b or g (Single Carrier)

The results are grouped by burst.

Frequency:	3 GHz		Ref Level: 7 dBm	External Att: 0 dB
Premable Type: Long PLCP			Modulation: 11 Mbps CCK	PSDU Len: 1/4095 Bytes

```
*   Att    20 dB       Cap. Time    3.5 ms    Gate Off
    Ref    7 dBm       No. Samples  154000    Burst 2 (2)
```

Screen A: Capture Buffer   (bars mark analyzed bursts)

Marker 1 -39.293 dBm   0 s

```
SGL

  -39

  -59

  -79
0.0000 ms              0.3500 ms/div              3.5000 ms
```

Screen B: Bitstream

```
Burst 1
PLCP Preamble
0          11111111  11111111  11111111  11111111  11111111  11111111
48         11111111  11111111  11111111  11111111  11111111  11111111
96         11111111  11111111  11111111  11111111  00000101  11001111
PLCP Header
0          01110110  00000000  00010011  00000000  01001000  11110011
PSDU
0          10000000  01000010  00110000  10011100  10101011  00001101
48         11101001  10111001  00010100  00101011  01001111  11011001
```

➡   Remote: `CONF:BURS:STAT:BSTR`

Signal Field (IEEE 802.11a, g, j – OFDM),
PLCP Header (IEEE 802.11b, g – Single Carrier)

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.
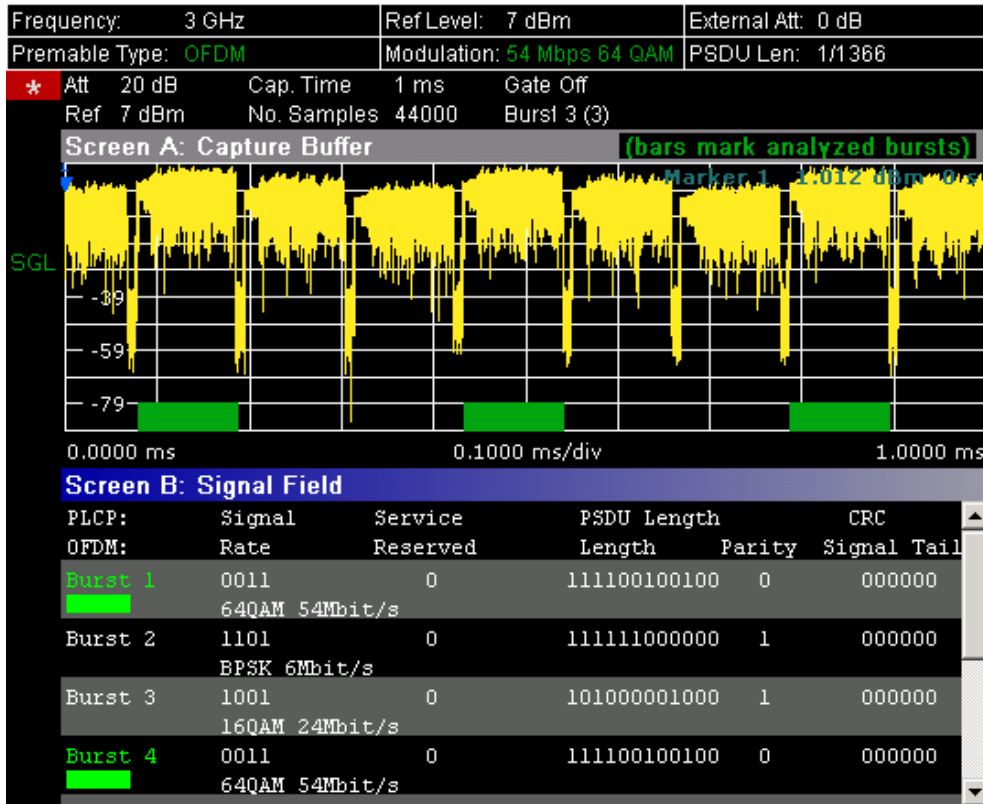
PLCP Header

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
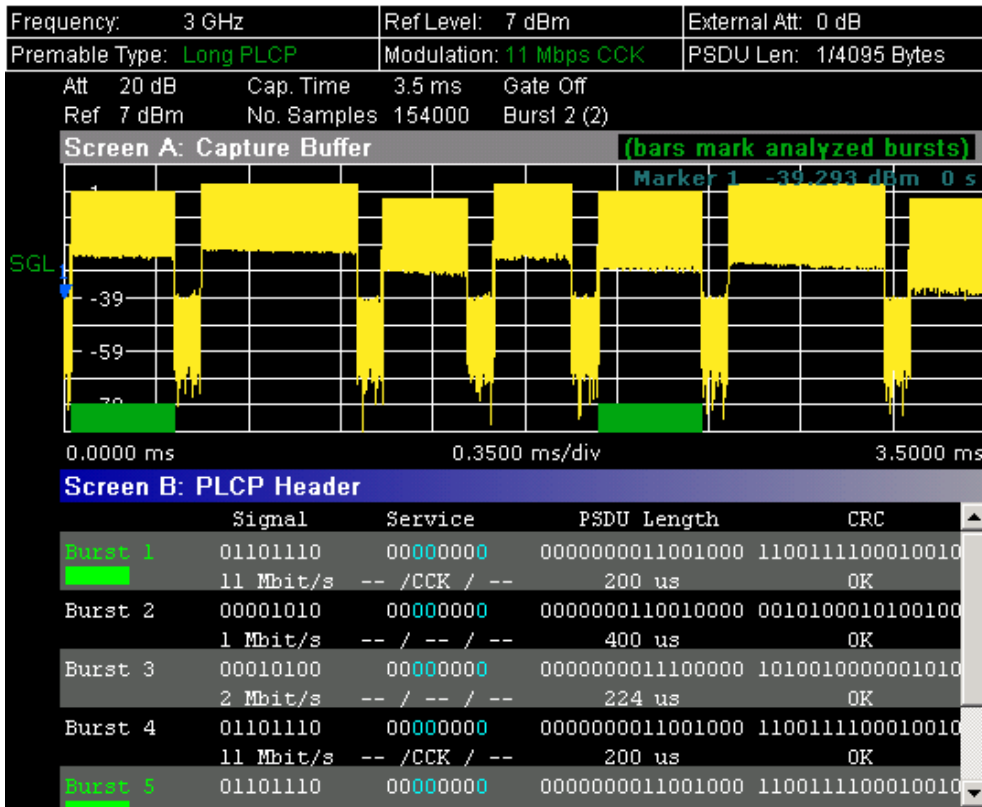
➡ Remote: `CONF:BURS:STAT:SFIeld`

Softkeys of the sweep menu (WLAN mode)

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 softkeys. If a softkey is only available with a special option, model or (measurement) mode, this information is delivered in the corresponding softkey description.

Command
Meas Single/Cont
Auto Level
Refresh

Meas Single/Cont

Selects the sweep mode.

Single   single sweep mode

Cont   continuous sweep mode

➡ Remote: `INIT:CONT OFF` (single sweep mode)

➡ Remote: `INIT:CONT ON` (continuous sweep mode)

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.

➡ Remote: `CONF:POW:AUTO ON`

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.

Softkeys of the marker menu (WLAN mode)

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.

Command
Marker 1
Unzoom
Marker Zoom
Marker Off

Marker 1

Opens a dialog box to adjust the marker. The contents of the dialog box depends 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.

➡ Remote: `CALC:MARK ON`

➡ Remote: `CALC:MARK:X 2ms`

➡ Remote: `CALC2:MARK:Y -2`

➡ Remote: `CALC:MARK:SYMB 2`

➡ Remote: `CALC:MARK:CARR -7`

Unzoom

Cancels the marker zoom.

➡ Remote: `CALC:MARK:FUNC:ZOOM 1`

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.

➡ Remote: `CALC:MARK:FUNC:ZOOM 3`

Marker Off

Switches off all makers in the active result display.

➡ Remote: `CALC:MARK:AOFF`

Softkeys of the marker–> menu (WLAN mode)

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.

Command
Peak
Min
MKR –> Trace

Peak (Spectrum Flatness result display)

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

➡ Remote: `CALC:MARK:MAX`

Min (Spectrum Flatness result display)

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

➡ Remote: `CALC:MARK:MIN`

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.

➡ Remote: `CALC:MARK:TRAC 2`

Softkeys of the lines menu (WLAN mode)

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 Result summary list and **Display List/Graph** softkey).

Command
Default Current
Default All

Default Current

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

➡ Remote: see CALCulate:LIMit Subsystem

Default All

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

➡ Remote: see CALCulate:LIMit Subsystem

Softkeys of the trace menu (WLAN mode)

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.

Command
Display List/Graph
Screen A/B
Screen Full/Split

Display List/Graph

For details refer to the **Display List/Graph** softkey in the WLAN menu.

Screen 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.

➡ Remote: `DISP:WIND1:SSEL`

Screen Full/Split

Changes the display between split and full screen for IQ measurement results. Frequency sweep measurement results are always displayed in full screen.

➡ Remote: `DISP:FORM SING`

WiMAX, WiBro Measurements (Option K93)

The WiMAX IEEE 802.16 OFDM, OFDMA Measurements option (R&S FSL–K93) extends the functionality of the R&S FSL to enable WiMAX IEEE 802.16e, WiBro Measurements according to the IEEE standards listed below. It includes also the functionality of the WiMAX 802.16 OFDM Measurements option.WiMAX 802.16 OFDM Measurements (R&S FSL–K93)

– IEEE 802.16–2004/Cor 1–2005 OFDM physical layer mode

The short forms *IEEE 802.16–2004 OFDM* is used in this section to reference this standard. The corresponding remote control mode is *OFDM*.

- WiMAX IEEE 802.16 OFDM, OFDMA Measurements option (R&S FSL–K93)

– IEEE 802.16–2004/Cor 1–2005, IEEE 802.16e–2005 OFDMA physical layer mode

The short form *IEEE 802.16e–2005 OFDMA* is used in this section to reference this standard. The corresponding remote control mode is *OFDMA*.

– IEEE 802.16–2004/Cor 1–2005, IEEE 802.16e–2005 based WiBro

The short form *IEEE 802.16e–2005 WiBro* is used in this section to reference this standard. The corresponding remote control mode is *WiBro*.

TX measurements of a WiMAX Device Under Test (DUT) according to the standards specified for the device are performed:

- Modulation formats

– IEEE 802.16–2004: BPSK (IEEE 802.16–2004 OFDM), QPSK, 16QAM, 64QAM

- 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

- Frequency and Phase error vs Symbol

- Transmit spectrum mask

- Adjacent Channel Power (absolute and relative)

- FFT, also over a selected part of the signal, e.g. preamble

- Payload bit information

- Capture time selectable up to 50 ms, multiple sweeps possible for large number of bursts

To open the measurement menu

➢ If the **WiMAX** mode is not the active measurement mode, press the **MODE** key and activate the **WiMAX** option.

➢ If the **WiMAX** mode is already active, press the **MENU** or **MEAS** key.

   The measurement menu is displayed. .

➢ To exit the **WiMAX** measurement mode, select another option. For details refer also to section "Measurement Mode Selection – MODE Key" on page 3.92.

Menu and softkey description

– "Softkeys of the WiMAX menu (WiMAX mode)" on page 3.252

– "Softkeys of the sweep menu (WiMAX mode)" on page 3.297

– "Softkeys of the marker menu (WiMAX mode)" on page 3.298

– "Softkeys of the marker–> menu (WiMAX mode)" on page 3.299

– "Softkeys of the lines menu (WiMAX mode)" on page 3.299

– "Softkeys of the trace menu (WiMAX mode)" on page 3.299

The file, setup, and print menus are provided as described for the base unit. For details refer to the corresponding menu descriptions. The span and bandwidth menus are not available in the **WiMAX** 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** softkey description (measurement menu).

Further information topics

– "Measurements and result displays" on page 3.246

– "Current restrictions to the IEEE 802.16e–2005 OFDMA/WiBro signal to be analyzed" on page 3.247

– "Title bar information" on page 3.252

– "Status bar information" on page 3.252

Tasks topics

– "To transfer the current R&S SMU WiMAX setting via LAN" on page 3.252

Measurements and result displays

The WiMAX IEEE 802.16 OFDM, OFDMA Measurements option provides two main measurement types:

• IQ measurements (based on captured IQ data)

   – Power vs Time (see **PVT** softkey)

   – EVM vs Symbol, EVM vs Carrier (see **EVM vs Symbol/Carrier** softkey)

   – Phase vs Preamble, Frequency vs Preamble (see **Error Frequency/Phase** softkey)

   – Spectrum Flatness (see **Spectrum Flat./Diff./Group Delay** softkey)

   – Spectrum Group Delay (see **Spectrum Flat./Diff./Group Delay** softkey)

   – Spectrum Flatness Adjacent Carrier Power Difference (see **Spectrum Flat./Diff./Group Delay** softkey)

- – Spectrum FFT (see **Spectrum FFT** softkey)

- – Constellation vs Symbol (see **Constell vs Symbol/Carrier** softkey)

- – Constellation vs Carrier (IEEE 802.16–2004 OFDM only, see **Constell vs Symbol/Carrier** softkey)

- – Conditional Cumulative Distribution Function (see **CCDF** softkey)

- – Bit Stream (see **Bitstream** softkey)

- frequency sweep measurements

   - – Spectrum Mask (see **Spectrum IEEE/ETSI** softkey)

   - – Spectrum ACP/ACPR (see **ACPR Abs/Rel** softkey)

For current restrictions refer to Current restrictions to the IEEE 802.16e–2005 OFDMA/WiBro signal to be analyzed.

The measurement result display is divided into two panes:

- Measurement settings

- Result displays

   The results can be displayed in form of a list or a graph (see also **Display Graph** softkey).

   - – Result summary list

   - – Result display graph

Current restrictions to the IEEE 802.16e–2005 OFDMA/WiBro signal to be analyzed

- standard

   - – IEEE 16–2004/Cor1–2005, IEEE 802.16e–2005, OFDMA Physical Layer Mode, 1 October 2004/28 February 2006

   - – IEEE 16–2004/Cor1–2005, IEEE 802.16e–2005 based WiBro

- FFT sizes

   The FFT sizes 128, 512, 1024 and 2048 are supported.

- subframes

   - – Either a DL subframe or a UL subframe can be analyzed at one point in time.

   - – One DL–PUSC zone per DL subframe is supported.

   - – One DL–FUSC zone immediately following the first mandatory DL–PUSC zone is supported (DL subframe).

   - – One UL–PUSC zone per UL subframe is supported.

   - – The subframes have to be separated by sufficient power off gaps.

- segments

   The first mandatory DL–PUSC zone must contain exclusively one segment. The assignment of subchannel groups to this segment is not restricted.

- symbols

   The signal to be analyzed must contain at least two OFDMA data symbols. More OFDMA data symbols will improve the accuracy of the measurement results.

- burst

Each OFDMA symbol of a zone must contain at least one active burst, i.e. each OFDMA symbol of the zone must comprise subchannels belonging to an active burst. The zone/segment must be covered by active bursts, i.e. no gaps at the beginning, mid or end of the zone/segment are allowed.

* UL subframes

In case of UL subframe analysis, the frame number must be constant for the signal to be analyzed.

Measurement settings

The overall measurement settings used to obtain the current measurement results are displayed below the title bar (see Fig. 3–31). The following settings are listed:

Setting	Description	Standard restrictions
Frequency	The frequency of the measured input signal.	
Burst Type	The type of burst being analyzed	IEEE 802.16–2004 OFDM only
Zone/Seg	The zone and segment being analyzed	IEEE 802.16e–2005 OFDMA/WiBro only
Signal Level	The expected mean signal level for the input signal.	
Modulation	Shows the active setting selected in the **Demod Settings** dialog box, **Demodulator** list. If the **Mod. Detection** field is set to **ALL**, **ALL** is displayed.	IEEE 802.16–2004 OFDM only
	Shows the active setting selected in the **Demod Settings** dialog box, **Demodulator** list. If the **Modulation Analysis Scope** field is set to **ALL**, **ALL** is displayed.	IEEE 802.16e–2005 OFDMA/WiBro only
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 spectrum analyzer), e.g.: External Att = 10 dB means that before the RF connector of the R&S FSL a 10 dB attenuator is used External Att = –20 dB means that before the RF connector of the R&S FSL a amplifier with 20 dB gain is used.	
Data Symbols	Shows the minimum and maximum number of data symbols that a burst may have to be considered in results analysis .	IEEE 802.16–2004 OFDM only
Zone Offset/Length	A combined display of the offset and length of the analyzed zone	IEEE 802.16e–2005 OFDMA/WiBro only

Fig. 3–31 Measurement settings for IEEE 802.16–2004 OFDM (example)

Fig. 3–32 Measurement settings for IEEE 802.16e–2005 OFDMA/WiBro (example)

Result summary list

If the results are displayed in tabular form (**Display Graph/List** softkey), the result summary list is displayed. It 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, when focused, via the keypad. Limits are modified for the currently selected modulation scheme. Each modulation scheme may have its own set of user defined limits. To reset the limit values to the values specified in the standard, use the lines menu (**LINES** key).

- IEEE 802.16–2004 OFDM

    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.

Fig. 3–33 Result summary list for IEEE 802.16–2004 OFDM (example)

- IEEE 802.16e–2005 OFDMA, WiBro

    For these measurement results, the minimum, mean, and maximum is taken over the analyzed zones of the current capture buffer content.

    Two lists are available:

    – Result Summary of Analyzed Subframes (list 1)

    – Result Summary of Analyzed Zone / Segment (list 2)

R&S FSL-K93 WIMAX		IEEE 802.16e-2005 OFDMA				
Frequency: 1 GHz		External Att: 0 dB	Signal Level Setting: -31.4 dBm			
Zone/Seg: DL-PUSC Seg. 0, Zone/Seg.		Modulation: ALL	Zone Offset/Length: 1/22 Symbols			
Result Summary of Analyzed Subframes						
No. of Subframes					2	
Bursts:	Min	Mean	Limit	Max	Limit	Unit
Freq. Error	539.14	539.17	± 2000	539.21	± 2000	Hz
Clock Error	0.54	0.54	± 2	0.54	± 2	ppm
TD Pwr DL Preamble	- 12.00	- 12.00		- 12.00		dBm
TD Pwr Subframe	- 15.58	- 15.58		- 15.58		dBm
TD Pwr Zone	- 15.84	- 15.84		- 15.84		dBm
Crest Factor	10.50	10.59		10.67		dB
RSSI	- 12.62	- 12.62		- 12.62		dBm
RSSI Stnd. Dev.		- 50.82				dBm
CINR	39.55	39.55		39.66		dB
CINR Stnd. Dev.		24.72				dB

Settings General Demod

Display List 2

Full Subframe

Rising Falling

More

Refresh Complete

Fig. 3–34 Result summary list 1 for IEEE 802.16e–2005 OFDMA/WiBro (example)

R&S FSL-K93 WIMAX		IEEE 802.16e-2005 OFDMA				
Frequency: 1 GHz		External Att: 0 dB	Signal Level Setting: -31.4 dBm			
Zone/Seg: DL-PUSC Seg. 0, Zone/Seg.		Modulation: ALL	Zone Offset/Length: 1/22 Symbols			
Result Summary of Analyzed Zone / Segment						
Zones/Segments					2	
Bursts:	Min	Mean	Limit	Max	Limit	Unit
BER Pilots	0.00	0.00	0.00	0.00	0.00	%
EVM Data & Pilots	- 43.29	- 43.22	- 30.00	- 43.15	- 30.00	dB
EVM Data	- 43.66	- 43.59	- 30.00	- 43.52	- 30.00	dB
EVM Pilots	- 41.55	- 41.49		- 41.43		dB
IQ Offset	- 57.63	- 57.62	- 15.00	- 57.61	- 15.00	dB
Gain Imbalance	- 0.01	- 0.01		- 0.01		dB
Quadrature Err	- 0.021	- 0.015		- 0.008		°
Power DL Preamble	- 6.42	- 6.42		- 6.42		dBm
Power Data & Pilots	- 10.20	- 10.20		- 10.20		dBm
Power Data	- 10.66	- 10.66		- 10.66		dBm
Power Pilots	- 8.17	- 8.17		- 8.17		dBm

Settings General Demod

Display Graph

Full Subframe

Rising Falling

More

Refresh Complete

Fig. 3–35 Result summary list 2 for IEEE 802.16e–2005 OFDMA/WiBro (example)

For details regarding how the results are calculated refer to the Operating Manual on CD, chapter "Advanced Measurement Examples".

Result display graph

- IQ measurements

    If the results are displayed in graphical form (**Display Graph/List** softkey), additionally to the selected graphical result display, the Magnitude Capture Buffer (power profile) 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. Only those bursts match the required criteria. The gate delay line (**GD**) and gate length line (**GL**) are displayed in red color.
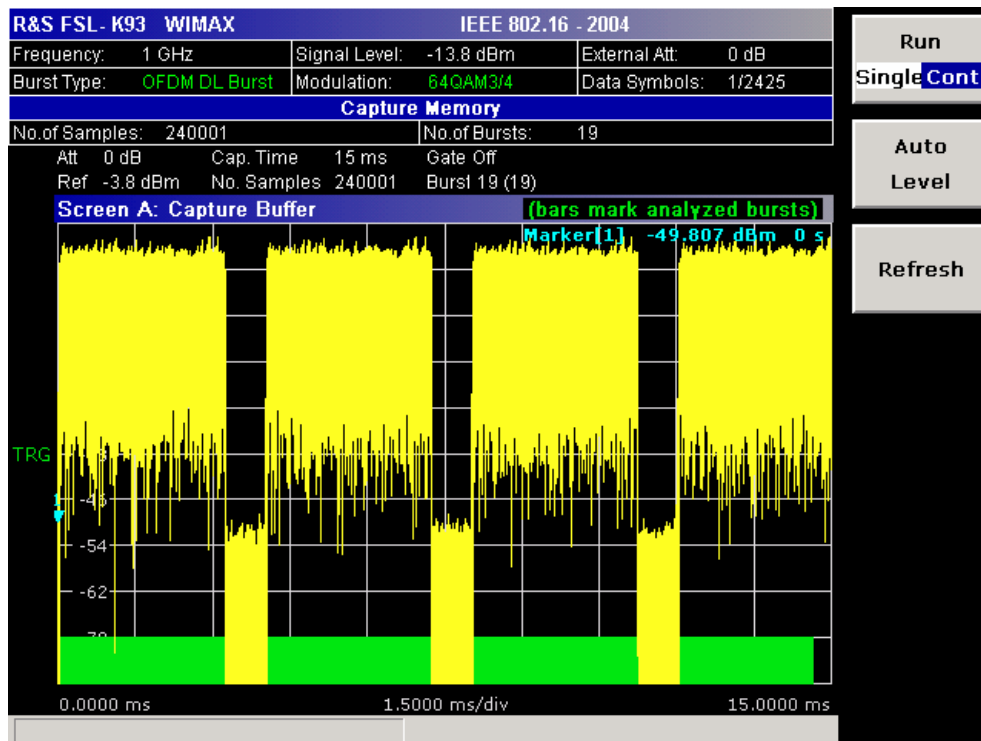
Fig. 3–36 Magnitude capture buffer results (example)

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).

When measuring OFDMA or WiBro measurements, the time from the start of the capture buffer to the start of the first frame is also displayed in the Magnitude Capture buffer. This time is marked with a vertical blue line, with the result displayed at the top of the graph.

- 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.

Further information

This section provides background information on measurements and displayed information. For details on signal processing refer to chapter "Advanced Measurement Examples", section "WiMAX, WiBro Measurements (Options K93)".

To transfer the current R&S SMU WiMAX setting via LAN

Prerequisite:

- The Windows Firewall of the R&S SMU is switched off.

1. Press the **Settings General/Demod** softkey to open the **General Settings** dialog box.

2. Under **Signal Characteristics** in the **Standard** list, select the **IEEE 802.16e–2005 OFDMA** or **IEEE 802.16e–2005 WiBro** standard.

3. Under **Setup** in the **SMU Address** field, specify the TCP/IP address of the R&S SMU.

4. Press the More ▼ softkey to change into the side menu.

5. Press the **File Manager** softkey to open the File Manager.

6. Under **Folders**, select the **SMU** entry.

7. Under **Files**, select the **Current SMU WiMAX Settings** entry using the **RIGHTARRROW** key.

8. Press the **Recall** softkey.

   The selected WiMAX setting file is transferred from the R&S ´SMU to the R&S FSL.

Title bar information

The title bar displays the following information:

- standard applicable to the current measurement

Status bar information

The status bar displays the following information:

- parameter values

  If a parameter in a settings dialog box is selected, the minimum and maximum values for the selected parameter are displayed.

  If a Boolean parameter in a dialog box is selected, the minimum and maximum values are displayed as N/A for not applicable.

- measurement status

  During the measurement, the current measurement status along with detailed information about the progress is displayed.

- error messages (with red background), for details refer to the Operating Manual on CD–ROM, chapter "Error Messages".

- warning messages (with blue background), for details refer to the Operating Manual on CD–ROM, chapter "Error Messages".

Softkeys of the WiMAX menu (WiMAX mode)

The following table shows all softkeys available in the WiMAX 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.

Menu / Command	Command
Settings General/Demod	
Display Graph/List	
PVT ▼	Settings General/Demod
	Display Graph/List
	Full Burst
	Start End
	Burst Selection
	Full Subframe
	Rising/Falling
	More ▼
	Gating Settings On/Off
	Import
	Export
	R&S Support
EVM Constell ▼	Settings General/Demod
	EVM vs Symbol/Carrier
	Error Frequency/Phase
	Constell vs Symbol/Carrier
	Carrier Selection
	Constell Selection
	More ▼
	Gating Settings On/Off
	Import
	Export
	Y–Axis/Div
	R&S Support
Spectrum ▼	Settings General/Demod
	Display Graph/List
	Spectrum Flat./Diff./Group Delay
	Spectrum IEEE/ETSI
	Spectrum Mask
	Spectrum FFT
	ACPR Abs/Rel
	More ▼
	Gating Settings On/Off
	SEM Settings
	ACP Settings
	Import
	Export
	R&S Support
Statistics ▼	Settings General/Demod
	Display Graph
	CCDF

Menu / Command	Command
	Bitstream
	Burst Summary
	Bit Selection
	More ▼
	Gating Settings On/Off
	Import
	Export
	R&S Support
File Manager ▼	For the available File Manager softkeys, see the description of the **File Manager** softkey.

Settings General/Demod

Opens the **General Settings** dialog box or the **Demod Settings** dialog box. Screenshots of the dialog boxes are provided in chapter "Advanced Measurement Examples", section "Measurement Examples of the WiMAX IEEE 802.16 OFDM, OFDMA Measurements option (K93)".

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

– **CENTER** 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** list

In the **General Settings** dialog box, all settings related to the overall measurement are 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:

Pane	Field/List	Standard Restrictions
Signal Characteristics	Standard	
	Frequency	
	Channel No	IEEE 802.16–2004 OFDM
	Frequency Band	
	FFT Size NFFT	IEEE 802.16e–2005 OFDMA/WiBro
	Channel BW	
	Sample Rate	
	G = Tg/Tb	
Level Settings	Signal Level	
	Auto Lev	
	Ext Att	
Data Capture Settings	Capture Time	
	Burst Count	
	Analyze Bursts	
	Sweep Time	
	Sweep Count	
Trigger Settings	Trigger Mode	
	Trigger Offset	
	Power Level	
	Auto Lvl	

Pane	Field/List	Standard Restrictions
Input Settings Advanced	Auto Level Time	
	Ref Level	
	Attenuation	
IQ Settings	Swap IQ	
Result Settings	RSSI, CINR avg.	
	List Results Unit	IEEE 802.16–2004 OFDM
Setup	SMU Address	IEEE 802.16e–2005 OFDMA/WiBro

In the **Demod Settings** dialog box, the settings associated with the signal modulation are modified. The content of the **Demod Settings** dialog box depends on the selected standard:

– IEEE 802.16–2004 OFDM

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. The settings under **Tracking** allow various errors in measurement results to be compensated for.

– IEEE 802.16e–2005 OFDMA/WiBro

The **Demod Settings** dialog box contains the three tabs. Use the left/right arrow keys to navigate between the tabs.

On the **Demod Settings** tab, the channel estimation range is set. The settings under **Bursts to Analyze** specify the characteristics of the bursts to be considered in the measurement results. The settings under **Tracking** allow various errors in measurement results to be compensated for.

On the **Frame Global** tab, the common settings associated with the frame to be analyzed can be modified.

On the **Frame Config** tab, the settings associated with the frame configuration can be modified. The **Zone/Segment List** and the **Burst List** are displayed. The content of the selected list is graphically displayed under The content of the selected list is graphically displayed under the **Zone/Segment Map** and the **Burst Map** respectively. To edit **Frame Config** tab, softkeys are available (see the table below).

The **Demod Settings** dialog box contains the following elements:

Tab/Pane	Field/List or Softkey	Standard Restrictions
Demod Settings		
Burst to Analyze	Burst Type	IEEE 802.16–2004 OFDM
	Link Mode	IEEE 802.16–2004 OFDM
	Use FCH Content	IEEE 802.16–2004 OFDM
	Mod. Detection	IEEE 802.16–2004 OFDM
	Demodulator	IEEE 802.16–2004 OFDM
	Subchannelization	IEEE 802.16–2004 OFDM
	Index	IEEE 802.16–2004 OFDM
	UL Phys. Modifier	IEEE 802.16–2004 OFDM
	Equal Burst Length	IEEE 802.16–2004 OFDM
	Data Symbols	IEEE 802.16–2004 OFDM
	Min Data Symbols	IEEE 802.16–2004 OFDM
	Max Data Symbols	IEEE 802.16–2004 OFDM
	Channel Estimation	IEEE 802.16–2004 OFDM
Tracking	Phase	IEEE 802.16–2004 OFDM
	Timing	IEEE 802.16–2004 OFDM

Tab/Pane	Field/List or Softkey	Standard Restrictions
	Level	IEEE 802.16–2004 OFDM
Demod Settings		
Channel Estimation Range	Downlink (DL)	IEEE 802.16e–2005 OFDMA/WiBro
	Uplink (UL)	IEEE 802.16e–2005 OFDMA/WiBro
Bursts To Analyze	Modulation Analysis Scope	IEEE 802.16e–2005 OFDMA/WiBro
	Demodulator	IEEE 802.16e–2005 OFDMA/WiBro
Tracking Settings	Phase	IEEE 802.16e–2005 OFDMA/WiBro
	Timing	IEEE 802.16e–2005 OFDMA/WiBro
	Pilots for Tracking DL	IEEE 802.16e–2005 OFDMA/WiBro
	Pilots for Tracking UL	IEEE 802.16e–2005 OFDMA/WiBro
Advanced	FFT start offset rel to CP center	IEEE 802.16e–2005 OFDMA/WiBro
Frame Global		
Frame	File Name	IEEE 802.16e–2005 OFDMA/WiBro
	IDCell	IEEE 802.16e–2005 OFDMA/WiBro
DL Subframe	Preamble Mode	IEEE 802.16e–2005 OFDMA/WiBro
	Preamble Index	
	Used Subchannel Bitmap	
UL Subframe	Frame Number	IEEE 802.16e–2005 OFDMA/WiBro
	Allocated Subchannel Bitmap	IEEE 802.16e–2005 OFDMA/WiBro
Frame Config		
	List Zone/Burst	IEEE 802.16e–2005 OFDMA/WiBro
	Copy Zone/Burst	IEEE 802.16e–2005 OFDMA/WiBro
	Insert Zone/Burst	IEEE 802.16e–2005 OFDMA/WiBro
	New Zone/Burst	IEEE 802.16e–2005 OFDMA/WiBro
	New Segment	IEEE 802.16e–2005 OFDMA/WiBro
	Delete Zone/Burst	IEEE 802.16e–2005 OFDMA/WiBro
	File Manager ▼	IEEE 802.16e–2005 OFDMA/WiBro

Standard (General Settings dialog box)

Displays a list of all installed standards to select the WiMAX/WiBro standard:

Standard	Installed with Option
IEEE 802.16–2004 OFDM	R&S FSL–K93
IEEE 802.16e–2005 OFDMA	R&S FSL–K93 only
IEEE 802.16e–2005 WiBro	R&S FSL–K93 only

All available entries represent a list of default settings in accordance to the specified standard. This ensures that the measurements are performed according to the specified standard with the correct limit values and limit lines.

➡ Remote: `CONF:STAN 0`

Frequency (General Settings dialog box)

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

➡ Remote: `FREQ:CENT 100MHz`

Channel No (General Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies the channel to be measured. If the field entry is modified, the center frequency is derived according to the section in the standard mentioned below and updated.

– For the Licensed Bands {ETSI, MMDS, WCS}:

Channel numbers are supported according to IEEE Std 802.16–2004 "8.3.10.2 Transmitter channel bandwidth and RF carrier frequencies". For the target frequency bands see IEEE Std 802.16–2004 "B.1 Targeted frequency bands".

– For the License Exempt Bands {U–NII, CEPT}:

Channel numbers are supported according to IEEE Std 802.16–2004 "8.5.1 Channelization".

➡ Remote: CONF:CHAN 9

Frequency Band (General Settings dialog box)

Specifies the relationship between the **Channel BW** and the **Sample Rate** parameters.

➡ Remote: CONF:WIM:FBAN ETSI

FFT Size N_{FFT} (General Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies the maximum number of carriers supported by the signal to be measured.

➡ Remote: CONF:WIM:NFFT FFT2048

Channel BW (General Settings dialog box)

Specifies the bandwidth of the channel to be measured.

➡ Remote: BAND:CHAN 7MHZ

Sample Rate (General Settings dialog box)

Specifies the sample rate used for IQ measurements.

➡ Remote: TRACE:IQ:SRAT 2000000

G = T_g/T_b (General Settings dialog box)

Specifies the guard time ratio.

➡ Remote: CONF:WIM:IGR 16

Signal Level (General Settings dialog box)

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

➡ Remote: CONF:POW:EXP:RF –20

Auto Lev (General Settings dialog box)

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. For details about level detection refer to the Operating Manual on CD, chapter "Advanced Measurement Examples".

Off   The reference level is defined manually in the **Signal Level** field.

➡ Remote: CONF:POW:AUTO ON

➡ Remote: CONF:POW:AUTO:SWE:TIME 200MS

Ext Att (General Settings dialog box)

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.

➡ Remote: DISP:TRAC:Y:RLEV:OFFS 10

Capture Time (General Settings dialog box)

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

➡ Remote: SWE:TIME 10ms

Burst Count (General Settings dialog box)

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.

➡ Remote: BURS:COUN:STAT ON

Analyze Bursts (General Settings dialog box)

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

If the number of bursts of the specified type is not contained in a single measurement sweep, the measurement sweeps continue until the requested number of bursts have been captured.

➡ Remote: BURS:COUN 16

Sweep Time (General Settings dialog box)

Specifies the sweep time for the Spectrum Mask and Spectrum ACP/ACPR measurements:

–   If the **Auto** option is activated, the sweep time is calculated automatically.

–   If the **Auto** option is deactivated, specify the sweep time.

➡ Remote: `SWE:ACPR:TIME 1S`

➡ Remote: `SWE:ACPR:TIME:AUTO OFF`

Sweep Count (General Settings dialog box)

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

➡ Remote: `SWE:COUNt 64`

Trigger Mode (General Settings dialog box)

Sets the trigger source for the measurement sweep.

Free Run	The measurement sweep starts immediately.
External	The measurement sweep starts if the external trigger signal meets or exceeds the external trigger level (a fixed value that cannot be altered) at the input connector EXT TRIGGER/GATE IN on the rear panel.
Power	The measurement sweep starts if the signal power meets or exceeds the specified power trigger level.

➡ Remote: `TRIG:MODE IMM`

Trigger Offset (General Settings dialog box)

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.

➡ Remote: `TRIG:HOLD 500us`

Power Level (General Settings dialog box)

Specifies the trigger level if the Power trigger mode is set (see **Trigger Mode** field).

➡ Remote: `TRIG:LEV:POW 10 DBM`

Auto Lvl (General Settings dialog box)

Activates or deactivates the automatic measurement of the power trigger level if the **Power** trigger mode is set (see **Trigger Mode** field).

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** field.

➡ Remote: `TRIG:LEV:POW:AUTO ON`

Auto Level Time (General Settings dialog box)

Specifies the sweep time used for the automatic level measurements.

➡ Remote: `CONF:POW:AUTO:SWE:TIME 200MS`

Ref Level (General Settings dialog box)

Specifies the reference level used 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 Lev** option is deactivated.

➡ Remote: `DISP:TRAC:Y:RLEV?`

Attenuation (General Settings dialog box)

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

➡ Remote: `INP:ATT 30dB`

Swap IQ (General Settings dialog box)

Activates or deactivates the inverted I/Q modulation.

On I and Q signals are interchanged.

Off Normal I/Q modulation.

➡ Remote: `SWAP ON`

RSSI, CINR avg. (General Settings dialog box)

Specifies the mean and standard deviation for the RSSI and CINR results (see IEEE Std 802.16–2004 "8.3.9.2 RSSI mean and standard deviation", "8.3.9.3 CINR mean and standard deviation").

➡ Remote: `CONF:WIM:AVER 0.1`

List Results Unit (General Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies the units for the results in the results summary table.

➡ Remote: `UNIT:TABL DB`

SMU Address (General Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies the TCP/IP address of an external R&S SMU signal generator connected via TCP/IP. This enables the R&S FSL to download the frame zone setup directly.

➡ Remote: `SYST:COMM:TCP:ADDR 192.168.1.1`

Burst Type (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies the type of burst to be included in measurement analysis. Only one burst type can be selected for the measurement results. The **OFDM** burst type is supported.

Link Mode (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies the link mode of bursts that are to be included in measurement analysis. The following link mode types are supported:

UL   Up Link

DL   Down Link

→   Remote: `CONF:WIM:LMOD UL`

Use FCH Content (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Activates or deactivates the decoding of the captured burst data FCH field.

OFF   This is the default setting and cannot be altered currently.

ON   Only the bursts with a modulation format matching the format specified in the **Demodulator** list are included in the results analysis.

Mod. Detection (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies the demodulation of the signal. The following values are supported:

None	No modulation detection is performed. The signal will be analyzed according to the **Demodulator** setting. Therefore the **Demodulator** setting must match with the modulation format of the subframe. This setting excludes the analysis of multiple modulation formats in a subframe.
First Symbol	The first data symbol specifies the modulation format, i.e. the signal will be analyzed according to the modulation format of the first data symbol. This setting supports multiple modulation formats in a subframe.
	If **First Symbol** is selected, the **Demodulator** setting is disabled and is automatically updated with the modulation scheme detected in the first symbol.
User	Only bursts matching the setting in the **Demodulator** list are analyzed. This setting supports multiple modulation formats in a subframe.
All	All bursts individual payload modulations are analyzed accordingly. This setting is useful to get an overview of the signal content.

→   Remote: `DEM:FORM:AUTO FIRS`

Demodulator (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Defines the modulation format for signal analysis if the Mod. Detection is set to None or User (see **Mod. Detection** field).

The measurement application does not distinguish between different coding rates for the same modulation format. If the signal to be analyzed contains the profiles (modulation format A, coding rate B) and (modulation format C, coding rate D), the signal to be analyzed must hold the following condition in order to produce correct measurement results:

$$[A == C \Rightarrow B == D]$$

→   Remote: `DEM:FORM:BAN '16QAM1/2`

Subchannelization (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Activates or deactivates the subchannelization, if the **Up Link** mode is set (see **Link Mode** field). If activated, the subchannel index of uplink bursts is analyzed, defined by the **Index** field.

➡ Remote: SUBC:STAT ON

Index (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Defines the subchannelization index of uplink bursts to be analyzed. Subchannelization index 16 is the default subchannel with full occupation.

➡ Remote: SUBC 12

UL Phys. Modifier (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies a common UL physical modifier for all uplink bursts.

➡ Remote: SUBC:ULPH 1

Equal Burst Length (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

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

| On | Only bursts with exactly the number of symbols specified in the **Data Symbols** field are considered for measurement analysis. |
| 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. |

➡ Remote: DEM:FORM:BAN:SYMB:EQU ON

Data Symbols (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies the number of symbols that a burst must have to be considered for measurement analysis. This field is only available if the **Equal Burst Length** option is activated.

➡ Remote: DEM:FORM:BAN:SYMB:MIN 16

Min Data Symbols (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies the minimum number of data symbols that a burst must have to be considered in measurement analysis. This field is only available if the **Equal Burst Length** option is deactivated.

➡ Remote: DEM:FORM:BAN:SYMB:MIN 16

Max Data Symbols (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

Specifies the maximum number of data symbols that a burst must have to be considered in measurement analysis. This field is only available if the **Equal Burst Length** option is deactivated.

➡ Remote: DEM:FORM:BAN:SYMB:MAX 1300

Channel Estimation (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

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.

➡ Remote: `DEM:CEST ON`

Phase (Demod Settings dialog box)

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

➡ Remote: `TRAC:PHAS ON`

Timing (Demod Settings dialog box)

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

➡ Remote: `TRAC:TIME ON`

Level (Demod Settings dialog box, IEEE 802.16–2004 OFDM)

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

➡ Remote: `TRAC:LEV ON`

Downlink (DL) (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies how channel estimation is performed for downlink signals.

Preamble Only	The channel estimation is performed in the preamble only.
Preamble and Payload	The channel estimation is performed in the preamble and in the payload (payload comprises pilots and data).
Payload Only	The channel estimation is performed in the payload only.

➡ Remote: `DEM:CEST PREAMPAYL`

Uplink (UL) (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Displays the channel estimation performed for uplink signals.

This field is for information purposes only as channel estimation for uplink signals are always performed in payload only (payload comprises pilots and data).

Modulation Analysis Scope (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Displays the modulation formats to be analyzed.

This field is for information purposes only as all detected modulation schemes are analyzed.

Demodulator (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Displays the modulation scheme detected in the analyzed signal. For signals using multiple modulation schemes, the modulation scheme with the highest data rate is displayed. The field also indicates the limits that are applied to the EVM results in the table or results.

This field is for information purposes only.

➡ Remote: `DEM:FORM:BAN?`

Pilots for Tracking DL (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies how, for downlink signals, the pilot sequence is determined for tracking purposes.

| **According to Standard** | The pilot sequence is computed according to the standard. |
| **Detected** | The pilot sequence uses the values detected in the signal. |

➡ Remote: `TRAC:PIL DET`

Pilots for Tracking UL (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Displays how, for uplink signals, the pilot sequence is determined for tracking purposes.

This field is for information purposes only as tracking is performed according to the selected standard.

FFT start offset rel to CP center (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Adds an offset to the FFT starting point determined by the application.

The setting range is from –100% to +100% of the cyclic prefix (CP) length. In the case of 0%, the optimal FFT starting point, determined by the application, is used. This is the default setting.

➡ Remote: `FFT:OFF 0`

File Name (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Displays the name of the loaded *.WIMAX settings file. If no file is loaded the '….' is displayed.

This field is for information purposes only.

IDCell (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies the downlink IDCell number and affects the definition of the preamble sequence (in conjunction with the used segments according to the **Used Subchannel Bitmap** setting), the pilot sequence of the first zone and the subchannel definition of the first zone.

➡ Remote: `CONF:WIM:DLSF:IDC 0`

Preamble Mode (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies how the preamble index is calculated.

Auto   The preamble index is automatically calculated according to the **IDCell** and **Used Subchannel Bitmap** parameters.

User   The preamble index can be specified manually, i.e. the preamble pattern is chosen according to the standard using the **Preamble Index** parameter.

➡ Remote: CONF:WIM:DLSF:PMOD AUTO

Preamble Index (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies the preamble pattern (according to the standard) to be used, if the **Preamble Mode** parameter is set to **User**.

➡ Remote: CONF:WIM:DLSF:PIND 31

Used Subchannel Bitmap (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Assigns subchannel groups to segments, see [802.16e–2005], page 360, table 268a "Subchannel index of the six subchannel groups". This table defines how many subchannels are available for the **Burst List** (**Frame Config** tab) belonging to the corresponding segment of a DL–PUSC zone (with Use All Subchannels being false). In the burst list – corresponding to the segment – this selection controls the height of the white area in the burst map.

➡ Remote: CONF:WIM:DLSF:SEGM1 63

Frame Number (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies the number of the frame to be analyzed. For UL subframe analysis, the frame number must be constant for the signal to be analyzed.

➡ Remote: CONF:WIM:ULSF:FRAM 0

Allocated Subchannel Bitmap (Demod Settings dialog box, IEEE 802.16e–2005 OFDMA/WiBro)

Specifies the subchannels to be analyzed.

This parameter is for information purposes only as all subchannels are used in the UL subframe.

List Zone/Burst (IEEE 802.16e–2005 OFDMA/WiBro)

Sets the focus on the **Zone/Segment List** or the **Burst List** to enter and modify data. To insert, copy, and delete rows, use the softkeys available with the **Frame Config** tab.

The content of the selected list is graphically displayed under the **Zone/Segment Map** and the **Burst Map** respectively.

The **Zone/Segment List** contains the following columns:

Column	Description
ID	Provides a unique ID for the zone. This parameter is read only. If there are any errors in the zone/segment configuration, the background is displayed in red color.
Bursts	Pressing the rotary knob or the **ENTER** key with focus on this field changes the focus to the **Burst List** and displays the **Burst Map**.
Analyze	Defines the zone/segment to be analyzed. Only one zone/segment can be selected for analysis at any given time.
Zone	Defines the zone type. The following types are supported: DL–PUSC, DL–FUSC, UL–PUSC
Segment	Defines the segment for a DL–PUSC zone. For DL–FUSC zones, this parameter has no effect.
Length	Defines the length in OFDMA symbols of the zone. The zone length must be a multiple of the symbol numbers per slot. If this is not the case, an error message is displayed in the status bar and the measurement does not start.
Offset	Defines the offset in OFDMA symbols from the start of the subframe. The first DL–PUSC zone starts with 1. The first UL–PUSC zone starts with 0.
PermBase	Specifies the permbase that is required for the calculation of the subchannel – physical carrier assignment permutation.
PRBS_ID	Specifies the permbase ID that is required for the calculation of the pilot sequence.

Fig. 3–37 Definition of the Zone Offset [green arrow] and the Zone Length [violet arrow] parameters from the Zone/Segment List

The **Burst List** contains the following parameters, depending on the zone selection:

Column	Description	Zone restrictions
ID	Provides a unique ID for the burst. This parameter is read only. The background color of this parameter reflects the modulation of the burst. If there are any errors in the burst configuration then the background of this item will be red.	
Modulation	Defines the modulation format of the burst. In the **Burst Map**, identical modulation formats are displays in the same color.	
No. of Subch.	Defines the number of logical subchannels occupied by the burst.	DL_FUSC, DL_PUSC
No. of Symb.	Defines the number of OFDMA symbols occupied by the burst. It must be a multiple of the symbol numbers per slot. If this is not the case, an error message is displayed in the status bar and the measurement does not start.	DL_FUSC, DL_PUSC
Duration [Slots]	Specifies the unit of time for the allocating bandwidth.	UL_PUSC
Auto	If selected, the Offset Subch. and the Offset Symb. parameters are set automatically.	UL_PUSC
Offset Subch.	Defines the offset in logical subchannels from subchannel 0.	
Offset Symb.	Defines the offset in OFDMA symbols. It must be a multiple of the number of symbols per slot. If this is not the case, an error message is displayed in the status bar and the measurement does not start. The start of the zone defines symbol 0.	
Power[dB]	Defines the boosting factor of the burst.	
Burst Type	Defines the burst type from the protocol layer perspective.	DL_FUSC, DL_PUSC
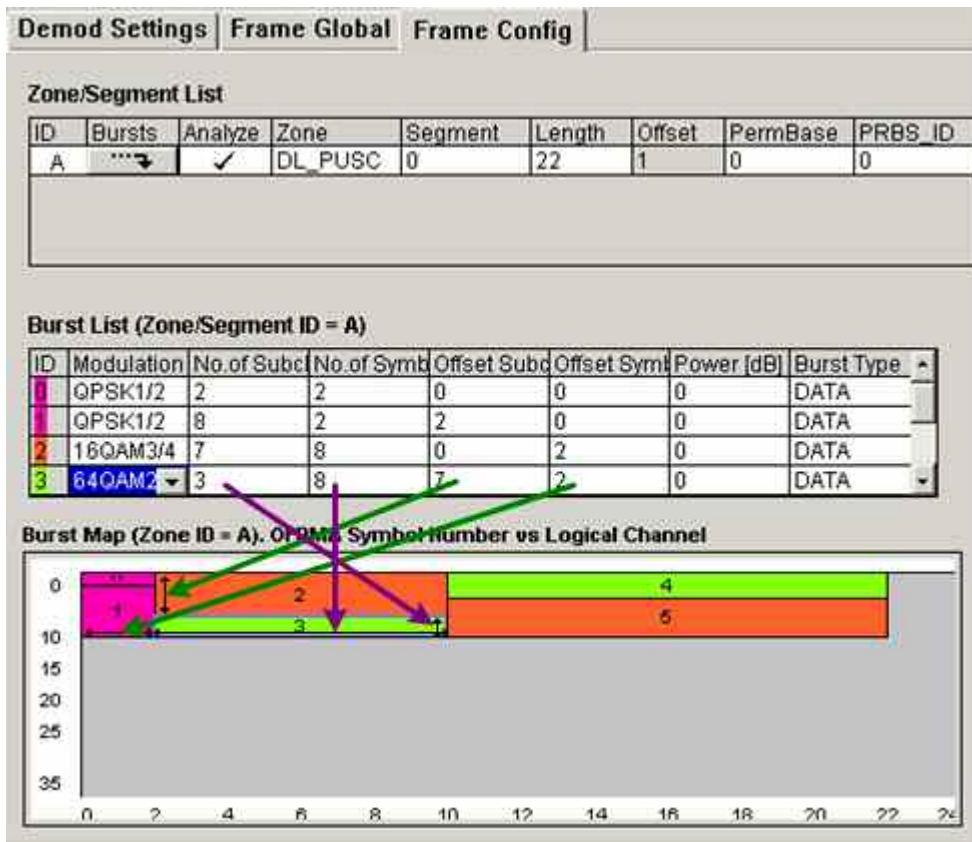
Fig. 3–38 Definition of the Burst Offset [green arrows] and the Burst Length [violet arrows] parameters from the Burst List

The **Zone/Segment Map** and the **Burst Map** display panes are located at the bottom of the **Frame Config** tab. They display a graphical view of the selected **Zone/Segment List**.

– **Zone/Segment Map**

Displays a graphical view of the selected **Zone/Segment List**.

– **Burst Map**

Displays a graphical view of the selected **Burst List**. The background color of each burst in the diagram match the modulation format of the burst. Any burst that is incorrectly configured is displayed with a red background. The measurement does only start if the frame definition is correct.

Example:

The **Burst Map** with burst 1 exceeds the available amount of logical subchannels. The area causing the problem is highlighted red.

Burst Map (Zone ID = A). OFDMA Symbol Number vs Logical Channel
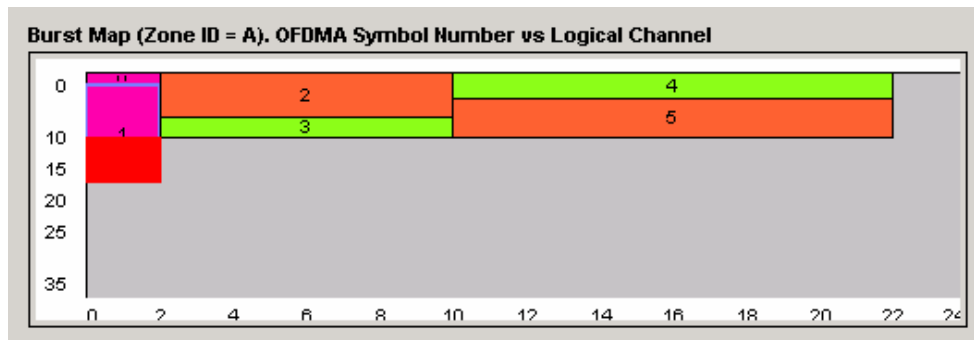
The configuration is corrected by doing one of the following:

   a) Reducing the number of subchannels for burst 1 in the **Burst List**.
   b) Assigning more subchannels to the zone/segment to which burst 1 belongs.
   c) Increasing N_{FFT}.

➡ Remote: `CONFigure:WIMax:ZONE<1…26>...`, for details see CONFigure Subsystem (WiMAX, K93)

Copy Zone/Burst (IEEE 802.16e–2005 OFDMA/WiBro)

Copies the selected zone or burst to the clipboard.

Insert Zone/Burst (IEEE 802.16e–2005 OFDMA/WiBro)

Pastes the zone or burst below the focused zone or burst.

New Zone/Burst (IEEE 802.16e–2005 OFDMA/WiBro)

Inserts a new zone or burst below the focused zone or burst.

➡ Remote: `CONF:WIM:ZONE1:CONT ON,DLFUSC,0,10,0,0,0` (zone)
➡ Remote: `CONF:WIM:ZONE1:BURS1:CONT QAM16_1_2,1D2,5,10,20,0,0,0, DATA` (burst)

New Segment (IEEE 802.16e–2005 OFDMA/WiBro)

Inserts a new segment below the focused zone/segment. This softkey is only available, if the focus is on the **Zone/Segment List**.

Delete Zone/Burst (IEEE 802.16e–2005 OFDMA/WiBro)

Deletes the focused zone or burst.

➡ Remote: `CONF:WIM:ZONE1:DEL` (zone)
➡ Remote: `CONF:WIM:ZONE1:BURS1:DEL` (burst)

Display Graph/List

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

For details on the result displays refer to "Result summary list" on page 3.249 and "Result display graph" on page 3.251.

➡ Remote: `DISP:TABL OFF`
➡ Remote: for result queries see section FETCh Subsystem

PVT

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

The PVT result displays show the measured input data over the full range or over complete bursts, displayed within the gating lines if gating is switched on. The results are displayed as a single burst. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the **Refresh** softkey in the sweep menu.

➡ Remote: `CONF:BURS:PVT`

Full Burst (IEEE 802.16–2004 OFDM)

Displays the PVT results in a single graph with all burst data being displayed (**Display Graph** selected), or in a list (**Display List** selected).
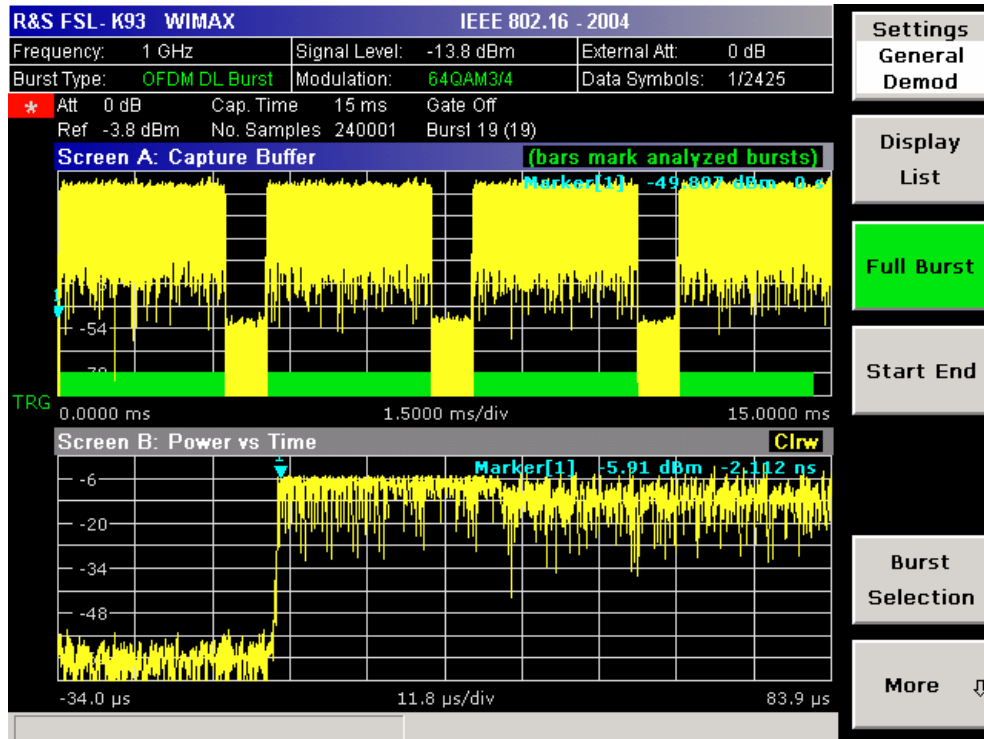
For further details refer to the PVT softkey.

➡ Remote: `CONF:BURS:PVT:SEL FULL`

Start End (IEEE 802.16–2004 OFDM)

Displays the results in two separate graphs, the left hand side showing the start and the right hand side showing the end of a burst (**Display Graph** selected), or in a list (**Display List** selected).
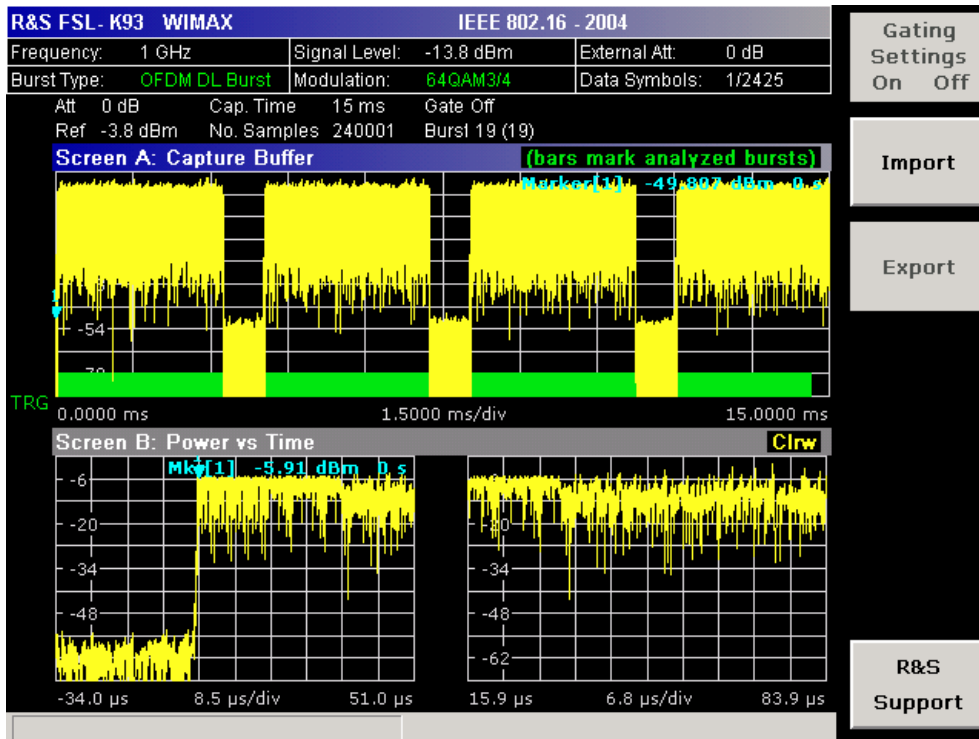
➡ Remote: `CONF:BURS:PVT:SEL EDGE`

Burst Selection (IEEE 802.16–2004 OFDM)

Opens an edit dialog box to select a burst by entering its number.

➡ Remote: `CONF:BURS:PVT:BURS 1`

Full Subframe (IEEE 802.16e–2005 OFDMA/WiBro)

Displays the results in a single graph with the minimum, mean, and maximum power profile of the subframe that contains the zone selected to be analyzed (**Display Graph** selected), or in two lists (**Display List 1/2** selected).
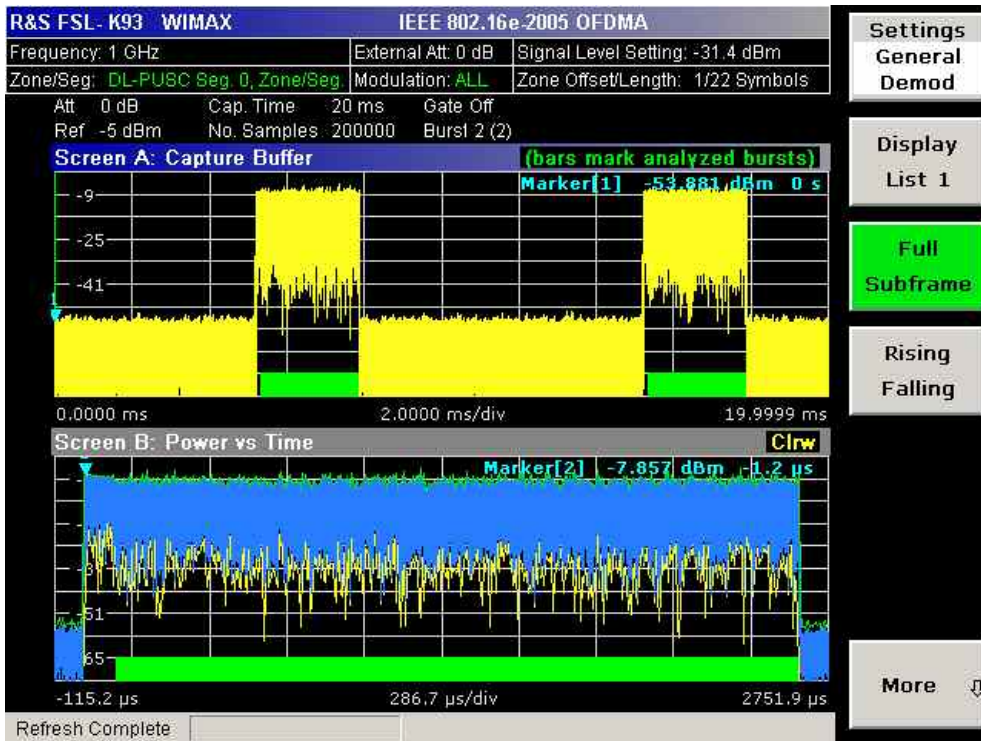
➡ Remote: `CONF:BURS:PVT:SEL FULL`

Rising/Falling (IEEE 802.16e–2005 OFDMA/WiBro)

Displays the results in two separate graphs: the minimum, mean, and maximum power profile of rising (on the left hand) respective falling (on the right hand) edge of the subframe that contains the zone selected to be analyzed (**Display Graph** selected), or in two lists (**Display List 1/2** selected).
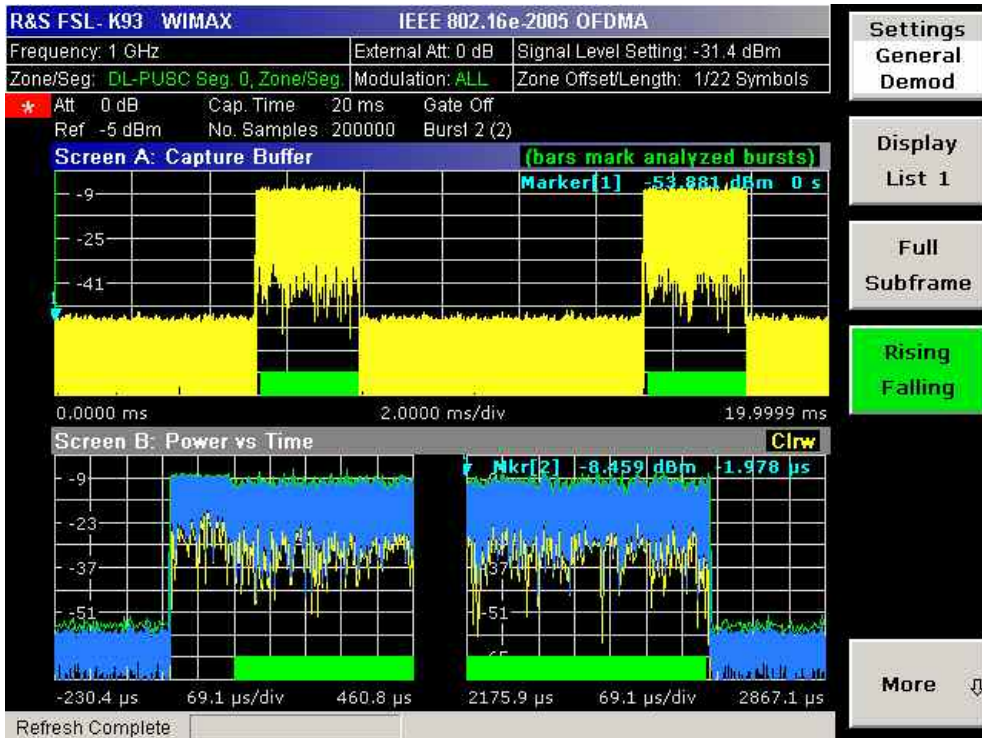
➡ Remote: `CONF:BURS:PVT:SEL EDGE`

Gating Settings On/Off (Spectrum Mask, Spectrum FFT, Spectrum ACPR, CCDF)

Activates or deactivates gating, or 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 Marker	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 if the gate is modified, and the gate lines move with the marker if the marker position is altered.

The gate settings are defined for following measurements: 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 help defining the gate settings correctly.

➡ Remote: `SWE:EGAT ON`

➡ Remote: `SWE:EGAT:HOLD 125us`, `SWE:EGAT:HOLD:SAMP` 2500 (Delay)

➡ Remote: `SWE:EGAT:LENG 100ms`, `SWE:EGAT:LENG:SAMP 2000000` (Length)

➡ Remote: `SWE:EGAT:LINK ON` (Link Gate and Mark)

SEM Settings (IEEE 802.16e–2005 WiBro)

Opens the **Spectrum Emission Mask Settings** dialog box to configure the Spectrum Emission Mask measurement.

Spectrum Emission Mask Settings

SEM according to	TTA Standard
File Name	TTA_SEM.xml
Link Direction	DL
Power Class	Auto
Reference Power	TX Channel Power RMS

TX Channel

Bandwidth	9.54 MHz
RBW	100 kHz

SEM Configuration

Start Freq	Stop Freq	RBW	VBW	Detector	Start Limit		Stop Limit		Evaluate
4.77 MHz	9.27 MHz	1 MHz	1 MHz	RMS	- 14.5	dB	- 14.5	dB	Yes
9.27 MHz	22.5 MHz	1 MHz	1 MHz	RMS	- 29	dB	- 29	dB	Yes
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
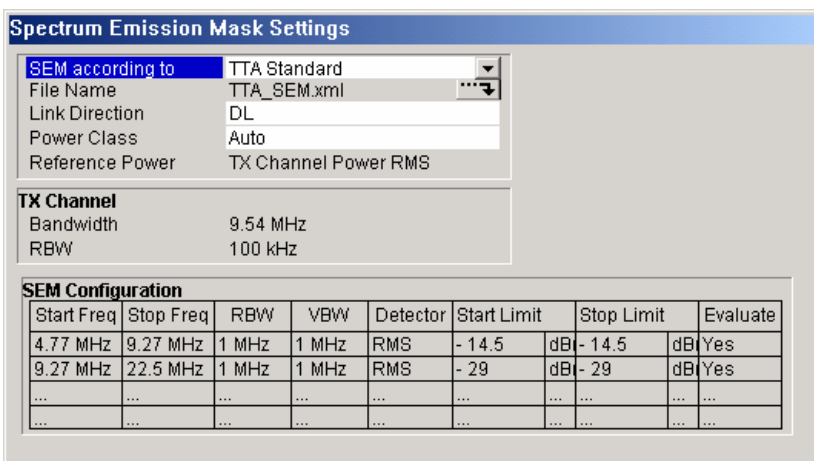
SEM according to	Specifies how the Spectrum Emission Mask settings and limits are applied:
	TTA Standard – as specified in the standard.
	User – as specified in the selected XML file
File Name	Specifies the XML file name
Link Direction	Sets the link direction:
	UL – uplink, **DL** – downlink
Power Class	Sets the power class:
	Auto – automatic selection
	(–INF, 23) dBm, **(23, INF) dBm** – power class values for uplink
	(–INF, 29) dBm, **(29, 40) dBm**, **(40, INF) dBm** – power class values for downlink

The other parameters are set by default.

The **SEM Configuration** shows the settings and limits applied over specified frequency ranges around the TX channel. The settings displayed are dependent on the selected **Link Direction** and **Power Class**.

➡ Remote: `POW:SEM:TTA STANDARD` (SEM according to)

➡ Remote: `POW:SEM:MOD UL` (Link Direction)

➡ Remote: `POW:SEM:CLAS 0` (Power Class)

Import

Opens the **Choose iqw file to import** dialog box.

Enter the path and the name of the IQ data file you want to import. Focus the **Select** button and press **ENTER** to load the specified IQ data file. The **Select** button becomes active only, if the entered name matches a file name in the selected directory.

➡ Remote: `MMEM:LOAD:IQ:STAT 1,'C:\R_S\Instr\user\data.iqw'`

Export

Opens the **Choose iqw file to export** dialog box.

Enter the path and the name of the IQ data file you want to export. Press **ENTER** to write the IQ data into the specified file. If the file cannot be created or there is no valid IQ data to export an error message is displayed.

➡ Remote: `MMEM:STOR:IQ:STAT 1,'C:\R_S\Instr\user\data.iqw'`

R&S Support

Creates files that help identifying the current problem. The files are stored under C:\R_S\Instr\user\Support. 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.

EVM vs Symbol/Carrier

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

– EVM vs Symbol (IEEE 802.16–2004 OFDM)

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. The minimum, average, and maximum traces are displayed.

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. For details of this measurements please refer to the Operating Manual on CD–ROM, chapter 2.
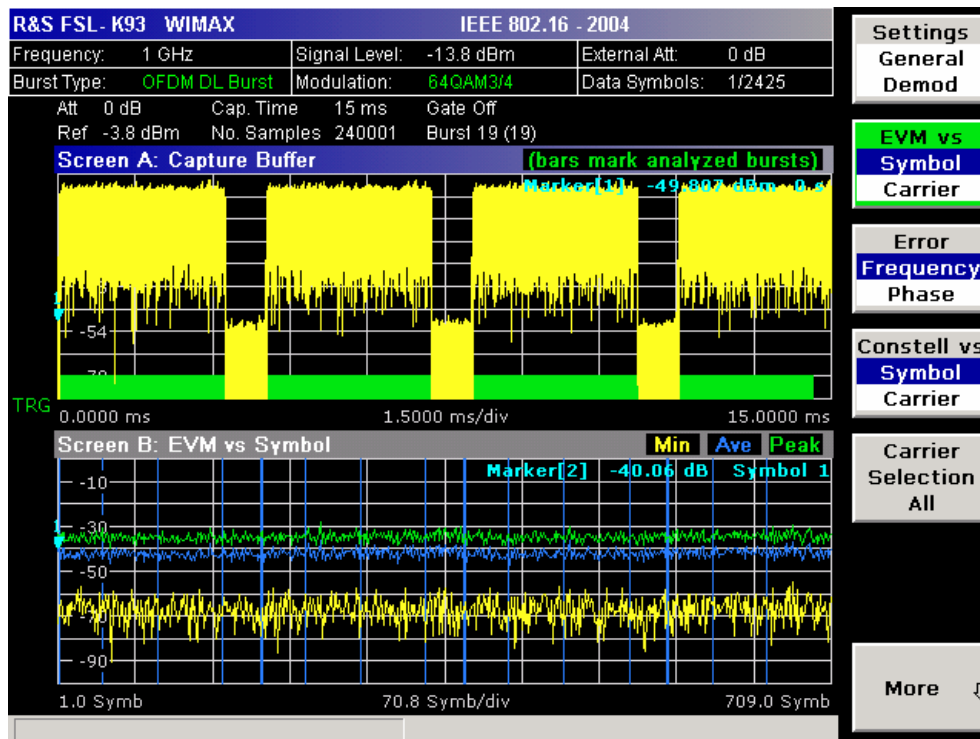
– EVM vs Symbol (IEEE 802.16e–2005 OFDMA/WiBro)

This result display shows all EVM values versus the symbols of the analyzed zone. If the capture buffer contains more than one analyzed zones, the corresponding result graphs will be appended. The minimum, mean, and maximum statistics is performed over carriers.
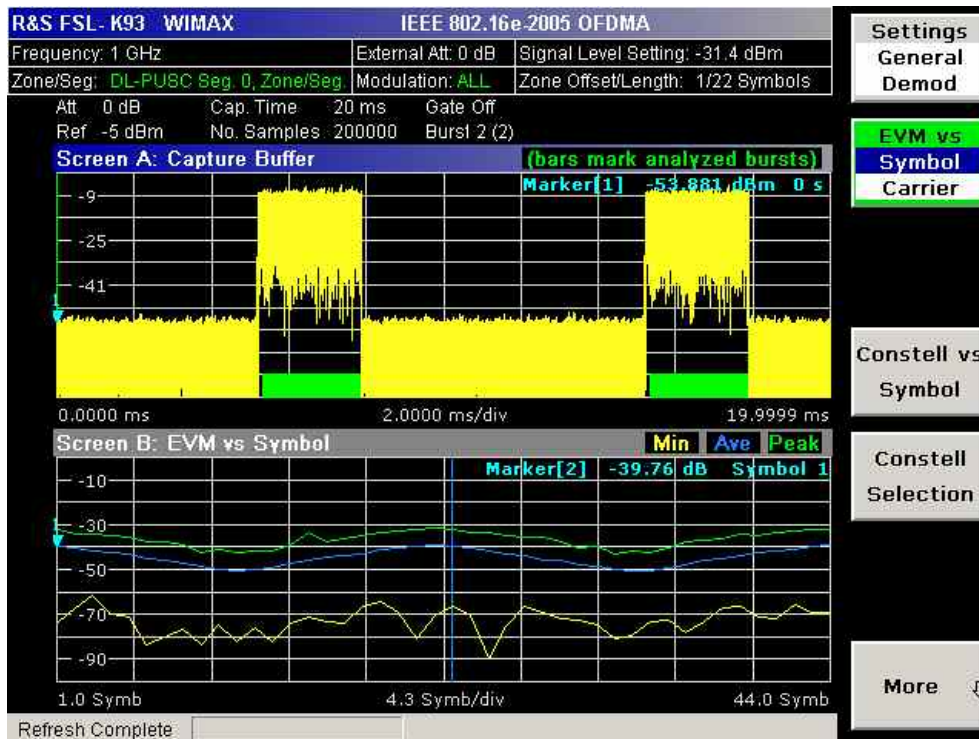
– EVM vs Carrier (IEEE 802.16–2004 OFDM)

This result display shows all EVM values recorded on a per–carrier basis over the full set of measured data. The minimum, average and maximum traces are displayed.
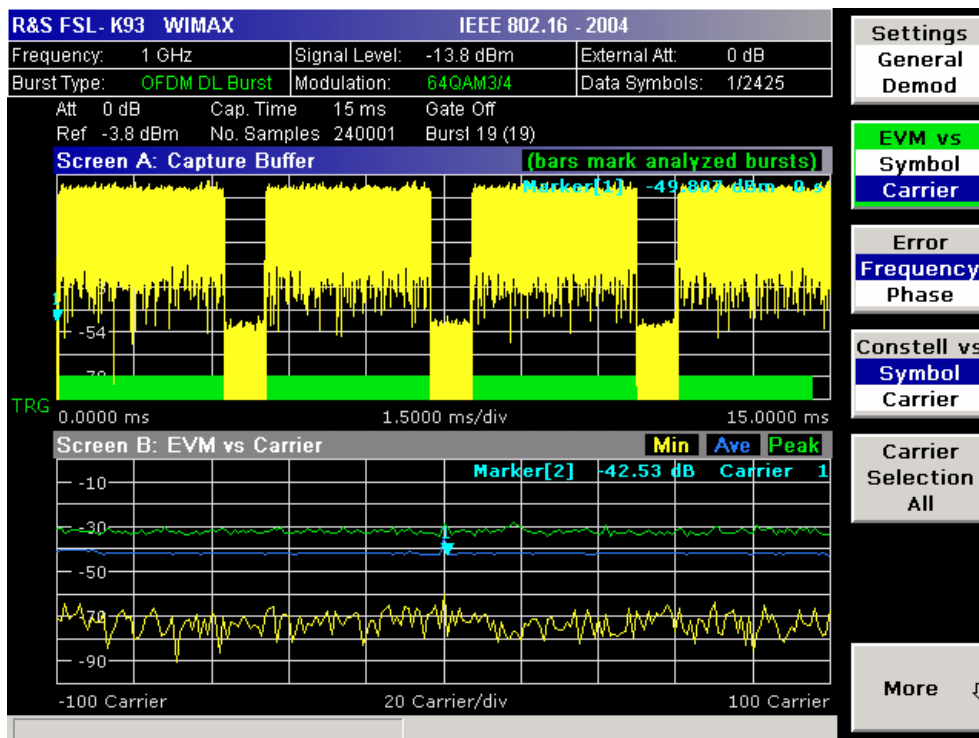
– EVM vs Carrier (IEEE 802.16e–2005 OFDMA/WiBro)

This result display shows all EVM values versus the physical carriers. The minimum, mean, and maximum statistics is performed over the symbols of all analyzed zones in the capture buffer.
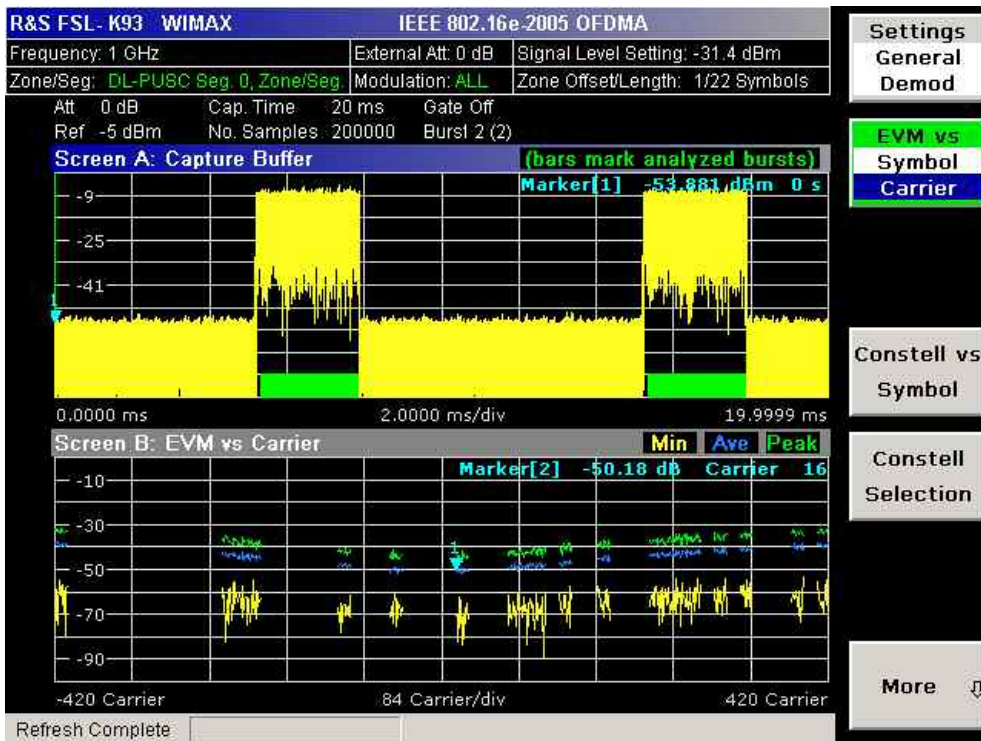
➡ Remote: `CONF:BURS:EVM:ESYM` (EVM vs Symbol)
➡ Remote: `CONF:BURS:EVM:ECAR` (EVM vs Carrier)

Error Frequency/Phase (IEEE 802.16–2004 OFDM)

Selects the 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.

Using the **Y–Axis/Div** softkey, the scaling of the y–axis can be modified to allow the results to be scaled to an optimum level.
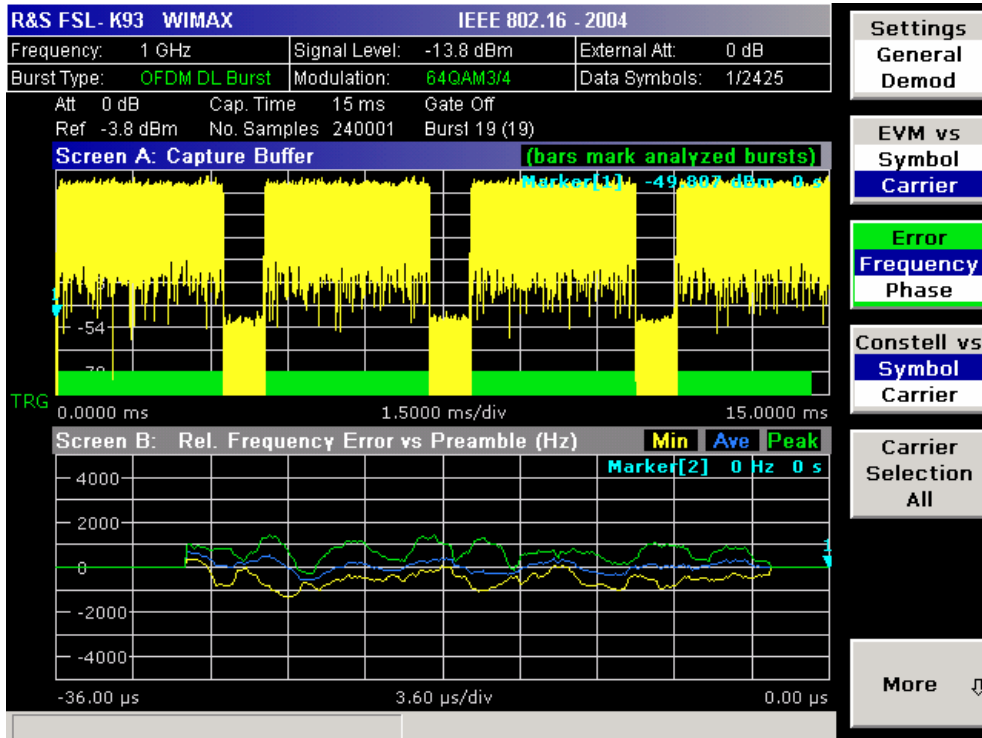
- ➡ Remote: `CONF:BURS:PRE`
- ➡ Remote: `CONF:BURS:PRE:SEL FREQ` (Frequency Error vs Preamble)
- ➡ Remote: `CONF:BURS:PRE:SEL PHAS` (Phase Error vs Preamble)

Constell vs Symbol/Carrier

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

– Constellation vs Symbol (IEEE 802.16–2004 OFDM)

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** softkey).

– Constellation vs Symbol (IEEE 802.16e–2005 OFDMA/WiBro)

This result display shows the complex constellation diagram of the modulation symbols. The modulation symbols belong to the bursts of the analyzed zone. The different modulation formats are displayed in unique colors. The same color assignment is used in the Bitstream result display.

The amount of data displayed in the Constellation result display can be reduced via the **Constell Selection** softkey.

– Constellation vs Carrier (IEEE 802.16–2004 OFDM)

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).
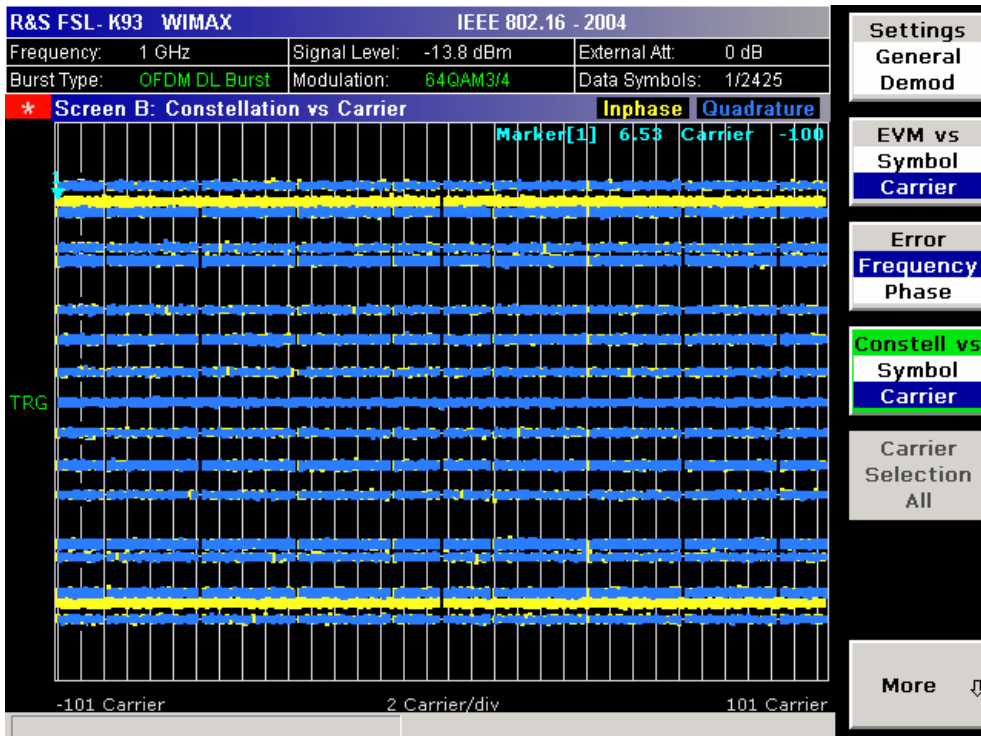
➡ Remote: `CONF:BURS:CONS:CSYM` (Constellation vs Symbol)

➡ Remote: `CONF:BURS:CONS:CCAR` (Constellation vs Carrier)

Carrier Selection (IEEE 802.16–2004 OFDM)

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

➡ Remote: `CONF:BURS:CONS:CARR:SEL –26`

Constell Selection (IEEE 802.16e–2005 OFDMA/WiBro)

Opens a dialog box for filtering the displayed results. The results may be filtered by any combination of modulation, burst, symbol, or carrier. If the constellation selection parameters are changed, the result display is updated accordingly.

➡ Remote: `CONF:BURS:CONS:SYMB:SEL 1` (symbol)

➡ Remote: `CONF:BURS:CONS:FORM:SEL QPSK` (modulation)

➡ Remote: `CONF:BURS:CONS:BURS:SEL 1` (burst)

Y–Axis/Div (EVM vs Symbol/Carrier, Error Frequency/Phase)

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.

This softkey is only available for the above mentioned measurements if trace data are displayed.

➡ Remote: `DISP:WIND2:TRAC1:Y:AUTO ON` (Auto Scaling)

➡ Remote: `DISP:WIND2:TRAC1:Y:PDIV 2` (Per Division)

➡ Remote: `UNIT:EVM PCT` (Unit – EVM vs Symbol/Carrier)

➡ Remote: `UNIT:PRE HZ` (Unit – Error Frequency/Phase)

Spectrum

Opens a submenu for frequency measurements.

Spectrum Flat./Diff./Group Delay

Sets the Spectrum Flatness result displays in graphical form (**Display Graph** selected), or in tabular form (**Display List 1/2** selected).

– Spectrum Flatness and Spectrum Flatness Group Delay (IEEE 802.16–2004 OFDM)

These result displays show either the Spectrum Flatness or the Group Delay values recorded on a per–carrier basis over the full set of measured data. A minimum, average and maximum trace are displayed for each of the result types. If the Spectrum Flatness result display is selected an upper and lower limit line representing the limits specified for the selected standard are displayed. An overall pass/fail status is displayed for the obtained (average) results against these limit lines.
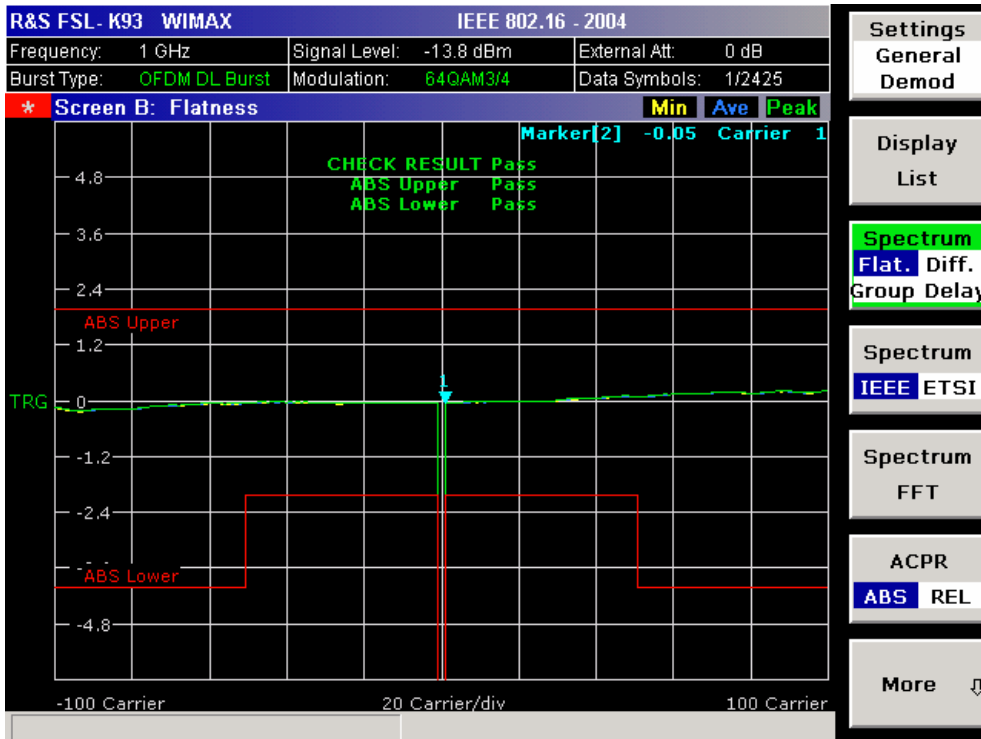
– Spectrum Flatness and Spectrum Flatness Group Delay (IEEE 802.16e–2005 OFDMA/WiBro)

This result display shows the average energy of the constellations for the physical carriers. The limit lines are displayed according to the requirements of the standard. The minimum, mean, and maximum statistics is performed over the analyzed zones in the capture buffer.

– Spectrum Flatness Difference (IEEE 802.16–2004 OFDM)

This result display shows the adjacent carrier power difference of the preamble part of the burst. A minimum, average and maximum trace are displayed.
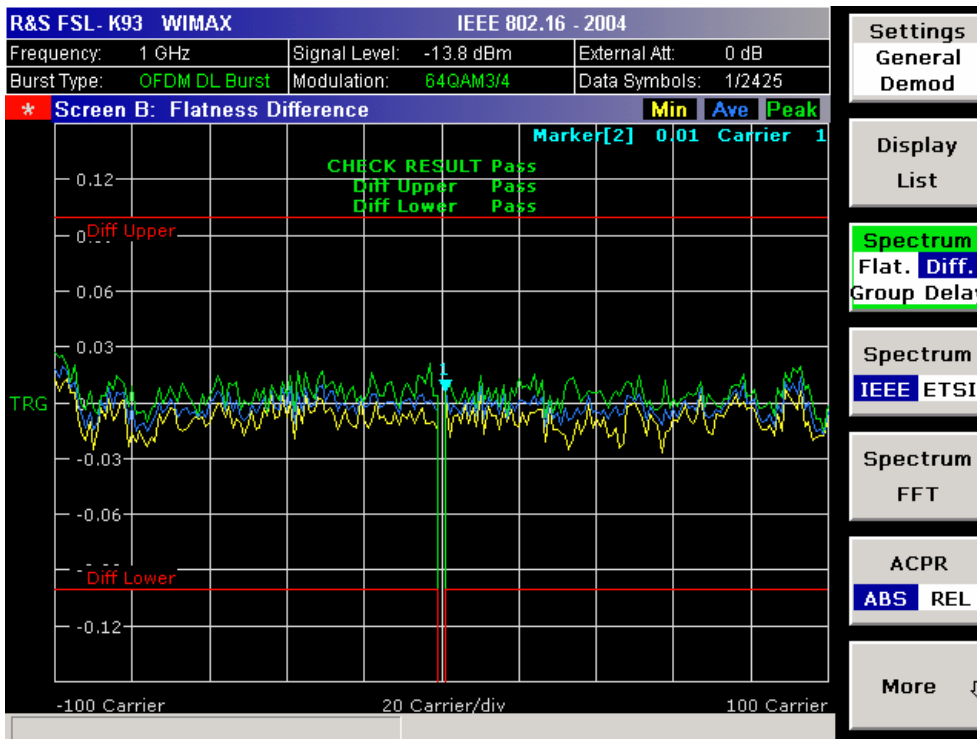
– Spectrum Flatness Difference (IEEE 802.16e–2005 OFDMA/WiBro)

This result display shows the absolute difference of adjacent carriers. The limit lines are displayed according to the requirements of the standard. The minimum, mean, and maximum statistics is performed over the analyzed zones in the capture buffer.

➡ Remote: `CONF:BURS:SPEC:FLAT`

➡ Remote: `CONF:BURS:SPEC:FLAT:SEL FLAT` (Spectrum Flatness)

➡ Remote: `CONF:BURS:SPEC:FLAT:SEL GRD` (Spectrum Flatness Group Delay)

➡ Remote: `CONF:BURS:SPEC:FLAT:SEL DIFF` (Spectrum Flatness Difference)

**Spectrum IEEE/ETSI (IEEE 802.16–2004 OFDM, IEEE 802.16e–2005 OFDMA) /
Spectrum Mask (IEEE 802.16e–2005 WiBro)**

Sets the Spectrum (Emission) Mask result display. For the IEEE 802.16–2004 OFDM, IEEE 802.16e–2005 OFDMA standards, the result is displayed in graphical form (**Display Graph** selected), or in tabular form (**Display List 1/2** selected). For the IEEE 802.16e–2005 WiBro standard, graph and table are displayed combined.

This result display shows power against 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.
For the IEEE 802.16–2004 OFDM, IEEE 802.16e–2005 OFDMA standards, the span of the results is related to the specified sample rate.
For the IEEE 802.16e–2005 WiBro standard, the table contains the results for each of the individual frequency ranges. On the trace, the highest power value is marked for each of the specified frequency ranges with a marker.

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. For the IEEE 802.16e–2005 WiBro standard, the Spectrum Emission Mask measurement is configured via the **SEM Settings** softkey.

– Spectrum IEEE (IEEE 802.16–2004 OFDM)
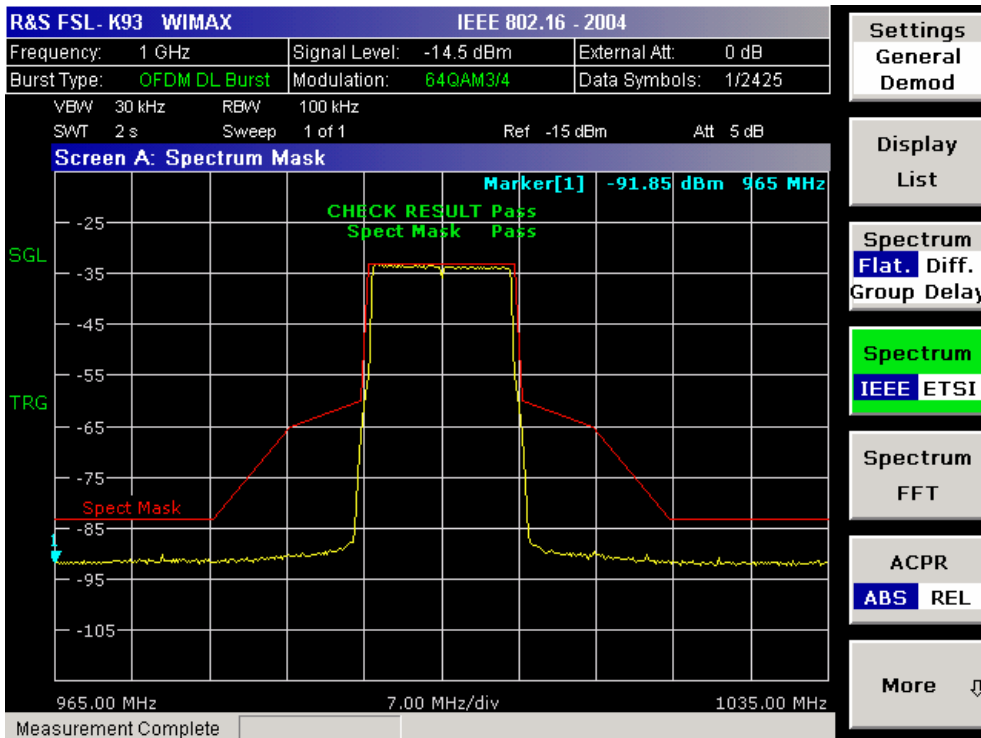
– Spectrum IEEE (IEEE 802.16e–2005 OFDMA)
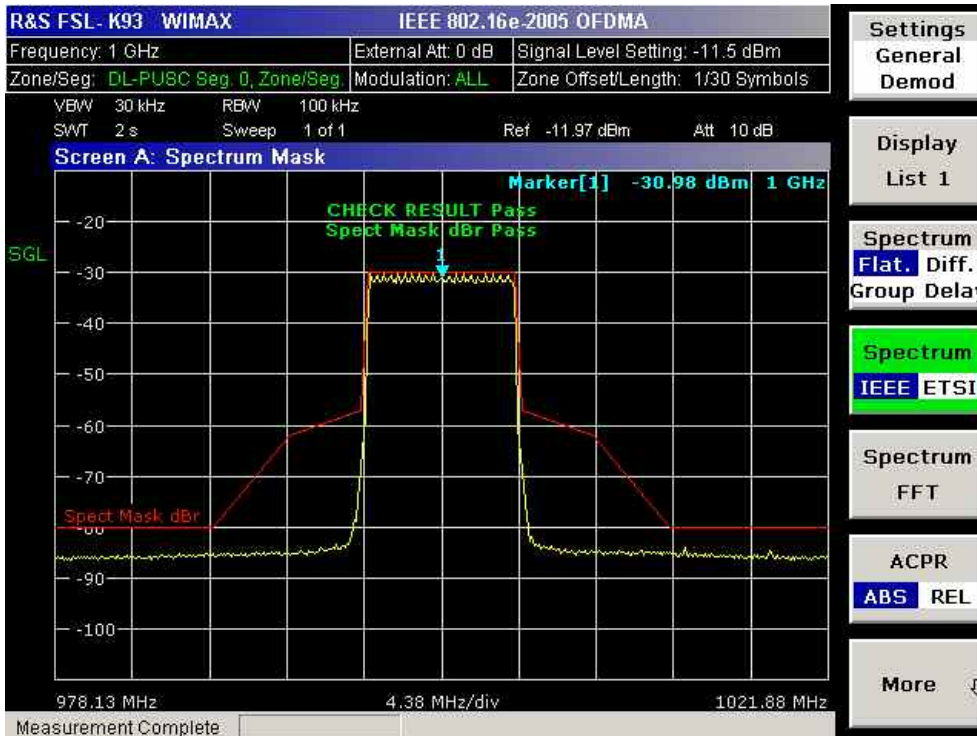
– Spectrum ETSI (IEEE 802.16–2004 OFDM)
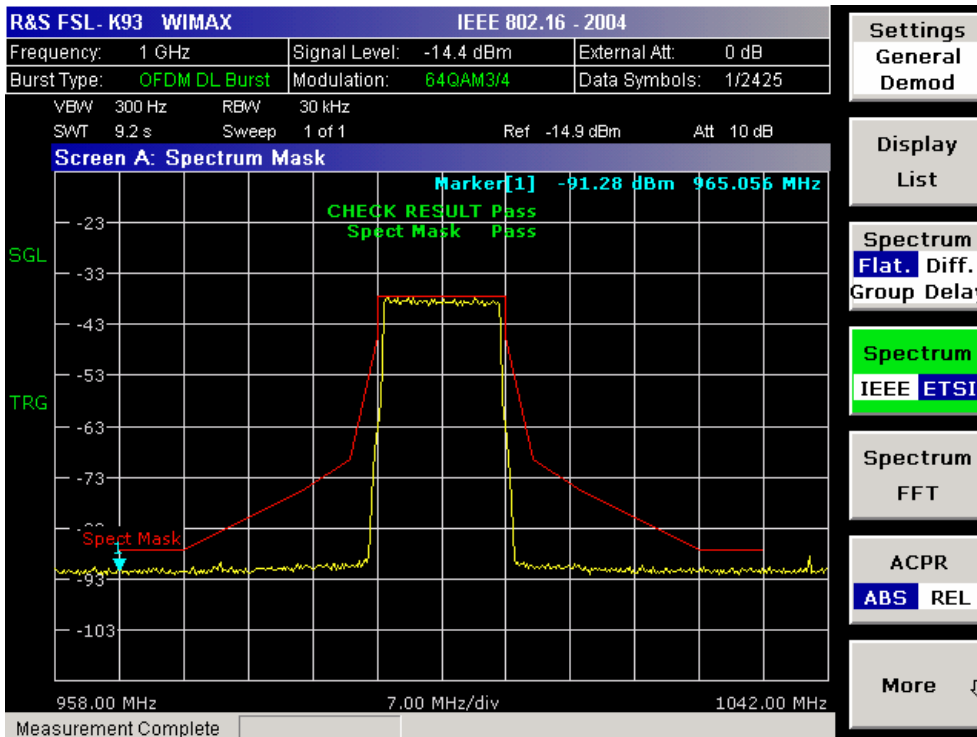
– Spectrum ETSI (IEEE 802.16e–2005 OFDMA)
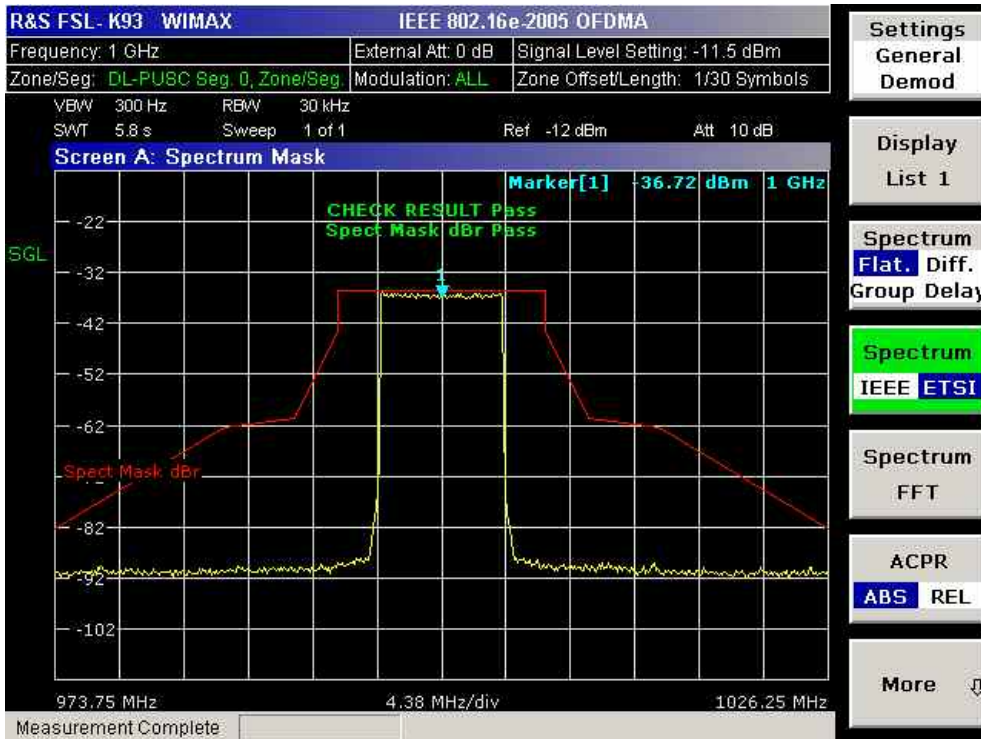
– IEEE 802.16e–2005 WiBro
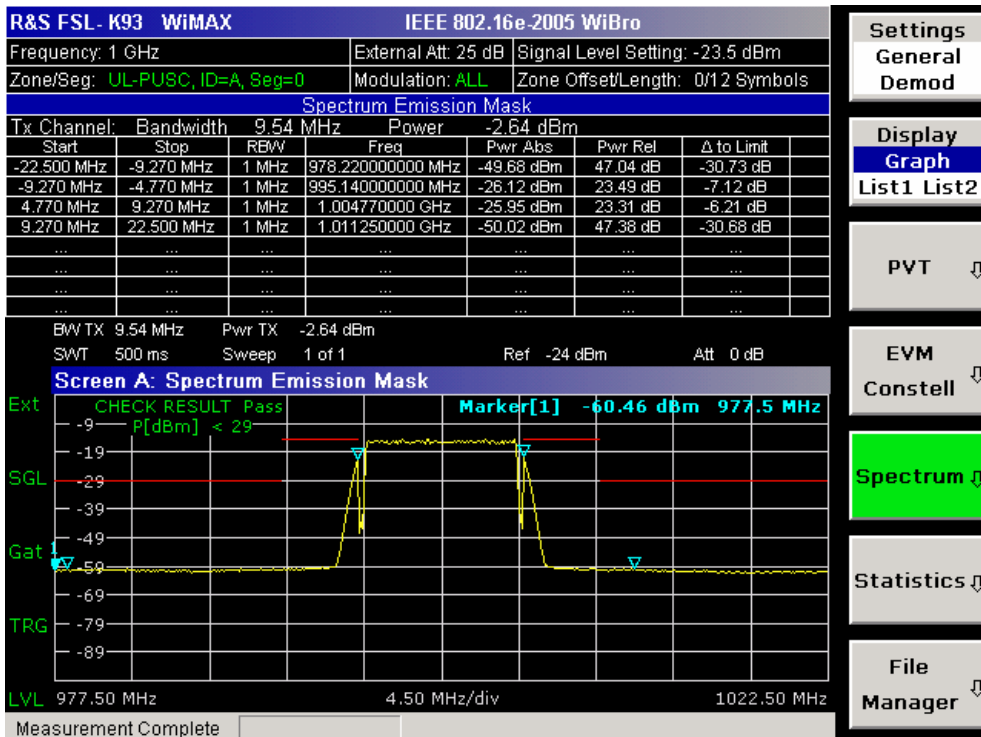
➡ Remote: `CONF:BURS:SPEC:MASK`

➡ Remote: `CONF:BURS:SPEC:MASK:SEL IEEE`

➡ Remote: `CONF:BURS:SPEC:MASK:SEL ETSI`

Spectrum FFT

Sets the Spectrum FFT result display in graphical form (**Display Graph** selected), or in tabular form (**Display List 1/2** selected).

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. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the **Refresh** softkey in the sweep menu.

– IEEE 802.16–2004 OFDM
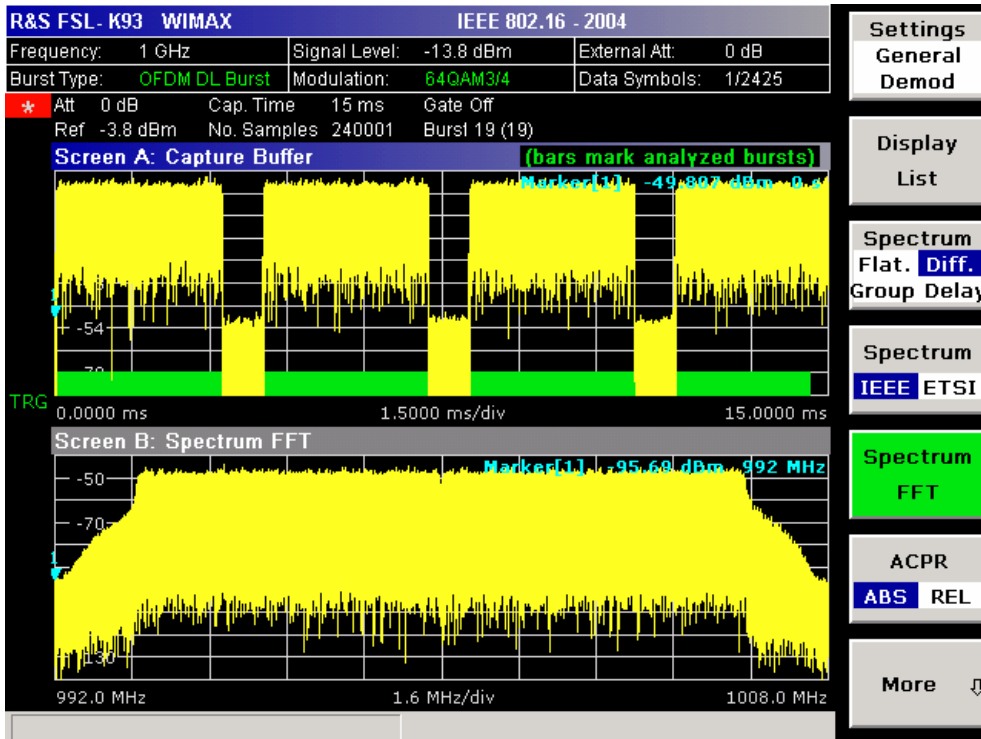
– IEEE 802.16e–2005 OFDMA/WiBro
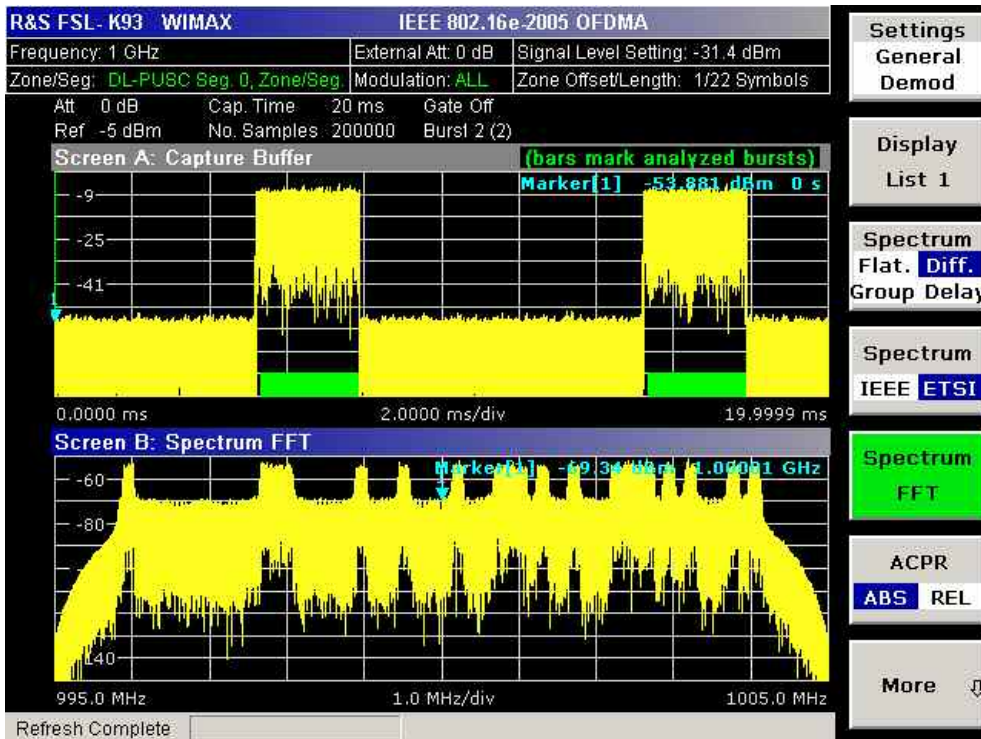
➡ Remote: `CONF:BURS:SPEC:FFT`

ACPR Abs/Rel

Sets the ACPR (Adjacent Channel Power Relative) result display in graphical form (**Display Graph** selected), or in tabular form (**Display List 1/2** selected).

This result display is similar to the Spectrum Mask measurement, and provides information about leakage into adjacent channels. The results show the 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 spectrum 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.

– IEEE 802.16–2004 OFDM
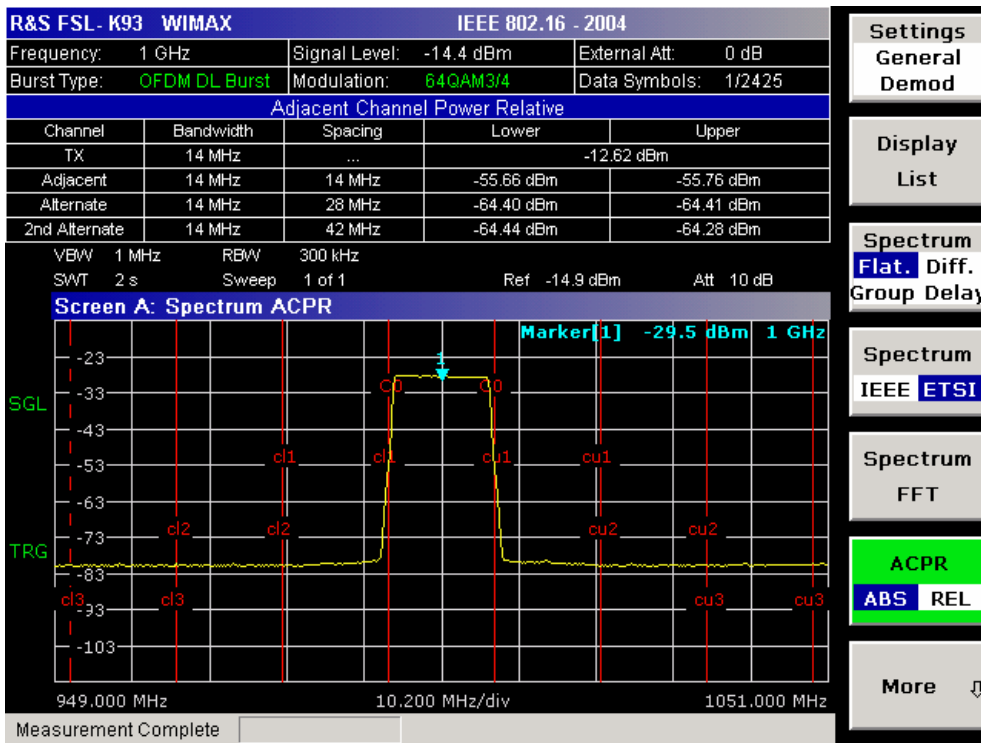
– IEEE 802.16e–2005 OFDMA/WiBro
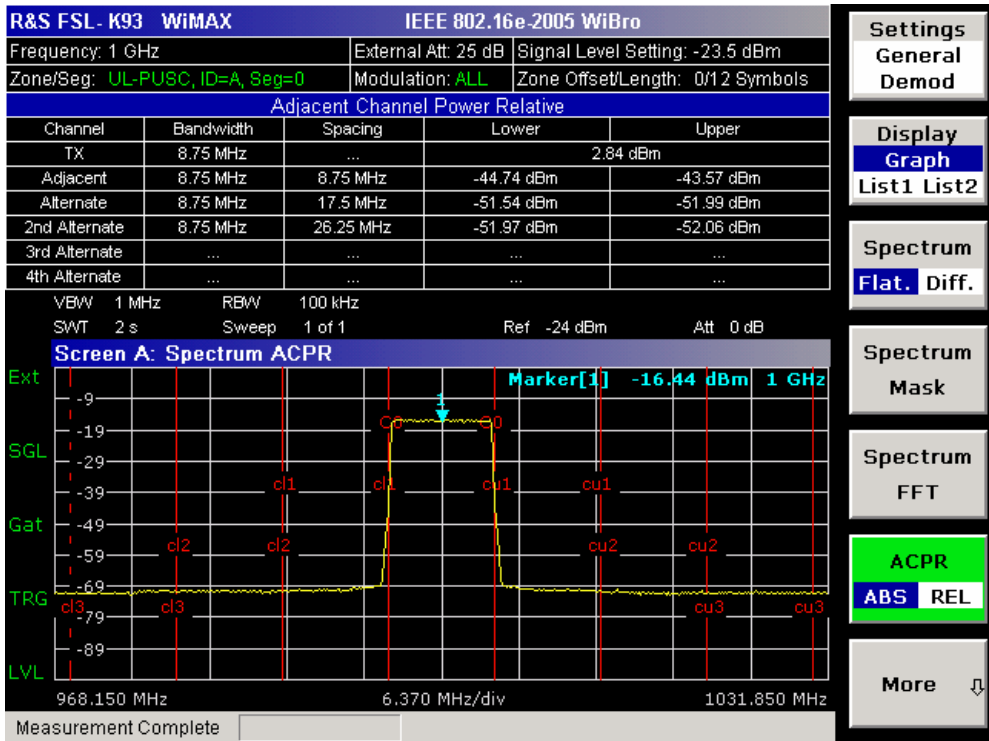
➡ Remote: `CONF:BURS:SPEC:ACPR`

➡ Remote: `CONF:BURS:SPEC:ACPR:SEL ABS`

➡ Remote: `CALC2:MARK:FUNC:POW:RES?` (result query)

➡ Remote: `CALC2:MARK:FUNC:POW:RES:MAXH?` (result query)

ACP Settings

Opens the **ACP Settings** dialog box to configure the ACPR result display. By default, the ACP settings are derived from the **General Settings** dialog box, **Channel BW** field.

Pane	Field	Description
Channels	No. of Channels	Specifies the number of channels adjacent to the transmit channel to be measured. If set to 0, only the transmit channel is measured.
TX/ACP Channel BW	TX	Specifies the bandwidth of the transmit channel to be measured by the ACP measurement.
	Adjacent, Alternate 1, Alternate 2, Alternate 3, Alternate 4	Specifies the bandwidth of the first to fifth channel before and after the transmit channel to be measured.
ACP Channel Spacing	Adjacent, Alternate 1, Alternate 2, Alternate 3, Alternate 4	Specifies the spacing of the first to fifth channel before and after the transmit channel to be measured.

➡ Remote: `POW:ACH:ACP 3` (No. of Channels)
➡ Remote: `POW:ACH:BAND 30kHz` (TX)
➡ Remote: `POW:ACH:SPAC 33kHz` (Adjacent/TX)
➡ Remote: `POW:ACH:SPAC:ALT1 100kHz` (Alternate 1 to 4/TX)
➡ Remote: `POW:ACH:BAND:ACH 30kHz` (Adjacent)
➡ Remote: `POW:ACH:BAND:ALT2 30kHz` (Alternate 1 to 4)

Statistics

Opens a submenu to display statistics measurement results.

CCDF

Sets the CCDF result display in graphical form (**Display Graph** selected), or in tabular form (**Display List 1/2** selected).

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.

If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the **Refresh** softkey in the sweep menu.

– IEEE 802.16–2004 OFDM
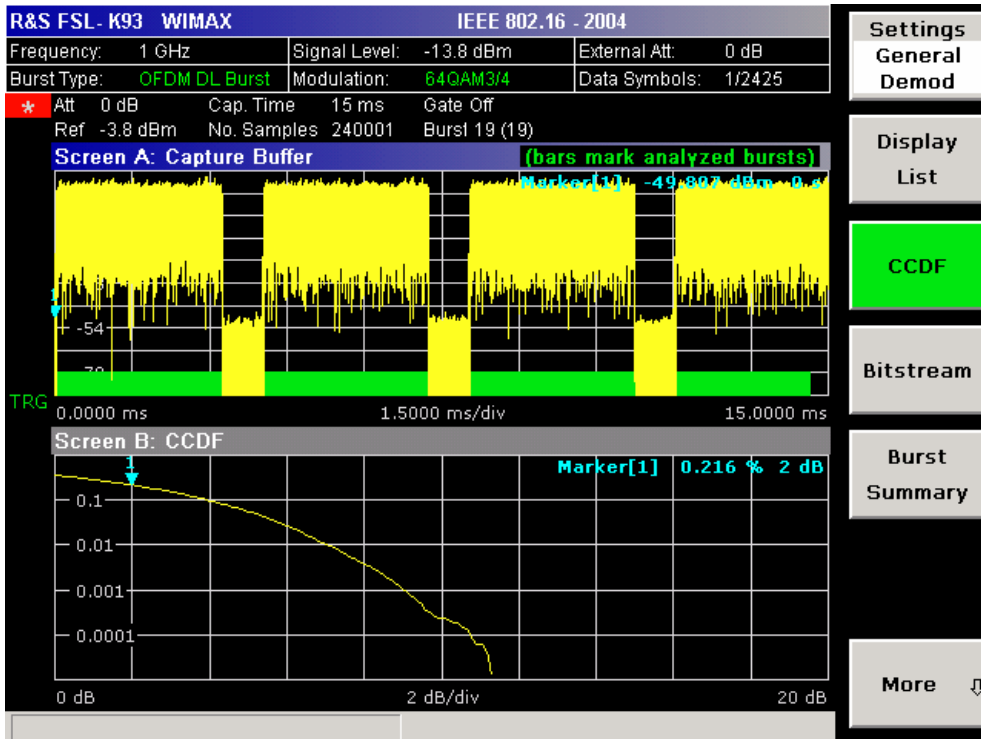
– IEEE 802.16e–2005 OFDMA/WiBro
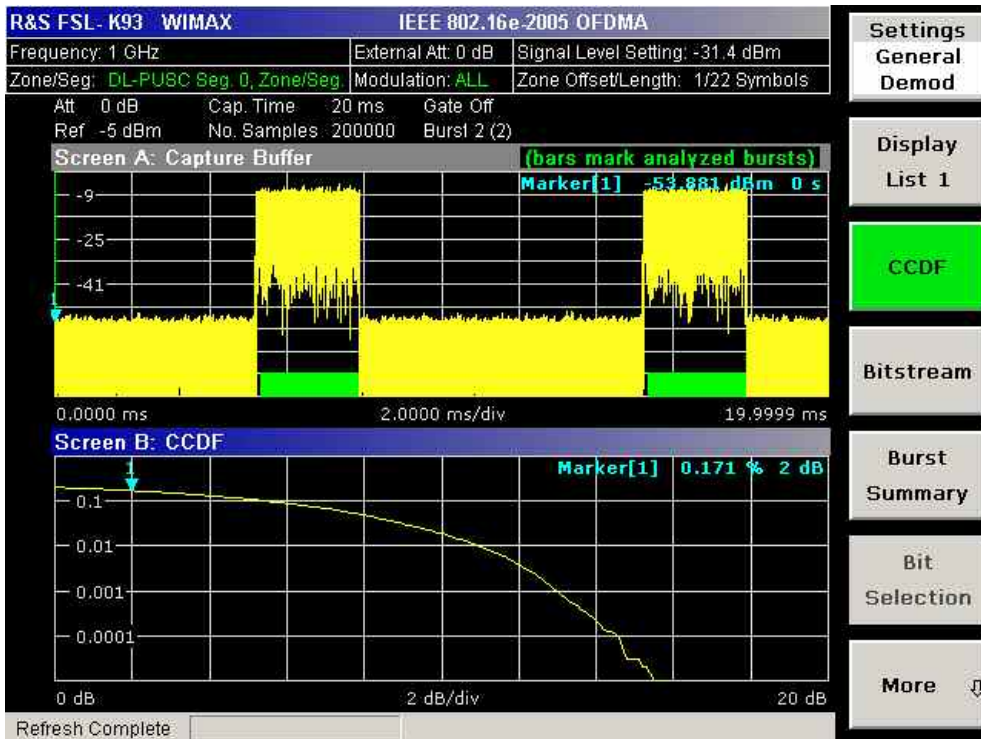
➡ Remote: `CONF:BURS:STAT:CCDF`

Bitstream

Sets the Bitstream result display in graphical form (**Display Graph** selected), or in tabular form (**Display List 1/2** selected).

– IEEE 802.16–2004 OFDM

This result display shows the demodulated data stream. These results are grouped by burst and symbol. If no dialog boxes are displayed, the results can be scrolled through using the cursor keys or rotary knob.
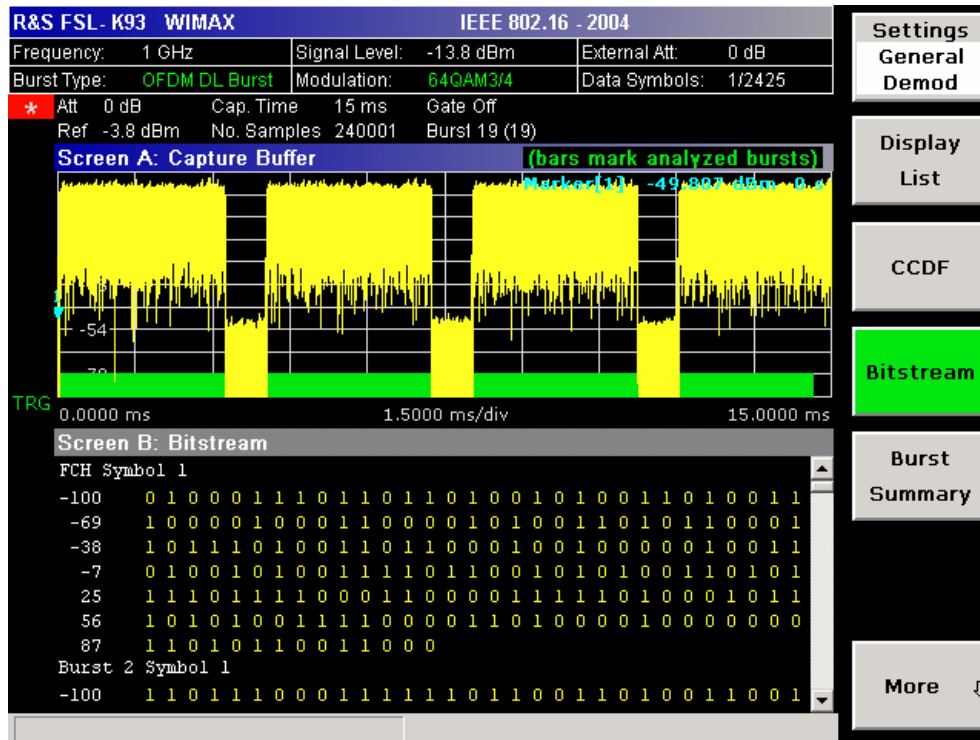
– IEEE 802.16e–2005 OFDMA/WiBro

This result display shows the modulation symbols of the bursts from the analyzed zone. The different modulation formats are displayed in unique colors. The same color assignment is used in the Constellation vs Symbol result display. The modulation symbols define bit sequences. The mapping is defined in the standard. Signals with erroneous pilot sequences (i.e where the detected pilot sequence does not match that according to the standard) are highlighted with a red background.

The amount of data displayed in the Bitstream result display can be reduced via the **Bit Selection** softkey.
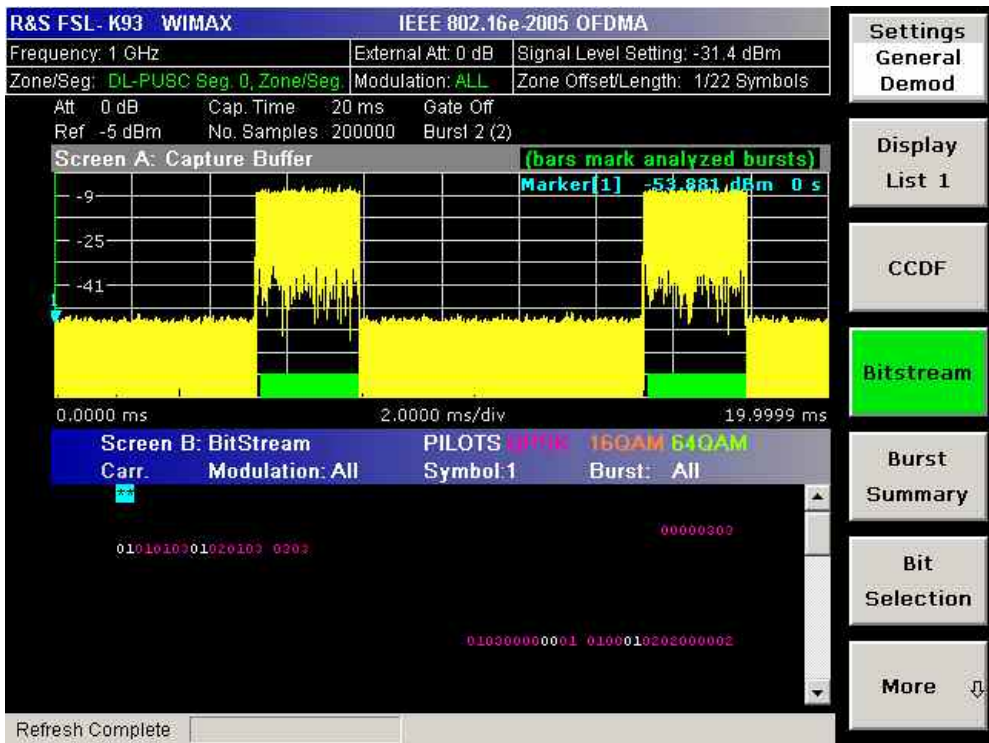
➡ Remote: `CONF:BURS:STAT:BSTR`

Burst Summary

This result display shows the summary data for the analyzed bursts. If no dialog boxes are displayed, the results can be scrolled through using the cursor keys or rotary knob.

– IEEE 802.16–2004 OFDM
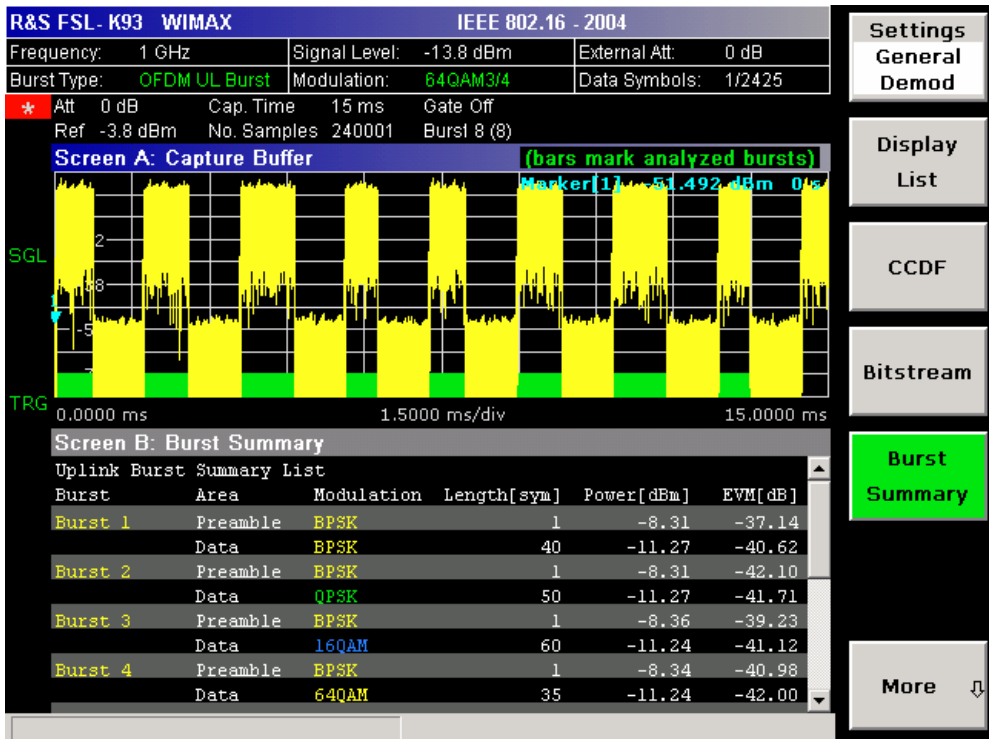
– IEEE 802.16e–2005 OFDMA/WiBro

This result display provides information about the bursts from the analyzed zone, i.e. modulation of the burst, power boosting information, EVM of the burst. Each analyzed zone will produce a set of burst results.
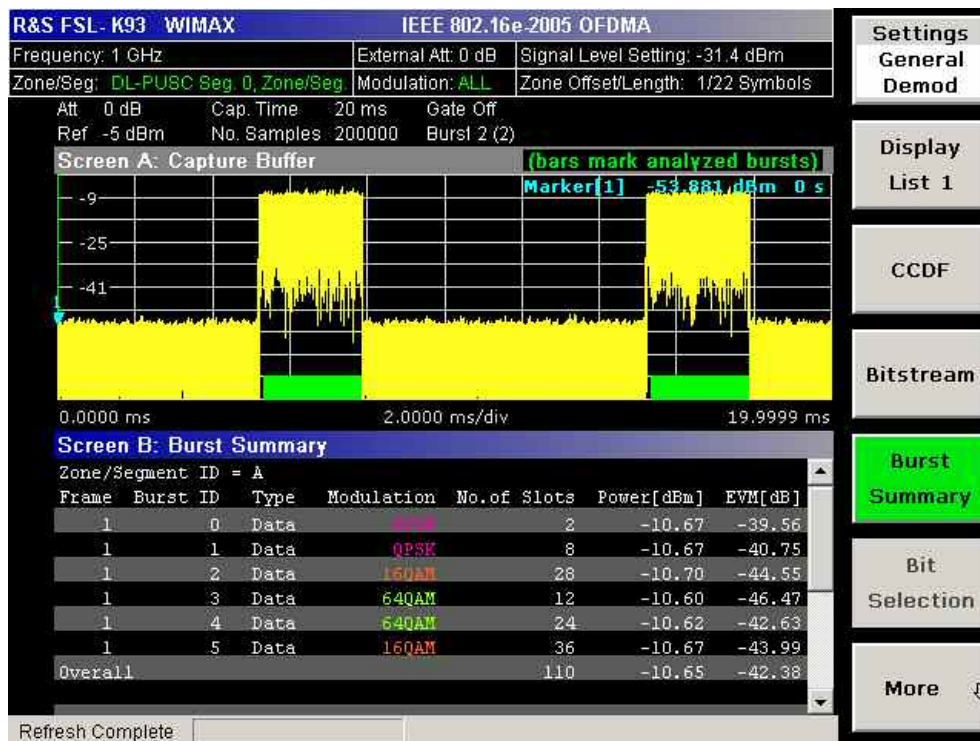
➡ Remote: CONF:BURS:STAT:BSUM

Bit Selection (IEEE 802.16e–2005 OFDMA/WiBro)

Opens a dialog box for filtering the displayed results. The results may be filtered by any combination of modulation, symbol or burst. If the bit selection parameters are changed, the result display is updated accordingly.

This softkey is only available if the Bitstream measurement (**Bitstream** softkey) is selected.

➡ Remote: CONF:BURS:BSTR:SYMB:SEL 1 (symbol)
➡ Remote: CONF:BURS:BSTR:FORM:SEL QPSK (modulation)
➡ Remote: CONF:BURS:BSTR:BURS:SEL 1 (burst)

File Manager (IEEE 802.16e–2005 OFDMA/WiBro)

Opens the **File Manager** dialog box. The File Manager provides the possibility to transfer WiMAX settings from an R&S SMU signal generator via LAN. For step–by–step instructions see . The File Manager also offers some general file management support.

The File Manager writes into the directory C:\R_S\Instr\user\WMAN and its subdirectories or a USB memory stick only.

Under **File Types**, filter the displayed files by selecting:

All (*.*)   All file types are displayed. Use this selection to perform general file management tasks.

    SMU WiMax   Only files with the extension WiMAX are displayed.

Depending on the focus, the following softkeys are provided:

– **Recall**

– **New Folder**

– **Copy**

– **Paste**

– **Rename**

– **Delete File**

Softkeys of the sweep menu (WiMAX mode)

The following table shows all softkeys available in the sweep menu in **WiMAX** mode (**SWEEP** 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.

Command
Run Single/Cont
Auto Level
Refresh

Run Single/Cont

Selects the sweep mode.

    Single   single sweep mode

    Cont   continuous sweep mode

A single measurement will complete once the requested number of bursts have been obtained or a single sweep has been completed, depending on the measurement settings. If a measurement is completed in continuous mode, a new measurement will be started.

If a measurement is started while another measurement is in progress, the first measurement will be aborted and the new measurement started immediately.

➡ Remote: `INIT:CONT OFF` (single sweep mode)

➡ Remote: `INIT:CONT ON` (continuous sweep mode)

Auto Level

Starts an automatic level detection measurement. After the automatic level detection has been completed, the trace is displayed in the Magnitude Capture Buffer display.

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.

➡ Remote: `CONF:POW:AUTO ON`

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, CCDF, Spectrum Mask, Spectrum ACPR) and if the gate settings are modified after a measurement result has been obtained.

➡ Remote: `INIT:REFR`

Softkeys of the marker menu (WiMAX mode)

The following table shows all softkeys available in the marker menu in **WiMAX** 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.

Command
Marker 1
Unzoom
Marker Zoom
Marker Off

Marker 1

Opens a dialog box to adjust the marker. The contents of the dialog box depends 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.

➡ Remote: `CALC1:MARK1 ON`
➡ Remote: `CALC:MARK:X 2ms`
➡ Remote: `CALC:MARK:Y?`
➡ Remote: `CALC2:MARK:SYMB 2`
➡ Remote: `CALC2:MARK:CARR –7`

Unzoom

Cancels the marker zoom.

➡ Remote: `CALC:MARK:FUNC:ZOOM 1`

Marker Zoom (Magnitude Capture Buffer, PVT, Constellation vs Symbol, Constellation vs Carrier)

Opens an edit dialog box to select the magnification factor for the zoom. The maximum magnification depends on the type of result display.

➡ Remote: `CALC:MARK:FUNC:ZOOM 4`

Marker Off

Switches off all makers in the active result display.

➡ Remote: `CALC2:MARK:AOFF`

Softkeys of the marker–> menu (WiMAX mode)

The following table shows all softkeys available in the marker–> menu in **WiMAX** 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.

Command
MKR –> Trace

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.

➡ Remote: `CALC2:MARK:TRAC 2`

Softkeys of the lines menu (WiMAX mode)

The following table shows all softkeys available in the lines menu in **WiMAX** 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 **Result summary list** and **Display Graph** softkey).

Command
Default Current
Default All

Default Current

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

➡ Remote: see CALCulate:LIMit Subsystem

Default All

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

➡ Remote: see CALCulate:LIMit Subsystem

Softkeys of the trace menu (WiMAX mode)

The following table shows all softkeys available in the trace menu in **WiMAX** 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.

Command
Display List/Graph
Screen Focus A/B
Screen Size Full/Split

Display List/Graph

For details refer to the **Display Graph/List** softkey in the WiMAX menu.

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.

➡   Remote: `DISP:WIND1:SSEL`

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.

➡   Remote: `DISP:FORM SING`

Contents of Chapter 4

4   Remote Control – Commands

This chapter describes all remote control commands for the software option R&S FSL-K1 in detail. For the basic settings functions please refer to the NWA Help System, chapter "Command Reference". The mode information is provided for each command.

A few commands are implemented for reasons of compatibility with the FSP family only. These commands are not described in the R&S ZVL-K1 documentation, because they have no effect.

Each subsystem starts with a list of commands, which provides quick access to all commands of the subsystem.

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

- Upper/Lower Case Notation

- Special Characters

- Description of Parameters

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	**spectrum analysis**
A–F	**spectrum analysis – span > 0 only (frequency mode)**
A–T	**spectrum analysis – zero span only (time mode)**
ADEMOD	**analog demodulation (option R&S FSL–K7)**
BT	**Bluetooth measurements (option R&S FSL–K8)**
NF	**noise figure measurements (option R&S–FSL–K30)**
OFDM	**WiMAX IEEE 802.16 OFDM measurements (options R&S FSL–K93)**
OFDMA/WiBro	**WiMAX IEEE 802.16e OFDMA/WiBro measurements (option R&S FSL–K93)**
PSM	**power sensor measurements (option R&S FSL–K9)**
SPECM	**spectrogram measurements (option R&S FSL–K14)**
WCDMA	**3GPP Base Station measurements (option R&S FSL–K72)**
WLAN	**WLAN TX measurements (option R&S FSL–K91)**

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. 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 is different, depending on which parameter is used.

Example: Selection of the parameters for the command

```
[SENSe<1|2>:]AVERage:TYPE VIDeo | LINear
```

If parameter SINGle is selected, full screen is displayed, in the case of SPLit, split screen is displayed.

[]   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 will be briefly explained in the following (for details refer to NWA Help System, section "Remote Control", "Messages", "SCPI 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.

Remote Control – Description of Analyzer Commands

In this section all remote control commands for analyzer functions are described in detail. For details on commands for basic settings refer to the NWA Help System, chapter "Command Reference".

Subsystems of the analyzer

– "

–

–

– ABORt Subsystem" on page 4.5
– "CALCulate Subsystem" on page 4.6
– "DISPlay Subsystem" on page 4.104
– "FORMat Subsytem" on page 4.109
– "INITiate Subsystem" on page 4.109
– "INPut Subsystem" on page 4.112
– "INSTrument Subsystem

The INSTrument subsystem controls the measurement mode.

Commands of the INSTrument Subsystem

– INSTrument[:SELect]
– INSTrument:NSELect

INSTrument[:SELect]

This command switches between the measurement modes by means of text parameters.

Remote control commands sent to the instrument can only be interpreted correctly if the corresponding mode is active. In order to use the R&S ZVL-K1 option you have to choose the spectrum analyzer mode.

Parameter

SANalyzer   spectrum analyzer

NWAnalyzer   network analyzer

The parameters of the other measurement modes are included in the corresponding option documentation.

Example

`INST SAN`
Switches the instrument to spectrum analyzer mode.

Characteristics

*RST value: NWAnalyzer

SCPI: conform

Mode

all

INSTrument:NSELect

This command switches between the measurement modes by means of numbers.

Parameter

1   spectrum analyzer

2   network analyzer

The parameters of the other measurement modes are included in the corresponding option documentation.

Example

`INST:NSEL 1`
Switches the instrument to spectrum analyzer mode.

Characteristics

*RST value: 2

SCPI: conform

Mode

all

– OUTPut Subsystem" on page 4.115

– "SENSe Subsystem" on page 4.117

– "STATus Subsystem" on page 4.157

– "SYSTem Subsystem" on page 4.168

– "TRACe Subsystem" on page 4.169

– "TRIGger Subsystem" on page 4.180

– "UNIT Subsystem" on page 4.185

ABORt Subsystem

The ABORt subsystem contains the commands for aborting triggered actions. An action can be triggered again immediately after being aborted. All commands trigger events, and therefore they have no *RST value.

Commands of the ABORt Subsystem

– ABORt

ABORt

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

Example

`ABOR;INIT:IMM`

Characteristics

RST value: –

SCPI: conform

Mode

all

CALCulate Subsystem

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSe subsystem.

The following subsystems are included:

CALCulate:DELTamarker Subsystem

The CALCulate:DELTamarker subsystem controls the delta marker functions of the instrument.

Commands of the CALCulate:DELTamarker Subsystem

- CALCulate<1|2>:DELTamarker<1...4>[:STATe]
- CALCulate<1|2>:DELTamarker<1...4>:AOFF
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe]
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:X
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:Y
-
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:Y:OFFSet
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe]
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise:RESult?
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt
- CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt

- CALCulate<1|2>:DELTamarker<1...4>:MODE
- CALCulate<1|2>:DELTamarker<1...4>:TRACe
- CALCulate<1|2>:DELTamarker<1...4>:X
- CALCulate<1|2>:DELTamarker<1...4>:X:RELative?
- CALCulate<1|2>:DELTamarker<1...4>:Y?

CALCulate<1|2>:DELTamarker<1...4>[:STATe]

This command switches on and off the delta marker when delta marker 1 is selected. The corresponding marker becomes the delta marker when delta marker 2 to 4 is selected. If the corresponding marker is not activated, it will be activated and positioned on the maximum of the measurement curve.

If no numeric suffix with DELTamarker is indicated, delta marker 1 is selected automatically.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:DELT3 ON

Switches marker 3 to delta marker mode.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

all

CALCulate<1|2>:DELTamarker<1...4>:AOFF

This command switches off all active delta markers.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:DELT:AOFF

Switches off all delta markers.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe]

This command switches the relative measurement to a fixed reference value on or off. Marker 1 will be activated previously and a peak search will be performed, if necessary. If marker 1 is activated, its position becomes the reference point for the measurement. The reference point can then be modified with the CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:X commands and CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:Y independently of the position of marker 1 and of a trace. It applies to all delta markers as long as the function is active.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:DELT:FUNC:FIX ON
Switches on the measurement with fixed reference value for all delta markers.

CALC:DELT:FUNC:FIX:RPO:X 128 MHZ
Sets the frequency reference to 128 MHz.

CALC:DELT:FUNC:FIX:RPO:Y 30 DBM
Sets the reference level to +30 dBm.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]

This command sets the reference point level for all delta markers for a measurement with fixed reference point (CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe]) to the peak of the selected trace.

For phase–noise measurements (CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe]), the command defines a new reference point level for delta marker 2.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Parameter

<numeric_value>

Example

CALC:DELT:FUNC:FIX:RPO:MAX
Sets the reference point level for delta markers to the peak of the selected trace.

Characteristics

RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:X

This command defines a new frequency reference (span > 0) or time (span = 0) for all delta markers for a measurement with fixed reference value
(`CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe]`).

For phase–noise measurements
(`CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe]`), the command defines a new frequency reference or time for delta marker 2.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<numeric_value>

Example

`CALC:DELT:FUNC:FIX:RPO:X 128MHz`
Sets the frequency reference to 128 MHz.

Characteristics

RST value: – (`CALCulate<1|2>:DELTamarker<1...4>:FUNCTION:FIXed[:STATe]` is set to OFF)

SCPI: device–specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:Y

This command defines a new reference point level for all delta markers for a measurement with fixed reference point
(`CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe]`).

For phase–noise measurements
(`CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe]`), the command defines a new reference point level for delta marker 2.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<numeric_value>

Example

`CALC:DELT:FUNC:FIX:RPO:Y –10dBm`
Sets the reference point level for delta markers to –10 dBm.

Characteristics

RST value: – (`CALCulate<1|2>:DELTamarker<1...4>:FUNCTION:FIXed[:STATe]` is set to OFF)

SCPI: device–specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:Y:OFFSet

This command defines an additional level offset for the measurement with fixed reference value
(`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`). For this measurement, the offset is included in the display of all delta markers.

For phase–noise measurements
(CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe]), the command
defines an additional level offset which is included in the display of delta marker 2.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<numeric_value>

Example

CALC:DELT:FUNC:FIX:RPO:Y:OFFS 10dB

Sets the level offset for the measurement with fixed reference value or the phase–noise
measurement to 10 dB.

Characteristics

RST value: 0 dB

SCPI: device–specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe]

This command switches on or off the phase–noise measurement with all active delta markers.
The correction values for the bandwidth and the log amplifier are taken into account in the
measurement.

Marker 1 will be activated, if necessary, and a peak search will be performed. If marker 1 is
activated, its position becomes the reference point for the measurement.

The reference point can then be modified with the
CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:X and
CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:Y commands
independently of the position of marker 1 and of a trace (the same commands used for the
measurement with fixed reference point).

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:DELT:FUNC:PNO ON

Switches on the phase–noise measurement with all delta markers.

CALC:DELT:FUNC:FIX:RPO:X 128 MHZ

Sets the frequency reference to 128 MHz.

CALC:DELT:FUNC:FIX:RPO:Y 30 DBM

Sets the reference level to +30 dBm

Characteristics

RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise:RESult?

This command queries the result of the phase–noise measurement. The measurement will be
switched on, if necessary.

The numeric suffixes <1|2> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

CALC:DELT:FUNC:PNO:RES?
Outputs the result of phase–noise measurement of the selected delta marker.

Characteristics

RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]

This command positions the delta marker to the current maximum value on the measured curve. If necessary, the corresponding delta marker will be activated first.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

CALC:DELT3:MAX
Sets delta marker 3 to the maximum value of the associated trace.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT

This command positions the delta marker to the next smaller maximum value to the left of the current value (i.e. descending X values). The corresponding delta marker will be activated first, if necessary.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

CALC:DELT:MAX:LEFT
Sets delta marker 1 to the next smaller maximum value to the left of the current value.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT

This command positions the delta marker to the next smaller maximum value on the measured curve. The corresponding delta marker will be activated first, if necessary.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

CALC:DELT2:MAX:NEXT
Sets delta marker 2 to the next smaller maximum value.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt

This command positions the delta marker to the next smaller maximum value to the right of the current value (i.e. ascending X values). The corresponding delta marker is activated first, if necessary.
The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

CALC:DELT:MAX:RIGH
Sets delta marker 1 to the next smaller maximum value to the right of the current value.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]

This command positions the delta marker to the current minimum value on the measured curve. The corresponding delta marker will be activated first, if necessary.
The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

CALC:DELT3:MIN
Sets delta marker 3 to the minimum value of the associated trace.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT

This command positions the delta marker to the next higher minimum value to the left of the current value (i.e. descending X values). The corresponding delta marker will be activated first, if necessary.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

`CALC:DELT:MIN:LEFT`
Sets delta marker 1 to the next higher minimum to the left of the current value.

Characteristics

RST value: –
SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT

This command positions the delta marker to the next higher minimum value of the measured curve. The corresponding delta marker will be activated first, if necessary.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

`CALC:DELT2:MIN:NEXT`
Sets delta marker 2 to the next higher minimum value.

Characteristics

RST value: –
SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt

This command positions the delta marker to the next higher minimum value to the right of the current value (i.e. ascending X values). The corresponding delta marker will be activated first, if necessary.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

`CALC:DELT:MIN:RIGH`
Sets delta marker 1 to the next higher minimum value to the right of the current value.

Characteristics

RST value: –
SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MODE

This command switches between relative and absolute frequency input of the delta marker (or time with span = 0).

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ABSolute | RELative

Example

`CALC:DELT:MODE ABS`
Switches the frequency/time indication for all delta markers to absolute values.

`CALC:DELT:MODE REL`
Switches the frequency/time indication for all delta markers to relative to marker 1.

Characteristics

RST value: REL

SCPI: device–specific

Mode

all

CALCulate<1|2>:DELTamarker<1...4>:TRACe

This command assigns the selected delta marker to the indicated trace. The selected trace must be active, i.e. its state must be different from "BLANK".

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

1 to 6

Example

`CALC:DELT3:TRAC 2`
Assigns delta marker 3 to trace 2.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV

CALCulate<1|2>:DELTamarker<1...4>:X

This command positions the selected delta marker to the indicated frequency (span > 0), time (span = 0) or level (APD measurement = ON or CCDF measurement = ON). The input is in absolute values or relative to marker 1 depending on the command CALCulate<1|2>:DELTamarker<1...4>:MODE. If reference fixed measurement (CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe] is ON) is active, relative values refer to the reference position are entered. The query always returns absolute values.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to MAX (frequency | sweep time)

Example

`CALC:DELT:MOD REL`
Switches the input for all delta markers to relative to marker 1.

`CALC:DELT2:X 10.7MHz`
Positions delta marker 2 10.7 MHz to the right of marker 1.

`CALC:DELT:X?`
Outputs the absolute frequency/time of delta marker 1.

`CALC:DELT:X:REL?`
Outputs the relative frequency/time/level of delta marker 1.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:X:RELative?

This command queries the frequency (span > 0) or time (span = 0) of the selected delta marker relative to marker 1 or to the reference position (for `CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe]` is ON). The command activates the corresponding delta marker, if necessary.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`CALC:DELT3:X:REL?`
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, WCDMA

CALCulate<1|2>:DELTamarker<1...4>:Y?

This command queries the measured value of the selected delta marker. The corresponding delta marker will be activated, if necessary. The output is always a relative value referred to marker 1 or to the reference position (reference fixed active).

To obtain a correct query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the delta marker and the query of the y value. This is only possible in single sweep mode.

Depending on the unit defined with `CALCulate<1|2>:UNIT:POWer` or on the activated measuring functions, the query result is output in the units below:

Parameter or measuring functions	Output unit
**DBM	DBPW	DBUV	DBMV	DBUA**	**dB (lin/log)**
**WATT	VOLT	AMPere**	**dB (lin), % (log)**
statistics function (APD or CCDF) on	**dimensionless output**

The numeric suffixes <1|2> are irrelevant for this command.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

CALC:DELT2 ON
Switches on delta marker 2.

INIT;*WAI
Starts a sweep and waits for its end.

CALC:DELT2:Y?
Outputs measurement value of delta marker 2.

Characteristics

RST value: –

SCPI: device–specific

Mode

A, ADEMOD, BT, CATV, WCDMA

CALCulate:DLINe Subsystem

The CALCulate:DLINe subsystem defines the position of the display lines.

Commands of the CALCulate:DLINe Subsystem

– CALCulate<1|2>:DLINe<1|2>

– CALCulate<1|2>:DLINe<1|2>:STATe

CALCulate<1|2>:DLINe<1|2>

This command defines the position of display line 1 or 2. These lines enable the user to mark any levels in the diagram. The unit depends on the setting made with CALCulate<1|2>:UNIT:POWer.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

MINimum to MAXimum (depending on current unit)

Example

CALC:DLIN –20dBm

Characteristics

*RST value: – (STATe to OFF)

SCPI: device–specific

Mode

A

CALCulate<1|2>:DLINe<1|2>:STATe

This command switches display line 1 or 2 (level lines) on or off.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:DLIN2:STAT OFF

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate:FLINe Subsystem

The CALCulate:FLINe subsystem defines the position of the frequency lines.

Commands of the CALCulate:FLINe Subsystem

– CALCulate<1|2>:FLINe<1|2>

– CALCulate<1|2>:FLINe<1|2>:STATe

CALCulate<1|2>:FLINe<1|2>

This command defines the position of the frequency lines that mark the frequencies.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to f_{max}

Example

CALC:FLIN2 120MHz

Characteristics

*RST value: – (STATe to OFF)

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:FLINe<1|2>:STATe

This command switches the frequency line on or off.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:FLIN2:STAT ON

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–F

CALCulate:LIMit Subsystem

The CALCulate:LIMit subsystem contains commands for the limit lines and the corresponding limit checks. Limit lines can be defined as upper or lower limit lines. The individual Y values of the limit lines correspond to the values of the x–axis (CONTrol). The number of X and Y values must be identical. For details on limit lines refer to chapter "Instrument Functions", section "Using Limit Lines and Display Lines – LINES Key".

The following subsystems are included:

Commands of the CALCulate:LIMit Subsystem

- CALCulate<1|2>:LIMit<1...8>:ACTive?
- CALCulate<1|2>:LIMit<1...8>:CLEar[:IMMediate]
- CALCulate<1|2>:LIMit<1...8>:COMMent
- CALCulate<1|2>:LIMit<1...8>:COPY
- CALCulate<1|2>:LIMit<1...8>:DELete
- CALCulate<1|2>:LIMit<1...8>:FAIL?
- CALCulate<1|2>:LIMit<1...8>:NAME
- CALCulate<1|2>:LIMit<1...8>:STATe
- CALCulate<1|2>:LIMit<1...8>:TRACe
- CALCulate<1|2>:LIMit<1...8>:UNIT

Further information

– Example (analyzer mode)

– Definition of the limit line

– Switching on and evaluating the line

Example (analyzer mode)

Definition and use of a new limit line 5 for trace 2 with the following features:

- upper limit line

- absolute x–axis with span > 0.

- 5 ref. values: 126 MHz/–40 dB, 127 MHz/–40 dB, 128 MHz/–20 dB, 129 MHz/–40 dB, 130 MHz/–40 dB

- relative y–axis with unit dB

- absolute threshold value at –35 dBm

- no safety margin

Definition of the limit line

1. Defining the name:

   ```
   CALC:LIM5:NAME 'TEST1'
   ```

2. Entering the comment:

   ```
   CALC:LIM5:COMM 'Upper limit line'
   ```

3. Associated trace:

   ```
   CALC:LIM5:TRAC 2
   ```

4. Defining the x–axis range:

   ```
   CALC:LIM5:CONT:DOM FREQ
   ```

5. Defining the x–axis scaling:

   ```
   CALC:LIM5:CONT:MODE ABS
   ```

6. Defining the y–axis unit:

   ```
   CALC:LIM5:UNIT DB
   ```

7. Defining the y–axis scaling:

   ```
   CALC:LIM5:UPP:MODE REL
   ```

8. Defining the x–axis values:

   ```
   CALC:LIM5:CONT 126MHZ, 127MHZ, 128MHZ, 129 MHZ, 130MHZ
   ```

9. Defining the y values:

   ```
   CALC:LIM5:UPP -40, -40, -30, -40, -40
   ```

10. Defining the y threshold value:

    ```
    CALC:LIM5:UPP:THR -35DBM
    ```

The definition of the safety margin and shifting in X and/or Y direction can take place as from here (see commands below).

Switching on and evaluating the line

1. Switching on the line:

   `CALC:LIM5:UPP:STAT ON`

2. Switching on the limit check:

   `CALC:LIM5:STAT ON`

3. Starting a new measurement with synchronization:

   `INIT;*WAI`

4. Querying the limit check result:

   `CALC:LIM5:FAIL?`

CALCulate<1|2>:LIMit<1...8>:ACTive?

This command queries the names of all active limit lines.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

`CALC:LIM:ACT?`
Queries the names of all active limit lines.

Return values

`'3GBAA,3GBBA,3GBCR'`
Returns the names of the active limit lines in alphabetical order, separated by commas.

Characteristics

RST value: –
SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:CLEar[:IMMediate]

This command deletes the result of the current limit check for all limit lines.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value.

Example

`CALC:LIM:CLE`
Deletes the result of the limit check.

Characteristics

*RST value: –
SCPI: conform

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:COMMent

This command defines a comment for the limit line selected (max. 40 characters).

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<string>, max. 40 alphanumeric characters

Example

CALC:LIM5:COMM 'Upper limit for spectrum'
Defines the comment for limit line 5.

Characteristics

*RST value: blank comment
SCPI: device–specific

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:COPY

This command copies one limit line onto another one
The numeric suffixes <1|2> are irrelevant for this command.
This command is an event and therefore has no *RST value and no query.

Parameter

1 to 8   number of the new limit line

<name>   name of the new limit line given as a string

Example

CALC:LIM1:COPY 2
Copies limit line 1 to line 2.
CALC:LIM1:COPY 'FM2'
Copies limit line 1 to a new line named FM2.

Characteristics

*RST value: –
SCPI: device–specific

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:DELete

This command deletes the selected limit line.
The numeric suffixes <1|2> are irrelevant for this command.
This command is an event and therefore has no *RST value and no query.

Example

CALC:LIM1:DEL
Deletes limit line 1.

Characteristics

*RST value: –
SCPI: device–specific

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>: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.

The numeric suffixes <1|2> are irrelevant for this command.

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.

Characteristics

*RST value: –

SCPI: conform

Mode

A, ADEMOD, NF, WLAN

CALCulate<1|2>:LIMit<1...8>:NAME

This command assigns a name to a limit line numbered 1 to 8. If it does not exist already, a limit line with this name is created.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<name of limit line>

Example

`CALC:LIM1:NAME 'FM1'`
Assigns the name FM1 to limit line 1.

Characteristics

*RST value: REM1 to REM8 for lines 1 to 8

SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:STATe

This command switches on or off the limit check for the selected limit line.

The result of the limit check can be queried with `CALCulate<1|2>:LIMit<1...8>:FAIL?`.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

`CALC:LIM:STAT ON`
Switches on the limit check for limit line 1.

Characteristics

*RST value: OFF

SCPI: conform

Mode

A, BT, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:TRACe

This command assigns a limit line to a trace.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

1 to 6

Example

`CALC:LIM2:TRAC 3`
Assigns limit line 2 to trace 3.

Characteristics

*RST value: 1

SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:UNIT

This command defines the unit of the selected limit line.

Upon selection of the unit DB the limit line is automatically switched to the relative mode. For units different from DB the limit line is automatically switched to absolute mode.

The units DEG, RAD, S, HZ, PCT are not available in spectrum analyzer mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

DBM | DBPW | WATT | DBUV | DBMV | VOLT |DBUA | AMPere | DBPT | DB | DEG | RAD | S | HZ | PCT | UNITLESS

Example

`CALC:LIM4:UNIT DBUV`
Sets the unit of limit line 4 to dBμV.

Characteristics

*RST value: DBM

SCPI: device–specific

Mode

A, ADEMOD

CALCulate:LIMit:ACPower Subsystem

The CALCulate:LIMit:ACPower subsystem defines the limit check for adjacent channel power measurement.

Commands of the CALCulate:LIMit:ACPower Subsystem

– CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe]

– CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]

– CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]:STATe

– CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute

– CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute:STATe

– CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:RESult?

– CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>[:RELative]

– CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>[:RELative]:STATe

– CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:ABSolute

– CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:ABSolute:STATe

– CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:RESult?

CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe]

This command switches on and off the limit check for adjacent–channel power measurements. The CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]:STATe or CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>[:RELative]:STATe commands must be used in addition to specify whether the limit check is to be performed for the upper/lower adjacent channel or for the alternate adjacent channels.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:LIM:ACP ON
Switches on the ACP limit check.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]

This command defines the relative limit of the upper/lower adjacent channel for adjacent–channel power measurements. The reference value for the relative limit value is the measured channel power.

It should be noted that the relative limit value has no effect on the limit check as soon as it is below the absolute limit value defined with the CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute command.

This mechanism allows automatic checking of the absolute basic values of adjacent–channel power as defined in mobile radio standards.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

Parameter

first value: 0 to 100dB; limit for the upper (lower) adjacent channel

second value: 0 to 100dB; is ignored but must be indicated for reasons of compatibility with the FSP family

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.

Characteristics

*RST value: 0 dB

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]:STATe

This command activates the limit check for the relative limit value of the adjacent channel when adjacent–channel power measurement is performed. Before the command, the limit check must be activated using CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe].

The result can be queried with

CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:RESult?. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no correct results are available.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

Parameter

ON | OFF

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 dBm.

`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 check of the relative limit values for adjacent channels.

`CALC:LIM:ACP:ACH:ABS:STAT ON`
Switches on the check of absolute limit values 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.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute

This command defines the absolute limit value for the lower/upper adjacent channel during adjacent–channel power measurement (Adjacent Channel Power).

It should be noted that the absolute limit value has no effect on the limit check as soon as it is below the relative limit value defined with
CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]. This mechanism allows automatic checking of the absolute basic values of adjacent–channel power as defined in mobile radio standards.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

Parameter

first value: –200DBM to 200DBM; limit for the lower and the upper adjacent channel

second value: –200 to 200DBM; is ignored but must be indicated for reasons of compatibility with the FSP family

Example

`CALC:LIM:ACP:ACH:ABS −35DBM, −35DBM`
Sets the absolute limit value for the power in the lower and upper adjacent channel to –35 dBm.

Characteristics

*RST value: –200DBM

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute:STATe

This command activates the limit check for the adjacent channel when adjacent–channel power measurement (Adjacent Channel Power) is performed. Before the command, the limit check for the channel/adjacent–channel measurement must be globally switched on using
CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe].

The result can be queried with
CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:RESult?. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no correct results are available.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

Parameter

ON | OFF

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 dBm.

`CALC:LIM:ACP ON`
Switches on globally the limit check for the channel/adjacent–channel measurement.

`CALC:LIM:ACP:ACH:REL:STAT ON`
Switches on the check of the relative limit values for adjacent channels.

`CALC:LIM:ACP:ACH:ABS:STAT ON`
Switches on the check of absolute limit values 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.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>: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.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

This command is a query and therefore has no *RST value.

Parameter

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.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, WLAN

CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>[:RELative]

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.

The numeric suffix after `ALTernate` denotes the alternate channel. The numeric suffixes <1|2> with CALCulate and <1...8> with LIMit are irrelevant for this command.

It should be noted that the relative limit value has no effect on the limit check as soon as it is below the absolute limit defined with

CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:ABSolute. This mechanism allows automatic checking of the absolute basic values of adjacent–channel power as defined in mobile radio standards.

Parameter

first value: 0 to 100dB; limit for the lower and the upper alternate adjacent channel

second value: 0 to 100dB; is ignored but must be indicated for reasons of compatibility with the FSP family

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.

Characteristics

*RST value: 0 DB

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>[:RELative]:STATe

This command activates the limit check for the alternate adjacent channels for adjacent channel power measurements. Before the command, the limit check must be activated using CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe].

The numeric suffix after ALTernate denotes the alternate channel. The numeric suffixes <1|2> with CALCulate and <1...8> with LIMit are irrelevant for this command.

The result can be queried with

CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:RESult?. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no correct results are obtained.

Parameter

ON | OFF

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.

CALC:LIM:ACP:ALT2:ABS −35DBM, −35DBM
Sets the absolute limit value for the power in the lower and upper second alternate adjacent channel to −35 dBm.

CALC:LIM:ACP ON
Switches on globally the limit check for the channel/adjacent channel measurement.

CALC:LIM:ACP:ALT2:STAT ON
Switches on the check of the relative limit values for the lower and upper second alternate adjacent channel.

CALC:LIM:ACP:ALT2:ABS:STAT ON
Switches on the check of absolute limit values for the lower and upper second alternate adjacent channel.

INIT;*WAI
Starts a new measurement and waits for the sweep end.

```
CALC:LIM:ACP:ALT2:RES?
```
Queries the limit check result in the second alternate adjacent channels.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:ABSolute

This command defines the absolute limit value for the lower/upper alternate adjacent–channel power measurement (Adjacent Channel Power).

The numeric suffix after `ALTernate` denotes the alternate channel. The numeric suffixes <1|2> with CALCulate and <1...8> with LIMit are irrelevant for this command.

It should be noted that the absolute limit value for the limit check has no effect as soon as it is below the relative limit value defined with
`CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>[:RELative]`. This mechanism allows automatic checking of the absolute basic values defined in mobile radio standards for the power in adjacent channels.

Parameter

first value: –200DBM to 200DBM; limit for the lower and the upper alternate adjacent channel

second value: –200DBM to 200DBM; is ignored but must be indicated for reasons of compatibility with the FSP family

Example

```
CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM
```
Sets the absolute limit value for the power in the lower and upper second alternate adjacent channel to –35 dBm.

Characteristics

*RST value: –200DBM

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:ABSolute:STATe

This command activates the limit check for the alternate adjacent channels for adjacent–channel power measurement (Adjacent Channel Power).

Before the command, the limit check must be globally switched on for the channel/adjacent–channel power with the `CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe]` command.

The numeric suffix after `ALTernate` denotes the alternate channel. The numeric suffixes <1|2> with CALCulate and <1...8> with LIMit are irrelevant for this command.

The result can be queried with
`CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no correct results are available.

Parameter

ON | OFF

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.

`CALC:LIM:ACP:ALT2:ABS −35DBM, −35DBM`
Sets the absolute limit value for the power in the lower and upper second alternate adjacent
channel to −35 dBm.

`CALC:LIM:ACP ON`
Switches on globally the limit check for the channel/adjacent channel measurement.

`CALC:LIM:ACP:ALT2:STAT ON`
Switches on the check of the relative limit values for the lower and upper second alternative
adjacent channels.

`CALC:LIM:ACP:ALT2:ABS:STAT ON`
Switches on the check of absolute limit values for the lower and upper second alternative
adjacent channels.

`INIT;*WAI`
Starts a new measurement and waits for the sweep end.

`CALC:LIM:ACP:ALT2:RES?`
Queries the limit check result in the second alternate adjacent channels.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:RESult?

This command queries the result of the limit check for the alternate adjacent channels for
adjacent channel power measurements.

The numeric suffix after `ALTernate` denotes the alternate channel. The numeric suffixes <1|2>
with CALCulate and <1...8> with LIMit are irrelevant for this command.

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

This command is a query and therefore has no *RST value.

Parameter

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

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.

`CALC:LIM:ACP:ALT2:ABS −35DBM, −35DBM`
Sets the absolute limit value for the power in the lower and upper second alternate adjacent
channel to −35 dBm.

`CALC:LIM:ACP ON`
Switches on globally the limit check for the channel/adjacent channel measurement.

`CALC:LIM:ACP:ALT2:STAT ON`
Switches on the limit check for the lower and upper second adjacent channel.

`INIT;*WAI`
Starts a new measurement and waits for the sweep end.

```
CALC:LIM:ACP:ALT2:RES?
```
Queries the limit check result in the second alternate adjacent channels.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, WLAN

CALCulate:LIMit:CONTrol Subsystem

The CALCulate:LIMit:CONTrol subsystem defines the x–axis (CONTrol axis).

Commands of the CALCulate:LIMit:CONTrol Subsystem

– CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA]

– CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain

– CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE

– CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFSet

– CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt

– CALCulate<1|2>:LIMit<1...8>:CONTrol:SPACing

CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA]

This command defines the x–axis values (frequencies or times) of the upper or lower limit lines.

The number of values for the CONTrol axis and for the corresponding UPPer and/or LOWer limit lines has to be identical. Otherwise default values are entered for missing values or not required values are deleted.

In analyzer mode, the unit of values depends on the span setting of the x–axis. For details refer to CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<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.

Characteristics

*RST value: – (CALCulate<1|2>:LIMit<1...8>:STATe is set to OFF)

SCPI: conform

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain

This command defines the span setting for the x–axis values.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

FREQuency | TIME

Example

CALC:LIM2:CONT:DOM TIME

Defines zero span for the x–axis of limit line 2.

Characteristics

*RST value: FREQuency

SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE

This command selects the relative or absolute scaling for the x–axis of the selected limit line.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

RELative | ABSolute

Example

CALC:LIM2:CONT:MODE REL

Defines the x–axis of limit line 2 as relatively scaled.

Characteristics

*RST value: ABSolute

SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFSet

This command defines an offset for the x–axis value of the selected relative limit line for span > 0 or zero span.

In analyzer mode, the unit of values depends on the span setting of the x–axis. For details refer to CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<numeric_value>

Example

CALC:LIM2:CONT:OFFS 100us

Sets the X offset for limit line 2 (defined in zero span) to 100µs.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt

This command moves a limit line by the indicated value in x direction. In contrast to CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFSet, the line is shifted by modifying the individual x values and not by means of an additive offset.

In analyzer mode, the unit of values depends on the span setting of the x–axis. For details refer to CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Parameter

<numeric_value>

Example

CALC:LIM2:CONT:SHIF 50KHZ
Shifts all reference values of limit line 2 by 50 kHz.

Characteristics

*RST value: –
SCPI: device–specific

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:CONTrol:SPACing

This command selects linear or logarithmic interpolation for the calculation of limit lines from frequency points.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

LINear | LOGarithmic

Example

CALC:LIM:CONT:SPAC LIN

Characteristics

*RST value: LIN
SCPI: device–specific

Mode

A

CALCulate:LIMit:LOWer Subsystem

The CALCulate:LIMit:LOWer subsystem defines the lower limit line.

Commands of the CALCulate:LIMit:LOWer Subsystem

– CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA]

– CALCulate<1|2>:LIMit<1...8>:LOWer:STATe

– CALCulate<1|2>:LIMit<1...8>:LOWer:OFFSet

– CALCulate<1|2>:LIMit<1...8>:LOWer:MARGin

– CALCulate<1|2>:LIMit<1...8>:LOWer:MODE

– CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt

– CALCulate<1|2>:LIMit<1...8>:LOWer:SPACing

– CALCulate<1|2>:LIMit<1...8>:LOWer:THReshold

CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA]

This command defines the values for the selected lower limit line.

The number of values for the CONTrol axis and for the corresponding LOWer limit line has to be identical. Otherwise default values are entered for missing values or not necessary values are deleted.

The unit must be identical with the unit selected by CALCulate<1|2>:LIMit<1...8>:UNIT. If no unit is indicated, the unit defined with CALCulate<1|2>:LIMit<1...8>:UNIT is automatically used.

If the measured values are smaller than the LOWer limit line, the limit check signals errors.

The units DEG, RAD, S, HZ, PCT are not available in the spectrum analyzer mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter
<numeric_value>,<numeric_value>

Example
CALC:LIM2:LOW -30,-40,-10,-40,-30
Defines 5 lower limit values for limit line 2 in the preset unit.

CALC:LIM2:LOW?
Outputs the lower limit values of limit line 2 separated by a comma.

Characteristics
*RST value: – (LIMit:STATe is set to OFF)
SCPI: conform

Mode
A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:LOWer:STATe

This command switches on or off the indicated limit line. The limit check is activated separately with CALCulate<1|2>:LIMit<1...8>:STATe.

In spectrum analyzer mode, the result of the limit check can be queried with CALCulate<1|2>:LIMit<1...8>:FAIL?.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter
ON | OFF

Example
CALC:LIM4:LOW:STAT ON
Switches on limit line 4 (lower limit).

Characteristics
*RST value: OFF
SCPI: conform

Mode
A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:LOWer:OFFSet

This command defines an offset for the y–axis of the selected relative lower limit line. In contrast to CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt, the line is not shifted by modifying the individual Y values but by means of an additive offset.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter
<numeric_value>

Example
CALC:LIM2:LOW:OFFS 3dB
Shifts limit line 2 by 3 dB upwards.

Characteristics
*RST value: 0
SCPI: device–specific

Mode
A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:LOWer:MARGin

This command defines a margin to a lower limit line, at which out–of–limit values are signaled (if the limit check is active), but not handled as a violation of the limit value.

Only the unit dB is available in spectrum analyzer mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter
<numeric_value>

Example
CALC:LIM:LOW:MARG 10dB

Characteristics
*RST value: 0
SCPI: device–specific

Mode
A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:LOWer:MODE

This command selects the relative or absolute scaling for the y–axis of the selected lower limit line.

Selecting RELative causes the unit to be switched to DB.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter
RELative | ABSolute

Example

CALC:LIM:LOW:MODE REL

Defines the y–axis of limit line 2 as relative scaled.

Characteristics

*RST value: ABSolute

SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt

This command shifts a limit line by the indicated value in Y direction. In contrast to CALCulate<1|2>:LIMit<1...8>:LOWer:OFFSet, the line is shifted by modifying the individual Y values but not by means of an additive offset.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Parameter

<numeric_value>

Example

CALC:LIM3:LOW:SHIF 20DB

Shifts all Y values of limit line 3 by 20 dB.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:LOWer:SPACing

This command selects linear or logarithmic interpolation for the lower limit line.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

LINear | LOGarithmic

Example

CALC:LIM:LOW:SPAC LIN

Characteristics

*RST value: LIN

SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:LOWer:THReshold

This command defines an absolute threshold value for limit lines with relative y–axis scaling. The absolute threshold value is used in the limit check as soon as it exceeds the relative limit value.

The unit must correspond to the unit selected with `CALCulate<1|2>:LIMit<1...8>:UNIT` (except dB which is not allowed). If no unit is indicated, the unit defined with `CALCulate<1|2>:LIMit<1...8>:UNIT` is automatically used (exception: dBm instead of dB).

The units DEG, RAD, S, HZ, PCT are not available in the spectrum analyzer mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<numeric_value>

Example

`CALC:LIM2:LOW:THR –35DBM`
Defines an absolute threshold value for limit line 2.

Characteristics

*RST value: –200 dBm

SCPI: device–specific

Mode

A, ADEMOD

CALCulate:LIMit:UPPer Subsystem

The CALCulate:LIMit:UPPer subsystem defines the upper limit line.

Commands of the CALCulate:LIMit:UPPer Subsystem

– CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA]

– CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin

– CALCulate<1|2>:LIMit<1...8>:UPPer:MODE

– CALCulate<1|2>:LIMit<1...8>:UPPer:OFFSet

– CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt

– CALCulate<1|2>:LIMit<1...8>:UPPer:SPACing

–

– CALCulate<1|2>:LIMit<1...8>:UPPer:STATe

– CALCulate<1|2>:LIMit<1...8>:UPPer:THReshold

CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA]

This command defines the values for the upper limit lines

The number of values for the CONTrol axis and for the corresponding UPPer and/or LOWer limit line has to be identical. Otherwise default values are entered for missing values or not necessary values are deleted.

The unit must be identical with the unit selected by CALCulate<1|2>:LIMit<1...8>:UNIT. If no unit is indicated, the unit defined with CALCulate<1|2>:LIMit<1...8>:UNIT is automatically used.

In spectrum analyzer mode, the limit check indicates errors if the measured values exceed the UPPer limit line. The units DEG, RAD, S, HZ, PCT are not available in spectrum analyzer mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<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.

Characteristics

*RST value: – (CALCulate<1|2>:LIMit<1...8>:STATe is set to OFF)

SCPI: conform

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin

This command defines a margin to an upper limit line, at which out–of–limit values are signaled (if the limit check is active), but not handled as a violation of the limit value.

Only the unit dB is available in spectrum analyzer mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<numeric_value>

Example

CALC:LIM2:UPP:MARG 10dB

Defines the margin of limit line 2 to 10 dB below the limit value.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:UPPer:MODE

This command selects the relative or absolute scaling for the y–axis of the selected upper limit line.

Selecting RELative causes the unit to be switched to DB.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

RELative | ABSolute

Example

CALC:LIM2:UPP:MODE REL

Defines the y–axis of limit line 2 as relative scaled.

Characteristics

*RST value: ABSolute

SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:UPPer:OFFSet

This command defines an offset for the y–axis of the selected relative upper limit line. In contrast to CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt, the line is not shifted by modifying the individual Y values but by means of an additive offset.

Only the unit dB is available in the spectrum analyzer mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

Example

`CALC:LIM2:UPP:OFFS 3dB`
Shifts limit line 2 by 3 dB upwards.

Characteristics

*RST value: 0
SCPI: device–specific

Mode

A, ADEMOD

CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt

This command moves a limit line by the indicated value in Y direction. In contrast to `CALCulate<1|2>:LIMit<1...8>:UPPer:OFFSet`, the line is shifted by modifying the individual Y values and not by means of an additive offset.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Parameter

<numeric_value>

Example

`CALC:LIM3:UPP:SHIF 20`
Shifts all Y values of limit line 3 by 20 limit line units, e.g. dB.

Characteristics

*RST value: –
SCPI: device–specific

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:UPPer:SPACing

This command selects linear or logarithmic interpolation for the upper limit line.
The numeric suffixes <1|2> are irrelevant for this command.

Parameter

LINear | LOGarithmic

Example

`CALC:LIM:UPP:SPAC LIN`

Characteristics

*RST value: LIN
SCPI: device–specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:UPPer:STATe

This command switches on or off the indicated limit line. The limit check is activated separately with CALCulate<1|2>:LIMit<1...8>:STATe.

In spectrum analyzer mode, the result of the limit check can be queried with CALCulate<1|2>:LIMit<1...8>:FAIL?.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:LIM4:UPP:STAT ON
Switches on limit line 4 (upper limit).

Characteristics

*RST value: OFF

SCPI: conform

Mode

A, ADEMOD, NF

CALCulate<1|2>:LIMit<1...8>:UPPer:THReshold

This command defines an absolute threshold value for limit lines with relative y–axis scaling. The absolute threshold value is used in the limit check as soon as it exceeds the relative limit value.

The unit must correspond to the unit selected with CALCulate<1|2>:LIMit<1...8>:UNIT (except dB which is not possible). If no unit is indicated, the unit defined with CALCulate<1|2>:LIMit<1...8>:UNIT is automatically used (exception: dBm instead of dB).

The units DEG, RAD, S, HZ, PCT are not available in the spectrum analyzer mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<numeric_value>

Example

CALC:LIM2:UPP:THR –35DBM
Defines an absolute threshold value for limit line 2.

Characteristics

*RST value: –200 dBm

SCPI: device–specific

Mode

A, ADEMOD

CALCulate:MARKer Subsystem

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

The following subsystem is included:

Commands of the CALCulate:MARKer Subsystem

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–   CALCulate<1|2>:MARKer<1...4>[:STATe]
–   CALCulate<1|2>:MARKer<1...4>:AOFF
–   CALCulate<1|2>:MARKer<1...4>:COUNt
–   CALCulate<1|2>:MARKer<1...4>:COUNt:FREQuency?

–

–   CALCulate<1|2>:MARKer<1...4>:COUNt:RESolution
–   CALCulate<1|2>:MARKer<1...4>:LOEXclude
–   CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]
–   CALCulate<1|2>:MARKer<1...4>:MAXimum:AUTO
–   CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT
–   CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT
–   CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt
–   CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK]
–   CALCulate<1|2>:MARKer<1...4>:MINimum:AUTO
–   CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT
–   CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT
–   CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt
–   CALCulate<1|2>:MARKer<1...4>:PEXCursion
–   CALCulate<1|2>:MARKer<1...4>:TRACe
–   CALCulate<1|2>:MARKer<1...4>:X
–   CALCulate<1|2>:MARKer<1...4>:X:SLIMits[:STATe]
–   CALCulate<1|2>:MARKer<1...4>:X:SLIMits:LEFT

– CALCulate<1|2>:MARKer<1...4>:X:SLIMits:RIGHT

– CALCulate<1|2>:MARKer<1...4>:X:SSIZe

–

– CALCulate<1|2>:MARKer<1...4>:Y?

– CALCulate<1|2>:MARKer<1...4>:Y:PERCent

CALCulate<1|2>:MARKer<1...4>[:STATe]

This command switches on or off the currently selected marker. If no indication is made, marker 1 is selected automatically. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

`CALC:MARK3 ON`
Switches on marker 3 or switches to marker mode.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:AOFF

This command switches off all active markers and all delta markers and active marker/delta marker measurement functions.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, WCDMA

CALCulate<1|2>:MARKer<1...4>:COUNt

This command switches on or off the frequency counter at the marker position.

The count result is queried with CALCulate<1|2>:MARKer<1...4>:COUNt:FREQuency?.

Frequency counting is possible only for one marker at a time. If it is activated for another marker, it is automatically deactivated for the previous marker.

It should be noted that a complete sweep must be performed after switching on the frequency counter to ensure that the frequency to be measured is actually reached. The synchronization to the sweep end required for this is only possible in single sweep mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

INIT:CONT OFF

Switches to single sweep mode.

CALC:MARK ON

Switches on marker 1.

CALC:MARK:COUN ON

Switches on the frequency counter for marker 1.

INIT;*WAI

Starts a sweep and waits for the end.

CALC:MARK:COUN:FREQ?

Outputs the measured value.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:COUNt:FREQuency?

This command queries the result of the frequency counter for the indicated marker. Before the command, the frequency counter should be switched on and a complete measurement performed to obtain a correct count result. Therefore, a single sweep with synchronization must be performed between switching on the frequency counter and querying the count result.

The numeric suffixes <1|2> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

INIT:CONT OFF

Switches to single sweep mode.

CALC:MARK2 ON

Switches on marker 2.

```
CALC:MARK2:COUN ON
```
Switches the frequency counter for marker 2.
```
INIT;*WAI
```
Starts a sweep and waits for the end.
```
CALC:MARK2:COUN:FREQ?
```
Outputs the measured value of marker 2.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:COUNt:RESolution

This command specifies the resolution of the frequency counter.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

0.1 | 1 | 10 | 100 | 1000 | 10000 Hz

Example
```
CALC:MARK:COUN:RES 1kHz
```
Sets the resolution of the frequency counter to 1 kHz.

Characteristics

*RST value: 1kHz

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:LOEXclude

This command switches the local oscillator suppression for peak search on or off. This setting applies to all markers and delta markers.

The numeric suffixes 1|2 and 1 to 4 are irrelevant.

Parameter

ON | OFF

Example
```
CALC:MARK:LOEX ON
```

Characteristics

*RST value: ON

SCPI: device–specific

Mode

A–F, ADEMOD, CATV, SPECM

CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]

This command positions the marker to the current maximum value of the corresponding trace. The corresponding marker is activated first or switched to the marker mode.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Note: *If no maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MAX

Positions marker 2 to the maximum value of the trace.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:MAXimum:AUTO

Activates the automatic peak search function for marker 1 at the end of each particular sweep. This function may be used during adjustments of a device under test to keep track of the actual peak marker position and level.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *If no maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Parameter

ON | OFF

Example

CALC:MARK:MAX:AUTO ON

Activates the automatic peak search function for marker 1 at the end of each particular sweep.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT

This command positions the marker to the next smaller maximum value to the left of the current value (i.e. in descending X values) on the trace.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MAX:LEFT

Positions marker 2 to the next lower maximum value to the left of the current value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, BT, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT

This command positions the marker to the next smaller maximum value of the corresponding trace.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MAX:NEXT

Positions marker 2 to the next lower maximum value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt

This command positions the marker to the next smaller maximum value to the right of the current value (i.e. in ascending X values) on the corresponding trace.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MAX:RIGH

Positions marker 2 to the next lower maximum value to the right of the current value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK]

This command positions the marker to the current minimum value of the corresponding trace. The corresponding marker is activated first or switched to marker mode, if necessary.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Note: *If no minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MIN

Positions marker 2 to the minimum value of the trace.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:MINimum:AUTO

Activates the automatic minimum value search function for marker 1 at the end of each particular sweep. This function may be used during adjustments of a device under test to keep track of the actual peak marker position and level.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *If no minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Parameter

ON | OFF

Example

CALC:MARK:MIN:AUTO ON

Activates the automatic minimum value search function for marker 1 at the end of each particular sweep.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT

This command positions the marker to the next higher minimum value to the left of the current value (i.e. in descending X direction) on the corresponding trace.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Note: *If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MIN

Positions marker 2 to the minimum value of the trace.

CALC:MARK2:MIN:LEFT

Positions marker 2 to the next higher minimum value to the left of the current value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT

This command positions the marker to the next higher minimum value of the corresponding trace.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Note: *If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MIN

Positions marker 2 to the minimum value of the trace.

CALC:MARK2:MIN:NEXT

Positions marker 2 to the next higher maximum value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt

This command positions the marker to the next higher minimum value to the right of the current value (i.e. in ascending X direction) on the corresponding trace.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Note: *If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MIN

Positions marker 2 to the minimum value of the trace.

CALC:MARK2:MIN:RIGH

Positions marker 2 to the next higher minimum value to the right of the current value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:PEXCursion

This command defines the peak excursion, i.e. the spacing below a trace maximum which must be attained before a new maximum is recognized, or the spacing above a trace minimum which must be attained before a new minimum is recognized. The set value applies to all markers and delta markers. The unit depends on the selected operating mode.

The numeric suffixes >1<2> and <1...4> are irrelevant.

Parameter

<numeric_value>

Example

CALC:MARK:PEXC 10dB
Defines peak excursion 10 dB in spectrum **Spectrum Analyzer** mode.

Characteristics

*RST value: 6dB in **Spectrum Analyzer** mode
SCPI: device–specific

Mode

A, ADEMOD, BT, CATV, SPECM

CALCulate<1|2>:MARKer<1...4>:TRACe

This command assigns the selected marker (1 to 4) to the indicated measurement curve. The corresponding trace must be active, i.e. its status must be different from "BLANK".

If necessary the corresponding marker is switched on prior to the assignment.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

1 to 6

Example

CALC:MARK3:TRAC 2
Assigns marker 3 to trace 2.

Characteristics

*RST value: –
SCPI: device–specific

Mode

A, ADEMOD, CATV

CALCulate<1|2>:MARKer<1...4>:X

This command positions the selected marker to the indicated frequency (span > 0), time (span = 0) or level (APD measurement or CCDF measurement ON).

If marker 2, 3 or 4 is selected and used as delta marker, it is switched to marker mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to MAX (frequency | sweep time)

Example

`CALC:MARK2:X 10.7MHz`
Positions marker 2 to frequency 10.7 MHz.

Characteristics

*RST value: –
SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM, WCDMA

CALCulate<1|2>:MARKer<1...4>:X:SLIMits[:STATe]

This command switches between a limited (ON) and unlimited (OFF) search range.

If the power measurement in zero span is active, this command limits the evaluation range on the trace.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

ON | OFF

Example

`CALC:MARK:X:SLIM ON`
Switches on search limitation.

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM

CALCulate<1|2>:MARKer<1...4>:X:SLIMits:LEFT

This command sets the left limit of the search range for markers and delta markers. Depending on the span setting of the x–axis the indicated value defines a frequency (span > 0) or time (span = 0).

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

If the power measurement in zero span is active, this command limits the evaluation range to the trace.

Note: *The function is only available if the search limit for marker and delta marker is switched on (*`CALCulate<1|2>:MARKer<1...4>:X:SLIMits[:STATe]`*).*

Parameter

0 to MAX (frequency | sweep time)

Example

`CALC:MARK:X:SLIM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:LEFT 10MHz`
Sets the left limit of the search range to 10 MHz.

Characteristics

*RST value: – (is set to the left diagram border when switching on search limits)
SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM

CALCulate<1|2>:MARKer<1...4>:X:SLIMits:RIGHT

This command sets the right limit of the search range for markers and delta markers. Depending on the span setting of the x–axis the indicated value defines a frequency (span > 0) or time (span = 0).

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

If the power measurement in zero span is active, this command limits the evaluation range to the trace.

Note: *The function is only available if the search limit for marker and delta marker is switched on (*CALCulate<1|2>:MARKer<1...4>:X:SLIMits[:STATe]*).*

Parameter

0 to MAX (frequency | sweep time)

Example

CALC:MARK:X:SLIM ON
Switches the search limit function on.

CALC:MARK:X:SLIM:RIGH 20MHz
Sets the right limit of the search range to 20 MHz.

Characteristics

*RST value: – (is set to the right diagram border when switching on search limits)

SCPI: device–specific

Mode

A, ADEMOD, CATV, SPECM

CALCulate<1|2>:MARKer<1...4>:X:SSIZe

This command defines the step size of the rotary knob for marker or delta marker value changes. It takes only effect in manual operation. It is available for all base unit measurements with the exception of statistics.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

STANdard   measurement point step size

POINts   measured value step size (number of measured values is defined via the [SENSe<1|2>:]SWEep:POINts command)

Example

CALC:MARK:X:SSIZ POIN
Sets the measured value step size.

Characteristics

RST value: STANdard

SCPI: device–specific

Mode

A

_____

CALCulate<1|2>:MARKer<1...4>:Y?

_____

This command queries the measured value of the selected marker. The corresponding marker is activated before or switched to marker mode, if necessary.

To obtain a correct query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the marker and the query of the Y value. This is only possible in single sweep mode.

The query result is output in the unit determined with `CALCulate<1|2>:UNIT:POWer`.

In the default setting, the output is made depending on the unit determined with `CALCulate<1|2>:UNIT:POWer`; only with linear level scaling is the output in %.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK2 ON`
Switches marker 2.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK2:Y?`
Outputs the measured value of marker 2.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, ADEMOD, BT, CATV, SPECM, WCDMA

_____

CALCulate<1|2>:MARKer<1...4>:Y:PERCent

_____

This command positions the selected marker to the given probability. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *The command is only available with the CCDF measurement switched on. The associated level value can be determined with the* `CALCulate<1|2>:MARKer<1...4>:X` *command.*

Parameter

0 to100%

Example

CALC1:MARK:Y:PERC 95PCT

Positions marker 1 to a probability of 95%.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, CATV

CALCulate:MARKer:FUNCtion Subsystem

The CALCulate:MARKer:FUNCtion subsystem checks the marker functions in the instrument.

The following subsystems are included:

Commands of the CALCulate:MARKer:FUNCtion Subsystem

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation[:STATe]

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:CONTinuous

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:HOLDoff

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SELect

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:CENTer

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:CSTep

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks[:IMMediate]

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:COUNt?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:SORT

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:X?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:Y?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth[:STATe]

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth:RESult?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth:SEARchsignal

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown

–

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:FREQuency?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:RESult?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:STATe

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:TIME?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe[:STATe]

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe:RESult?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:REFerence

–   CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI[:STATe]

–

–   CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI:RESult?
–   CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI:SEARchsignal

–

–   CALCulate<1|2>:MARKer<1...4>:FUNCtion:ZOOM

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation[:STATe]

This command switches on or off the audio demodulator when the indicated marker is reached. With span > 0 the hold time can be defined at the corresponding marker position with CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:HOLDoff. In zero span the demodulation is permanently active.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:MARK3:FUNC:DEM ON

Switches on the demodulation for marker 3.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:CONTinuous

This command switches on or off the continuous demodulation for span >0. Thus acoustic monitoring of the signals can be performed.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC2:MARK3:FUNC:DEM:CONT ON

Switches on the continuous ' demodulation.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:HOLDoff

This command defines the hold time at the marker position for the demodulation with span > 0. The setting is independent of the selected marker, the suffixes <1|2> and <1...4> are irrelevant.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

10ms to 1000s

Example:

`CALC:MARK:FUNC:DEM:HOLD 3s`

Characteristics:

*RST value: – (DEModulation is set to OFF)

SCPI: device–specific

Mode:

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SELect

This command selects the demodulation type for the audio demodulator. The command is independent of the selected marker, the suffixes 1|2 and 1 to 4 are irrelevant.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

AM | FM

Example

`CALC:MARK:FUNC:DEM:SEL FM`

Characteristics

*RST value: AM

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:CENTer

This command sets the center frequency equal to the frequency of the indicated marker.

If marker 2, 3 or 4 is selected and used as delta marker, the marker is switched to the marker mode.

The numeric suffix <1|2> are irrelevant for this command.

This command is an "event" and therefore has no *RST value and no query.

Example

`CALC:MARK2:FUNC:CENT`

Sets the center frequency to the frequency of marker 2.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F, CATV, SPECM

CALCulate<1|2>:MARKer<1...4>:FUNCtion:CSTep

This command sets the step size of the center frequency to the X value of the current marker. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to the marker mode.

The numeric suffix <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

CALC:MARK3:FUNC:CST
Sets the center frequency to the same value as the frequency of marker 3.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks[:IMMediate]

This command searches the selected trace for the indicated number of maxima. The results are entered in a list and can be queried with the
CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:X? and
CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:Y? commands. The number of maxima found can be queried with
CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:COUNt?. The trace to be examined is selected with CALCulate<1|2>:MARKer<1...4>:TRACe. The order of the results in the list can be defined with CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:SORT.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *The number of maxima found depends on the waveform and value set for the Peak Excursion parameter (*CALCulate<1|2>:MARKer<1...4>:PEXCursion*), however, a maximum number of 50 maxima are determined. Only the signals which exceed their surrounding values at least by the value indicated by the peak excursion parameter will be recognized as maxima. Therefore, the number of maxima found is not automatically the same as the number of maxima desired.*

Parameter

<numeric_value>

Example

INIT:CONT OFF
Switches to single sweep mode

INIT;*WAI
Starts measurement and synchronizes to end

CALC:MARK:TRAC 1
Sets marker 1 to trace 1

CALC:MARK:FUNC:FPE:SORT X
Sets the sort mode to increasing X values

CALC:MARK:FUNC:FPE 3
Searches the 3 highest maxima for trace 1

CALC:MARK:FUNC:COUN?
Queries the number of maxima found

`CALC:MARK:FUNC:Y?`
Queries the level of maxima found
`CALC:MARK:FUNC:X?`
Queries the frequencies (span <> 0) or time (span = 0) of maxima found.

Characteristics
*RST value: –
SCPI: device–specific

Mode
A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:COUNt?

This query reads out the number of maxima found during the search. If no search for maxima has been performed, 0 is returned.
The numeric suffixes <1|2> are irrelevant for this command.

Example
`CALC:MARK:FUNC:FPE 3`
Searches the 3 highest maxima for trace 1
`CALC:MARK:FUNC:FPE:COUN?`
Queries the number of maxima found

Characteristics
*RST value: –
SCPI: device–specific

Mode
A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:SORT

This command sets the sort mode for the search for maxima:
X: the maxima are sorted in the list of responses according to increasing X values
Y: the maxima are sorted in the list of responses according to decreasing Y values
The numeric suffixes <1|2> are irrelevant for this command.

Parameter
X | Y

Example
`CALC:MARK:FUNC:FPE:SORT Y`
Sets the sort mode to decreasing y values

Characteristics
*RST value: –
SCPI: device–specific

Mode
A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:X?

This query reads out the list of X values of the maxima found. The number of available values can be queried with CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:COUNt?.

With sort mode X, the X values are in increasing order; with sort mode Y the order corresponds to the decreasing order of the Y values.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:MARK:FUNC:FPE:SORT Y
Sets the sort mode to decreasing y values

CALC:MARK:FUNC:FPE 3
Searches the 3 highest maxima for trace 1

CALC:MARK:FUNC:FPE:COUN?
Queries the number of maxima found

CALC:MARK:FPE:FUNC:X?
Queries the frequencies (span <> 0) or. time (span = 0) of the maxima found

Return values

107.5E6,153.8E6,187.9E6
frequencies in increasing order

2.05E-3,2.37E-3, 3.71e-3
times in increasing order

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:Y?

This query reads out the list of X values of the maxima found. The number of available values can be queried with CALCulate<1|2>:MARKer<1...4>:FUNCtion:FPEaks:COUNt?.

With sort mode X, the X values are in increasing order; with sort mode Y the order corresponds to the decreasing order of the Y values.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:MARK:FUNC:FPE:SORT Y
Sets the sort mode to decreasing y values

CALC:MARK:FUNC:FPE 3
Searches the 3 highest maxima for trace 1

CALC:MARK:FUNC:FPE:COUN?
Queries the number of maxima found

CALC:MARK:FUNC:FPE:Y?
Queries the levels of the maxima found

Return values

-37.5,-58.3,-59.6
level in decreasing order

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth[:STATe]

This command switches on the measurement of the AM modulation depth. An AM–modulated carrier is required on the screen for correct operation. If necessary, marker 1 is previously activated and set to the largest signal available.

The level value of marker 1 is regarded as the carrier level. On activating the function, marker 2 and marker 3 are automatically set as delta markers symmetrically to the carrier to the adjacent maxima of the trace.

If the position of delta marker 2 is changed, delta marker 3 is moved symmetrically with respect to the reference marker (marker 1). If the position of delta marker 3 is changed, fine adjustment can be performed independently of delta marker 2.

The power at the marker positions is calculated from the measured levels.

The AM modulation depth is calculated from the ratio of power values at the reference marker and the delta markers. If the two AM sidebands differ in power, the average value of the two power values is used for calculating the AM modulation depth.

The numeric suffix <1|2> and <1...4> are irrelevant for this command.

Example

`CALC:MARK:X 10MHZ`

Sets the reference marker (marker 1) to the carrier signal at 10 MHz.

`CALC:MARK:FUNC:MDEP ON`

Switches on the modulation depth measurement.

`CALC:DELT2:X 10KHZ`

Sets delta markers 2 and 3 to the signals at 10 kHz from the carrier signal.

`CALC:DELT3:X 9.999KHZ`

Corrects the position of delta marker 3 relative to delta marker 2.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth:RESult?

This command queries the AM modulation depth.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffix <1|2> and <1...4> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`

Switches to single sweep mode.

`CALC:MARK:X 10MHZ`

Sets the reference marker (marker 1) to the carrier signal at 10 MHz.

`CALC:MARK:FUNC:MDEP ON`

Switches on the modulation depth measurement.

`INIT;*WAI`
Starts a sweep and waits for the end.
`CALC:MARK:FUNC:MDEP:RES?`
Outputs the measured value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth:SEARchsignal

This command starts the search of the signals required for the modulation depth measurement.

The numeric suffix <1|2> are irrelevant for this command.

Note: *No new measurement is done. Only the currently available trace selected for the modulation depth measurement is used*

Parameter

ONCE

Example

`CALC:MARK:FUNC:MDEP:SEAR ONCE`
Executes the search of an AM modulated signal at the currently available trace.

Characteristics

*RST value: –

SCPI: conform

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown

This command defines the level spacing of the two delta markers to the right and left of marker 1. Marker 1 is always used as the reference marker.

The temporary markers T1 and T2 are positioned by n dB below the active reference marker. The frequency spacing of these markers can be queried with
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:RESult?**?**.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

<numeric_value>

Example

`CALC:MARK:FUNC:NDBD 3dB`
Sets the level spacing to 3 dB.

Characteristics

*RST value: 6dB

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:FREQuency?

This command queries the two frequencies of the n dB down marker. The two frequency values are separated by comma and output in ascending order.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:NDBD ON`
Switches on the n dB down function.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:NDBD:FREQ?`
Outputs the frequencies of the temporary markers.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:RESult?

This command queries the frequency spacing (bandwidth) of the n dB down markers.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value in order to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:NDBD ON`
Switches on the n dB down function.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:NDBD:RES?`
Outputs the measured value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:STATe

This command switches the "N dB Down" function on or off. Marker 1 is activated first, if necessary.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

ON | OFF

Example

`CALC:MARK:FUNC:NDBD:STAT ON`
Switches on the "N dB Down" function.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:TIME?

This command queries the two frequencies of the n dB down marker. The two frequency values are separated by comma and output in ascending order.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode

`CALC:MARK:FUNC:NDBD ON`
Switches on the n dB down function.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:NDBD:TIME?`
Outputs the time values of the temporary markers.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe[:STATe]

This command switches the noise measurement on or off for all markers. The noise power density is measured at the position of the markers. The result can be queried with CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe:RESult?.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter
ON | OFF

Example
CALC:MARK:FUNC:NOIS ON
Switches on the noise measurement.

Characteristics
*RST value: OFF
SCPI: device–specific

Mode
A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe:RESult?

This command queries the result of the noise measurement.

A complete sweep with synchronization to the sweep end must be performed between switching on the function and querying the measured value in order to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example
INIT:CONT OFF
Switches to single sweep mode.
CALC:MARK2 ON
Switches on marker 2.
CALC:MARK:FUNC:NOIS ON
Switches on noise measurement.
INIT;*WAI
Starts a sweep and waits for the end.
CALC:MARK2:NOIS:RES?
Outputs the noise result of marker 2.

Characteristics
*RST value: –
SCPI: device–specific

Mode
A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:REFerence

This command sets the reference level to the power measured by the indicated marker. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to marker mode.

The numeric suffix <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

`CALC:MARK2:FUNC:REF`
Sets the reference level to the level of marker 2.

Characteristics

*RST value: –
SCPI: device–specific

Mode

A, CATV, SPECM

CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI[:STATe]

This command initiates the measurement of the third–order intercept point.

A two–tone signal with equal carrier levels is expected at the RF input of the instrument. Marker 1 and marker 2 (both normal markers) are set to the maximum of the two signals. Delta marker 3 and delta marker 4 are positioned to the intermodulation products. The delta markers can be modified separately afterwards with the `CALCulate<1|2>:DELTamarker<1...4>:X` command.

The third–order intercept is calculated from the level spacing between the normal markers and the delta markers.

The numeric suffix <1|2> and <1...4> are irrelevant for this command.

Parameter

ON | OFF

Example

`CALC:MARK:FUNC:TOI ON`
Switches on the measurement of the third–order intercept.

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI:RESult?

This command queries the third–order intercept point measurement.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffix <1|2> and <1...4> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:TOI ON`
Switches the intercept measurement.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:TOI:RES?`
Outputs the measured value.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI:SEARchsignal

This command starts the search of the signals required for the third order intercept measurement.

The numeric suffix <1|2> are irrelevant for this command.

Note: *No new measurement is done. Only the currently available trace selected for the TOI measurement is used*

Parameter

ONCE

Example

`CALC:MARK:FUNC:TOI:SEAR ONCE`
Executes the search for 2 signals and their intermodulation product at the currently available trace.

Characteristics

*RST value: –

SCPI: conform

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ZOOM

This command defines the range to be zoomed around marker 1. Marker 1 is activated first, if necessary.

The subsequent frequency sweep is stopped at the marker position and the frequency of the signal is counted. This frequency becomes the new center frequency, and the zoomed span is

set. In order to recognize the end of the operation the synchronization to the sweep end should be activated. This is only possible in single sweep mode.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Parameter

<numeric_value>

Example

`INIT:CONT OFF`

Switches to single sweep mode

`CALC:MARK:FUNC:ZOOM 1kHz;*WAI`

Activates zooming and waits for its end.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F

CALCulate:MARKer:FUNCtion:HARMonics Subsystem

The CALCulate:MARKer:FUNCtion:POWER subsystem contains the commands to define the settings for harmonics measurement.

Commands of the CALCulate:MARKer:FUNCtion:HARMonics Subsystem

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics[:STATe]

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:BANDwidth:AUTO

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:DISTortion?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:LIST?

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:NHARmonics

– CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:PRESet

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics[:STATe]

This command activates/deactivates the harmonic distortion measurement.

If the measurement is started in span > 0, the last span defines the search range for the first harmonic. The level is determined for the first harmonic.

If the measurement is started in zero span, center frequency and level are used unchanged.

The numeric suffix <1|2> and <1...4> are irrelevant for this command.

Parameter

ON | OFF

Example

`CALC:MARK:FUNC:HARM ON`

Activates the harmonic distortion measurement.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

A–F, A–T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:BANDwidth:AUTO

This command defines the resolution bandwidth of the harmonic in respect to the bandwidth of the first harmonic. For details refer to chaper "Instrument Functions", section "Harmonic RBW Auto".

The numeric suffix <1|2> are irrelevant for this command.

Parameter

OFF   identical

ON   a multiple

Example

`CALC:MARK:FUNC:HARM:BAND:AUTO OFF`
Deactivates the automatic bandwidth enlargement.

Characteristics

RST value: ON

SCPI: device–specific

Mode

A–F, A–T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:DISTortion?

This command queries the distortion results (THD: total harmonic distortion). Two values separated by a comma are returned: <THD in %>, <THD in dB>.

To obtain a correct result, a complete sweep with synchronization to the end of the sweep must be performed before a query is output. Synchronization is possible only in the single sweep mode.

The numeric suffix <1|2> and <1...4> are irrelevant for this command.

Parameter

TOTal

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:HARM:NHARM 3`
Sets the number of harmonics to be measured to 3.

`CALC:MARK:FUNC:HARM ON`
Activates the harmonic distortion measurement.

`INIT;*WAI`
Starts a sweep and waits for the end of the sweep.

`CALC:MARK:FUNC:HARM:DIST? TOT`
Returns the total distortion in % and dB.

Characteristics

RST value: –

SCPI: device–specific

Mode

A–F, A–T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:LIST?

This command reads out the list of the harmonics. The first value is the absolute power of the first harmonic (the unit is set via the CALCulate<1|2>:UNIT:POWer command). The following values are relative to the carrier signal and have the unit dB. They are separated by commas and correspond to the harmonics to be measured (set via the CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:NHARmonics command).

To obtain a correct result, a complete sweep with synchronization to the end of the sweep must be performed before a query is output. Synchronization is possible only in the single sweep mode.

The numeric suffixes <1/2> are not relevant.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:HARM:NHARM 3`
Sets the number of harmonics to be measured to 3.

`CALC:MARK:FUNC:HARM ON`
Activates the harmonic distortion measurement.

`INIT;*WAI`
Starts a sweep and waits for the end of the sweep.

`CALC:MARK:FUNC:HARM:LIST?`
Returns the values for the 3 measured harmonics.

Characteristics

RST value: –

SCPI: device–specific

Mode

A–F, A–T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:NHARmonics

This command sets the number of harmonics to be measured.

The numeric suffix <1|2> and <1...4> are irrelevant for this command.

Parameter

1...26

Example

`CALC:MARK:FUNC:HARM:NHARM 3`
Sets the number of harmonics to be measured to 3.

Characteristics

RST value: 10

SCPI: device–specific

Mode

A–F, A–T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:PRESet

This command optimizes the device settings depending on the span setting:

span > 0   Frequency and level of the first harmonic are determined and used for the measurement list.

zero span   The level of the first harmonic is determined. The frequency remains unchanged.

The numeric suffixes <1/2> and <1...4> are irrelevant.

This command is an event and therefore has no *RST value.

Example

CALC:MARK:FUNC:HARM:PRES
Optimizes the device settings for the harmonic measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

A–F, A–T

CALCulate:MARKer:FUNCtion:POWer Subsystem

The CALCulate:MARKer:FUNCtion:POWER subsystem contains the commands for control of power measurement.

Commands of the CALCulate:MARKer:FUNCtion:POWer Subsystem

– CALCulate<1|2>:MARKer:FUNCtion:POWer[:STATe]

– CALCulate<1|2>:MARKer:FUNCtion:POWer:MODe

– CALCulate<1|2>:MARKer:FUNCtion:POWer:PRESet

– CALCulate<1|2>:MARKer:FUNCtion:POWer:RESult?

– CALCulate<1|2>:MARKer:FUNCtion:POWer:RESult:PHZ

– CALCulate<1|2>:MARKer:FUNCtion:POWer:SELect

Further information

– CDMA standard abbreviations

CDMA standard abbreviations

Parameter	Standard
NADC	**NADC IS136**
TETRA	**TETRA**
PDC	**PDC**
PHS	**PHS**
CDPD	**CDPD**
FIS95A, F8CDma	**CDMA IS95A forward**
RIS95A, R8CDma	**CDMA IS95A reverse**
FJ008, F19CDma	**CDMA J–STD008 forward**
RJ008, R19CDma	**CDMA J–STD008 reverse**
FIS95C0	**CDMA IS95C Class 0 forward**
RIS95C0	**CDMA IS95C Class 0 reverse**
FIS95C1	**CDMA IS95C Class 1 forward**
RIS95C1	**CDMA IS95C Class 1 reverse**
FWCDma	**W–CDMA 4.096 MHz forward**
RWCDma	**W–CDMA 4.096 MHz reverse**
FW3Gppcdma	**W–CDMA 3.84 MHz forward**
RW3Gppcdma	**W–CDMA 3.84 MHz reverse**
D2CDma	**CDMA 2000 direct sequence**
S2CDma	**CDMA 2000 MC1 multi carrier with 1 carrier**
M2CDma	**CDMA 2000 MC3 multi carrier with 3 carriers**
FTCDMa / TCDMa	**TD–SCDMA forward**
RTCDMA	**TD–SCDMA reverse**
AWLan	**WLAN 802.11A**
BWLan	**WLAN 802.11B**
WIMax	**WiMAX**
WIBRo	**WIBRO**

CALCulate<1|2>:MARKer:FUNCtion:POWer[:STATe]

This command switches off the power measurement.

The numeric suffixes <1/2> are not relevant.

This command is an event and therefore has no *RST value.

Parameter

OFF

Example

`CALC:MARK:FUNC:POW OFF`
Switches off the power measurement.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:POWer:MODe

This commands defines the method by which the channel power values are calculated from the current trace.

The numeric suffixes <1/2> are not relevant.

Parameter

WRITe   The channel power and the adjacent channel powers are calculated directly from the current trace

MAXHold   The power values are calculated from the current trace and compared with the previous power value using a maximum algorithm.

Example

CALC:MARK:FUNC:POW:MODE MAXH
Sets the Maxhold channel power mode.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:POWer:PRESet

This command selects the power measurement setting for a standard and previously switches on the corresponding measurement, if required.

The configuration for a standard comprises of the parameters weighting filter, channel bandwidth and spacing, resolution and video bandwidth, as well as detector and sweep time.

The numeric suffixes <1/2> are not relevant.

Note: *The settings for standards IS95A and C differ as far as the calculation method of channel spacings is concerned. For IS95A and J–STD008 the spacing is calculated from the center of the main channel to the center of the corresponding adjacent channel, for IS95C from the center of the main channel to the nearest border of the adjacent channel.*

Parameter

NADC | TETRA | PDC | PHS | CDPD | FWCDma | RWCDma | F8CDma | R8CDma | F19Cdma | R19Cdma | FW3Gppcdma | RW3Gppcdma | D2CDma | S2CDma | M2CDma | FIS95A | RIS95A | FIS95C0 | RIS95C0 | FIS95C1 | RIS95C1 | FJ008 | RJ008 | TCDMa | FTCDMa | RTCDMa | AWLan | BWLan | WIMax | WIBRo | NONE

For further details refer to "CDMA standard abbreviations" on page 4.73.

Example

CALC:MARK:FUNC:POW:PRES NADC
Selects the standard setting for NADC

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:POWer:RESult?

This command queries the result of the performed power measurement. If necessary, the measurement is switched on prior to the query.

The channel spacings and channel bandwidths are configured in the "SENSe:POWer Subsystem" on page 4.143.

To obtain a correct result, a complete sweep with synchronization to the end of the sweep must be performed before a query is output. Synchronization is possible only in the single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is a query and therefore has no *RST value.

Parameter

ACPower   Adjacent–channel power measurement

Results are output in the following sequence, separated by commas:

Power of transmission channel
Power of lower adjacent channel
Power of upper adjacent channel
Power of lower alternate channel 1
Power of upper alternate channel 1
Power of lower alternate channel 2
Power of upper alternate channel 2

The number of measured values returned depends on the number of adjacent/alternate channels selected with [SENSe<1|2>:]POWer:ACHannel:ACPairs.

With logarithmic scaling (RANGE LOG), the power is output in the currently selected level unit; with linear scaling (RANGE LIN dB or LIN %), the power is output in W. If [SENSe<1|2>:]POWer:ACHannel:MODE is set to REL, the adjacent/alternate–channel power is output in dB.

CPOWer   Channel power measurement

With logarithmic scaling (RANGE LOG), the channel power is output in the currently selected level unit; with linear scaling (RANGE LIN dB or LIN %), the channel power is output in W.

MCACpower   Channel/adjacent–channel power measurement with several carrier signals

Results are output in the following sequence, separated by commas:

Power of carrier signal 1 to 12 in ascending order
Total power of all carrier signals
Power of lower adjacent channel
Power of upper adjacent channel
Power of lower alternate channel 1
Power of upper alternate channel 1
Power of lower alternate channel 2
Power of upper alternate channel 2

The number of measured values returned depends on the number of carrier signals and adjacent/alternate channels selected with

[SENSe<1|2>:]POWer:ACHannel:TXCHannel:COUNt and
[SENSe<1|2>:]POWer:ACHannel:ACPairs.

If only one carrier signal is measured, the total value of all carrier signals will not be output.

With logarithmic scaling (RANGE LOG), the power is output in dBm; with linear scaling (RANGE LIN dB or LIN %), the power is output in W. If [SENSe<1|2>:]POWer:ACHannel:MODE is set to REL, the adjacent/alternate–channel power is output in dB.

OBANdwidth | OBWidth	Measurement of occupied bandwidth
	The occupied bandwidth in Hz is returned.
CN	Measurement of carrier–to–noise ratio
	The carrier–to–noise ratio in dB is returned.
CN0	Measurement of carrier–to–noise ratio referenced to 1 Hz bandwidth.
	The carrier–to–noise ratio in dB/Hz is returned.

Example of channel/adjacent–channel power measurement

`POW:ACH:ACP 3`
Sets the number of adjacent/alternate channels to 3.

`POW:ACH:BAND 30KHZ`
Sets the bandwidth of the transmission channel to 30 kHz.

`POW:ACH:BAND:ACH 40KHZ`
Sets the bandwidth of each adjacent channel to 40 kHz.

`POW:ACH:BAND:ALT1 50KHZ`
Sets the bandwidth of each alternate channel to 50 kHz.

`POW:ACH:BAND:ALT2 60KHZ`
Sets the bandwidth of alternate channel 2 to 60 kHz.

`POW:ACH:SPAC 30KHZ`
Sets the spacing between the transmission channel and the adjacent channel to 30 kHz, the spacing between the transmission channel and alternate channel 1 to 60 kHz, and the spacing between the transmission channel and alternate channel 2 to 90 kHz.

`POW:ACH:SPAC:ALT1 100KHZ`
Sets the spacing between the alternate adjacent channels and the TX channel. For details refer to the `[SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1...11>` command.

`POW:ACH:SPAC:ALT2 140KHZ`
Sets the spacing between the transmission channel and alternate channel 2 to 140 kHz.

`POW:ACH:MODE ABS`
Switches on absolute power measurement.

`CALC:MARK:FUNC:POW:SEL ACP`
Switches on the adjacent–channel power measurement.

`INIT:CONT OFF`
Switches over to single sweep mode.

`INIT;*WAI`
Starts a sweep and waits for the end of the sweep.

`CALC:MARK:FUNC:POW:RES? ACP`
Queries the result of adjacent–channel power measurement.

`POW:ACH:REF:AUTO ONCE`
Defines the measured channel power as the reference value for relative power measurements.

Note: *If the channel power only is to be measured, all commands relating to adjacent/alternate channel bandwidth and channel spacings are omitted. The number of adjacent/alternate channels is set to 0 with* `[SENSe<1|2>:]POWer:ACHannel:ACPairs`*.*

Example of occupied bandwidth measurement

`POW:BAND 90PCT`
Defines 90% as the percentage of the power to be contained in the bandwidth range to be measured.

`INIT:CONT OFF`
Switches over to single sweep mode.

```
INIT;*WAI
```
Starts a sweep and waits for the end of the sweep.

```
CALC:MARK:FUNC:POW:RES? OBW
```
Queries the occupied bandwidth measured.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F, WCDMA

CALCulate<1|2>:MARKer:FUNCtion:POWer:RESult:PHZ

This command switches the query response of the power measurement results between output of absolute values and output referred to the measurement bandwith.

The measurement results are output with the `CALCulate<1|2>:MARKer:FUNCtion:POWer:RESult?` command.

The numeric suffixes <1/2> are not relevant.

Parameter

ON   Results output referred to measurement bandwidth

OFF   Results output in absolute values

Example

```
CALC2:MARK:FUNC:POW:RES:PHZ ON
```
Output of results referred to the channel bandwidth.

For details on a complete measurement example refer to Example of channel/adjacent–channel power measurement.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:POWer:SELect

This command selects – and switches on – specified power measurement type.

The channel spacings and channel bandwidths are configured in the "SENSe:POWer Subsystem" on page 4.143.

The numeric suffixes <1/2> are not relevant.

Note: *If CPOWer is selected, the number of adjacent channels (`[SENSe<1|2>:]POWer:ACHannel:ACPairs`) is set to 0. If ACPower is selected, the number of adjacent channels is set to 1, unless adjacent–channel power measurement is switched on already.*
            The channel/adjacent–channel power measurement is performed for the trace selected with `[SENSe<1|2>:]POWer:TRACe`.

The occupied bandwidth measurement is performed for the trace on which marker 1 is positioned. To select another trace for the measurement, marker 1 is to be positioned on the desired trace by means of `CALCulate<1|2>:MARKer<1...4>:TRACe`.

Parameter

ACPower	Adjacent–channel power measurement with a single carrier signal
CPOWer	Channel power measurement with a single carrier signal (equivalent to adjacent–channel power measurement with *NO. OF ADJ CHAN* = 0)
MCACpower	Channel/adjacent–channel power measurement with several carrier signals
OBANdwidth | OBWidth	Measurement of occupied bandwidth
CN	Measurement of carrier–to–noise ratio
CN0	Measurement of carrier–to–noise ratio referenced to 1 Hz bandwidth

Example

`CALC:MARK:FUNC:POW:SEL ACP`

Switches on adjacent–channel power measurement.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F

CALCulate:MARKer:FUNCtion:STRack Subsystem

The CALCulate:MARKer:FUNCtion:STRack subsystem defines the settings of the signal track.

Commands of the CALCulate:MARKer:FUNCtion:STRack Subsystem

– CALCulate<1|2>:MARKer:FUNCtion:STRack[:STATe]

– CALCulate<1|2>:MARKer:FUNCtion:STRack:BANDwidth|BWIDth

– CALCulate<1|2>:MARKer:FUNCtion:STRack:THReshold

– CALCulate<1|2>:MARKer:FUNCtion:STRack:TRACe

CALCulate<1|2>:MARKer:FUNCtion:STRack[:STATe]

This command switches the signal–track function on or off.

With signal track activated, the maximum signal is determined after each frequency sweep and the center frequency is set to the frequency of this signal. Thus with drifting signals the center frequency follows the signal.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

CALC:MARK:FUNC:STR ON
Switches on the signal track function.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:STRack:BANDwidth|BWIDth

These commands have the same function. They define the bandwidth around the center frequency within which the largest signal is searched.

The numeric suffixes <1/2> are not relevant.

Note: *The entry of the search bandwidth is only possible if the Signal Track function is switched on (*CALCulate<1|2>:MARKer:FUNCtion:STRack[:STATe]*).*

Parameter

10Hz to MAX (span)

Example

CALC:MARK:FUNC:STR:BAND 1MHZ
Sets the search bandwidth to 1 MHz.

CALC:MARK:FUNC:STR:BWID 1MHZ
Alternative command for the same function.

Characteristics

*RST value: – (= span/10 on activating the function)

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:STRack:THReshold

This command defines the threshold above which the largest signal is searched for.

The response unit depends on the settings defined with `CALCulate<1|2>:UNIT:POWer`.

The numeric suffixes <1/2> are not relevant.

Note: *The entry of the search bandwidth is only possible if the Signal Track function is switched on (`CALCulate<1|2>:MARKer:FUNCtion:STRack[:STATe]`).*

Parameter

–330dBm to +30dBm

Example

`CALC:MARK:FUNC:STR:THR –50DBM`
Sets the threshold for signal tracking to –50 dBm.

Characteristics

*RST value: –120 dBm

SCPI: device–specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:STRack:TRACe

This command defines the trace on which the largest signal is searched for.

The numeric suffixes <1/2> are not relevant.

Parameter

1 to 6

Example

`CALC:MARK:FUNC:STR:TRAC 3`
Defines trace 3 as the trace for signal tracking.

Characteristics

*RST value: 1

SCPI: device–specific

Mode

A–F

CALCulate:MARKer:FUNCtion:SUMMary Subsystem

This subsystem contains the commands for controlling the power functions in zero span.

Commands of the CALCulate:MARKer:FUNCtion:SUMMary Subsystem

– CALCulate<1|2>:MARKer:FUNCtion:MSUMmary?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary[:STATe]
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AOFF
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN[:STATe]
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN:AVERage:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN:PHOLd:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MODE
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PHOLd
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak[:STATe]
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:AVERage:RESult?
–
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:PHOLd:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:REFerence:AUTO
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS[:STATe]
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS:AVERage:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS:PHOLd:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation[:STATe]
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:AVERage:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:PHOLd:RESult?
– CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:RESult?

CALCulate<1|2>:MARKer:FUNCtion:MSUMmary?

The commands of this subsystem are used to determine the power of a sequence of signal pulses having the same interval, as are typical for the slots of a GSM signal, for example. The number of pulses to be measured as well as the measurement time and the period can be set. To define the position of the first pulse in the trace, a suitable offset can be entered.

The evaluation is performed on the measurement data of a previously recorded trace. The data recorded during the set measurement time is combined to a measured value for each pulse according to the detector specified and the indicated number of results is output as a list.

Trace 1 is always used by the function.

The numeric suffixes <1/2> are not relevant.
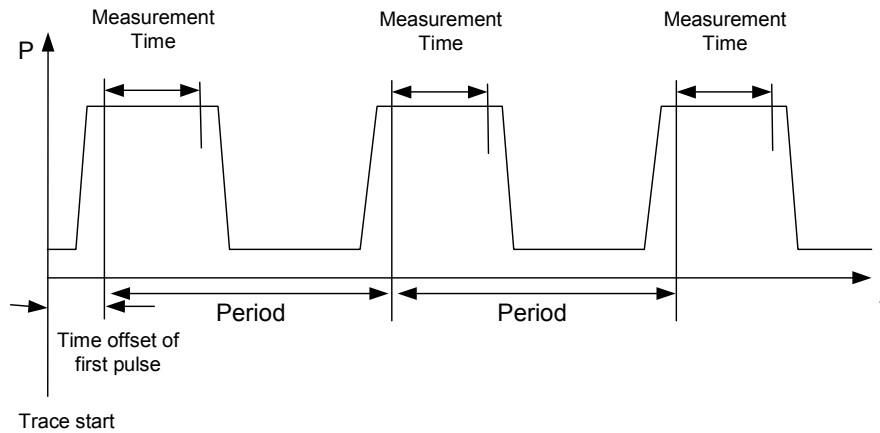
Parameter

<time offset of first pulse>, <measurement time>, <period>, < # of pulses to measure>

Example

`DISP:WIND:TRAC:Y:RLEV –10dBm`
Sets the reference level to 10 dB

`INP:ATT 30 dB`
Sets the input attenuation to 30 dB

`FREQ:CENT 935.2MHz;SPAN 0Hz`
Sets the receive frequency to 935.2 MHz and the span to 0 Hz

`BAND:RES 1MHz;VID 3MHz`
Sets the resolution bandwidth to 1 MHz and the video bandwidth to 3 MHz

`DET RMS`
Sets the RMS detector

`TRIG:SOUR VID;LEV:VID 50 PCT`
Selects the trigger source VIDeo and sets the level of the video trigger source to 50 PCT

`SWE:TIME 50ms`
Sets the sweep time to 50 ms

`INIT;*WAI`
Starts the measurement with synchronization

`CALC:MARK:FUNC:MSUM? 50US,450US,576.9US,8`
Queries 8 bursts with an offset of 50 μs, a test time of 450 μs and a period of 576.9 μs

Characteristics

*RST value: –
SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary[:STATe]

This command switches on or off the previously selected power measurements in zero span. Thus one or several measurements can be first selected and then switched on and off together with CALCulate<1|2>:MARKer:FUNCtion:SUMMary[:STATe].

The numeric suffixes <1/2> are not relevant.

Parameter
ON | OFF

Example
CALC:MARK:FUNC:SUMM:STAT ON

Characteristics
*RST value: OFF
SCPI: device–specific

Mode
A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AOFF

This command switches off all measurements in zero span.

The numeric suffixes <1/2> are not relevant.

This command is an event and therefore has no *RST value and no query.

Example
CALC:MARK:FUNC:SUMM:AOFF
Switches off the functions for power measurement in zero span.

Characteristics
*RST value: –
SCPI: device–specific

Mode
A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage

This command switches on or off averaging for the active power measurement in zero span.

Averaging is reset by switching it off and on again.

The number of results required for the calculation of average is defined with [SENSe<1|2>:]AVERage:COUNt.

Synchronization to the end of averaging is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

Parameter
ON | OFF

Example
INIT:CONT OFF
Switches to single sweep mode.
CALC:MARK:FUNC:SUMM:AVER ON
Switches on the calculation of average.

`AVER:COUN 200`
Sets the measurement counter to 200.

`INIT;*WAI`
Starts a sweep and waits for the end.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN[:STATe]

This command switches on or off the measurement of the mean value.

The numeric suffixes <1/2> are not relevant.

Note: *The measurement is performed on the trace on which marker 1 is positioned. In order to evaluate another trace, marker 1 must be positioned on another trace with* `CALCulate<1|2>:MARKer<1...4>:TRACe`*.*

Parameter

ON | OFF

Example

`CALC:MARK:FUNC:SUMM:MEAN ON`
Switches on the function.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN:AVERage:RESult?

This command queries the result of the measurement of the averaged mean value. The query is only possible if averaging has been activated previously using `CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage`.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:MEAN ON`
Switches on the function.

`CALC:MARK:FUNC:SUMM:AVER ON`
Switches on the average value calculation.

`INIT;*WAI`
Starts a sweep and waits for the end.

CALC:MARK:FUNC:SUMM:MEAN:AVER:RES?
Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN:PHOLd:RESult?

This command queries the result of the measurement of the mean value with active peak hold. The query is only possible if the peak hold function has been switched on previously using CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PHOLd.

The query is possible only if the peak hold function is active.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

INIT:CONT OFF
Switches to single sweep mode.

CALC:MARK:FUNC:SUMM:MEAN ON
Switches on the function.

CALC:MARK:FUNC:SUMM:PHOL ON
Switches on the peak value measurement.

INIT;*WAI
Starts a sweep and waits for the end.

CALC:MARK:FUNC:SUMM:MEAN:PHOL:RES?
Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN:RESult?

This command queries the result of the measurement of the mean value.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

INIT:CONT OFF
Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:MEAN ON`
Switches on the function.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:MEAN:RES?`
Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MODE

This command selects absolute or relative power measurement in zero span.

The reference power for relative measurement is defined with
CALCulate<1|2>:MARKer:FUNCtion:SUMMary:REFerence:AUTO. If the reference power
is not defined, the value 0 dBm is used.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

ABSolute | RELative

Example

`CALC:MARK:FUNC:SUMM:MODE REL`
Switches the power measurement in zero span to relative.

Characteristics

RST value: ABSolute

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PHOLd

This command switches on or off the peak–hold function for the active power measurement in
zero span.

The peak–hold function is reset by switching it off and on again.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

`CALC:MARK:FUNC:SUMM:PHOL ON`
Switches on the function.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak[:STATe]

This command switches on or off the measurement of the positive peak value.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

CALC:MARK:FUNC:SUMM:PPE ON

Switches on the function.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:AVERage:RESult?

This command is used to query the result of the measurement of the averaged positive peak value. The query is only possible if averaging has been activated previously using CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

INIT:CONT OFF

Switches to single sweep mode.

CALC:MARK:FUNC:SUMM:PPE ON

Switches on the function.

CALC:MARK:FUNC:SUMM:AVER ON

Switches on the calculation of average.

INIT;*WAI

Starts a sweep and waits for the end.

CALC:MARK:FUNC:SUMM:PPE:AVER:RES?

Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:PHOLd:RESult?

This command is used to query the result of the measurement of the positive peak value with active peak hold function. The query is only possible if the peak hold function has been activated previously using CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PHOLd.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:PPE ON`
Switches on the function.

`CALC:MARK:FUNC:SUMM:PHOL ON`
Switches on the measurement of the peak value.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:PPE:PHOL:RES?`
Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:RESult?

This command is used to query the result of the measurement of the positive peak value. The measurement may have to be switched on previously.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:PPE ON`
Switches on the function.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:PPE:RES?`
Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:REFerence:AUTO

This command sets the currently measured average value
(`CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN[:STATe]`) and RMS value
(`CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS[:STATe]`) as reference values for
relative measurements in zero span.

If the measurement of RMS value and average is not activated, the reference value 0 dBm is
used.

If the function `CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage` or
`CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PHOLd` is switched on, the current value is
the accumulated measurement value at the time considered.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Parameter

ONCE

Example

`CALC:MARK:FUNC:SUMM:REF:AUTO ONCE`
Takes the currently measured power as reference value for the relative power measurement in
zero span.

Characteristics

RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS[:STATe]

This command switches on or off the measurement of the effective (RMS) power. If necessary
the function is switched on previously.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

`CALC:MARK:FUNC:SUM:RMS ON`
Switches on the function.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS:AVERage:RESult?

This command queries the result of the measurement of the averaged RMS value. The query is
only possible if averaging has been activated previously using
`CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage`.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:RMS ON`
Switches on the function.

`CALC:MARK:FUNC:SUMM:AVER ON`
Switches on the average value calculation.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:RMS:AVER:RES?`
Outputs the result.

Characteristics

*RST– value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS:PHOLd:RESult?

This command queries the result of the measurement of the RMS value with active peak hold. The query is only possible only if the peak hold function has been activated previously using CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PHOLd.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:RMS ON`
Switches on the function.

`CALC:MARK:FUNC:SUMM:PHOL ON`
Switches on the peak value measurement.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:RMS:PHOL:RES?`
Outputs the result.

Characteristics

*RST– value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS:RESult?

This command queries the result of the measurement of the RMS power value.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:RMS ON`
Switches on the function.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:RMS:RES?`
Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation[:STATe]

This command switches on or off the measurement of the standard deviation.

On switching on the measurement, the mean power measurement is switched on as well.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

`CALC:MARK:FUNC:SUMM:SDEV ON`
Switches on the measurement of the standard deviation.

Characteri

stics

*RST value: OFF

SCPI: device–specific

ModeA

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:AVERage:RESult?

This command queries the result of the averaged standard deviation determined in several sweeps. The query is possible only if averaging is active.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`

Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:SDEV ON`

Switches on the function.

`CALC:MARK:FUNC:SUMM:AVER ON`

Switches on the calculation of average.

`INIT;*WAI`

Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:MEAN:SDEV:RES?`

Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:PHOLd:RESult?

This command queries the maximum standard deviation value determined in several sweeps. The query is possible only if the peak hold function is active.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`

Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:SDEV ON`

Switches on the function.

`CALC:MARK:FUNC:SUMM:PHOL ON`

Switches on the peak value measurement.

`INIT;*WAI`

Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:SDEV:PHOL:RES?`

Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:RESult?

This command queries the results of the standard deviation measurement.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is only a query and therefore has no *RST value.

Example

`INIT:CONT OFF`
Switches to single sweep mode.

`CALC:MARK:FUNC:SUMM:SDEV ON`
Switches on the function.

`INIT;*WAI`
Starts a sweep and waits for the end.

`CALC:MARK:FUNC:SUMM:SDEV:RES?`
Outputs the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–T

CALCulate:MATH Subsystem

The CALCulate:MATH subsystem allows to process data from the SENSe–subsystem in numeric expressions.

Commands of the CALCulate:MATH Subsystem

– CALCulate<1|2>:MATH[:EXPression][:DEFine]

– CALCulate<1|2>:MATH:POSition

– CALCulate<1|2>:MATH:STATe

CALCulate<1|2>:MATH[:EXPression][:DEFine]

This command defines the mathematical expression for relating traces to trace1.

Parameter

(TRACE1–TRACE2)	Subtracts trace 2 from trace 1.
(TRACE1–TRACE3)	Subtracts trace 3 from trace 1.
(TRACE1–TRACE4)	Subtracts trace 4 from trace 1.
(TRACE1–TRACE5)	Subtracts trace 5 from trace 1.
(TRACE1–TRACE6)	Subtracts trace 6 from trace 1.

Example

```
CALC1:MATH (TRACE1 – TRACE2)
```
Selects the subtraction of trace 2 from trace 1.

Characteristics

*RST value: –
SCPI: conform

Mode

A

CALCulate<1|2>:MATH:POSition

This command defines the position of the result of the trace mathematics. The indication is in % of the screen height, with 100% corresponding to the upper diagram border.

Parameter

–100PCT to 200PCT

Example

```
CALC:MATH:POS 50PCT
```
Sets the position to the horizontal diagram center.

Characteristics

*RST value: 50PCT
SCPI: device–specific

Mode

A

CALCulate<1|2>:MATH:STATe

This command switches the mathematical relation of traces on or off.

Parameter

ON | OFF

Example

`CALC:MATH:STAT ON`
Switches on the trace mathematics.

Characteristics

*RST value: OFF
SCPI: conform

Mode

A

CALCulate:STATistics Subsystem

The CALCulate:STATistics subsystem controls the statistical measurement functions in the instrument.

Commands of the CALCulate:STATistics Subsystem

– CALCulate:STATistics:APD[:STATe]
– CALCulate:STATistics:CCDF[:STATe]
– CALCulate:STATistics:NSAMples
– CALCulate:STATistics:PRESet
–
– CALCulate:STATistics:RESult<1...4>?
– CALCulate:STATistics:SCALe:AUTO
– CALCulate:STATistics:SCALe:X:RANGe
– CALCulate:STATistics:SCALe:X:RLEVel
– CALCulate:STATistics:SCALe:Y:LOWer
– CALCulate:STATistics:SCALe:Y:UPPer

CALCulate:STATistics:APD[:STATe]

This command switches on or off the measurement of amplitude distribution (APD). On activating this function, the CCDF measurement is switched off.

Parameter

ON | OFF

Example

`CALC:STAT:APD ON`
Switches on the APD measurement.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate:STATistics:CCDF[:STATe]

This command switches on or off the measurement of the complementary cumulative distribution function (CCDF). On activating this function, the APD measurement is switched off.

Parameter

ON | OFF

Example

`CALC:STAT:CCDF ON`
Switches on the CCDF measurement.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A

CALCulate:STATistics:NSAMples

This command sets the number of measurement points to be acquired for the statistical measurement functions.

Parameter

100 to 1E9

Example

`CALC:STAT:NSAM 500`

Sets the number of measurement points to be acquired to 500.

Characteristics

*RST value: 100000

SCPI: device–specific

Mode

A, CATV

CALCulate:STATistics:PRESet

This command resets the scaling of the X and Y axes in a statistical measurement. The following values are set:

x–axis ref level:	–20 dBm
x–axis range APD:	100 dB
x–axis range CCDF:	20 dB
y–axis upper limit:	1.0
y–axis lower limit:	1E–6

This command is an event and therefore has no *RST value and no query.

Example

`CALC:STAT:PRES`

Resets the scaling for statistical functions

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, CATV

CALCulate:STATistics:RESult<1...4>?

This command reads out the results of statistical measurements of a recorded trace. The trace is selected with the numeric suffix <1...4> attached to RESult.

Parameter

The required result is selected via the following parameters:

MEAN   Average (=RMS) power in dBm measured during the measurement time.

PEAK   Peak power in dBm measured during the measurement time.

CFACtor   Determined CREST factor (= ratio of peak power to average power) in dB.

ALL   Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example

`CALC:STAT:RES2? ALL`

Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, CREST factor 13.69 dB

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, CATV

CALCulate:STATistics:SCALe:AUTO

This command optimizes the level setting of the instrument depending on the measured peak power, in order to obtain maximum instrument sensitivity.

To obtain maximum resolution, the level range is set as a function of the measured spacing between peak power and the minimum power for the APD measurement and of the spacing between peak power and mean power for the CCDF measurement. In addition, the probability scale for the number of test points is adapted.

This command is an event and therefore has no *RST value and no query.

Note: *Subsequent commands have to be synchronized with* `*WAI`, `*OPC` *or* `*OPC?` *to the end of the auto range process which would otherwise be aborted.*

Parameter

ONCE

Example

`CALC:STAT:SCAL:AUTO ONCE;*WAI`

Adapts the level setting for statistical measurements.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A, CATV

CALCulate:STATistics:SCALe:X:RANGe

This command defines the level range for the x–axis of the measurement diagram. The setting is identical to the level range setting defined with the DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe] command.

Parameter

10dB to 200dB

Example

CALC:STAT:SCAL:X:RANG 20dB

Characteristics

*RST value: 100dB

SCPI: device–specific

Mode

A, CATV

CALCulate:STATistics:SCALe:X:RLEVel

This command defines the reference level for the x–axis of the measurement diagram. The setting is identical to the reference level setting using the DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel command.

With the reference level offset <> 0 the indicated value range of the reference level is modified by the offset.

The unit depends on the setting performed with CALCulate<1|2>:UNIT:POWer.

Parameter

–120dBm to 20dBm

Example

CALC:STAT:SCAL:X:RLEV –60dBm

Characteristics

*RST value: –20dBm

SCPI: device–specific

Mode

A, CATV

CALCulate:STATistics:SCALe:Y:LOWer

This command defines the lower limit for the y–axis of the diagram in statistical measurements. Since probabilities are specified on the y–axis, the entered numerical values are dimensionless.

Parameter

$1E{-}9$ to 0.1

Example

CALC:STAT:SCAL:Y:LOW 0.001

Characteristics

*RST value: $1E{-}6$

SCPI: device–specific

Mode

A, CATV

CALCulate:STATistics:SCALe:Y:UPPer

This command defines the upper limit for the y–axis of the diagram in statistical measurements. Since probabilities are specified on the y–axis, the entered numerical values are dimensionless.

Parameter

1E–8 to 1.0

Example

`CALC:STAT:Y:UPP 0.01`

Characteristics

*RST value: 1.0

SCPI: device–specific

Mode

A, CATV

CALCulate:THReshold Subsystem

The CALCulate:THReshold subsystem controls the threshold value for the maximum/minimum search of markers.

Commands of the CALCulate:THReshold Subsystem

– CALCulate<1|2>:THReshold

– CALCulate<1|2>:THReshold:STATe

CALCulate<1|2>:THReshold

This command defines the threshold value for the maximum/minimum search of markers with marker search functions. The associated display line is automatically switched on.

The numeric suffixes <1/2> are not relevant.

Parameter

MINimum to MAXimum (depending on current unit)

Example

CALC:THR –82DBM
Sets the threshold value to –82 dBm.

Characteristics

*RST value: – (STATe to OFF)
SCPI: device–specific

Mode

A, ADEMOD, SPECM

CALCulate<1|2>:THReshold:STATe

This command switches on or off the threshold line. The unit depends on the setting performed with CALCulate<1|2>:UNIT:POWer.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

CALC:THR:STAT ON
Switches on the threshold line.

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

A, ADEMOD, SPECM

CALCulate:TLINe Subsystem

The CALCulate:TLINe subsystem defines the position of the time lines.

Commands of the CALCulate:TLINe Subsystem

– CALCulate<1|2>:TLINe<1|2>
– CALCulate<1|2>:TLINe<1|2>:STATe

CALCulate<1|2>:TLINe<1|2>

This command defines the position of the time lines that mark the times.
The numeric suffixes <1/2> are not relevant.

Parameter
0 to 1000s

Example
`CALC:TLIN 10ms`

Characteristics
*RST value: – (STATe to OFF)
SCPI: device–specific

Mode
A–T

CALCulate<1|2>:TLINe<1|2>:STATe

This command switches the time line on or off.
The numeric suffixes <1/2> are not relevant.

Parameter
ON | OFF

Example
`CALC:TLIN2:STAT ON`

Characteristics
*RST value: OFF
SCPI: device–specific

Mode
A–T

CALCulate:UNIT Subsystem

The CALCulate:UNIT subsystem defines the units for the parameters that can be set and the measurement results.

Commands of the CALCulate:UNIT Subsystem

–   CALCulate<1|2>:UNIT:POWer

CALCulate<1|2>:UNIT:POWer

This command selects the unit for power.

The numeric suffixes <1/2> are not relevant.

Parameter

DBM | V | A | W | DBPW | WATT | DBPT | DBUV | DBMV | VOLT | DBUA | AMPere

Example

CALC:UNIT:POW DBM

Sets the power unit to dBm.

Characteristics

*RST value: dBm

SCPI: device–specific

Mode

A

DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

– DISPlay[:WINDow<1|2>]:SIZE
– DISPlay[:WINDow<1|2>]:TRACe<1...6>[:STATe]
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:MODE
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:MODE:HCONtinuous
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y:SPACing
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:MODE
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel:OFFSet
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RVALue:AUTO

DISPlay[:WINDow<1|2>]:SIZE

This command switches the measurement window for channel and adjacent–channel power measurements to full screen or half screen. Only "1" is allowed as a numerical suffix.

Parameter

LARGe | SMALl

Example

```
DISP:SIZE LARG
```
Displays the measurement diagram in full screen size.

Characteristics

*RST value: SMALl

SCPI: device–specific

Mode

A, ADEMOD

DISPlay[:WINDow<1|2>]:TRACe<1...6>[:STATe]

This command switches on or off the display of the corresponding trace.
The numeric suffixes <1|2> are irrelevant.

Parameter

ON | OFF

Example

```
DISP:TRAC3 ON
```

Characteristics

*RST value: ON for TRACe1, OFF for TRACe2 to 6

SCPI: conform

Mode

all

DISPlay[:WINDow<1|2>]:TRACe<1...6>:MODE

This command defines the type of display and the evaluation of the traces. WRITE corresponds to the Clr/Write mode of manual operation. The trace is switched off (= BLANK in manual operation) with `DISPlay[:WINDow<1|2>]:TRACe<1...6>[:STATe]`.

The number of measurements for AVERage, MAXHold and MINHold is defined with the `[SENSe<1|2>:]AVERage:COUNt` or `[SENSe<1|2>:]SWEep:COUNt` commands. It should be noted that synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

If calculation of average values is active, selection between logarithmic and linear averaging is possible. For more detail see command `SENSe:AVERage:TYPE`.

The numeric suffixes <1|2> are irrelevant.

Parameter

WRITe | VIEW | AVERage | MAXHold | MINHold |RMS

For details on trace modes refer to chapter "Instrument Functions", section "Trace mode overview".

Example

`SWE:CONT OFF`
Switching to single sweep mode.

`SWE:COUN 16`
Sets the number of measurements to 16.

`DISP:TRAC3:MODE MAXH`
Switches on the calculation of the for trace 3.

`INIT;*WAI`
Starts the measurement and waits for the end of the 16 sweeps.

Characteristics

*RST value: WRITe for TRACe1, STATe OFF for TRACe2/3/4/5/6

SCPI: device–specific

Mode

all

DISPlay[:WINDow<1|2>]:TRACe<1...6>:MODE:HCONtinuous

This command defines, whether traces in Min Hold, Max Hold and Average mode are reset after parameter change or not.

Normally, the measurement is started anew after parameter changes, before the measurement results are evaluated (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

The numeric suffixes <1|2> are irrelevant.

Parameter

OFF   After certain parameter changes the traces are reset.

ON   The automatic reset is switched off.

Example

DISP:WIND:TRAC3:MODE:HCON ON
Switches off the reset function.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A, CATV

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y:SPACing

This command toggles between linear and logarithmic display. On a linear scale, switchover between the units % and dB is also possible (DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y:SPACing command).

The numeric suffixes <1|2> and <1...6> are irrelevant.

Parameter

LINear | LOGarithmic | PERCent | LDB

Example

DISP:TRAC:Y:SPAC LIN

Characteristics

*RST value: LOGarithmic

SCPI: conform

Mode

A, ADEMOD, CATV

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]

This command defines the display range of the y–axis (level axis) with logarithmic scaling (DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y:SPACing).

For linear scaling, the display range is fixed and cannot be modified.

The numeric suffixes <1|2> and <1...6> are irrelevant.

Parameter

10 dB to 200 dB or value in Hz

Example

DISP:TRAC:Y 110dB

Characteristics

*RST value: 100dB

SCPI: device–specific

Mode

all

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:MODE

This command defines the scale type of the y–axis (absolute or relative).

When `SYSTem:DISPlay:UPDate` is set to OFF, this command has no immediate effect on the screen. The numeric suffixes <1|2> and <1...6> are irrelevant.

Parameter

ABSolute | RELative

Example

`DISP:TRAC:Y:MODE REL`

Characteristics

*RST value: ABS

SCPI: device–specific

Mode

all

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel

This command defines the reference level.

With the reference level offset <> 0, the indicated value range of the reference level is modified by the offset.

The unit depends on the setting defined with `CALCulate<1|2>:UNIT:POWer`.

The numeric suffixes <1|2> and <1...6> are irrelevant.

Parameter

<numeric_value> in dBm, range specified in data sheet

Example

`DISP:TRAC:Y:RLEV –60dBm`

Characteristics

*RST value: –20dBm

SCPI: conform

Mode

A, CATV, WCDMA

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel:OFFSet

This command defines the offset of the reference level.

The numeric suffixes <1|2> and <1...6> are irrelevant.

Parameter

–200dB to 200dB

Example

`DISP:TRAC:Y:RLEV:OFFS –10dB`

Characteristics

*RST value: 0dB

SCPI: conform

Mode

A, CATV, PSM, WCDMA, WLAN

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RVALue:AUTO

This command defines whether the reference value for the y–axis is coupled to the reference level (default) or not.

The numeric suffixes <1|2> and <1...6> are irrelevant.

Parameter

ON | OFF

Example

```
DISP:TRAC:Y:RVAL:AUTO ON
```

Characteristics

*RST value: ON

SCPI: device–specific

Mode

A

FORMat Subsytem

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

Commands of the FORMat Subsystem

– FORMat:DEXPort:DSEParator

FORMat:DEXPort:DSEParator

This command defines which decimal separator (decimal point or comma) is to be used for outputting measurement data to the file in ASCII format. Different languages of evaluation programs (e.g. MS–Excel) can thus be supported.

Parameter

POINt | COMMA

Example

```
FORM:DEXP:DSEP POIN
```
Sets the decimal point as separator.

Characteristics

*RST value: – (factory setting is POINt; *RST does not affect setting)
SCPI: device–specific

Mode

all

INITiate Subsystem

The INITiate subsystem is used to control the init–measurement function.

Commands of the INITiate Subsystem

– INITiate<1|2>[:IMMediate]

– INITiate<1|2>:CONMeas

–

– INITiate<1|2>:CONTinuous

– INITiate<1|2>:DISPlay

INITiate<1|2>[: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.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

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.

Characteristics

*RST value: –
SCPI: conform

Mode

all

INITiate<1|2>:CONMeas

This command continues a stopped measurement at the current position in single sweep mode. The function is useful especially for trace functions MAXHold, MINHold and AVERage, if the previous results are not to be cleared with sweep count > 0 or average count > 0 on restarting the measurement (INIT:IMMediate resets the previous results on restarting the measurement).

The single sweep mode is automatically switched on. Synchronization to the end of the indicated number of measurements can then be performed with the commands `*OPC`, `*OPC?` or `*WAI`. In the continuous sweep mode, synchronization to the sweep end is not possible since the overall measurement "never" ends.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

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.

`INIT:CONM;*WAI`
Continues the measurement (next 20 sequences) and waits for the end.

Characteristics

*RST value: –
SCPI: device–specific

Mode

A, CATV

INITiate<1|2>:CONTinuous

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

In the **Spectrum Analyzer** mode, this setting refers to the sweep sequence (switching between continuous/single sweep).

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

INIT:CONT OFF
Switches the sequence single sweep.

INIT:CONT ON
Switches the sequence to continuous sweep.

Characteristics

*RST value: ON

SCPI: conform

Mode

all

INITiate<1|2>:DISPlay

This command switches the display during a single sweep measurement on (ON) or off (OFF).

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

INIT:CONT OFF
Switches to single sweep mode

INIT:DISP OFF
Sets the display behavior to OFF

INIT;*WAI
Starts the measurement with display switched off.

Characteristics

*RST value: ON

SCPI: device–specific

Mode

A

INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

Commands of the INPut Subsystem

- INPut<1|2>:ATTenuation
- INPut<1|2>:ATTenuation:AUTO
- INPut<1|2>:GAIN:STATe (option RF Preamplifier, B22)
- INPut<1|2>:IMPedance
- INPut<1|2>:UPORt[:VALue]?
- INPut<1|2>:UPORt:STATe

INPut<1|2>:ATTenuation

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 DEC command.

The attenuation can be set in 5 dB steps. If the defined reference level cannot be set for the set RF attenuation, the reference level will be adjusted accordingly.

In the default state with **Spectrum Analyzer** 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.

Parameter

<numeric_value> in dB; range specified in data sheet

Example

INP:ATT 30dB
Sets the attenuation on the attenuator to 30 dB and switches off the coupling to the reference level.

Characteristics

*RST value: 0 dB (AUTO is set to ON)
SCPI: conform

Mode

all

INPut<1|2>:ATTenuation:AUTO

This command automatically couples the input attenuation to the reference level (state ON) or switches the input attenuation to manual entry (state OFF). The minimum input attenuation set with the coupling switched on is 5 dB.

Parameter

ON | OFF

Example

INP:ATT:AUTO ON
Couples the attenuation set on the attenuator to the reference level.

Characteristics

*RST value: ON

SCPI: conform

Mode

all

INPut<1|2>:GAIN:STATe (option RF Preamplifier, B22)

This command switches the preamplifier on or off.

Parameter

ON | OFF

Example

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

Characteristics

*RST value: OFF

SCPI: conform

Mode

A, CATV, NF, WCDMA

INPut<1|2>:IMPedance

This command sets the nominal input impedance of the instrument. The set impedance is taken into account in all level indications of results.

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

Parameter

50 | 75

Example

INP:IMP 75

Characteristics

*RST value: 50 Ω

SCPI: conform

Mode

all

INPut<1|2>:UPORt[:VALue]?

This command queries the control lines of the user ports.
This command is a query and therefore has no *RST value.

Example

INP:UPOR?

Characteristics

RST value: –

SCPI: device–specific

Mode

all

___

INPut<1|2>:UPORt:STATe

This command toggles the control lines of the user ports between INPut and OUTPut. With ON, the user port is switched to INPut, with OFF to OUTPut.

Parameter

ON | OFF

Example

INP:UPOR:STAT ON

Characteristics

RST value: ON

SCPI: device–specific

Mode

all

___

INSTrument Subsystem

The INSTrument subsystem controls the measurement mode.

Commands of the INSTrument Subsystem

– INSTrument[:SELect]
– INSTrument:NSELect

INSTrument[:SELect]

This command switches between the measurement modes by means of text parameters.

Remote control commands sent to the instrument can only be interpreted correctly if the corresponding mode is active. In order to use the R&S ZVL-K1 option you have to choose the spectrum analyzer mode.

Parameter

SANalyzer   spectrum analyzer

NWAnalyzer   network analyzer

The parameters of the other measurement modes are included in the corresponding option documentation.

Example

```
INST SAN
```
Switches the instrument to spectrum analyzer mode.

Characteristics

*RST value: NWAnalyzer

SCPI: conform

Mode

all

INSTrument:NSELect

This command switches between the measurement modes by means of numbers.

Parameter

1   spectrum analyzer

2   network analyzer

The parameters of the other measurement modes are included in the corresponding option documentation.

Example

```
INST:NSEL 1
```
Switches the instrument to spectrum analyzer mode.

Characteristics

*RST value: 2

SCPI: conform

Mode

all

OUTPut Subsystem

The OUTPut subsystem controls the output features of the instrument.

Commands of the OUTPut Subsystem

– OUTPut:UPORt[:VALue]

– OUTPut:UPORt:STATe

OUTPut:UPORt[:VALue]

This command sets the control lines of the user ports.

The user port is written to with the given binary pattern. If the user port is programmed to INPut instead of OUTPut, the output value is temporarily stored.

Parameter

#B00000000 to #B11111111

Example

```
OUTP:UPOR #B10100101
```

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

OUTPut:UPORt:STATe

This command switches the control line of the user ports between INPut and OUTPut. The user port is switched to OUTPut with parameter ON, to INPut with OFF.

Parameter

ON | OFF

Example

```
OUTP:UPOR:STAT ON
```

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

all

SENSe Subsystem

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device–specific settings, they do not refer to the signal characteristics of the measurement signal.

The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The following subsystems are included:

SENSe:AVERage Subsystem

The SENSe:AVERage subsystem calculates the average of the acquired data. A new test result is obtained from several successive measurements.

There are two types of average calculation: logarithmic and linear. In case of logarithmic average calculation (denoted with VIDeo), the average value of the measured logarithmic power is calculated and in case of linear average calculation, the linear power is averaged before the logarithm is applied.

Commands of the SENSe:AVERage Subsystem

- [SENSe<1|2>:]AVERage[:STATe<1...4>]
- [SENSe<1|2>:]AVERage:COUNt
- [SENSe<1|2>:]AVERage:COUNt:AUTO
- [SENSe<1|2>:]AVERage:TYPE

[SENSe<1|2>:]AVERage[:STATe<1...4>]

This command switches on or off the average calculation for the selected trace (STATe<1...4>).
The numeric suffixes <1/2> are not relevant.

Parameter
ON | OFF

Example
```
AVER OFF
```
Switches off the average calculation for trace 1.
```
AVER:STAT3 ON
```
Switches on the average calculation for trace 3.

Characteristics
*RST value: OFF

SCPI: conform

Mode

all

[SENSe<1|2>:]AVERage:COUNt

This command defines the number of measurements which contribute to the average value.

It should be noted that continuous averaging will be performed after the indicated number has been reached in continuous sweep mode.

In single sweep mode, the sweep is stopped as soon as the indicated number of measurements (sweeps) is reached. Synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

The [SENSe<1|2>:]AVERage:COUNt command effects the same as the [SENSe<1|2>:]SWEep:COUNt command. In both cases, the number of measurements is defined whether the average calculation is active or not.

The number of measurements applies to all traces.

The numeric suffixes <1/2> are not relevant.

Parameter

0 to 32767

Example

SWE:CONT OFF
Switching to single sweep mode.

AVER:COUN 16
Sets the number of measurements to 16.

AVER:STAT ON
Switches on the calculation of average.

INIT;*WAI
Starts the measurement and waits for the end of the 16 sweeps.

Characteristics

*RST value: 0
SCPI: conform

Mode

all

[SENSe<1|2>:]AVERage:COUNt:AUTO

This command is implemented only for reasons of compatibility with the FSP family. It selects a suitable number of counts for the selected measurement type.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

AVER:COUN:AUTO ON

Characteristics

RST value: OFF

SCPI: conform

Mode

all

[SENSe<1|2>:]AVERage:TYPE

This command selects the type of average function.

Parameter

VIDeo   The logarithmic power values are averaged.

LINear   The power values are averaged before they are converted to logarithmic values.

Example

```
AVER:TYPE LIN
```
Switches to linear average calculation.

Characteristics

RST value: VIDeo

SCPI: device–specific

Mode

A

SENSe:BANDwidth Subsystem

This subsystem controls the setting of the instruments filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions.

Commands of the SENSe:BANDwidth Subsystem

– [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]

– [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO

– [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio

– [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE

– [SENSe<1|2>:]BANDwidth|BWIDth:VIDeo

– [SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO

– [SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio

– [SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:TYPE

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]

This command defines the analyzers resolution bandwidth.

The available resolution bandwidths are specified in the data sheet. For details on the correlation between resolution bandwidth and filter type refer to chapter "Instrument Functions", section "To choose the appropriate filter type".

If the resolution bandwidth is modified, the coupling to the span is automatically switched off.

The numeric suffixes <1/2> are not relevant.

Parameter

refer to data sheet

Example

```
BAND 1MHz
```
Sets the resolution bandwidth to 1 MHz

Characteristics

*RST value: – (AUTO is set to ON)

SCPI: conform

Mode

all, except ADEMOD

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO

This command either automatically couples the resolution bandwidth of the instrument to the span or cancels the coupling.

The automatic coupling adapts the resolution bandwidth to the currently set frequency span according to the relationship between frequency span and resolution bandwidth. The 6 dB bandwidths 200 Hz, 9 kHz and 120 kHz and the channel filters available are not set by the automatic coupling.

The ratio resolution bandwidth/span can be modified with the [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio command.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

`BAND:AUTO OFF`

Switches off the coupling of the resolution bandwidth to the span.

Characteristics

*RST value: ON

SCPI: conform

Mode

A–F, CATV

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio

This command defines the ratio resolution bandwidth (Hz) / span (Hz). The ratio to be entered is reciprocal to the ratio span/RBW used in manual operation.

The numeric suffixes <1/2> are not relevant.

Parameter

0.0001 to 1

Example

`BAND:RAT 0.1`

Characteristics

*RST value: 0.02 with BAND:TYPE NORMal or RBW > 30 kHz; 0.01 with BAND:TYPE FFT for RBW $\leq$ 30 kHz

SCPI: conform

Mode

A

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE

This command switches the filter type for the resolution bandwidth between "normal" analog or FIR filters in 1, 3, 10 steps and the FFT filtering for bandwidths <100 kHz.

For detailed information on filters see chapter "Instrument Functions", section "To choose the appropriate filter" and "List of available RRC and channel filters".

The numeric suffixes <1/2> are not relevant.

Note: *When changing the filter type, the next larger filter bandwidth is selected if the same filter bandwidth is not available for the new filter type.*

Parameter

NORMal	Gaussian filters
FFT	FFT filters
CFILter	channel filters
RRC	RRC filters
PULSe	EMI (6dB) filters

Example

`BAND:TYPE NORM`

Characteristics

*RST value: NORMal

SCPI: device–specific

Mode
all, except ADEMOD

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo

This command defines the instruments video bandwidth. The available video bandwidths are specified in the data sheet. The command is not available if FFT filtering is switched on and the set bandwidth is ≤ 30 kHz or if the quasi–peak detector is switched on.
The numeric suffixes <1/2> are not relevant.

Parameter
refer to data sheet

Example
BAND:VID 10kHz

Characteristics
*RST value: – (AUTO is set to ON)
SCPI: conform

Mode
A, CATV

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO

This command either automatically couples the instruments video bandwidth to the resolution bandwidth or cancels the coupling.
The ratio video bandwidth/resolution bandwidth can be modified with the
[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio command.
The numeric suffixes <1/2> are not relevant.

Parameter
ON | OFF

Example
BAND:VID:AUTO OFF

Characteristics
*RST value: ON
SCPI: conform

Mode
A, CATV

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio

This command defines the ratio video bandwidth (Hz) / resolution bandwidth (Hz).The ratio to be entered is reciprocal to the ratio RBW/VBW used in manual operation.
The numeric suffixes <1/2> are not relevant.

Parameter
0.01 to 1000

Example
BAND:VID:RAT 3
Sets the coupling of video bandwidth to video bandwidth = 3*resolution bandwidth

Characteristics
*RST value: 3
SCPI: conform

Mode
A

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:TYPE

This command selects the position of the video filter in the signal path, provided that the resolution bandwidth is ≤100 kHz.

The essential difference between the two modes is the transient response at falling signal edges: If LINear is selected, the measurement with logarithmic level scaling yields a much "flatter" falling edge than LOGarithmic. This behavior is due to the conversion of linear power into logarithmic level. If the linear power is halved, the level decreases by only 3 dB.

The numeric suffixes <1/2> are not relevant.

Parameter

LINear   The video filter is connected ahead of the logarithmic amplifier (default).

LOGarithmic   The video filter follows the logarithmic amplifier

Example
```
BAND:VID:TYPE LIN
```
Video filter ahead of the logarithmic amplifier

Characteristics
RST value: LIN
SCPI: device–specific

Mode
A

[SENSe<1|2>:]CORRection:COLLect[:ACQuire]

When the tracking generator is active, this command determines the type of result acquisition for the normalization reference measurement and starts the measurement selected:

To obtain a correct reference measurement, a complete sweep with synchronization to the end of the sweep must have been carried out. This is only possible in the single sweep mode.

The numeric suffixes <1/2> are not relevant.

This command is an "event" and therefore has no *RST value and no query.

Parameter

THRough	"TRANsmission" mode	calibration with direct connection between tracking generator and device input
	"REFLection" mode	calibration with short circuit at the input
OPEN	only allowed in "REFLection" mode	calibration with open input

Example

```
INIT:CONT OFF
```
Selects single sweep operation

```
CORR:COLL THR;*WAI
```
Starts the measurement of reference data using direct connection between generator and device input and waits for the sweep end.

Characteristics

*RST value: –

SCPI: conform

Mode

A

[SENSe<1|2>:]CORRection:EGAin:INPut[:MAGNitude]

This command makes an external gain known to the analyzer, which will take it into account during the display of measurement results. With this function the gain of an antenna or of an external preamplifier can be taken into account for the measurement values.

The numeric suffixes <1/2> are not relevant.

Parameter

–200...200dB

Example

```
CORR:EGA:INP 10DB
```
Takes 10 dB external gain into account.

Characteristics

*RST value: 0 dB

SCPI: device–specific

Mode

A

[SENSe<1|2>:]CORRection:METHod

This command selects the type of measurement with active tracking generator (transmission/reflection).

The numeric suffixes <1/2> are not relevant.

Parameter

TRANsmission | REFLection

Example

CORR:METH TRAN

Sets the type of measurement to "transmission".

Characteristics

*RST value: TRANsmission

SCPI: device–specific

Mode

A

[SENSe<1|2>:]CORRection:RECall

This command restores the instrument setting that was applied to the measurement of the reference data, provided that the tracking generator is active.

The numeric suffixes <1/2> are not relevant.

This command is an event and therefore has no *RST value and no query.

Example

CORR:REC

Characteristics

*RST value: –

SCPI: conform

Mode

A

SENSe:DETector Subsystem

The SENSe:DETector subsystem controls the acquisition of measurement data via the selection of the detector for the corresponding trace.

Commands of the SENSe:DETector Subsystem

– [SENSe<1|2>:]DETector<1...4>[:FUNCtion]

– [SENSe<1|2>:]DETector<1...4>[:FUNCtion]:AUTO

[SENSe<1|2>:]DETector<1...4>[:FUNCtion]

This command switches on the detector for the data acquisition in the selected trace.

The trace is indicated as numeric suffix in DETector.

The numeric suffixes <1/2> are not relevant.

Parameter

APEak | NEGative | POSitive | SAMPle | RMS | AVERage | QPEak

For details on detectors refer to chapter "Instrument Functions", section "Detector overview".

Example

DET POS
Sets the detector to "positive peak".

Characteristics

*RST value: APEak
SCPI: conform

Mode

A, CATV

[SENSe<1|2>:]DETector<1...4>[:FUNCtion]:AUTO

This command either couples the detector to the current trace setting or turns coupling off. The trace is selected by the numeric suffix at DETector.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

DET:AUTO OFF

Characteristics

*RST value: ON
SCPI: conform

Mode

A, CATV

SENSe:FREQuency Subsystem

The SENSe:FREQuency subsystem defines the frequency axis of the active display. The frequency axis can either be defined via the start/stop frequency or via the center frequency and span.

Commands of the SENSe:FREQuency Subsystem

– [SENSe<1|2>:]FREQuency:CENTer
– [SENSe<1|2>:]FREQuency:CENTer:STEP
– [SENSe<1|2>:]FREQuency:CENTer:STEP:AUTO
– [SENSe<1|2>:]FREQuency:CENTer:STEP:LINK
– [SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor
– [SENSe<1|2>:]FREQuency:MODE
– [SENSe<1|2>:]FREQuency:OFFSet
– [SENSe<1|2>:]FREQuency:SPAN
– [SENSe<1|2>:]FREQuency:SPAN:FULL
– [SENSe<1|2>:]FREQuency:STARt
– [SENSe<1|2>:]FREQuency:STOP

[SENSe<1|2>:]FREQuency:CENTer

This command defines the center frequency of the analyzer or the measuring frequency for span = 0.

The numeric suffixes <1/2> are not relevant.

Parameter

0 to f_{max}

f_{max} is specified in the data sheet. To help analyze signals located at the end of the frequency range, the f_{max} value is extended by 0.05 GHz for direct entry. The preset and maximum values remain unchanged.

Example

```
FREQ:CENT 100MHz
```

Characteristics

*RST value: f_{max} /2 with f_{max} = maximum frequency

SCPI: conform

Mode

all

[SENSe<1|2>:]FREQuency:CENTer:STEP

This command defines the step size of the center frequency.

The numeric suffixes <1/2> are not relevant.

Parameter

0 to f_{max}

Example

```
FREQ:CENT:STEP 120MHz
```

Characteristics

*RST value: – (AUTO 0.1 × SPAN is switched on)

SCPI: conform

Mode

all

[SENSe<1|2>:]FREQuency:CENTer:STEP:AUTO

This command couples the step size of the center frequency to the span (ON) or sets the value of the center frequency entered via [SENSe<1|2>:]FREQuency:CENTer:STEP (OFF).

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

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

Characteristics

*RST value: ON

SCPI: device–specific

Mode

all

[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK

This command couples the step size of the center frequency to span (span >0) or to the resolution bandwidth (span = 0) or cancels the couplings.

The numeric suffixes <1/2> are not relevant.

Parameter

SPAN   coupling to frequency display range (for span > 0)

RBW   coupling to resolution bandwidth (for span = 0)

OFF   manual input, no coupling

Example

```
FREQ:CENT:STEP:LINK SPAN
```
Characteristics

*RST value: SPAN

SCPI: device–specific

Mode

A, ADEMOD

[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor

This command couples the step size of the center frequency with a factor to the span (span >0) or to the resolution bandwidth (span = 0).

The numeric suffixes <1/2> are not relevant.

Parameter

1 to 100 PCT

Example

FREQ:CENT:STEP:LINK:FACT 20PCT

Characteristics

*RST value: – (AUTO 0.1 × SPAN is switched on)

SCPI: device–specific

Mode

A

[SENSe<1|2>:]FREQuency:MODE

This command switches between span > 0 (SWEep) and zero span (CW | FIXed) in the **Spectrum Analyzer** mode.

For CW and FIXed, the frequency setting is via the [SENSe<1|2>:]FREQuency:CENTer command. In the sweep mode, the setting is via the [SENSe<1|2>:]FREQuency:STARt, [SENSe<1|2>:]FREQuency:STOP, [SENSe<1|2>:]FREQuency:CENTer, and [SENSe<1|2>:]FREQuency:SPAN commands.

The numeric suffixes <1/2> are not relevant.

Parameter

CW | FIXed | SWEep

Example

FREQ:MODE SWE

Characteristics

*RST value: SWEep

SCPI: conform

Mode

A

[SENSe<1|2>:]FREQuency:OFFSet

This command defines the frequency offset of the instrument.

The numeric suffixes <1/2> are not relevant.

Parameter

–100 GHz to 100 GHz

Example

FREQ:OFFS 1GHZ

Characteristics

*RST value: 0 Hz

SCPI: conform

Mode

A, ADEMOD, WCDMA

[SENSe<1|2>:]FREQuency:SPAN

This command defines the frequency span in the **Spectrum Analyzer** mode.

The numeric suffixes <1/2> are not relevant.

Parameter

0 to f_{max}

f_{max} is specified in the data sheet. To help analyze signals located at the end of the frequency range, the f_{max} value is extended by 0.05 GHz for direct entry. The preset and maximum values remain unchanged.

Example

```
FREQ:SPAN 10MHz
```

Characteristics

*RST value: f_{max} with f_{max} = maximum frequency

SCPI: conform

Mode

A, CATV

[SENSe<1|2>:]FREQuency:SPAN:FULL

This command sets the frequency span to its maximum.

The numeric suffixes <1/2> are not relevant.

Example

```
FREQ:SPAN:FULL
```

Characteristics

*RST value: –

SCPI: conform

Mode

A, CATV

[SENSe<1|2>:]FREQuency:STARt

This command defines the start frequency of the analyzer. This command is only available with span > 0.

The numeric suffixes <1/2> are not relevant.

Parameter

0 to f_{max}

f_{max} is specified in the data sheet. To help analyze signals located at the end of the frequency range, the f_{max} value is extended by 0.05 GHz for direct entry. The preset and maximum values remain unchanged.

Example

FREQ:STAR 20MHz

Characteristics

*RST value: 0

SCPI: conform

Mode

A–F, CATV

[SENSe<1|2>:]FREQuency:STOP

This command defines the stop frequency of the analyzer. This command is only available with span > 0.

The numeric suffixes <1/2> are not relevant.

Parameter

0 to f_{max}

f_{max} is specified in the data sheet. To help analyze signals located at the end of the frequency range, the f_{max} value is extended by 0.05 GHz for direct entry. The preset and maximum values remain unchanged.

Example

FREQ:STOP 2000MHz

Characteristics

*RST value: f_{max}

SCPI: conform

Mode

A–F, CATV

SENSe:LIST Subsystem

The commands of this subsystem are used for measuring the power at a list of frequency points with different device settings. The measurement is always performed in zero span. A new trigger event is required for each test point (exception: trigger FREE RUN).

The results are output as a list in the order of the entered frequency points. The number of results per test point depends on the number of concurrently active measurements (peak/RMS/average). The number of frequencies is limited to 100 entries.

Selection of concurrently active measurements and setting of parameters that are constant for the whole measurement is performed via a configuration command (`[SENSe<1|2>:]LIST:POWer:SET`). This also includes the setting for trigger and gate parameters.

Note: *Settings that are not directly included in commands of this subsystem can be configured by sending the corresponding commands prior to the SENSe:LIST Subsystem commands.*
Please note that changes to the trigger level have to be executed in zero span in order to take effect for the SENSe:LIST Subsystem commands.

Commands of the SENSe:LIST Subsystem

–   [SENSe<1|2>:]LIST:POWer[:SEQuence]

–   [SENSe<1|2>:]LIST:POWer:RESult?

–   [SENSe<1|2>:]LIST:POWer:SET

–   [SENSe<1|2>:]LIST:POWer:STATe

Further information

–   More details on the SENSe:LIST Subsystem

More details on the SENSe:LIST Subsystem

The following setting parameters can be selected independently for each frequency point:

- analyzer frequency

- reference level

- resolution filter

- resolution bandwidth

- video bandwidth

- measurement time

- detector

The commands of this subsystem can be used in two different ways:

- Instrument setup, measurement and querying of the results in a single command line. With this method, there is the least delay between the measurement and the result output. However, it requires the control computer to wait for the response from the instrument.

- Instrument setup and querying of the result list at the end of the measurement: With this method, the control computer may be used for other activities while the measurement is being performed. However, more time is needed for synchronization via service request.

[SENSe<1|2>:]LIST:POWer[:SEQuence]

This command configures the list of settings (max. 200 entries) for the multiple power measurement and starts a measurement sequence. When synchronizing the command with *OPC, a service request is generated as soon as all frequency points are processed and the defined number of individual measurements is reached.

To reduce the setting time, all indicated parameters are set up simultaneously at each test point.

The query form of the command processes the list and immediately returns the list of results. The number of results per test point depends on the setting of the [SENSe<1|2>:]LIST:POWer:SET command.

The numeric suffixes <1/2> are not relevant.

Parameter

The following parameters are the settings for an individual frequency point. They are repeated for every other frequency point.

<analyzer freq>	Receive frequency for the signal to be measured (= center frequency in manual operation)
	Range of values: 0 Hz to max. frequency, depending on the instrument model.
<ref level>	Reference level
	Range of values: +20 dBm to –130 dBm in 0.1 dB steps
<rf att>	RF input attenuation
	Range of values: 0 dB to 30 dB in 5 dB steps
<rf att 2>	Only listed due to reasons of compatibility with the FSP family. Takes no effect.
<filter type>	For details refer to "[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE" on page 4.121

<rbw>   Resolution bandwidth

For the range of values refer to chapter "Instrument Functions", section "Res BW Manual".

Refer to chapter "Instrument Functions", section "To choose the appropriate filter type", for possible combinations of filter type and filter bandwidth for the <filter type> = CFILter and <filter type> = RRC.

<vbw>   Video bandwidth

Range of values:1 Hz to 10 MHz in 1, 3, 10 steps. The value is ignored for <filter type> = CFILter or RRC

<meas time>   Measurement time

Range of values: 1us to 16000s

For details refer to chapter "Instrument Functions", section "Sweeptime Manual"

<trigger level>   Reserved. Must be set to 0.

Return values

The query command returns a list of comma–separated values (CSV) which contains the power measurement results in floating–point format. The unit depends on the setting with CALCulate<1|2>:UNIT:POWer

The command

```
SENSe:LIST:POWer?
935.2MHz,0dBm,10dB,OFF,NORM,1MHz,3MHz,440us,0,
935.4MHz,0dBm,10dB,10dB,NORM,30kHz,100kHz,440us,0,
935.6MHz,0dBm,10dB,20dB,NORM,30kHz,100kHz,440us,0
```

thus returns the following list, for example:

–28.3,–30.6,–38.1

If the command sequence is extended to

```
SENSe:LIST:POWer:SET ON,ON,ON,IMM,POS,0,0
SENSe:LIST:POWer?
935.2MHz,0dBm,10dB,OFF,NORM,1MHz,3MHz,440us,0,
935.4MHz,0dBm,10dB,10dB,NORM,30kHz,100kHz,440us,0,
935.6MHz,0dBm,10dB,20dB,NORM,30kHz,100kHz,440us,0
```

the result list is extended to 3 results per frequency point (peak, RMS and average):

–28.3, –29.6, 1.5, –30.6, –31.9, 0.9, –38.1, –40.0, 2.3

Example

```
SENSe:LIST:POWer
935.2MHz,0dBm,10dB,OFF,NORM,1MHz,3MHz,440us,0,
935.4MHz,0dBm,10dB,10dB,CFIL,30kHz,100kHz,440us,0,
935.6MHz,0dBm,10dB,20dB,CFIL,30kHz,100kHz,440us,0
```

Performs a measurement sequence with the following settings:

Step	Freq. [MHz]	Ref Level [dBm]	RF Att [dB]	el Att [dB]	Filter type	RBW	VBW	Meas Time [us]	TRG Level (reserved)
1	935.2	0	10	OFF	Normal	1 MHz	3 MHz	440	0
2	935.4	0	10	10	Channel	30 kHz	100 kHz	440	0
3	935.6	0	10	20	Channel	30 kHz	100 kHz	440	0

```
SENSe:LIST:POWer?
935.2MHz,0dBm,10dB,OFF,NORM,1MHz,3MHz,440us,0,
935.4MHz,0dBm,10dB,10dB,CFIL,30kHz,100kHz,440us,0,
935.6MHz,0dBm,10dB,20dB,CFIL,30kHz,100kHz,440us,0
```
Performs the same measurement and returns the result list immediately after the last frequency point.

Note: *The measurement is performed in zero span and therefore the span is set to 0 Hz. If the span > 0 is set, the function is automatically switched off.*
The measurement is not compatible with other measurements, especially as far as marker, adjacent channel power measurement or statistics are concerned. The corresponding commands thus automatically deactivate the function.
The function is only available in REMOTE operation. It is deactivated when switching the instrument back to LOCAL.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F, A–T

[SENSe<1|2>:]LIST:POWer:RESult?

This command queries the result of a previous list measurement as configured and initiated with [SENSe<1|2>:]LIST:POWer[:SEQuence]. The measured results are output in a list of floating point values separated by commas. The unit of the results depends on the setting made with the CALCulate<1|2>:UNIT:POWer command.

This command may be used to obtain measurement results in an asynchronous way, using the service request mechanism for synchronization with the end of the measurement.

If no measurement results are available, the command will return a query error.

The numeric suffixes <1/2> are not relevant.

Example
```
*ESE 1
*SRE 32
```
Configuration of the status reporting system for the generation of an SRQ on operation complete
```
SENSe:LIST:POWer
935.2MHz,−20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
935.4MHz,−20dBm,10dB,10dB,NORM,30kHz,100kHz,434us,0,
935.6MHz,−20dBm,10dB,20dB,NORM,30kHz,100kHz,434us,0;
*OPC
```
Configuring and starting the measurement
```
...
```
Further actions of the control computer during measurement
```
On SRQ:
SENSe:LIST:POWer:RESult?
```
Response to service request

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F, A–T

[SENSe<1|2>:]LIST:POWer:SET

This command defines the constant settings for the list during multiple power measurement.

Parameters <PEAK meas>, <RMS meas> and <AVG meas> define, which measurements are to be performed at the same time at the frequency point. Correspondingly, one, two or three results per frequency point are returned for the `[SENSe<1|2>:]LIST:POWer[:SEQuence]` command. If all three parameters are set to OFF, the command generates an execution error. The numeric suffixes <1/2> are not relevant.

Parameter

<PEAK meas>	ON: activates the measurement of the peak power (peak detector)
	OFF: deactivates the measurement of the peak power
<RMS meas>	ON: activates the measurement of the RMS power (RMS detector)
	OFF: deactivates the measurement of the RMS power
<AVG meas>	ON: activates the measurement of the average power (average detector)
	OFF: deactivates the measurement of the average power
<trigger mode>	Selection of the trigger source used for the list measurement
	Possible values: IMMediate | EXTernal | VIDeo | IFPower
<trigger slope>	Used trigger slope
	Possible values: POSitive | NEGative
<trigger offset>	Offset between the detection of the trigger signal and the start of the measurement at the next frequency point.
	Range of values: 0 s, 125 ns to 100s
<gate length>	Gate length with gated sweep
	Range of values: 0 s, 125 ns to 100s
	The value 0 s deactivates the use of gated trigger; other values activate the gated trigger function.
	Values <> 0 s are only possible if <trigger mode> is different from IMMediate. Otherwise, an execution error is triggered.

Return values

The query command returns a list of comma–separated values (CSV) of the settings, i.e.
`ON,ON,ON,IMM,POS,0,0`
if the configuration has been set with the command
`SENSe:LIST:POWer:SET ON,ON,ON,IMM,POS,0,0`

Example

`SENSe:LIST:POWer:SET ON,OFF,OFF,EXT,POS,10US,434US`

Characteristics

*RST value: ON,OFF,OFF,IMM,POS,0S,0S
SCPI: device–specific

Mode

A–F, A–T

[SENSe<1|2>:]LIST:POWer:STATe

This command deactivates the list measurement.

The numeric suffixes <1/2> are not relevant.

Parameter

OFF

Example

SENSe:LIST:POWer:STATe OFF

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F, A–T

SENSe:MPOWer Subsystem

The commands of this subsystem are used to determine the mean burst power or peak burst power for a given number of signal bursts, and for outputting the results in a list. Since all the settings required for a measurement are combined in a single command, the measurement speed is considerably higher than when using individual commands.

For measuring the signal bursts, the gated sweep function is used in zero span. The gate is controlled either by an external trigger signal or by the video signal. An individual trigger event is required for each burst to be measured. If an external trigger signal is used, the threshold is fixed to TTL level, while with a video signal the threshold can be set as desired.

Commands of the SENSe:MPOWer Subsystem

– [SENSe<1|2>:]MPOWer[:SEQuence]

– [SENSe<1|2>:]MPOWer:FTYPe

– [SENSe<1|2>:]MPOWer:RESult[:LIST]?

– [SENSe<1|2>:]MPOWer:RESult:MIN?

Further information

– More details on the SENSe:MPOWer Subsystem

More details on the SENSe:MPOWer Subsystem

The following graphics shows the relation between trigger time, trigger offset (for delayed gate opening) and measurement time.
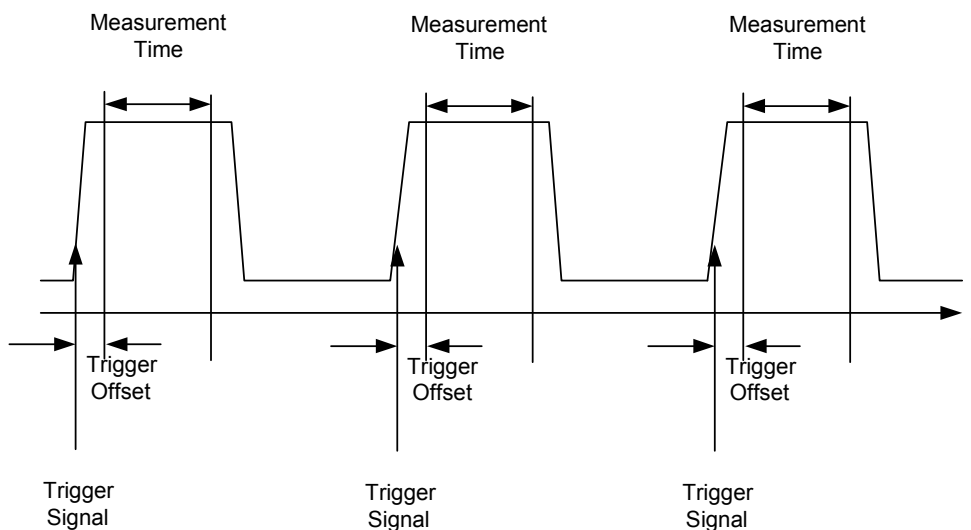
Depending on the settings made, the measurements are performed with the RMS detector for RMS power or the PEAK detector for peak power. For all these measurements, trace 1 of the selected system is used.

The setting parameters for this measurement are:

- analyzer frequency

- resolution bandwidth

- measurement time used for a single burst

- trigger source

- trigger level

- trigger offset

- type of power measurement (PEAK, MEAN)

- number of bursts to be measured

The commands of this subsystem can be used in two different ways:

- Setting up the instrument and at the same time querying the result list: This method ensures the smallest delay between measurement and the output of the measured values, but requires the control computer to wait actively for the response of the instrument.

- Setting up the instrument and querying the result list after synchronization to the end of measurement: With this method the control computer can be used for other activities while the instrument is performing the measurement at the cost of additional time needed for synchronization via service request.

[SENSe<1|2>:]MPOWer[:SEQuence]

This command configures the instrument setup for multiple burst power measurement and starts a measurement sequence. When synchronizing the command with `*OPC`, a service request is generated as soon as the defined number of individual measurements (# of meas) is reached.

To reduce the setting time, the setup is performed simultaneously for all selected parameters.

The command in the form of a query makes the instrument settings, performs the defined number of measurements and outputs the measurement results list.

The numeric suffixes <1/2> are not relevant.

Parameter

<analyzer freq>	Receive frequency for the burst signals to be measured (= center frequency in manual operation)
	Range: 0 Hz to max. frequency, depending on instrument model
<rbw>	resolution bandwidth for the measurement
	Range: 10 Hz to 10 MHz in steps of 1, 3, 10
<meas time>	Time span during which measurement samples are sampled for RMS / peak measurement. The type of measurement is selected by <type of meas>.
	Range: 1us to 30s
<trigger source>	trigger signal source. Possible settings:
	EXTernal: The trigger signal is fed from the "Ext. Trigger/Gate" input on the rear of the unit.
	VIDeo: The internal video signal is used as trigger signal.
<trigger level>	Signal level at which the trigger becomes active. For <trigger source> = VIDeo this is the level of the video signal as a percentage of the diagram height. If <trigger source> = EXTernal is selected, the value entered here is ignored, as in this case the trigger input uses TTL levels.
	Range: 0 – 100PCT(<trigger source> = VIDeo)
<trigger offset>	Offset between the detection of the trigger signal and the start of the measurement.
	Range: 125 ns to 100s

<type of meas>   Determines whether mean power (RMS) or peak power (PEAK) is to be measured. The detector is selected accordingly.

                  Possible values: MEAN, PEAK

<# of meas>   Number of individual bursts to be measured.

                  Range: 1 to 32001

Return values

The query command returns a list separated by commas (comma separated values = CSV), which contains the power measurement results in floating–point format. The unit used for the return values is always dBm.

The command SENSe:MPOWer? 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20

may, for instance, cause the following list to be returned:

18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0, 17.9

Example

```
SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20
```
Performs a measurement sequence with the following settings:

Frequency = 935.2 MHz,

Resolution bandwidth = 1 MHz

Measurement time = 434 μs

Trigger source = VIDEO

Trigger threshold = 50%

Trigger offset = 5 μs

Type of measurement = MEAN power

No. of measurements = 20

```
SENSe:MPOWer? 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20
```
Performs the same measurement and in addition returns the results list immediately after completion of the last measurement.

Note: *The measurement function always uses trace 1.*
Repeated use of the command without changes to its parameters (i.e. using the same settings again) will speed up the measurement since the previous hardware settings will be cached and therefore additional hardware settling times will be avoided. This also holds true if only part of the parameters (e.g. only the trigger delay) are changed, as in this case the rest of the parameters will be cached.
This measurement is not compatible with other measurements, especially as far as marker functions, adjacent–channel measurement or statistics are concerned. The corresponding functions are therefore automatically switched off. In return incompatible commands will automatically deactivate the multi burst power function.
The function is only available in the REMOTE operation. It is deactivated on switching back to LOCAL.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

[SENSe<1|2>:]MPOWer:FTYPe

This command defines the filter type for the measurement.

The numeric suffixes <1/2> are not relevant.

Parameter

NORMal | CFILter | RRC

Example

`SENSe:MPOWer:FTYPe CFILter`

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

[SENSe<1|2>:]MPOWer:RESult[:LIST]?

This command queries the results of a multiple burst power measurement as configured and initiated with `[SENSe<1|2>:]MPOWer[:SEQuence]`. The results are output in a comma–separated list of floating point values. The unit used for the return values is always dBm.

This command may be used to obtain measurement results in an asynchronous way using the service request mechanism for synchronization with the end of the measurement.

The numeric suffixes <1/2> are not relevant.

If no measurement results are available, the command will return a query error.

Example

```
*ESE 1
*SRE 32
```
Configuration of status reporting systems for the generation of an SRQ on operation complete

`SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20;*OPC`
Configuring and starting the measurement

`...`
Further actions of the control computer during measurement

`On SRQ:`
Response to service request

`SENSe:MPOWer:RESult?`

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

[SENSe<1|2>:]MPOWer:RESult:MIN?

This command queries the minimum power value in a multiple burst power measurement as configured and initiated with `[SENSe<1|2>:]MPOWer[:SEQuence]`. The unit used for the return values is always dBm.

The numeric suffixes <1/2> are not relevant.

If no measurement result is available, the command will return a query error.

Example

```
*ESE 1
*SRE 32
```
Configuration of status reporting systems for the generation of an SRQ on operation complete
```
SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20;*OPC
```
Configuring and starting the measurement
```
...
```
Further actions of the control computer during measurement
```
On SRQ:
```
Response to service request
```
SENSe:MPOWer:RESult:MIN?
```
Characteristics

*RST value: –

SCPI: device–specific

Mode

A

SENSe:POWer Subsystem

This subsystem controls the setting of the instruments channel and adjacent channel power measurements.

Commands of the SENSe:POWer Subsystem

– [SENSe<1|2>:]POWer:ACHannel:ACPairs

– [SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]

– [SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel

– [SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1...11>

– [SENSe<1|2>:]POWer:ACHannel:MODE

– [SENSe<1|2>:]POWer:ACHannel:PRESet

– [SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel

– [SENSe<1|2>:]POWer:ACHannel:REFerence:AUTO

– [SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:AUTO

– [SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:MANual

– [SENSe<1|2>:]POWer:ACHannel:SPACing[:ACHannel]

– [SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1...11>

– [SENSe<1|2>:]POWer:ACHannel:SPACing:CHANnel

– [SENSe<1|2>:]POWer:ACHannel:TXCHannel:COUNt

– [SENSe<1|2>:]POWer:BANDwidth|BWIDth

– [SENSe<1|2>:]POWer:HSPeed

– [SENSe<1|2>:]POWer:TRACe

[SENSe<1|2>:]POWer:ACHannel:ACPairs

This command sets the number of adjacent channels (upper and lower channel in pairs).The figure 0 stands for pure channel power measurement.

The numeric suffixes <1/2> are not relevant.

Parameter

1 to 12

Example

```
POW:ACH:ACP 3
```
Sets the number of adjacent channels to 3, i.e. the adjacent channel and alternate adjacent channels 1 and 2 are switched on.

Characteristics

*RST value: 1

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]

This command sets the channel bandwidth of the radio communication system. The bandwidths of adjacent channels are not influenced by this modification.

With [SENSe<1|2>:]POWer:HSPeed set to ON, steep–edged channel filters are available. For further information on filters refer to chapter "Instrument Functions", section "List of available RRC and channel filters".

The numeric suffixes <1/2> are not relevant.

Parameter

100 Hz to 1000 MHz

Example

POW:ACH:BWID 30kHz
Sets the bandwidth of the TX channel to 30 kHz.

Characteristics

*RST value: 14 kHz

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel

This command defines the channel bandwidth of the adjacent channel of the radio transmission system. If the bandwidth of the adjacent channel is changed, the bandwidths of all alternate adjacent channels are automatically set to the same value.

With [SENSe<1|2>:]POWer:HSPeed set to ON, steep–edged channel filters are available. For further information on filters refer to chapter "Instrument Functions", section "List of available RRC and channel filters".

The numeric suffixes <1/2> are not relevant.

Parameter

100 Hz to 1000 MHz

Example

POW:ACH:BWID:ACH 30kHz
Sets the bandwidth of all adjacent channels to 30 kHz.

Characteristics

*RST value: 14 kHz

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1...11>

This command defines the channel bandwidth of the alternate adjacent channels of the radio transmission system. If the channel bandwidth of alternate adjacent channel 1 is changed, the bandwidth of alternate adjacent channels 2 to 11 is automatically set to the same value.

With [SENSe<1|2>:]POWer:HSPeed set to ON, steep–edged channel filters are available. For further information on filters refer to chapter "Instrument Functions", section "List of available RRC and channel filters".

Parameter

100 Hz to 1000 MHz

Example

POW:ACH:BWID:ALT2 30kHz

Characteristics

*RST value: 14 kHz

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:MODE

This command switches between absolute and relative adjacent channel measurement. The command is only available with span > 0 and if the number of adjacent channel is greater than 0.

The numeric suffixes <1/2> are not relevant.

Parameter

ABSolute | RELative

Example

POW:ACH:MODE REL

Sets the adjacent channel measurement mode to relative.

Characteristics

RST value: RELative

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:PRESet

This command adjusts the frequency span, the measurement bandwidths and the detector as required for the number of channels, the channel bandwidths and the channel spacings selected in the active power measurement. If necessary, adjacent–channel power measurement is switched on prior to the adjustment.

To obtain correct results, a complete sweep with synchronization to the end of the sweep must be performed after the adjustment. Synchronization is possible only in the single sweep mode.

The result is queried with the CALCulate<1|2>:MARKer:FUNCtion:POWer:RESult? command.

The numeric suffixes <1/2> are not relevant.

Parameter

ACPower | CPOWer | MCACpower | OBANdwidth | OBWidth | CN | CN0

Example

POW:ACH:PRES ACP

Sets the frequency span, the measurement bandwidths and the detector as required for the ACP measurement.

INIT:CONT OFF

Switches over to single sweep mode.

INIT;*WAI

Starts a sweep and waits for the end of the sweep.

`CALC:MARK:FUNC:POW:RES? ACP`
Queries the result of the adjacent–channel power measurement.

Characteristics
*RST value: –
SCPI: device–specific

Mode
A–F

[SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel

This command adapts the reference level to the measured channel power and – if required – switches on previously the adjacent channel power measurement. This ensures that the signal path of the instrument is not overloaded. Since the measurement bandwidth is significantly smaller than the signal bandwidth in channel power measurements, the signal path can be overloaded although the trace is still significantly below the reference level. If the measured channel power equals the reference level, the signal path is not overloaded.

The numeric suffixes <1/2> are not relevant.

This command is an event and therefore has no *RST value and no query.

Note: *Subsequent commands have to be synchronized with* `*WAI, *OPC` *or* `*OPC?` *to the end of the auto range process which would otherwise be aborted.*

Example
`POW:ACH:PRES:RLEV;*WAI`
Adapts the reference level to the measured channel power.

Characteristics
*RST value: –
SCPI: device–specific

Mode
A–F, CATV, WCDMA

[SENSe<1|2>:]POWer:ACHannel:REFerence:AUTO

This command sets the reference value to the currently measured channel power for the relative measurement.
The numeric suffixes <1/2> are not relevant.

This command is an event and therefore has no *RST value and no query.

Parameter
ONCE

Example
`POW:ACH:REF:AUTO ONCE`

Characteristics
RST value: –
SCPI: device–specific

Mode
A–F

[SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:AUTO

This command activates the automatic selection of a transmission channel to be used as a reference channel in relative adjacent–channel power measurements.

The transmission channel with the highest power, the transmission channel with the lowest power, or the transmission channel nearest to the adjacent channels can be defined as a reference channel.

The command is available only for multicarrier channel and adjacent–channel power measurements with span > 0 (CALCulate<1|2>:MARKer:FUNCtion:POWer:SELect).

The numeric suffixes <1/2> are not relevant.

Parameter

MINimum   Transmission channel with the lowest power

MAXimum   Transmission channel with the highest power

LHIGhest   Lowermost transmission channel for the lower adjacent channels, uppermost transmission channel for the upper adjacent channels

Example

POW:ACH:REF:TXCH:AUTO MAX

The transmission channel with the highest power is used as a reference channel.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:MANual

This command selects a transmission channel to be used as a reference channel in relative adjacent–channel power measurements.

The command is available only for multicarrier channel and adjacent–channel power measurements with span > 0 (CALCulate<1|2>:MARKer:FUNCtion:POWer:SELect).

The numeric suffixes <1/2> are not relevant.

Parameter

1 to 12

Example

POW:ACH:REF:TXCH:MAN 3

Transmission channel 3 is used as a reference channel.

Characteristics

*RST value: 1

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:SPACing[:ACHannel]

This command defines the channel spacing of the adjacent channel to the TX channel. At the same time, the spacing of alternate adjacent channels 1 and 2 is set to the double or triple of the entered value.

The numeric suffixes <1/2> are not relevant.

Parameter

100 Hz to 2000 MHz

Example

`POW:ACH:SPAC 33kHz`

Sets the spacing between the carrier signal and the adjacent channel to 33 kHz or the alternate adjacent channel 1 to 66 kHz or the alternate adjacent channel 2 to 99 kHz

Characteristics

*RST value: 14 kHz

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1...11>

This command defines the spacing between the alternate adjacent channels and the TX channel. If the spacing to the alternate adjacent channel ALTernate1 is modified, the spacing to all higher alternate adjacent channels is multiplied by the same factor (new spacing value / old spacing value). The lower adjacent channels remain unchanged.

Parameter

100 Hz to 2000 MHz

Example

`POW:ACH:SPAC:ALT1 100kHz`

Sets the spacing between TX channel and alternate adjacent channel 1 (ALT1) from 40 kHz to 100 kHz. In consequence, the spacing between TX channel and all higher alternate adjacent channels is increased by the factor 100/40 = 2.5: ALT2 = 150 kHz, ALT3 = 200 kHz, ALT4 = 250 kHz.

Characteristics

*RST value: 40 kHz (ALT1), 60 kHz (ALT2), 80 kHz (ALT3), ...

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:SPACing:CHANnel

This command defines the channel spacing for the carrier signals.

The numeric suffixes <1/2> are not relevant.

Parameter

100 Hz to 2000 MHz

Example

`POW:ACH:SPAC:CHAN 25kHz`

Characteristics

*RST value: 20 kHz

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:TXCHannel:COUNt

This command selects the number of carrier signals.

The command is available only for multicarrier channel and adjacent–channel power measurements with span > 0 (`CALCulate<1|2>:MARKer:FUNCtion:POWer:SELect`).

The numeric suffixes <1/2> are not relevant.

Parameter

1 to 12

Example

`POW:ACH:TXCH:COUN 3`

Characteristics

*RST value: 1

SCPI: device–specific

Mode

A

[SENSe<1|2>:]POWer:BANDwidth|BWIDth

This command defines the percentage of the power with respect to the total power. This value is the basis for the occupied bandwidth measurement
(`[SENSe<1|2>:]POWer:ACHannel:PRESet`).

The numeric suffixes <1/2> are not relevant.

Parameter

10 to 99.9PCT

Example

`POW:BWID 95PCT`

Characteristics

*RST value: 99PCT

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:HSPeed

This command switches on or off the high–speed channel/adjacent channel power measurement. The measurement itself is performed in zero span on the center frequencies of the individual channels. The command automatically switches to zero span and back.

Depending on the selected mobile radio standard, weighting filters with $\sqrt{cos}$ characteristic or very steep–sided channel filters are used for band limitation.
The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

`POW:HSP ON`

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–F

[SENSe<1|2>:]POWer:TRACe

This command assigns the channel/adjacent channel power measurement to the indicated trace. The corresponding trace must be active, i.e. its state must be different from blank.

The numeric suffixes <1/2> are not relevant.

Note: *The measurement of the occupied bandwidth (OBW) is performed on the trace on which marker 1 is positioned. To evaluate another trace, marker 1 must be positioned to another trace with* CALCulate<1|2>:MARKer<1...4>:TRACe.

Parameter

1 to 6

Example

POW:TRAC 2

Assigns the measurement to trace 2.

Characteristics

*RST value: –

SCPI: device–specific

Mode

A

SENSe:SWEep Subsystem

The SENSe:SWEep subsystem controls the sweep parameters.

Commands of the SENSe:SWEep Subsystem

– [SENSe<1|2>:]SWEep:COUNt

– [SENSe<1|2>:]SWEep:COUNt:CURRent?

– [SENSe<1|2>:]SWEep:EGATe

– [SENSe<1|2>:]SWEep:EGATe:HOLDoff

– [SENSe<1|2>:]SWEep:EGATe:LENGth

– [SENSe<1|2>:]SWEep:EGATe:POLarity

– [SENSe<1|2>:]SWEep:EGATe:SOURce

– [SENSe<1|2>:]SWEep:EGATe:TYPE

– [SENSe<1|2>:]SWEep:POINts

– [SENSe<1|2>:]SWEep:TIME

– [SENSe<1|2>:]SWEep:TIME:AUTO

[SENSe<1|2>:]SWEep:COUNt

This command defines the number of sweeps started with single sweep, which are used for calculating the average or maximum value. If the values 0 or 1 are set, one sweep is performed.

The numeric suffixes <1/2> are not relevant.

Parameter

0 to 32767

Example

```
SWE:COUN 64
```
Sets the number of sweeps to 64.
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a sweep and waits for its end.

Characteristics

*RST value: 0

SCPI: conform

Mode

A, ADEMOD, CATV, WCDMA

[SENSe<1|2>:]SWEep:COUNt:CURRent?

This query command returns the current number of started sweeps. A sweep count value should be set and the device should be in single sweep mode.

The numeric suffixes <1/2> are not relevant.

Example

`SWE:COUNt 64`
Sets sweep count to 64

`INIT:CONT OFF`
Switches to single sweep mode

`INIT`
Starts a sweep (without waiting for the sweep end!)

`SWE:COUN:CURR?`
Queries the number of started sweeps

Characteristics

*RST value: 0

SCPI: conform

Mode

A, ADEMOD

[SENSe<1|2>:]SWEep:EGATe

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 (501 in **Spectrum Analyzer** mode) has been recorded.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | 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.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A, WLAN, OFDM, OFDMA/WiBro

[SENSe<1|2>:]SWEep:EGATe:HOLDoff

This command defines the delay time between the external gate signal and the continuation of the sweep.

The numeric suffixes <1/2> are not relevant.

Parameter

125 µs to 100 s

Example

SWE:EGAT:HOLD 100us

Characteristics

*RST value: 0s

SCPI: device–specific

Mode

A, BT

[SENSe<1|2>:]SWEep:EGATe:LENGth

In case of edge triggering, this command determines the time interval during which the instrument sweeps.

The numeric suffixes <1/2> are not relevant.

Parameter

0 to 100 s

Example

SWE:EGAT:LENG 10ms

Characteristics

*RST value: 0s

SCPI: device–specific

Mode

A, BT

[SENSe<1|2>:]SWEep:EGATe:POLarity

This command determines the polarity of the external gate signal. The setting applies both to the edge of an edge–triggered signal and the level of a level–triggered signal.

The numeric suffixes <1/2> are not relevant.

Parameter

POSitive | NEGative

Example

SWE:EGAT:POL POS

Characteristics

*RST value: POSitive

SCPI: device–specific

Mode

A

[SENSe<1|2>:]SWEep:EGATe:SOURce

This command toggles between external gate signal and IF power signal as a signal source for the gate mode. If an IF power signal is used, the gate is opened as soon as a signal at > –20 dBm is detected within the IF path bandwidth (10 MHz).

The numeric suffixes <1/2> are not relevant.

Parameter

EXTernal | IFPower | VIDeo

Example

SWE:EGAT:SOUR IFP
Switches the gate source to IF power.

Characteristics

*RST value: IFPower

SCPI: device–specific

Mode

A

[SENSe<1|2>:]SWEep:EGATe:TYPE

This command sets the type of triggering (level or edge) by the external gate signal.

The gate is edge–triggered ([SENSe<1|2>:]SWEep:EGATe:TYPE):
After detection of the set gate signal edge, the gate remains open until the gate delay ([SENSe<1|2>:]SWEep:EGATe:HOLDoff) has expired.

The gate is level–triggered ([SENSe<1|2>:]SWEep:EGATe:TYPE):
After detection of the gate signal, the gate remains open until the gate signal disappears. The gate opening time cannot be defined with the parameter [SENSe<1|2>:]SWEep:EGATe:LENGth.

A delay between applying the gate signal and the start of recording measured values can be defined with [SENSe<1|2>:]SWEep:EGATe:HOLDoff.

The numeric suffixes <1/2> are not relevant.

Parameter

LEVel | EDGE

Example

SWE:EGAT:TYPE EDGE

Characteristics

*RST value: EDGE

SCPI: device–specific

Mode

A

[SENSe<1|2>:]SWEep:POINts

This command defines the number of measurement points to be collected during one sweep.
The numeric suffixes <1/2> are not relevant.

Parameter

125 | 251 | 501 | 1001 | 2001 | 4001 | 8001 | 16001 | 32001

Example

SWE:POIN 251

Characteristics

*RST value: 501

SCPI: conform

Mode

A, CATV, SPECM

[SENSe<1|2>:]SWEep:TIME

This command defines the sweep time. The available time values vary depending on the span setting.

If [SENSe<1|2>:]SWEep:TIME is directly programmed, automatic coupling to resolution bandwidth and video bandwidth is switched off.

The numeric suffixes <1/2> are not relevant.

Parameter

refer to data sheet

Example

SWE:TIME 10s

Characteristics

*RST value: – (AUTO is set to ON)

SCPI: conform

Mode

A, ADEMOD, CATV, NF, OFDM, OFDMA/WiBro, SPECM, WLAN

[SENSe<1|2>:]SWEep:TIME:AUTO

This command controls the automatic coupling of the sweep time to the frequency span and bandwidth settings.

If [SENSe<1|2>:]SWEep:TIME is directly programmed, automatic coupling is switched off.

The numeric suffixes <1/2> are not relevant.

Parameter

ON | OFF

Example

SWE:TIME:AUTO ON

Switches on the coupling to frequency span and bandwidths.

Characteristics

*RST value: ON

SCPI: conform

Mode
A, CATV, SPECM

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (for details refer to the NWA Help System, section "Remote Control", section "Status Reporting System"). *RST does not influence the status registers.

The following subsystem is included:

- "STATus:QUEStionable Subsystem" on page 4.157

STATus:QUEStionable Subsystem

The STATus:QUEStionable subsystem contains information about the observance of limits during adjacent power measurements, the reference and local oscillator, the observance of limit lines and limit margins and possible overloads of the unit.

Commands of the STATus:QUEStionable Subsystem

- STATus:QUEStionable:ACPLimit[:EVENt]?
- STATus:QUEStionable:ACPLimit:CONDition?
- STATus:QUEStionable:ACPLimit:ENABle
- STATus:QUEStionable:ACPLimit:NTRansition
- STATus:QUEStionable:ACPLimit:PTRansition
- STATus:QUEStionable:FREQuency[:EVENt]?
- STATus:QUEStionable:FREQuency:CONDition?
- STATus:QUEStionable:FREQuency:ENABle
- STATus:QUEStionable:FREQuency:NTRansition
-
- STATus:QUEStionable:FREQuency:PTRansition
- STATus:QUEStionable:LIMit<1|2> [:EVENt]?
- STATus:QUEStionable:LIMit<1|2>:CONDition?
- STATus:QUEStionable:LIMit<1|2>:ENABle
- STATus:QUEStionable:LIMit<1|2>:NTRansition
- STATus:QUEStionable:LIMit<1|2>:PTRansition
- STATus:QUEStionable:LMARgin<1|2>[:EVENt]?
- STATus:QUEStionable:LMARgin<1|2>:CONDition?
- STATus:QUEStionable:LMARgin<1|2>:ENABle
- STATus:QUEStionable:LMARgin<1|2>:NTRansition
- STATus:QUEStionable:LMARgin<1|2>:PTRansition
- STATus:QUEStionable:POWer[:EVENt]?
- STATus:QUEStionable:POWer:CONDition?
- STATus:QUEStionable:POWer:ENABle
- STATus:QUEStionable:POWer:NTRansition
- STATus:QUEStionable:POWer:PTRansition

– STATus:QUEStionable:SYNC[:EVENt]?

– STATus:QUEStionable:SYNC:CONDition?

– STATus:QUEStionable:SYNC:ENABle

–

– STATus:QUEStionable:SYNC:NTRansition

– STATus:QUEStionable:SYNC:PTRansition

STATus:QUEStionable:ACPLimit[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:ACPLimit register. Readout deletes the contents of the EVENt section.

Example

STAT:QUES:ACPL?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:ACPLimit:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:ACPLimit register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:ACPL:COND?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:ACPLimit:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:ACPLimit register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:ACPL:ENAB 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:ACPLimit:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: ACPLimit register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:ACPL:NTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:ACPLimit:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: ACPLimit register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:ACPL:PTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:FREQuency[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable: FREQuency register.

Readout deletes the contents of the EVENt section.

Example

STAT:QUES:FREQ?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:FREQuency:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:FREQuency register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:FREQ:COND?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:FREQuency:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:FREQuency register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:FREQ:ENAB 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:FREQuency:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:FREQ:NTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all, except NF

STATus:QUEStionable:FREQuency:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:FREQ:PTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all, except NF

STATus:QUEStionable:LIMit<1|2> [:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LIMit register. Readout deletes the contents of the EVENt section.

Example

STAT:QUES:LIM?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LIMit register.

Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:LIM:COND?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:LIMit<1|2>:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:LIM:ENAB 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:LIMit<1|2>:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:LIM:NTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all, except NF

STATus:QUEStionable:LIMit<1|2>:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:LIM:PTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all, except NF

STATus:QUEStionable:LMARgin<1|2>[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LMARgin register. Readout deletes the contents of the EVENt section.

Example

STAT:QUES:LMAR?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:LMARgin<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LMARgin register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:LMAR:COND?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:LMARgin<1|2>:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:LMARgin register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:LMAR:ENAB 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:LMARgin<1|2>:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:LMARgin register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:LMAR:NTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:LMARgin<1|2>:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:LMARgin
register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:LMAR:PTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:POWer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:POWer
register. Readout deletes the contents of the EVENt section.

Example

STAT:QUES:POW?

Characteristics

*RST value: –

SCPI: conform

Mode

all

STATus:QUEStionable:POWer:CONDition?

This command queries the contents of the CONDition section of the
STATus:QUEStionable:POWer register. Readout does not delete the contents of the CONDition
section.

Example

STAT:QUES:POW:COND?

Characteristics

*RST value: –

SCPI: conform

Mode

all

STATus:QUEStionable:POWer:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:POWer register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:POW:ENAB 65535

Characteristics

*RST value: –

SCPI: conform

Mode

all

STATus:QUEStionable:POWer:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUE:POWS:NTR 65535

Characteristics

*RST value: –

SCPI: conform

Mode

all

STATus:QUEStionable:POWer:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:POW:PTR 65535

Characteristics

*RST value: –

SCPI: conform

Mode

all

STATus:QUEStionable:SYNC[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:SYNC register.

Readout deletes the contents of the EVENt section.

Example

STAT:QUES:SYNC?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:SYNC:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:SYNC register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:SYNC:COND?

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:SYNC:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:SYNC register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:ENAB 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:SYNC:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:SYNC register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:NTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

STATus:QUEStionable:SYNC:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:SYNC register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:PTR 65535

Characteristics

*RST value: –

SCPI: device–specific

Mode

all

SYSTem Subsystem

This subsystem contains a series of commands for general functions.

The following subsystem is included:

-

SYSTem:SPEaker Subsystem

This subsystem controls the headset functions.

Commands of the SYSTem:SPEaker Subsystem

– SYSTem:SPEaker:VOLume

SYSTem:SPEaker:VOLume

This command sets the volume of the headset for demodulated signals.

Parameter

0 to 1; value 0 is the lowest volume, value 1 the highest volume.

Example

```
SYST:SPE:VOL 0.5
```

Characteristics

*RST value: 0

SCPI: device–specific

Mode

all

TRACe Subsystem

The TRACe subsystem controls access to the instruments internal trace memory.

The following subsystem is included:

-

Commands of the TRACe Subsystem

–

–

TRACe<1|2>[:DATA]

This command transfers trace data from the control computer to the instrument, the query reads trace data out of the instrument. The transfer of trace data from the control computer to the instrument takes place by indicating the trace name and then the data to be transferred.

For details on saving and recalling data refer to the NWA Help System, section "Command Reference", "MMEMory".

Parameter

TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6,<block> | <numeric_value>

TRACE1 to TRACE6   trace memory to be read out

<block> or <numeric_value>   data to be transferred

Return values

501 results are returned. The returned values are scaled in the current level unit.

FORMat REAL,32 is used as format for binary transmission, and FORMat ASCii for ASCII transmission. For details on formats refer to "Formats for returned values: ASCII format and binary format" on page 4.201.

Note: *With the auto peak detector, only positive peak values can be read out.*

Example
```
TRAC TRACE1
TRAC? TRACE1
```
Characteristics
*RST value: –
SCPI: conform

Mode
all

TRACe:COPY

This command copies data from one trace to another.
This command is an event and therefore has no query and no *RST value.

Parameter
TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6,TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

The first operand the destination of the data to be copied, the second operand describes the source.

Example

`TRAC:COPY TRACE1,TRACE2`

Characteristics

*RST value: –

SCPI: conform

Mode

A, CATV

TRACe:IQ Subsystem

The commands of this subsystem are used for collection and output of measured IQ data. A special memory is therefore available in the instrument with 512k words for the I and Q data. The measurement is always performed in zero span at the selected center frequency. The number of samples to be collected and the sample rate can be set (for details refer to "Sample rate" on page 4.171). Prior to being stored in memory or output via GPIB, the measurement data are corrected in terms of frequency response.

The block diagram below shows the analyzer hardware from the IF section to the processor. The A/D converter samples the IF signal (47.9 MHz) at a rate of 65.83 MHz.

The digital signal is down–converted to the complex baseband, lowpass–filtered, and the sampling rate is reduced. The output sampling rate is set between 10 kHz and 65.83 MHz. The continuously adjustable sampling rates are realized using an optimal decimation filter and subsequent resampling on the set sampling rate.

The I/Q data are written to separate memories of 512 k words each. The memories are hardware–triggered. 512 samples are designated as buffer for triggering, which leads to a max. recording length of (512k – 512) samples.

Data aquisition hardware
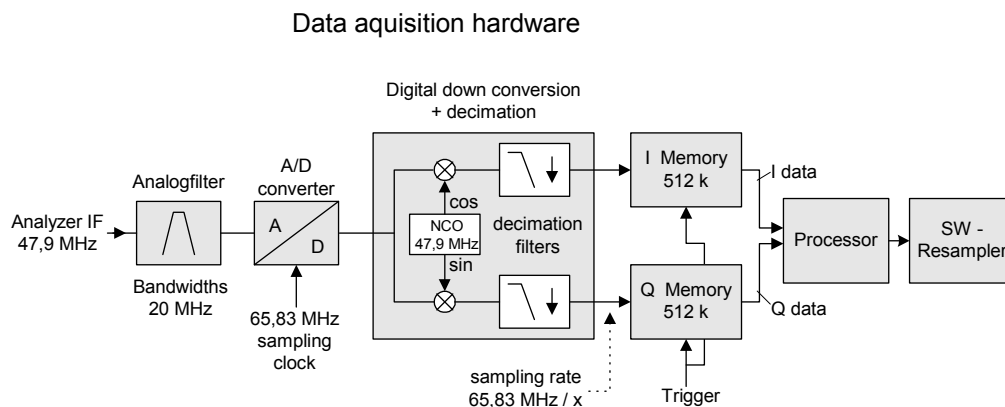
Fig. 4–1   Block diagram illustrating signal processing in analyzer

The trigger sources EXT (external trigger) and IFP (IF Power Trigger) can be used for triggering, additionally IMM (Free Run). The number of test points to be recorded prior to the trigger point can be selected for all available trigger sources, except for FREE RUN.

The measurement results are output in the form of a list, with the Q values following immediately after the list of I values in the output buffer. The `FORMAT` command can be used to select between binary output (32 bit IEEE 754 floating–point values) and output in ASCII format.

For details on formats refer to "Formats for returned values: ASCII format and binary format" on page 4.201.

The commands of this subsystem can be used in two ways:

- Measurement and result query with one

  This method causes the least delay between measurement and output of the result data, but it requires the control computer to wait actively for the response data.

- Setting up the instrument, start of the measurement via `INIT` and query of the result list at the end of the measurement:

  With this method the control computer can be used for other activities during the measurement. In this case the additional time needed for synchronization via service request must be taken into account.

Commands of the TRACe:IQ Subsystem

– TRACe<1|2>:IQ[:STATe]

–

– TRACe<1|2>:IQ:AVERage[:STATe]

– TRACe<1|2>:IQ:AVERage:COUNt

–

– TRACe<1|2>:IQ:DATA?

– TRACe<1|2>:IQ:DATA:MEMory?

– TRACe<1|2>:IQ:SET

– TRACe<1|2>:IQ:SRATe

Further information

– Sample rate

Sample rate

Depending on the sample rate, the maximum bandwidths listed in the table can be obtained during the measurement. The sample rate can be set in the range from 10 kHz to 65.83 MHz.

– 65.8 MHz to 10.7 MHz

– 10.7 MHz to 3.2 MHz

– 3.2 MHz to 1 MHz

– 1 MHz to 105 kHz

– 105 kHz to 10 kHz

65.8 MHz to 10.7 MHz

Sample rate from [Hz]	Sample rate to [Hz]	Max bandwidth [Hz]
65 800 000.000	32 916 666.670	20 000 000.000
22 500 000.000	20 248 687.500	17 998 833.330
20 248 687.500	16 401 436.880	14 579 055.000
16 401 436.880	14 812 500.000	13 166 666.670
14 812 500.000	13 331 250.000	11 850 000.000
13 331 250.000	11 998 125.000	10 665 000.000
11 998 125.000	10 798 312.500	9 598 500.000

10.7 MHz to 3.2 MHz

Sample rate from [Hz]	Sample rate to [Hz]	Max bandwidth [Hz]
10 798 312.500	9 875 000.000	8 777 777.778
9 875 000.000	8 887 500.000	7 900 000.000
8 887 500.000	7 998 750.000	7 110 000.000
7 998 750.000	7 406 250.000	6 583 333.333
7 406 250.000	6 665 625.000	5 925 000.000
6 665 625.000	6 583 333.333	5 851 851.852
6 583 333.333	5 925 000.000	5 266 666.667
5 925 000.000	5 332 500.000	4 740 000.000
5 332 500.000	4 937 500.000	4 388 888.889
4 937 500.000	4 443 750.000	3 950 000.000
4 443 750.000	4 232 142.857	3 761 904.762
4 232 142.857	3 950 000.000	3 511 111.111
3 950 000.000	3 703 125.000	3 291 666.667
3 703 125.000	3 332 812.500	2 962 500.000
3 332 812.500	3 291 666.667	2 925 925.926

3.2 MHz to 1 MHz

Sample rate from [Hz]	Sample rate to [Hz]	Max bandwidth [Hz]
3 291 666.667	2 962 500.000	2 633 333.333
2 962 500.000	2 821 428.571	2 507 936.508
2 821 428.571	2 539 285.714	2 257 142.857
2 539 285.714	2 468 750.000	2 194 444.444
2 468 750.000	2 370 000.000	2 106 666.667
2 370 000.000	2 194 444.444	1 950 617.284
2 194 444.444	2 116 071.429	1 880 952.381
2 116 071.429	1 975 000.000	1 755 555.556
1 975 000.000	1 851 562.500	1 645 833.333
1 851 562.500	1 795 454.545	1 595 959.596
1 795 454.545	1 645 833.333	1 462 962.963
1 645 833.333	1 481 250.000	1 316 666.667
1 481 250.000	1 346 590.909	1 196 969.697
1 346 590.909	1 234 375.000	1 097 222.222
1 234 375.000	1 139 423.077	1 012 820.513
1 139 423.077	1 039 473.684	923 976.608

1 MHz to 105 kHz

Sample rate from [Hz]	Sample rate to [Hz]	Max bandwidth [Hz]
1 039 473.684	940 476.191	835 978.836
940 476.191	846 428.571	752 380.952
846 428.571	779 605.263	692 982.456
779 605.263	705 357.143	626 984.127
705 357.143	637 096.774	566 308.244
637 096.774	580 882.353	516 339.869
580 882.353	529 017.857	470 238.095
529 017.857	477 822.581	424 731.183
477 822.581	435 661.765	387 254.902
435 661.765	395 000.000	351 111.111
395 000.000	359 090.909	319 191.919
359 090.909	323 770.492	287 795.993
323 770.492	294 776.119	262 023.217
294 776.119	266 891.892	237 237.237
266 891.892	240 853.659	214 092.141
240 853.659	217 032.967	192 918.193
217 032.967	195 544.555	173 817.382
195 544.555	176 339.286	156 746.032
176 339.286	159 274.194	141 577.061
159 274.194	143 810.680	127 831.715
143 810.680	129 934.211	115 497.076
129 934.211	117 559.524	104 497.355
117 559.524	105 803.571	94 047.619

105 kHz to 10 kHz

Sample rate from [Hz]	Sample rate to [Hz]	Max bandwidth [Hz]
105 803.571	95 410.628	84 809.447
95 410.628	85 869.565	76 328.502
85 869.565	77 450.980	68 845.316
77 450.980	69 787.986	62 033.765
69 787.986	62 898.089	55 909.413
62 898.089	56 752.874	50 446.999
56 752.874	51 077.586	45 402.299
51 077.586	46 001.553	40 890.269
46 001.553	41 404.612	36 804.100
41 404.612	37 264.151	33 123.690
37 264.151	33 588.435	29 856.387
33 588.435	30 229.592	26 870.748
30 229.592	27 228.860	24 203.431
27 228.860	24 524.007	21 799.117
24 524.007	22 075.261	19 622.454
22 075.261	19 869.215	17 661.525
19 869.215	17 889.493	15 901.771
17 889.493	16 100.543	14 311.594
16 100.543	14 493.640	12 883.235
14 493.640	13 044.914	11 595.479
13 044.914	11 741.974	10 437.310
11 741.974	10 572.805	9 398.049
10 572.805	10 000.000	8 460.509

TRACe<1|2>:IQ[:STATe]

This command switches the I/Q data acquisition on or off.

Note: *The I/Q data acquisition is not compatible with other measurement functions. Therefore all other measurement functions will be switched off as soon as the I/Q measurement function is switched on. Additionally a trace display is not possible in this operating mode. Therefore all traces are set to "BLANK".*

Parameter
ON | OFF

Example
`TRAC:IQ ON`
Switches on I/Q data acquisition

Characteristics
*RST value: OFF
SCPI: device–specific

Mode
A–T

TRACe<1|2>:IQ:AVERage[:STATe]

The command enables averaging of the recorded I/Q data provided that I/Q data acquisition was previously enabled with `TRACe<1|2>:IQ[:STATe]`.

Parameter

ON | OFF

Example

`TRAC:IQ ON`
Switches on acquisition of I/Q data.

`TRAC:IQ:AVER ON`
Enables averaging of the I/Q measurement data.

`TRAC:IQ:AVER:COUN 10`
Selects averaging over 10 data sets.

`TRAC:IQ:DATA?`
Starts the measurement and reads out the averaged data.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

A–T

TRACe<1|2>:IQ:AVERage:COUNt

This command defines the number of I/Q data sets that are to serve as a basis for averaging.

Parameter

0 to 32767

Example

`TRAC:IQ ON`
Switches on acquisition of I/Q data.

`TRAC:IQ:AVER ON`
Enables averaging of the I/Q measurement data

`TRAC:IQ:AVER:COUN 10`
Selects averaging over 10 data sets

`TRAC:IQ:DATA?`
Starts the measurement and reads out the averaged data.

Characteristics

*RST value: 0

SCPI: conform

Mode

all

TRACe<1|2>:IQ:DATA?

This command starts a measurement with the settings defined via `TRACe<1|2>:IQ:SET` and returns the list of measurement results immediately after they are corrected in terms of frequency response. The number of measurement results depends on the settings defined with `TRACe<1|2>:IQ:SET`, the output format depends on the settings of the FORMat subsystem.

Note: *The command requires that all response data are read out completely before the instrument accepts further commands.*

Return values

The result values are scaled linear in unit *Volt* and correspond to the voltage at the RF input of the instrument. In ASCII format, the number of the returned values is 2 * the number of samples. The first set contains the I–data, the second the Q–data.

Note: *If the sampling rate exceeds 512k ($\equiv$ 524288), the data are output in 512k blocks.*

In binary format, the number of I– and Q–data can be calculated as follows:

$$\# \ of \ I-Data \ = \ \# \ of \ Q-Data \ = \ \frac{\# \ of \ DataBytes}{8}$$

The offset of Q–data in the output buffer can be calculated as follows:

$$Q-Data-Offset \ = \ \frac{(\# \ of \ DataBytes)}{2} + LengthIndicatorDigits$$

with LengthIndicatorDigits being the number of digits of the length indicator including the #. In the example above (#41024...) this results in a value of 6 for LengthIndicatorDigits and the offset for the Q–data will result in 512 + 6 = 518.

For further details on formats refer to "Formats for returned values: ASCII format and binary format" on page 4.201.

Example

`TRAC:IQ:STAT ON`
Enables acquisition of I/Q data

`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096`
Measurement configuration:

Sample Rate: 32 MHz

Trigger Source: External

Trigger Slope: Positive

Pretrigger Samples: 0

# of Samples: 4096

`FORMat REAL,32`
Selects format of response data

`TRAC:IQ:DATA?`
Starts measurement and reads results

Characteristics

*RST value: –

Note: *Using the command with the *RST values for the* `TRACe<1|2>:IQ:SET` *command, the following minimum buffer sizes for the response data are recommended: ASCII format 10 kBytes, binary format: 2 kBytes*

SCPI: device–specific

Mode

A–T

TRACe<1|2>:IQ:DATA:MEMory?

This command permits the readout of previously acquired (and frequency response corrected) I/Q data from the memory, with indication of the offset related to the start of measurement and with indication of the number of measurement values. Therefore a previously acquired data set can be read out in smaller portions. The maximum amount of available data depends on the settings of the TRACe<1|2>:IQ:SET command, the output format on the settings in the FORMat subsystem.

Note: *The command requires that all response data are read out completely before the instrument accepts further commands.*
                If there are not I/Q data available in memory because the corresponding measurement had not been started, the command will cause a query error.

Parameter

<offset samples>   Offset of the values to be read related to the start of the acquired data.

                        Value range: 0 to <# of samples> – 1, with <# of samples> being the value indicated with the TRACe<1|2>:IQ:SET command.

<# of samples>   Number of measurement values to be read.

                        Value range: 1 to <# of samples> – <offset samples> with <# of samples> being the value indicated with the TRACe<1|2>:IQ:SET command.

Return values

The returned values are scaled linear in unit Volt and correspond to the voltage at the RF input of the instrument.

The format of the output buffer corresponds to the

TRACe<1|2>:IQ:DATA? command.

Example

`TRAC:IQ:STAT ON`
Enables acquisition of I/Q data

`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,100,4096`
To configure the measurement:

Sample Rate: 32 MHz

Trigger Source: External

Slope: Positive

Pretrigger Samples: 100

# of Samples: 4096

`INIT;*WAI`
Starts measurement and wait for sync

`FORMat REAL,32`
Determines output format

To read the results:

`TRAC:IQ:DATA:MEM? 0,2048`
Reads 2048 I/Q data starting at the beginning of data acquisition

`TRAC:IQ:DATA:MEM? 2048,1024`
Reads 1024 I/Q data from half of the recorded data

`TRAC:IQ:DATA:MEM? 100,512`
Reads 512 I/Q data starting at the trigger point (<Pretrigger Samples> was 100)

Characteristics

*RST value: –
SCPI: device–specific

Mode

A–T, WLAN, OFDM, OFDMA/WiBro

TRACe<1|2>:IQ:SET

This command defines the settings of the analyzer hardware for the measurement of I/Q data. This allows setting the bandwidth of the analog filters in front of the A/D converter as well as setting the sample rate, trigger conditions and the record length.

Note: *If this command is omitted, the current analyzer settings will be used for the corresponding parameters.*
       This command switches to IQ mode automatically (see also TRACe<1|2>:IQ[:STATe]*).*
       The parameter <filter_type> has no effect but is indicated for reasons of compatibility with the FSP family.
       The trigger level can be set using the TRIGger<1|2>[:SEQuence]:LEVel:IFPower *command.*

Parameter

<filter type>	can be omitted
<rbw>	can be omitted
<sample rate>	Sampling rate for the data acquisition.
	Value range: 10 kHz to 65.83 MHz, continuously adjustable
<trigger mode>	Selection of the trigger source used for the measurement.
	Values: IMMediate | EXTernal | IFPower
<trigger slope>	Used trigger slope.
	Values: POSitive
<pretrigger samples>	Number of measurement values to be recorded before the trigger point.
	Range:–16253439 (= –(2^{24}–1–512k –512)) ... 523775 (= 512*1024 – 512 – 1). Negative values correspond to a trigger delay.
<# of samples>	Number of measurement values to record.
	Value range:1 ... 523776(= 512*1024 – 512)

Example

```
TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,2048
```
Reads 2048 I/Q–values starting at the trigger point.

sample rate: 32 MHz

trigger: External

slope: Positive

```
TRAC:IQ:SET NORM,10MHz,4MHz,EXT,POS,1024,512
```
Reads 512 I/Q–values from 1024 measurement points before the trigger point.

filter type: NORMAL

RBW: 10 MHz

sample rate: 4 MHz

trigger: External

slope: Positive

Characteristics

*RST values: –,–,32MHz,IMM,POS,0,128

Note: *For using these default settings with the*

TRACe<1|2>:IQ:DATA? command the following minimum buffer sizes for the response data are recommended: ASCII format 10 kBytes, Binary format 2 kBytes.

SCPI: device–specific

Mode

A–T

TRACe<1|2>:IQ:SRATe

This command sets the sampling rate for the I/Q data acquisition. Thus the sample rate can be modified without affecting the other settings.

Parameter

10 kHz to 65.83 MHz, continuously adjustable

Example

```
TRAC:IQ:SRAT 4MHZ
```

Characteristics

*RST value: 32 MHz

SCPI: device–specific

Mode

A–T

TRIGger Subsystem

The TRIGger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep.

Commands of the TRIGger Subsystem

– TRIGger<1|2>[:SEQuence]:HOLDoff[:TIME]

– TRIGger<1|2>[:SEQuence]:IFPower:HOLDoff

– TRIGger<1|2>[:SEQuence]:IFPower:HYSTeresis

– TRIGger<1|2>[:SEQuence]:LEVel:IFPower

– TRIGger<1|2>[:SEQuence]:LEVel:VIDeo

– TRIGger<1|2>[:SEQuence]:SLOPe

– TRIGger<1|2>[:SEQuence]:SOURce

– TRIGger<1|2>[:SEQuence]:TIME:RINTerval

– TRIGger<1|2>[:SEQuence]:VIDeo:CONTinuous (option TV Trigger, B6)

– TRIGger<1|2>[:SEQuence]:VIDeo:FIELd:SELect (option TV Trigger, B6)

–

– TRIGger<1|2>[:SEQuence]:VIDeo:FORMat:LPFRame (option TV Trigger, B6)

– TRIGger<1|2>[:SEQuence]:VIDeo:LINE:NUMBer (option TV Trigger, B6)

– TRIGger<1|2>[:SEQuence]:VIDeo:SSIGnal:POLarity (option TV Trigger, B6)

TRIGger<1|2>[:SEQuence]:HOLDoff[:TIME]

This command defines the length of the trigger delay.

A negative delay time (pretrigger) can be set in zero span only.

Parameter

–100 s to +100 s

for TV trigger (option B6): –50 µs to +50 µs

Example

```
TRIG:HOLD 500us
```

Characteristics

*RST value: 0 s

SCPI: conform

Mode

all

TRIGger<1|2>[:SEQuence]:IFPower:HOLDoff

ffThis command sets the holding time before the next IF power trigger event.

Parameter

<numeric_value> in s: 150 ns to 1000 s

Example

`TRIG:SOUR IFP`
Sets the IF power trigger source.

`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Characteristics

*RST value: 150 ns

SCPI: device–specific

Mode

A–F

TRIGger<1|2>[:SEQuence]:IFPower:HYSTeresis

sThis command sets the limit that the hysteresis value has to fall below in order to trigger the next measurement.

Parameter

<numeric_value> in dB: 3 dB to 50 dB

Example

`TRIG:SOUR IFP`
Sets the IF power trigger source.

`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Characteristics

*RST value: 3 dB

SCPI: device–specific

Mode

A–F

TRIGger<1|2>[:SEQuence]:LEVel:IFPower

This command sets the level of the IF power trigger source.

Parameter

–50 to –10 DBM

Example

`TRIG:LEV:IFP -30DBM`

Characteristics

*RST value: –20 DBM

SCPI: device–specific

Mode

all

TRIGger<1|2>[:SEQuence]:LEVel:VIDeo

This command sets the level of the video trigger source.

Parameter

0 to 100 PCT

Example

`TRIG:LEV:VID 50PCT`

Characteristics

*RST value: 50 PCT

SCPI: device–specific

Mode

all, except ADEMOD

TRIGger<1|2>[:SEQuence]:SLOPe

This command selects the slope of the trigger signal. The selected trigger slope applies to all trigger signal sources except the TV trigger (option B6).

Parameter

POSitive | NEGative

Example

`TRIG:SLOP NEG`

Characteristics

*RST value: POSitive

SCPI: conform

Mode

all

TRIGger<1|2>[:SEQuence]:SOURce

This command selects the trigger source for the start of a sweep.

Parameter

IMMediate (Free Run) | EXTern | IFPower | VIDeo | TIMe

TV (option TV Trigger, B6)

For details on trigger modes refer to chapter "Instrument Functions", section "Trigger mode overview".

Example

`TRIG:SOUR EXT`

Selects the external trigger input as source of the trigger signal

Characteristics

*RST value: IMMediate

SCPI: conform

Mode

A, ADEMOD, CATV, SPECM, WCDMA

TRIGger<1|2>[:SEQuence]:TIME:RINTerval

This command sets the time intervall for the time trigger source.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0.1 to 5000 s

Example

TRIG:SOUR TIM
Selects the time trigger input for triggering.

TRIG:TIME:RINT 50
The sweep starts after 50 s.

Characteristics

RST value: 1.0
SCPI: device–specific

Mode

A, SPECM

TRIGger<1|2>[:SEQuence]:VIDeo:CONTinuous (option TV Trigger, B6)

Activates or deactivates the free run trigger mode.

Parameter

ON | OFF

Example

TRIG:VID:CONT ON

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

A–T

TRIGger<1|2>[:SEQuence]:VIDeo:FIELd:SELect (option TV Trigger, B6)

With active TV trigger this command activates triggering at the vertical sync signal.

Parameter

ALL (both fields) | ODD (odd fields) | EVEN (even fields)

Example

TRIG:VID:FIEL:SEL ALL

Characteristics

*RST value: –
SCPI: conform

Mode

A–T

TRIGger<1|2>[:SEQuence]:VIDeo:FORMat:LPFRame (option TV Trigger, B6)

This command defines the line system in use (525 or 625 lines) with active TV trigger.

Parameter
525 | 625

Example
`TRIG:VID:FORM:LPFR 525`

Characteristics
*RST value: 625
SCPI: conform

Mode
A–T

TRIGger<1|2>[:SEQuence]:VIDeo:LINE:NUMBer (option TV Trigger, B6)

With active TV trigger this command activates triggering at the horizontal sync signal of the indicated line number.

Parameter
<numeric_value>

Example
`TRIG:VID:LINE:NUMB 17`

Characteristics
*RST value: –
SCPI: conform

Mode
A–T

TRIGger<1|2>[:SEQuence]:VIDeo:SSIGnal:POLarity (option TV Trigger, B6)

With active TV trigger this command selects the polarity of the video sync signal.

Parameter
NEGative | POSitive

Example
`TRIG:VID:SSIG:POL NEG`

Characteristics
*RST value: NEGative
SCPI: conform

Mode
A–T

UNIT Subsystem

The UNIT subsystem sets the basic unit of the setting parameters.

Commands of the UNIT Subsystem

– UNIT<1|2>:POWer

UNIT<1|2>:POWer

This command selects the default unit.

Parameter

DBM | V | A | W | DBPW | WATT | DBPT | DBUV | DBMV | VOLT | DBUA | AMPere

Example

```
UNIT:POW DBUV
```
Sets the power unit to dBm.

Characteristics

*RST value: DBM

SCPI: conform

Mode

A

Remote Commands of the Analog Demodulation Option (K7)

In this section all remote control commands for Analog Demodulation option are described in detail. The abbreviation ADEMOD stands for the Analog Demodulation operating mode. For details on conventions used in this chapter refer to section "Notation" on page 4.1 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in "Remote Control – Description of Analyzer Commands" on page 4.3.

Subsystems of the Analog Demodulation option (K7)

CALCulate Subsystem (Analog Demodulation, K7)

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSe subsystem.

The following subsystems are included:

CALCulate:DELTamarker Subsystem (Analog Demodulation, K7)

The CALCulate:DELTamarker subsystem controls the delta marker functions of the instrument.

Commands of the CALCulate:DELTamarker Subsystem

– CALCulate<1|2>:DELTamarker<1...4>:Y?

CALCulate<1|2>:DELTamarker<1...4>:Y?

Depending on the unit defined with `CALCulate<1|2>:UNIT:POWer` or on the activated measuring functions, the query result is output in the units below:

Result display	Output unit
AM result display (R&S FSL–K7)	% (lin) dB (log)
FM result display (R&S FSL–K7)	Hz (lin) dB (log)
PM result display (R&S FSL–K7)	rad | deg (lin) dB (log)
RF result display (R&S FL–K7)	output unit defined with `CALCulate<1|2>:UNIT:POWer`

For further details refer to "CALCulate<1|2>:DELTamarker<1...4>:Y?" on page 4.15.

CALCulate:FEED Subsystem (Analog Demodulation, K7)

The CALCulate:FEED subsystem selects the evaluation method of the measured data. This corresponds to the selection of the result display in manual mode.

Commands of the CALCulate:FEED Subsystem

– CALCulate<1|2>:FEED

CALCulate<1|2>:FEED

This command selects the measured data that are to be displayed.

The numeric suffixes <1|2> are irrelevant.

Parameter

XTIM:AM:RELative[:TDOMain]	Demodulated AM signal in standardized display
XTIM:AM:RELative:AFSPectrum<1...4>	AF spectrum of the demodulated AM signal in standardized display, results referenced to traces 1 to 4
XTIM:AM[:ABSolute][:TDOMain]	Demodulated AM signal in level display
	Same as 'XTIM:RFPower'
XTIM:RFPower[:TDOMain]	RF power of the signal
XTIM:FM[:TDOMain]	Demodulated FM signal
XTIM:FM:AFSPectrum<1...4>	AF spectrum of the demodulated FM signal, results referenced to traces 1 to 4
XTIM:PM[:TDOMain]	Demodulated PM signal
XTIM:PM:AFSPectrum<1...4>	AF spectrum of the demodulated PM signal, results referenced to traces 1 to 4
XTIM:AMSummary<1...4>[:ABSolute]	AM results in level display, referenced to traces 1 to 4
XTIM:AMSummary<1...4>:RELative	AM results in standardized display, referenced to traces 1 to 4
XTIM:FMSummary<1...4>	FM results, referenced to traces 1 to 4
XTIM:PMSummary<1...4>	PM results, referenced to traces 1 to 4
XTIM:SPECtrum	RF spectrum of the signal determined from the measured data via FFT

Example

`INST:SEL ADEM`
Activates analog demodulator.
`CALC:FEED 'XTIM:FM'`
Selects the display of the FM signal.

Characteristics

RST value: –

SCPI: conform

Mode

ADEMOD

CALCulate:FORMat Subsystem (Analog Demodulation, K7)

The CALCulate:FORMat subsystem defines the conversion of measured data.

Commands of the CALCulate:FORMat Subsystem

– CALCulate<1|2>:FORMat

CALCulate<1|2>:FORMat

This command activates the limitation to ±180°.
The numeric suffixes <1|2> are irrelevant.

Parameter

PHASe   Limitation to ±180°

UPHase   Unwrapped

Example

CALC:FORM PHAS
Activates the limitation to ±180°.

Characteristics

RST value: UPHase
SCPI: conform

Mode

ADEMOD

CALCulate:MARKer Subsystem (Analog Demodulation, K7)

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

The following subsystem is included:

- "CALCulate:MARKer:FUNCtion:ADEMod Subsystem (Analog Demodulation, K7)" on page 4.191

Commands of the CALCulate:MARKer Subsystem

– CALCulate<1|2>:MARKer<1...4>:PEXCursion

– CALCulate<1|2>:MARKer<1...4>:Y?

CALCulate<1|2>:MARKer<1...4>:PEXCursion

The unit depends on the active display.

Example

CALC:MARK:PEXC 100 HZ
Defines peak excursion 100 Hz

Characteristics

*RST value:

6dB	RF displays
5 PCT	AM displays
50 kHz	FM displays
0.5 RAD	PM displays

For further details refer to "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

CALCulate<1|2>:MARKer<1...4>:Y?

If the analog demodulator (option Analog Demodulation, R&S FSL–K7) is activated, the query result is output in the following units:

Result display	Output unit
AM	**%**
FM	**Hz**
PM	**rad/deg (defined with CALCulate<1|2>: UNIT:ANGLe)**
RF	**output unit defined with CALCulate<1|2>:UNIT:POWer**

For further details refer to "

CALCulate<1|2>:MARKer<1...4>:Y?.

CALCulate:MARKer:FUNCtion:ADEMod Subsystem (Analog Demodulation, K7)

The CALCulate:MARKer:FUNCtion:ADEMod subsystem contains the marker functions for the option Analog Demodulation, R&S FSL–K7.

Commands of the CALCulate:MARKer:FUNCtion:ADEMod Subsystem

– CALCulate<1|2>:MARKer:FUNCtion:ADEMod:AFRequency[:RESult<1...4>?]

– CALCulate<1|2>:MARKer:FUNCtion:ADEMod:AM[:RESult<1...4>?]

– CALCulate<1|2>:MARKer:FUNCtion:ADEMod:CARRier[:RESult<1...4>?]

– CALCulate<1|2>:MARKer:FUNCtion:ADEMod:FERRor[:RESult<1...4>?]

– CALCulate<1|2>:MARKer:FUNCtion:ADEMod:FM[:RESult<1...4>?]

– CALCulate<1|2>:MARKer:FUNCtion:ADEMod:PM[:RESult<1...4>?]

– CALCulate<1|2>:MARKer:FUNCtion:ADEMod:SINad:RESult<1...4>?

– CALCulate<1|2>:MARKer:FUNCtion:ADEMod:THD:RESult<1...4>?

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:AFRequency[:RESult<1...4>?]

This command queries the audio frequency with analog demodulation. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected. The numeric suffixes <1|2> are irrelevant.

Note: *If several demodulation modes are activated simultaneously (e.g. with the* [SENSe:]ADEMod:FM[:TDOMain][:TYPE] *command, the audio frequency of the display mode selected with* CALCulate<1|2>:FEED *is returned.*

Example
ADEM ON
Switches on analog demodulator

CALC:FEED 'XTIM:AM:TDOM'
Switches on AM result display.

or

CALC:FEED 'XTIM:FM:TDOM'
Switches on FM result display.

or

CALC:FEED 'XTIM:FM:AFSP'
DISP:TRAC ON
Switches on AF spectrum result display of FM and trace.

CALC:MARK:FUNC:ADEM:AFR?
Queries the audio frequency.

Characteristics
*RST value: –
SCPI: device–specific

Mode
ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:AM[:RESult<1...4>?]

This command queries the results of the AM modulation measurement. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected. The numeric suffixes <1|2> are irrelevant.

Parameter

PPEak   Result of measurement with detector +PK

MPEak   Result of measurement with detector –PK

MIDDle   Result of averaging ±PK/2

RMS   Result of rms measurement

Example

```
ADEM ON
```
Switches on the analog demodulator.
```
CALC:FEED 'XTIM:AM:REL:TDOM'
```
Switches on the AM result display.
```
DISP:TRAC ON
```
Switches on the trace.
```
CALC:MARK:FUNC:ADEM:AM? PPE
```
Queries the peak value.

Characteristics

RST value: –

SCPI: device–specific

Mode

ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:CARRier[:RESult<1...4>?]

This command queries the carrier power. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected. The numeric suffixes <1|2> are irrelevant.

With RF Power result display, the carrier power is determined from trace 1 to 4 indicated in the numeric suffix. With all other result displays, the carrier power is determined from the current trace data (CLR/WRITE trace).

This command is only a query and therefore has no *RST value.

Example

```
ADEM ON
```
Switches on analog demodulator
```
CALC:FEED 'XTIM:RFP'
```
Switches on RF power result display
```
CALC:MARK:FUNC:ADEM:CARR?
```
Queries the carrier power

Characteristics

*RST value: –

SCPI: device–specific

Mode
ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:FERRor[:RESult<1...4>?]

This command queries the frequency error with FM and PM demodulation. With FM demodulation, trace 1 to 4 is selected with the numeric suffix (:RESult<1...4>). With PM demodulation, the frequency error is determined from the current measurement data (CLR/WRITE trace). The numeric suffixes <1|2> are irrelevant.

The offset thus determined differs from that calculated in the [SENSe:]ADEMod:FM:OFFSet? command since, for determination of the frequency deviation, the modulation is removed by means of lowpass filtering, producing results that are different from those obtained by averaging with the SENSe command.

This command is only available for traces in the FM and PM result display. If another result display is selected, the command is disabled.

Example

ADEM ON
Switches on analog demodulator

CALC:FEED 'XTIM:FM:TDOM'
Switches on FM result display

CALC:MARK:FUNC:ADEM:FERR?
Queries the frequency error of trace 1

Characteristics

*RST value: –
SCPI: device–specific

Mode
ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:FM[:RESult<1...4>?]

This command queries the results of FM modulation measurement. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected. The numeric suffixes <1|2> are irrelevant.

Parameter

PPEak	Result of measurement with detector +PK
MPEak	Result of measurement with detector –PK
MIDDle	Result of averaging ±PK/2
RMS	Result of rms measurement

Example

ADEM ON
Switches on the analog demodulator.

CALC:FEED 'XTIM:FM:TDOM'
Switches on the FM result display.

CALC:MARK:FUNC:ADEM:FM? PPE
Queries the peak value.

Characteristics
*RST value: –
SCPI: device–specific

Mode
ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:PM[:RESult<1...4>?]

This command queries the results of PM modulation measurement of analog demodulation. The numeric suffix (`:RESult<1...4>`) indicates whether trace 1, 2, 3 or 4 is selected. The numeric suffixes <1|2> are irrelevant.

Parameter

PPEak   Result of measurement with detector +PK

MPEak   Result of measurement with detector –PK

MIDDle   Result of averaging ±PK/2

RMS   Result of rms measurement

Example
```
ADEM ON
```
Switches on the analog demodulator.
```
CALC:FEED 'XTIM:PM:TDOM'
```
Switches on the FM result display.
```
CALC:MARK:FUNC:ADEM:PM? PPE
```
Queries the peak value.

Characteristics
*RST value: –
SCPI: device–specific

Mode
ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:SINad:RESult<1...4>?

This command queries the result of the SINAD measurement. The numeric suffix (`:RESult<1...4>`) indicates whether trace 1, 2, 3 or 4 is selected. The numeric suffixes <1|2> are irrelevant.

This command is a query only and thus has no *RST value.

Example
```
ADEM ON
```
Switches on analog demodulator
```
CALC:FEED 'XTIM:FM:AFSP'
DISP:TRAC ON
```
Switches on AF spectrum of FM and trace
```
CALC:MARK:FUNC:ADEM:SIN:RES?
```
Queries SINAD value

Characteristics

*RST value: –

SCPI: device–specific

Mode

ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:THD:RESult<1...4>?

This command queries the result of the THD measurement. The numeric suffix (`:RESult<1...4>`) indicates whether trace 1, 2, 3 or 4 is selected. The numeric suffixes <1|2> are irrelevant.

This command is a query only and thus has no *RST value.

Example

`ADEM ON`
Switches on analog demodulator

`CALC:FEED 'XTIM:FM:AFSP'`
Switches on AF spectrum of FM and trace

`DISP:TRAC ON`
Switches on the trace

`CALC:MARK:FUNC:ADEM:THD:RES?`
Queries THD result

Characteristics

*RST value: –

SCPI: device–specific

Mode

ADEMOD

CALCulate:UNIT Subsystem (Analog Demodulation, K7)

The CALCulate:Unit subsystem defines the units for the parameters that can be set and the measurement results.

Commands of the CALCulate:UNIT Subsystem

– CALCulate<1|2>: UNIT:ANGLe

CALCulate<1|2>: UNIT:ANGLe

This command selects the unit for angles.

Parameter

DEG | RAD

Example:

CALC:UNIT:ANGL DEG

Characteristics:

*RST value: RAD

SCPI: device–specific

Mode

ADEMOD

DISPlay Subsystem (Analog Demodulation, K7)

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

– DISPlay[:WINDow<1|2>]:SIZE
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:PDIVision
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RPOSition
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RVALue
– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y:SPACing

DISPlay[:WINDow<1|2>]:SIZE

This command switches the measurement window for active analog demodulation to full screen or half screen.

For further details refer to "DISPlay[:WINDow<1|2>]:SIZE" on page 4.104.

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:PDIVision

This command defines the scaling of the y–axis in the current unit. The numeric suffix in TRACe<1...6> is irrelevant. The numeric suffixes <1|2> are irrelevant.

Parameter

<numeric_value>

Example

```
DISP:TRAC:Y:PDIV +10kHz
```
Sets the Y scale to 10 kHz/div.

Characteristics

*RST value:

20 PCT	linear AM display
50 kHz	linear FM display
2 rad	linear PM display
10 dB	logarithmic AF spectrum display

SCPI: conform

Mode

ADEMOD

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RPOSition

Characteristics

*RST value:

100 PCT	AF spectrum display of AM, FM, or PM
50 PCT	AM, FM, or PM display

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RVALue

This command defines the reference value assigned to the reference position. Separate reference values are maintained for the various displays.

Example

`DISP:TRAC:Y:RVAL 0`
Sets the value assigned to the reference position to 0 Hz (analog demodulation)

Characteristics

*RST value:

0 PCT	AM display
0 Hz	FM display
0 rad	PM display
100 PCT	AF spectrum display of AM signal
250 kHz	AF spectrum display of FM signal
10 rad	AF spectrum display of PM signal

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y:SPACing

When the AF spectrum result display is selected, only the parameters LINear and LOGarithmic are allowed.

For further details refer to "DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y:SPACing" on page 4.106.

INSTrument Subsystem (Analog Demodulation, K7)

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

Commands of the INSTrument Subsystem

–   INSTrument[:SELect]

–   INSTrument:NSELect

INSTrument[:SELect]

Parameter

ADEMod (Analog Demodulation option, R&S FSL–K7)

For further details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

INSTrument:NSELect

Parameter

3 (Analog Demodulation option, R&S FSL–K7)

For further details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

SENSe Subsystem (Analog Demodulation, K7)

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device–specific settings, they do not refer to the signal characteristics of the measurement signal.

The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The following subsystems are included:

*   "SENSe:ADEMod Subsystem" on page 4.199

*   "SENSe:BANDwidth Subsystem" on page 4.222

*   "SENSe:FILTer Subsystem" on page 4.223

*   "SENSe:FREQuency Subsystem" on page 4.226

*   "SENSe:SWEep Subsystem" on page 4.226

SENSe:ADEMod Subsystem (Analog Demodulation, K7)

The SENSe:ADEMod Subsystem contains commands to set up the instrument for the measurement of analog demodulated signals and query the result at the end of the measurement.

Commands of the SENSe:ADEMod Subsystem

–   [SENSe:]ADEMod[:STATe]

– [SENSe:]ADEMod:SRATe?

– [SENSe:]ADEMod:ZOOM[:STATe]

– [SENSe:]ADEMod:ZOOM:STARt

Further information

– Trace mode result types

– Formats for returned values: ASCII format and binary format

Trace mode result types

The following result types can be set:

WRITe   The current trace results will be obtained

AVERage   The trace results will be averaged over the given # of measurements

MAXHold   The maximum trace result values will be obtained over the given # of measurements

MINHold   The minimum trace result values will be obtained over the given # of measurements

VIEW   The trace results are frozen and displayed, i.e. they are not calculated for subsequent measurements. Traces in this mode cannot be queried.

OFF   The result type will not be used.

> *Note:* It is not possible to query trace data when result type VIEW is selected.
> Each value besides OFF can only be assigned to one result type at a time.
> If all result types are set to OFF, the AM, FM, or PM demodulator will be deactivated.

Formats for returned values: ASCII format and binary format

• ASCII Format (FORMat ASCII):

The command reads out a list of comma separated values (CSV) of the measured values in floating point format.

• Binary Format (FORMat REAL,32):

The command reads out binary data (Definite Length Block Data according to IEEE 488.2), each measurement value being formatted in 32 Bit IEEE 754 Floating–Point–Format. The schematics of the result string will be as follows:

#41024<value1><value2>...<value n> with

#4   number of digits (= 4 in the example) of the following number of data bytes

1024   number of following data bytes (= 1024 in the example)

<value>   4–byte floating point value

[SENSe:]ADEMod[:STATe]

This command activates the analog demodulator of the instrument. The instrument will be set to zero span at the current center frequency. The sample detector will be set, the demodulator itself will be set up according to the parameters of command `[SENSe:]ADEMod:SET`.

Parameter
ON | OFF

Example

```
ADEM ON
```
Switches the analog demodulator on.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:CENTer

This command sets the center frequency for AF spectrum result display.

Parameter

<numeric_value>

Example

```
ADEM ON
```
Switches on the analog demodulator

```
CALC:FEED 'XTIM:FM:AFSP'
```
Switches on AF spectrum result display of FM

```
ADEM:BAND 5 MHz
```
Sets the measurement bandwidth to 5 MHz

```
ADEM:AF:CENT 500kHz
```
Sets the AF center frequency to 500 kHz

```
ADEM:AF:SPAN 200kHz
```
Sets the AF span to 200 kHz

Characteristics

*RST value: 1.25 MHz

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:COUPling

This command selects the coupling of the AF path of the analyzer.

Parameter

AC | DC

Example

ADEM:AF:COUP DC
Switches on DC coupling.

Characteristics

*RST value: AC (PM); DC (FM)

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:SPAN

This command sets the span for AF spectrum result display.l

The span is limited to half the measurement bandwidth of analog demodulation
([SENSe:]ADEMod:BANDwidth|BWIDth:DEModulation).

Parameter

<numeric_value>

Example

ADEM ON
Switches on the analog demodulator

CALC:FEED 'XTIM:FM:AFSP'
Switches on AF spectrum result display of FM

ADEM:BAND 5 MHz
Sets the measurement bandwidth to 5 MHz

ADEM:AF:CENT 500kHz
Sets the AF center frequency to 500 kHz

ADEM:AF:SPAN 200kHz
Sets the AF span to 200 kHz

Characteristics

*RST value: 2.5 MHz

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:SPAN:FULL

This command sets the maximum span for AF spectrum result display.

The maximum span corresponds to half the measurement bandwidth of analog demodulation (`[SENSe:]ADEMod:BANDwidth|BWIDth:DEModulation`).

Example

`ADEM ON`
Switches on the analog demodulator

`CALC:FEED 'XTIM:FM:AFSP'`
Switches on AF spectrum result display of FM

`ADEM:BAND 5 MHz`
Sets the measurement bandwidth to 5 MHz

`ADEM:AF:SPAN:FULL`
Sets the AF span to 2.5 MHz

Characteristics

*RST value: –
SCPI: device–specific

Mode
ADEMOD

[SENSe:]ADEMod:AF:STARt

This command sets the start frequency for AF spectrum result display.

Parameter

<numeric_value>

Example

`ADEM ON`
Switches on analog demodulator

`CALC:FEED 'XTIM:FM:AFSP'`
Switches on AF spectrum result display of FM

`ADEM:BAND 5 MHz`
Sets the measurement bandwidth to 5 MHz

`ADEM:AF:STAR 0kHz`
Sets the AF start frequency to 0 kHz

`ADEM:AF:STOP 500kHz`
Sets the AF stop frequency to 500 kHz

Characteristics

*RST value: 0 MHz
SCPI: device–specific

Mode
ADEMOD

[SENSe:]ADEMod:AF:STOP

This command sets the stop frequency for AF spectrum result display.

The stop frequency is limited to half the measurement bandwidth of analog demodulation (`[SENSe:]ADEMod:BANDwidth|BWIDth:DEModulation`).

Parameter

<numeric_value>

Example

ADEM ON

Switches on the analog demodulator

CALC:FEED 'XTIM:FM:AFSP'

Switches on AF spectrum result display of FM

ADEM:BAND 5 MHz

Sets the measurement bandwidth to 5 MHz

ADEM:AF:STAR 0kHz

Sets the AF start frequency to 0 kHz

ADEM:AF:STOP 500kHz

Sets the AF stop frequency to 500 kHz

Characteristics

*RST value: 2.5 MHz

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain][:TYPE]

This command selects the result types of the RF signal to be measured simultaneously in zero span.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW, OFF; for details see "Trace mode result types" on page 4.201.

Example

ADEM:AM AVER,MAXH,MINH

Determines average, max hold and min hold values at a time.

ADEM:AM WRIT,OFF,OFF

Determines only the current measurement values.

ADEM:AM OFF,OFF,OFF

Switches AM demodulation off.

Characteristics

*RST value: WRITe,OFF,OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain]:RESult?

This command reads the result data of the RF signal in zero span for the specified result type. The data format of the output data block is defined by the FORMat command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "Trace mode result types" on page 4.201.

Note: *The result type indicated must be one of those configured by*
`[SENSe:]ADEMod:AM[:ABSolute][:TDOMain][:TYPE]`. *Otherwise a query error will be generated.*

Return values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "Formats for returned values: ASCII format and binary format" on page 4.201. The ouput units are described in "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

Example

`ADEM:SET 8MHz,32000,EXT,POS,-500,30`
Sets up demodulator parameters

`ADEM:AM AVER,MAXH,MINH`
Sets up AM results to be measured

`ADEM ON`
Switches on demodulator

`INIT;*WAI`
Starts measurement and waits for sync

`FORM ASC`
Selects output format

`ADEM:AM:RES? AVER`
Reads AM average results

`ADEM:AM:RES? MAXH`
Reads AM max hold results

`ADEM:AM:RES? MINH`
Reads AM min hold results

Characteristics

*RST value: –
SCPI: device–specific

Mode
ADEMOD

[SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE]

This command selects the result types to be measured simultaneously by AM demodulation.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW, OFF; for details see "Trace mode result types" on page 4.201.

Example

`ADEM:AM:REL AVER,MAXH,MINH`
Determines average, max hold and min hold values simultaneously.

`ADEM:AM:REL WRIT,OFF,OFF`
Determines only the current measurement values.

`ADEM:AM:REL OFF,OFF,OFF`
Switches AM demodulation off.

Characteristics

*RST value: OFF,OFF,OFF
SCPI: device–specific

Mode
ADEMOD

[SENSe:]ADEMod:AM:RELative[:TDOMain]:RESult?

This command reads the result data obtained by AM demodulation for the specified result type. The data format of the output data block is defined by the `FORMat` command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "Trace mode result types" on page 4.201.

Note: *The result type indicated must be one of those configured by* `[SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE]`. *Otherwise a query error will be generated.*

Return values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "Formats for returned values: ASCII format and binary format" on page 4.201. The ouput units are described in "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

Example

`ADEM:SET 8MHz,32000,EXT,POS,-500,30`
Sets up demodulator parameters

`ADEM:FM AVER,MAXH,MINH`
Selects FM results to be measured

`ADEM:AM:REL WRIT,OFF,OFF`
Selects AM results to be measured

`ADEM ON`
Switches on demodulator

`INIT;*WAI`
Starts measurement and waits for sync

`FORM ASC`
Selects output format

`ADEM:FM:RES? AVER`
Reads FM average results

`ADEM:FM:RES? MAXH`
Reads FM max hold results

`ADEM:FM:RES? MINH`
Reads FM min hold results

`ADEM:AM:REL:RES? WRIT`
Reads current AM result data

Characteristics

*RST value: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AM:RELative:AFSPectrum[:TYPE]

This command selects the AF spectrum result types of the AM–demodulated signal to be measured simultaneously.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW, OFF; for details see "Trace mode result types" on page 4.201.

Note: *The result type "AF spectrum of AM–demodulated signal" cannot be activated at the same time as "AF spectrum of FM or PM demodulated signal".*

Example

```
ADEM:AM:REL:AFSP AVER,MAXH,MINH
```
Determines average, maximum and minimum value simultaneously

```
ADEM:AM:REL:AFSP WRIT,OFF,OFF
```
Determines only current measurement results

```
ADEM:AM:REL:AFSP OFF,OFF,OFF
```
Switches off calculation of the AF spectrum

Characteristics

*RST value: OFF,OFF,OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AM:RELative:AFSPectrum:RESult?

This command reads out the AF spectrum result data of the AM–demodulated signal for the specified result type. The data format of the output data is determined with the `FORMat` command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "Trace mode result types" on page 4.201.

Note: *The specified result type must be one of those configured with the* `[SENSe:]ADEMod:AM:RELative:AFSPectrum[:TYPE]` *command. Otherwise a query error will be generated.*

Return values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "Formats for returned values: ASCII format and binary format" on page 4.201. The ouput units are described in section "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```
Sets the demodulator

```
ADEM:FM AVER,MAXH,MINH
```
Selects the FM results to be measured

```
ADEM:AM:REL WRIT,OFF,OFF
```
Selects the AM results to be measured

```
ADEM:AM:REL:AFSP WRIT,OFF,OFF
```
Selects the AF spectrum results of the demodulated AM signal to be measured

```
ADEM ON
```
Switches on the demodulator

```
INIT;*WAI
```
Starts the measurement and waits for the termination

```
FORM ASC
```
Selects the output format

```
ADEM:FM:RES? AVER
```
Reads the FM average result data

```
ADEM:FM:RES? MAXH
```
Reads the FM Maxhold result data

`ADEM:FM:RES? MINH`
Reads the FM Minhold result data

`ADEM:AM:REL:RES? WRIT`
Reads the current AM result data

`ADEM:AM:REL:AFSP:RES? WRIT`
Reads the current AF spectrum result data of the demodulated AM signal

Characteristics

*RST value: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:BANDwidth|BWIDth:DEModulation

This command defines the demodulation bandwidth used for analog demodulation. The required sampling rate is automatically set depending on the selected demodulation bandwidth. The available demodulation bandwidths are determined by the existing sampling rates (see table below).

Parameter

<numeric_value>

For details on the correlation of bandwidth and sample rate refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".

Example

`ADEM:BAND:DEM 1MHz`
Sets the demodulation bandwidth to 1 MHz.

Characteristics

*RST value: 5 MHz

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:FM[:TDOMain][:TYPE]

This command selects the result types to be created in parallel by analog demodulation.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW, OFF; for details see "Trace mode result types" on page 4.201.

Example

`ADEM:FM AVER,MAXH,MINH`
"Creates average, max hold and min hold values simultaneously

`DEM:FM WRIT,OFF,OFF`
Only creates the current measurement values

`ADEM:FM OFF,OFF,OFF`
Switches analog demodulator off

Characteristics

*RST value: WRITe,OFF,OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:FM[:TDOMain]:RESult?

This command reads the result data obtained by analog demodulation for the specified result type. The data format of the output data block is defined by the FORMat command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "Trace mode result types" on page 4.201.

Note: *The result type indicated must be one of those configured by* [SENSe:]ADEMod:FM[:TDOMain][:TYPE]. *Otherwise a query error will be generated.*

Return values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "Formats for returned values: ASCII format and binary format" on page 4.201. The ouput units are described in "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

Example

ADEM:SET 8MHz,32000,EXT,POS,-500,30

Sets up demodulator parameters

ADEM:FM AVER,MAXH,MINH

Selects FM results to be measured

ADEM:AM WRIT,OFF,OFF

Selects AM results to be measured

ADEM ON

Switches on demodulator

INIT;*WAI

Starts measurement and waits for sync

FORM ASC

Selects output format

ADEM:FM:RES? AVER

Reads FM average results

ADEM:FM:RES? MAXH

Reads FM max hold results

ADEM:FM:RES? MINH

Reads FM min hold results

ADEM:AM:RES? WRIT

Reads current AM results

Characteristics

*RST value: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:FM:AFSPectrum[:TYPE]

This command selects the AF spectrum result types of the FM demodulated signal to be measured simultaneously.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW, OFF; for details see "Trace mode result types" on page 4.201.

Note: *The result type "AF spectrum of the FM demodulated signal" cannot be activated at the same time as "AF spectrum of AM or PM demodulated signal".*

Example

`ADEM:FM:AFSP AVER,MAXH,MINH`
Determines average, maximum and minimum value simultaneously

`ADEM:FM:AFSP WRIT,OFF,OFF`
Determines only current measurement results

`ADEM:FM:AFSP OFF,OFF,OFF`
Switches calculation of AF spectrum off

Characteristics

*RST value: OFF,OFF,OFF

SCPI: device–specific

Mode

A

[SENSe:]ADEMod:FM:AFSPectrum:RESult?

This command reads out the AF spectrum result data of the FM demodulated signal for the specified result type. The data format of the output data is determined with the `FORMat` command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "Trace mode result types" on page 4.201.

Note: *The specified result type must be one of those configured with the* `[SENSe:]ADEMod:FM:AFSPectrum[:TYPE]` *command. Otherwise a query error will be generated.*

Return values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "Formats for returned values: ASCII format and binary format" on page 4.201. The ouput units are described in "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

Example

`ADEM:SET 8MHz,32000,EXT,POS,-500,30`
Sets demodulator

`ADEM:FM AVER,MAXH,MINH`
Selects the FM results to be measured

`ADEM:AM:REL WRIT,OFF,OFF`
Selects the AM results to be measured

`ADEM:FM:AFSP WRIT,OFF,OFF`
Selects the AF spectrum results of the demodulated FM signal to be measured

`ADEM ON`
Switches the demodulator on

```
INIT;*WAI
```
Starts the measurement and waits for termination

```
FORM ASC
```
Selects output format

```
ADEM:FM:RES? AVER
```
Reads FM average result data

```
ADEM:FM:RES? MAXH
```
Reads FM maxhold result data

```
ADEM:FM:RES? MINH
```
Reads FM minhold result data

```
ADEM:AM:RES? WRIT
```
Reads current AM result data

```
ADEM:FM:AFSP:RES? WRIT
```
Reads current AF spectrum result data of demodulated FM signal

Characteristics

*RST value: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:FM:OFFSet?

This command calculates the FM offset of the currently available measurement data set.

If averaging has been activated before acquiring the data set (using `[SENSe:]ADEMod:FM[:TDOMain][:TYPE]`, the averaged FM offset over several measurements can also be obtained by setting <result type> = AVERage.

The offset thus determined differs from the one calculated by the `CALCulate<1|2>:MARKer:FUNCtion:ADEMod:FERRor[:RESult<1...4>?]` command since, for determination of the frequency deviation, the modulation is removed by means of lowpass filtering, producing results that are different from those obtained by averaging.

Parameter

<result type>

IMMediate   The current measurement results will be used for calculating the FM offset

AVERage   The measurement results that were averaged over the given # of measurements will be used for calculating the FM offset

> *Note: If no average measurement was active during the last measurement sequence only the* `[SENSe:]ADEMod:FM:OFFSet?` IMMediate *command will return a correct result (data to calculate the offset are taken from the last measured data set).* `[SENSe:]ADEMod:FM:OFFSet?` AVERage *will cause a query error in this case.*

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```
Sets up demodulator parameters to execute 30 measurements

```
ADEM:FM AVER,OFF,OFF
```
Selects FM results to perform averaging

```
ADEM:AM OFF,OFF,OFF
```
Switches off AM demodulation

```
ADEM ON
```
Switches on analog demodulator

```
INIT;*WAI
```
Starts measurement and waits for sync

```
ADEM:FM:OFFS? IMM
```
Reads FM offset of last measurement of the sequence of 30

```
ADEM:FM:OFFS? AVER
```
Reads FM offset averaged over 30 measurements

Characteristics

*RST values: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:MTIMe

This command defines the measurement time for analog demodulation.

Parameter

<numeric_value>

Example

```
ADEM:MTIM 62.5us
```
Sets the measurement time to 62.5 μs.

Characteristics

*RST value: 62.5us

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:PM[:TDOMain][:TYPE]

This command selects the result types of the PM–demodulated signal to be created simultaneously.

Note: *Only one result type can be assigned at a time. If all result types are set to OFF, the PM demodulator is switched off.*

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW; for details see "Trace mode result types" on page 4.201.

Example

```
ADEM:PM AVER,MAXH,MINH
```
Determines average, maximum and minimum value simultaneously

```
ADEM:PM WRIT,OFF,OFF
```
Determines only current measurement results

```
ADEM:PM OFF,OFF,OFF
```
Switches the PM demodulator off.

Characteristics

RST value: OFF,OFF,OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:PM[:TDOMain]:RESult?

This command reads the result data of the PM demodulation for the specified result type. The data format of the output data is determined with the `FORMat` command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "Trace mode result types" on page 4.201.

Note: *The specified result type must be one of those configured with the* `[SENSe:]ADEMod:PM[:TDOMain][:TYPE]` *command. Otherwise a query error will be generated.*

Return values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "Formats for returned values: ASCII format and binary format" on page 4.201. The ouput units are described in "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

Example

`ADEM:SET 8MHz,32000,EXT,POS,-500,30`
Sets the demodulator parameters.

`ADEM:PM AVER,MAXH,MINH`
Selects the PM results to be measured.

`ADEM:AM WRIT,OFF,OFF`
Selects the AM results to be measured.

`ADEM ON`
Switches on the demodulator.

`INIT;*WAI`
Starts the measurement and waits for termination.

`FORM ASC`
Selects the output format.

`ADEM:PM:RES? AVER`
Reads the PM average result data.

`ADEM:PM:RES? MAXH`
Reads the PM maxhold result data.

`ADEM:PM:RES? MINH`
Reads the PM minhold result data.

`ADEM:AM:RES? WRIT`
Reads the current AM result data.

Characteristics

RST value: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:PM:AFSPectrum[:TYPE]

This command selects the AF spectrum result types of the PM–demodulated signal to be measured simultaneously.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW; for details see "Trace mode result types" on page 4.201.

Note:　*The result type "AF spectrum of the PM demodulated signal" cannot be activated at the same time as "AF spectrum of AM or FM demodulated signal".*

Example

ADEM:PM:AFSP AVER,MAXH,MINH
Determines average, maximum and minimum value simultaneously

ADEM:PM:AFSP WRIT,OFF,OFF
Determines only current measurement results

ADEM:PM:AFSP OFF,OFF,OFF
Switches calculation of AF spectrum off

Characteristics

RST value: OFF,OFF,OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:PM:AFSPectrum:RESult?

This command reads out the AF spectrum result data of the PM–demodulated signal for the specified result type. The data format of the output data is determined with the FORMat command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "Trace mode result types" on page 4.201.

Note:　*The specified result type must be one of those configured with the*

[SENSe:]ADEMod:PM:AFSPectrum[:TYPE] command. Otherwise a query error will be generated.

Return values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "Formats for returned values: ASCII format and binary format" on page 4.201. The ouput units are described in section "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

Example

ADEM:SET 8MHz,32000,EXT,POS,-500,30
Sets demodulator

ADEM:PM AVER,MAXH,MINH
Selects the PM results to be measured

ADEM:AM:REL WRIT,OFF,OFF
Selects the AM results to be measured

ADEM:PM:AFSP WRIT,OFF,OFF
Selects the AF spectrum results of the demodulated PM signal to be measured

ADEM ON
Switches the demodulator on

```
INIT;*WAI
```
Starts the measurement and waits for termination

```
FORM ASC
```
Selects output format

```
ADEM:PM:RES? AVER
```
Reads PM average result data

```
ADEM:PM:RES? MAXH
```
Reads PM maxhold result data

```
ADEM:PM:RES? MINH
```
Reads PM minhold result data

```
ADEM:AM:RES? WRIT
```
Reads current AM result data

```
ADEM:PM:AFSP:RES? WRIT
```
Reads current AF spectrum result data of demodulated PM signal

Characteristics

RST value: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:PM:RPOint[:X]

This command determines the position where the phase of the PM–demodulated signal is set to 0 rad. The maximum possible value depends on the measurement time selected in the instrument; this value is output in response to the query `ADEM:PM:RPO:X? MAX`.

Parameter

0 s to measurement time

Example

```
ADEM:PM:RPO 500us
```
Sets the position where the phase to 0 rad setting to 500 µs.

Characteristics

RST value: 0 s

SCPI: conform

Mode

ADEMOD

[SENSe:]ADEMod:RLENgth?

This command returns the record length set up for the current analog demodulation measurement.

Example

```
ADEM:RLEN?
```
Returns the current record length.

Characteristics

*RST value: –

SCPI: device–specific

Mode
ADEMOD

[SENSe:]ADEMod:SET

This command configures the analog demodulator of the instrument.

Parameter

<sample rate>	The frequency at which measurement values are taken from the A/D–converter and stored in I/Q memory.
	Allowed range: refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".
<record length>	Number of samples to be stored in I/Q memory.
	Allowed range: 1 to 400001 with AF filter or AF trigger active 1 to 480001 with both AF filter and AF trigger deactive
<trigger source>	Selection of the trigger source to use for the demodulator.
	Allowed values: IMMediate | EXTernal | IFPower | RFPower| AF | AM | AMRelative | FM | PM (see note below)
<trigger slope>	Used slope of the trigger signal.
	Allowed values: POSitive | NEGative
	The value indicated here will be ignored for <trigger source> = IMMediate.
<offset samples>	Number of samples to be used as an offset to the trigger signal.
	Allowed range: –65024 to 130559 (= –64 * 1024 + 512 to 128 * 1024 – 513)
	The value indicated here will be ignored for <trigger source> = IMMediate.
<# of meas>	Number of repetitions of the measurement to be executed. The value indicated here is especially necessary for the average/maxhold/minhold function.
	Allowed range: 0 to 32767

Note: *After selecting IFPower, the trigger threshold can be set with the* `TRIGger<1|2>[:SEQuence]:LEVel:IFPower` *command.*

Example
```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```
Performs a measurement at:

sample rate	8 MHz
record length	32000
trigger source	EXTernal
trigger slope	POSitive
offset samples	–500 (500 samples before trigger occurred)
# of meas	30

Characteristics

*RST value:

sample rate	8 MHz
record length	501
trigger source	IMMediate
trigger slope	POSitive
offset samples	0
# of meas	0

SCPI: device–specific

Mode
ADEMOD

[SENSe:]ADEMod:SPECtrum[:TYPE]

This command selects the result types to be created in parallel by the RF spectrum measurement with active analog demodulation.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW, OFF; for details see "Trace mode result types" on page 4.201.

Example

`ADEM:SPEC AVER,MAXH,MINH`
Creates average, max hold and min hold values at a time

`ADEM:SPEC WRIT,OFF,OFF`
Only creates the current measurement values

`ADEM:SPEC OFF,OFF,OFF`
Switches analog demodulator off

Characteristics

*RST value: OFF,OFF,OFF
SCPI: device–specific

Mode
ADEMOD

[SENSe:]ADEMod:SPECtrum:BANDwidth|BWIDth[:RESolution]

This command sets the resolution bandwidth for spectrum representation that was determined from the analog demodulation data.

The recording time required is calculated from the sampling rate indirectly set via [SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum] or [SENSe:]ADEMod:BANDwidth|BWIDth:DEModulation. If the available recording time is not sufficient for the given bandwidth, the recording time is set to is maximum and the resolution bandwidth is enlarged to the resulting bandwidth.

Parameter

refer to data sheet

Example

`ADEM ON`
Switches on the analog demodulator

```
CALC:FEED 'XTIM:SPEC'
```
Switches on the RF spectrum result display

or
```
CALC:FEED 'XTIM:FM:AFSP'
```
Switches on the AF spectrum result display of FM signal
```
ADEM:SPEC:BAND 61.2kHz
```
Sets the resolution bandwidth to 61.2 kHz.

Characteristics

*RST value: 61.2 kHz

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:SPECtrum:RESult?

This command reads out the RF spectrum result data for the specified result type. The data format of the output data block is defined by the `FORMat` command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "Trace mode result types" on page 4.201.

Note: *The result type indicated must be one of those configured by*
          `[SENSe:]ADEMod:SPECtrum[:TYPE]`. *Otherwise a query error will be generated.*

Return values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "Formats for returned values: ASCII format and binary format" on page 4.201. The ouput units are described in "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

Example
```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```
Sets up demodulator parameters
```
ADEM:SPEC AVER,MAXH,MINH
```
Selects RF spectrum results to be measured
```
ADEM:SPEC WRIT,OFF,OFF
```
Selects AM results to be measured
```
ADEM ON
```
Switches on demodulator
```
INIT;*WAI
```
Starts measurement and waits for sync
```
FORM ASC
```
Selects output format
```
ADEM:SPEC:RES? AVER
```
Reads RF spectrum average results
```
ADEM:SPEC:RES? MAXH
```
Reads RF spectrum max hold results
```
ADEM:SPEC:RES? MINH
```
Reads RF spectrum min hold results
```
ADEM:SPEC:RES? WRIT
```
Reads spectrum current results

Characteristics

*RST value: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum]

This command sets the maximum frequency range for displaying the RF spectrum that was determined from the FM demodulation data. The maximum span corresponds to the measurement bandwidth of analog demodulation (for details refer to [SENSe:]ADEMod:BANDwidth|BWIDth:DEModulation).For details refer on the relation of bandwidth and sample rate refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".

Parameter

<numeric_value>

Example

ADEM ON
Switches on the analog demodulator

CALC:FEED 'XTIM:SPEC'
Switches on RF spectrum result display.

ADEM:SPEC:SPAN:MAX 5 MHz
Sets the max. span to 5 MHz

ADEM:SPEC:SPAN:ZOOM 1 MHz
Sets the displayed span to 1 MHz

Characteristics

*RST value: 5 MHz

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM

This command sets the frequency range for the RF spectrum result display determined from analog demodulation data. The frequency range for result display is limited to the maximum span ([SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum]) or to the measurement bandwidth of analog demodulation ([SENSe:]ADEMod:BANDwidth|BWIDth:DEModulation).

Parameter

<numeric_value>

Example

ADEM ON
Switches on the analog demodulator

CALC:FEED 'XTIM:SPEC'
Switches on RF spectrum result display"

ADEM:SPEC:SPAN:MAX 5 MHz
Sets the maximum span to 5 MHz

ADEM:SPEC:SPAN:ZOOM 1 MHz
Sets displayed span to 1 MHz

Characteristics

*RST value: 5 MHz

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:SRATe?

This command returns the sample rate set up for the current analog demodulation measurement.

Example

ADEM:SRAT?
Returns the current sample rate.

Characteristics

*RST value: –
SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:ZOOM[:STATe]

The command enables or disables the zoom function for the analog–demodulated measurement data. Depending on the selected measurement time and the demodulation bandwidth, the number of recorded test points may be greater than that shown on the display.

If the zoom function is enabled, 501 test points of the result memory are displayed from the specified start time with [SENSe:]ADEMod:ZOOM:STARt.

If the zoom function is disabled, data reduction is used to adapt the test points to the number of points available on the display.

Parameter

ON | OFF

Example

ADEM:ZOOM ON
Switches on the zoom function

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:ZOOM:STARt

The command selects the start time for the display of individual measured values of the analog demodulation. The maximum possible value depends on the measurement time, which is set in the instrument and can be queried with the [SENSe:]ADEMod:MTIMe command.

If the zoom function is enabled, 501 test points of the result memory are displayed from the specified start time with [SENSe:]ADEMod:ZOOM:STARt.

Parameter

0 s to measurement time – (500 * 1/sample rate)

Example

`ADEM:ZOOM ON`
Switches on the zoom function

`ADEM:ZOOM:STAR 500us`
Sets the starting point of the display to 500 μs.

Characteristics

*RST value: 0 s
SCPI: device–specific

Mode

ADEMOD

SENSe:BANDwidth Subsystem (Analog Demodulation, K7)

This subsystem controls the setting of the instruments filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions.

Commands of the SENSe:BANDwidth Subsystem

– [SENSe<1|2>:]BANDwidth|BWIDth:DEMod

[SENSe<1|2>:]BANDwidth|BWIDth:DEMod

This command sets the bandwidth for analog demodulation. Depending on the selected demodulation bandwidth, the instrument selects the required sampling rate.

The available values of the demodulation bandwidths are determined by the sampling rates. For details on the correlation between demodulation bandwidth and sampling rate refer to chapter "Instrument Functions", sections "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".

Parameter

<numeric_value>

Example:

`BAND:DEM 1MHz`
Sets test bandwidth to 1 MHz

Characteristics:

*RST value: 5 MHz
SCPI: device–specific

Mode

A–F, ADEMOD

SENSe:FILTer Subsystem (Analog Demodulation, K7)

The SENSe:FILTer subsystem selects the filters to reduce the bandwidth of the demodulated signal. The selected filters are used for AM, FM and PM demodulation in common.

Commands of the SENSe:FILTer subsystem

– [SENSe<1|2>:]FILTer:DEMPhasis[:STATe]

– [SENSe<1|2>:]FILTer:DEMPhasis:TCONstant

– [SENSe<1|2>:]FILTer:HPASs[:STATE]

– [SENSe<1|2>:]FILTer:HPASs:FREQuency

– [SENSe<1|2>:]FILTer:LPASs[:STATE]

– [SENSe<1|2>:]FILTer:LPASs:FREQuency[:ABSolute]

– [SENSe<1|2>:]FILTer:LPASs:FREQuency:RELative

[SENSe<1|2>:]FILTer:DEMPhasis[:STATe]

This command activates/deactivates the selected deemphasis.

The numeric suffixes <1|2> are irrelevant.

Parameter

ON | OFF

Example

```
FILT:DEMP ON
```
Activates the selected deemphasis.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:DEMPhasis:TCONstant

This command selects the deemphasis. For details on deemphasis refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)", **Deemphasis** softkey.

The numeric suffixes <1|2> are irrelevant.

Parameter

25 us | 50 us | 75 us | 750 us

Example

```
FILT:DEMP:TCON 750us
```
Selects the deemphasis for the demodulation bandwidth range from 800 Hz to 4 MHz with a time constant of 750 µs.

Characteristics

RST value: 50 us

SCPI: device–specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:HPASs[:STATE]

This command activates/deactivates the selected high pass filter.

The numeric suffixes <1|2> are irrelevant.

Parameter

ON | OFF

Example

`FILT:HPAS ON`

Activates the selected high pass filter.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:HPASs:FREQuency

This command selects the high pass filter type. For details on filters refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)", **High Pass AF Filter** softkey.

The numeric suffixes <1|2> are irrelevant.

Parameter

50Hz | 300Hz

Example

`FILT:HPAS:FREQ 300Hz`

Selects the high pass filter for the demodulation bandwidth range from 800 Hz to 16 MHz.

Characteristics

RST value: 300Hz

SCPI: device–specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:LPASs[:STATE]

This command activates/deactivates the selected low pass filter.

The numeric suffixes <1|2> are irrelevant.

Parameter

ON | OFF

Example

`FILT:LPAS ON`

Activates the selected low pass filter.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:LPASs:FREQuency[:ABSolute]

This command selects the absolute low pass filter type. For details on filters refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)", **Low Pass AF Filter** softkey.

The numeric suffixes <1|2> are irrelevant.

Parameter

3kHz | 15kHz | 150kHz

Example

`FILT:LPAS:FREQ 150kHz`

Selects the low pass filter for the demodulation bandwidth range from 400 kHz to 16 MHz.

Characteristics

RST value: 15kHz

SCPI: device–specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:LPASs:FREQuency:RELative

This command selects the relative low pass filter type. For details on filters refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)", **Low Pass AF Filter** softkey.

The numeric suffixes <1|2> are irrelevant.

Parameter

5PCT | 10PCT | 25PCT

Example

`FILT:LPAS:FREQ 25PCT`

Selects the low pass filter as 25% of the demodulation bandwidth.

Characteristics

RST value: 25PCT

SCPI: device–specific

Mode

ADEMOD

SENSe:FREQuency Subsystem (Analog Demodulation, K7)

The SENSe:FREQuency subsystem defines the frequency axis of the active display. The frequency axis can either be defined via the start/stop frequency or via the center frequency and span.

Commands of the SENSe:FREQuency Subsystem

– [SENSe<1|2>:]FREQuency:CENTer:STEP:LINK

[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK

Parameter

SPAN　　coupling to frequency display range (for RF spectrum result display)

RBW　　coupling to resolution bandwidth (for all result displays except RF spectrum)

OFF　　manual input, no coupling

SENSe:SWEep Subsystem (Analog Demodulation, K7)

The SENSe:SWEep subsystem controls the sweep parameters.

Commands of the SENSe:SWEep Subsystem

– [SENSe<1|2>:]SWEep:TIME

[SENSe<1|2>:]SWEep:TIME

Parameter

Refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".

TRACe Subsystem (Analog Demodulation, K7)

The TRACe subsystem controls access to the instruments internal trace memory.

Commands of the TRACe Subsystem

– TRACe<1|2>[:DATA]

TRACe<1|2>[:DATA]

If the analog demodulator (option Analog Demodulation, R&S FSL–K7) is active, only the displayed trace data is read out and recalled. A portion of the measurement data that can be called by means of a marker, however, is calculated from the raw measurement data. These results are no longer available after recalling a trace; the associated queries generate a query error.

TRIGger Subsystem (Analog Demodulation, K7)

The TRIGger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep.

Commands of the TRIGger Subsystem

– TRIGger<1|2>[:SEQuence]:LEVel:AM[:ABSolute]
– TRIGger<1|2>[:SEQuence]:LEVel:AM:RELative
– TRIGger<1|2>[:SEQuence]:LEVel:FM
– TRIGger<1|2>[:SEQuence]:LEVel:PM
– TRIGger<1|2>[:SEQuence]:SOURce

TRIGger<1|2>[:SEQuence]:LEVel:AM[:ABSolute]

The command sets the level when RF power signals are used as trigger source.

Note: *For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.*

Parameter

–100 to +30 dBm

Example

`TRIG:LEV:AM –30 dBm`
Sets the RF power signal trigger threshold to –30 dBm

Characteristics

*RST value: –20 dBm
SCPI: device–specific

Mode

ADEMOD

TRIGger<1|2>[:SEQuence]:LEVel:AM:RELative

The command sets the level when AM–modulated signals are used as trigger source.

Note: *For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.*

Parameter

–100 to +100 %

Example

`TRIG:LEV:AM:REL –20 %`
Sets the AM trigger threshold to –20 %

Characteristics

*RST value: 0 %
SCPI: device–specific

Mode

ADEMOD

TRIGger<1|2>[:SEQuence]:LEVel:FM

The command sets the level when FM–modulated signals are used as trigger source.

Note: *For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.*

Parameter

–10 to +10 MHz

Example

`TRIG:LEV:FM 10 kHz`
Sets the FM trigger threshold to 10 kHz

Characteristics

*RST value: 0 Hz
SCPI: device–specific

Mode

ADEMOD

TRIGger<1|2>[:SEQuence]:LEVel:PM

The command sets the level when PM–modulated signals are used as trigger source.

Note: *For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.*

Parameter

–1000 to +1000 RAD | DEG

Example

`TRIG:LEV:PM 1.2 RAD`
Sets the PM trigger threshold to 1.2 rad

Characteristics

*RST value: 0 RAD
SCPI: device–specific

Mode

ADEMOD

TRIGger<1|2>[:SEQuence]:SOURce

Parameter

IMMediate (Free Run) | EXTern | IFPower | AF | FM | AM | AMRelative | PM

The parameter AM corresponds to the RF power signal, the parameter AMRelative corresponds to the AM signal.

For details on trigger modes refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)".

Note: *For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.*

For further details refer to ".

UNIT Subsystem (Analog Demodulation, K7)

The UNIT subsystem sets the basic unit of the setting parameters.

Commands of the UNIT Subsystem

– UNIT:ANGLe

UNIT:ANGLe

This command selects the unit for angles.

Parameter
DEG | RAD

Example
UNIT:ANGL DEG

Characteristics
RST value: RAD
SCPI: conform

Mode
ADEMOD

Remote Commands of the Bluetooth Measurements Option (K8)

In this section all remote control commands for the Bluetooth Measurements option are described in detail. The abbreviation BT stands for the Bluetooth operating mode. For details on conventions used in this chapter refer to section "Notation" on page 4.1 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in "Remote Control – Description of Analyzer Commands" on page 4.3.

Subsystems of the Bluetooth Measurements option (K9)

CALCulate:BTOoth Subsystem (BLUETOOTH, K8)

The following commands are used to configure the BLUETOOTH analyzer operating mode. This operating mode requires option R&S FSL–K8.

Commands of the CALCulate:BTOoth Subsystem

– CALCulate<1|2>:BTOoth:ACLR[:LIST]?

– CALCulate<1|2>:BTOoth:ACLR:EXCeptions?

– CALCulate<1|2>:BTOoth:CFDRift[:MAXimum]?

– CALCulate<1|2>:BTOoth:CFDRift:RATE?

– CALCulate<1|2>:BTOoth:CFSTability:COUNt?

– CALCulate<1|2>:BTOoth:CFSTability:DEVM:[RMS]?

– CALCulate<1|2>:BTOoth:CFSTability:DEVM:D99Pct?

– CALCulate<1|2>:BTOoth:CFSTability:DEVM:DPCT?

– CALCulate<1|2>:BTOoth:CFSTability:DEVM:PEAK?

– CALCulate<1|2>:BTOoth:CFSTability:FERRor:[TOTal]?

– CALCulate<1|2>:BTOoth:CFSTability:FERRor:BLOCk?

– CALCulate<1|2>:BTOoth:CFSTability:FERRor:INITial?

– CALCulate<1|2>:BTOoth:DPENcoding:[TOTal]?

– CALCulate<1|2>:BTOoth:DPENcoding:BER?

– CALCulate<1|2>:BTOoth:DPENcoding:NERRor?

– CALCulate<1|2>:BTOoth:IBSemissions:[List]?

Further information

Example: Adapting the settings to the characteristics of the DUT

```
INST:SEL BTO
```
Activates the Bluetooth Measurements option
```
INIT:CONT OFF
```
Selects single sweep operation
```
CONF:BTO:CHAN 10
```
Selects channel 10
```
CONF:BTO:PCL 1
```
Selects power class 1
```
CONF:BTO:PRAT 4
```
Selects 4 points per symbol
```
CONF:BTO:PTYP DH1
```
Selects 1 slot packet
```
DDEM:SEAR:SYNC ON
```
Activates the FIND SYNC function
```
DDEM:SEAR:SYNC:OFFS 0
```
Sets the sync offset = 0
```
DDEM:SEAR:SYNC:LAP #H0
```
Sets the lower address part = 0

```
DDEM:SEAR:TIME:AUTO ON
```
Selects automatic search length

CALCulate<1|2>:BTOoth:ACLR[:LIST]?

This command determines the power of the selected adjacent channels. The number of adjacent channel pairs is defined with the CONFigure:BTOoth:ACLR:ACPairs command.

The results are returned as a list of power values. The structure of the list is as follows:

<TX channel – n>...<TX channel – 1> <TX channel> <TX channel + 1>...<TX channel + n>

The number of adjacent channels is limited at the Bluetooth band limits.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Adjacent Channel Power measurement (see CONFigure:BTOoth:MEASurement command). With all other measurements this command will lead to a query error.*

Example

INST:SEL BTO
Activates the Bluetooth Measurements option.

INIT:CONT OFF
Selects single sweep operation.

CONF:BTO:MEAS ACLR
Activates the Adjacent Channel Power measurement.

INIT;*WAI
Starts the measurement with synchronization.

CALC:BTO:ACLR?
Queries the power list.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:ACLR:EXCeptions?

This command determines the number of exceptions which occurred during the adjacent channel power measurement according to the Bluetooth specification.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Adjacent Channel Power measurement (see CONFigure:BTOoth:MEASurement command). With all other measurements this command will lead to a query error.*

Example

INST:SEL BTO
Activates the Bluetooth Measurements option.

INIT:CONT OFF
Selects single sweep operation.

CONF:BTO:MEAS ACLR
Activates the Adjacent Channel Power measurement.

INIT;*WAI
Starts the measurement with synchronization.

CALC:BTO:ACLR?
Queries the power list.

CALC:BTO:ACLR:EXC?
Queries the number of exceptions.

Characteristics
RST value: –
SCPI: device–specific

Mode
BT

CALCulate<1|2>:BTOoth:CFDRift[:MAXimum]?

This command determines the maximum Carrier Frequency Drift.

The numeric suffixes <1|2> are irrelevant for this command.

Note: This command is only available with active Carrier Frequency Drift measurement (see CONFigure:BTOoth:MEASurement command). With all other measurements this command will lead to a query error.

Example
For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

CONF:BTO:MEAS CFDR
Activates the Carrier Frequency Drift measurement.

INIT;*WAI
Starts the measurement with synchronization.

CALC:BTO:CFDR?
Queries the result.

Characteristics
RST value: –
SCPI: device–specific

Mode
BT

CALCulate<1|2>:BTOoth:CFDRift:RATE?

This command determines the maximum Carrier Frequency Drift per 50 μs.

The numeric suffixes <1|2> are irrelevant for this command.

Note: This command is only available with active Carrier Frequency Drift measurement (see CONFigure:BTOoth:MEASurement command). With all other measurements this command will lead to a query error.

Example
For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

CONF:BTO:MEAS CFDR
Activates the Carrier Frequency Drift measurement.

INIT;*WAI
Starts the measurement with synchronization.

CALC:BTO:CFDR:RATE?
Queries the result.

Characteristics
RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:CFSTability:COUNt?

This command reads the number of measured blocks during or after a measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Carrier Frequency Stability and Modulation Accuracy measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS CFST`

Activates the Carrier Frequency Stability and Modulation Accuracy measurement.

`INIT;*WAI`

Starts the measurement with synchronization.

`CALC:BTO:CFST:COUNt?`

Reads the number of measured blocks.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:CFSTability:DEVM:[RMS]?

This command reads the root mean square (RMS) of the differential error vector magnitude (DEVM) in the Carrier Frequency Stability and Modulation Accuracy measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Carrier Frequency Stability and Modulation Accuracy measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS CFST`

Activates the Carrier Frequency Stability and Modulation Accuracy measurement.

`INIT;*WAI`

Starts the measurement with synchronization.

`CALC:BTO:CFST:DEVM? AVER`

Reads the root mean square of the average differential error vector magnitude.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:CFSTability:DEVM:D99Pct?

This command reads 99% of the differential error vector magnitude (DEVM) in the Carrier Frequency Stability and Modulation Accuracy measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Carrier Frequency Stability and Modulation Accuracy measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS CFST`

Activates the Carrier Frequency Stability and Modulation Accuracy measurement.

`INIT;*WAI`

Starts the measurement with synchronization.

`CALC:BTO:CFST:DEVM:D99Pct?`

Reads 99% of the differential error vector magnitude.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:CFSTability:DEVM:DPCT?

This command is synonym to `CALCulate<1|2>:BTOoth:CFSTability:DEVM:D99Pct?`.

Characteristics

RST value: –

SCPI: conform

Mode

BT

CALCulate<1|2>:BTOoth:CFSTability:DEVM:PEAK?

This command reads the peak of the differential error vector magnitude (DEVM) in the Carrier Frequency Stability and Modulation Accuracy measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Carrier Frequency Stability and Modulation Accuracy measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

```
CONF:BTO:MEAS CFST
```
Activates the Carrier Frequency Stability and Modulation Accuracy measurement.
```
INIT;*WAI
```
Starts the measurement with synchronization.
```
CALC:BTO:CFST:DEVM:PEAK?
```
Reads the peak of the differential error vector magnitude.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:CFSTability:FERRor:[TOTal]?

This command reads the carrier frequency deviation of all packets in the Carrier Frequency Stability and Modulation Accuracy measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Carrier Frequency Stability and Modulation Accuracy measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.
```
CONF:BTO:MEAS CFST
```
Activates the Carrier Frequency Stability and Modulation Accuracy measurement.
```
INIT;*WAI
```
Starts the measurement with synchronization.
```
CALC:BTO:CFST:FERR? MIN
```
Reads the minimum carrier frequency deviation of all packets.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:CFSTability:FERRor:BLOCk?

This command reads the maximum frequency deviation of all blocks in the Carrier Frequency Stability and Modulation Accuracy measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Carrier Frequency Stability and Modulation Accuracy measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS CFST`

Activates the Carrier Frequency Stability and Modulation Accuracy measurement.

`INIT;*WAI`

Starts the measurement with synchronization.

`CALC:BTO:CFST:FERR:BLOC? AVER`

Reads the maximum average frequency deviation of all blocks.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:CFSTability:FERRor:INITial?

This command reads the combined frequency deviation of all packets and all blocks in the Carrier Frequency Stability and Modulation Accuracy measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Carrier Frequency Stability and Modulation Accuracy measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS CFST`

Activates the Carrier Frequency Stability and Modulation Accuracy measurement.

`INIT;*WAI`

Starts the measurement with synchronization.

`CALC:BTO:CFST:FERR:INIT? MAX`

Reads the combined maximum frequency deviation of all packets and all blocks.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:DPENcoding:[TOTal]?

This command reads the number of tested packets in the Differential Phase Encoding measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Differential Phase Encoding measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS DPEN`
Activates the Differential Phase Encoding measurement.

`INIT;*WAI`
Starts the measurement with synchronization.

`CALC:BTO:DPEN?`
Reads the number of tested packets.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:DPENcoding:BER?

This command reads the bit error rate (BER) in the Differential Phase Encoding measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Differential Phase Encoding measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS DPEN`
Activates the Differential Phase Encoding measurement.

`INIT;*WAI`
Starts the measurement with synchronization.

`CALC:BTO:DPEN:BER?`
Reads the bit error rate.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:DPENcoding:NERRor?

This command reads the number of passed packets in the Differential Phase Encoding measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Differential Phase Encoding measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

```
CONF:BTO:MEAS DPEN
```
Activates the Differential Phase Encoding measurement.

```
INIT;*WAI
```
Starts the measurement with synchronization.

```
CALC:BTO:DPEN:NERR?
```
Reads the number of passed packets.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:IBSemissions:[List]?

This command reads the power of all adjacent channels in the In–band Spurious Emissions measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active In–band Spurious Emissions measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

```
CONF:BTO:MEAS IBS
```
Activates the In–band Spurious Emissions measurement.

```
CONF:BTO:CHAN 7
```
Adjust the TX channel number.

```
INIT;*WAI
```
Starts the measurement with synchronization.

```
CALC:BTO:IBS?
```
Reads the results of the In–band Spurious Emissions measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:IBSemissions:EXCeptions?

This command reads the number of results that exceeded the specified limits in the In–band Spurious Emissions measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active In–band Spurious Emissions measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

```
CONF:BTO:MEAS IBS
```
Activates the In–band Spurious Emissions measurement.
```
CONF:BTO:CHAN 7
```
Adjust the TX channel number.
```
INIT;*WAI
```
Starts the measurement with synchronization.
```
CALC:BTO:IBS:EXC?
```
Reads the number of results that exceeded the specified limits.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:IBSemissions:HADJacent?

This command reads the maximum power of the upper or lower frequency band (500 kHz) of the TX channel in the In–band Spurious Emissions measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active In–band Spurious Emissions measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Parameter

UPPer | LOWer

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.
```
CONF:BTO:MEAS IBS
```
Activates the In–band Spurious Emissions measurement.
```
CONF:BTO:CHAN 7
```
Adjust the TX channel number.
```
INIT;*WAI
```
Starts the measurement with synchronization.
```
CALC:BTO:IBS:HADJ? LOW
```
Reads the maximum power of the lower frequency band.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:IBSemissions:TXReference?

This command reads the TX channel reference power.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active In–band Spurious Emissions measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

```
CONF:BTO:MEAS IBS
```
Activates the In–band Spurious Emissions measurement.

```
CONF:BTO:CHAN 7
```
Adjust the TX channel number.

```
INIT;*WAI
```
Starts the measurement with synchronization.

```
CALC:BTO:IBS:TXR?
```
Reads the TX channel reference power.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:ICFTolerance?

This command determines the Initial Carrier Frequency Tolerance.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Modulation Characteristics measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

```
CONF:BTO:MEAS ICFT
```
Activates the Initial Carrier Frequency Tolerance measurement.

```
CONF:BTO:SWE:COUN 20
```
Initiates the sweep counter with 20.

```
INIT;*WAI
```
Starts the measurement with synchronization.

```
CALC:BTO:ICFT? AVER
```
Queries the average value.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:MCHar:DF<1|2>:AVERage?

This command determines the average frequency deviation for varying bit patterns of the payload. The suffixes of DF<1|2> assign the frequency deviation and the bit pattern as follows:

Frequency deviation	$\Delta f1_{avg}$	$\Delta f2_{avg}$
Bit pattern	**"11110000"**	**"10101010"**

The numeric suffixes <1|2> of CALCulate are irrelevant for this command.

Note: *This command is only available with active Modulation Characteristics measurement (see* CONFigure:BTOoth:MEASurement *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS MCH`

Activates the Modulation Characteristics measurement.

`CONF:BTO:SWE:COUN 20`

Initiates the sweep counter with 20.

... EUT emits bit pattern 1111000

`INIT:IMM;*WAI`

Starts the measurement with synchronization and erase previous measurement results.

`CALC:BTO:MCH:DF1:AVER? MIN`

Queries minimum value "11110000".

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:MCHar:DF<1|2>:MAXimum?

This command determines the maximum frequency deviation for different bit patterns of the payload. The suffixes of DF<1|2> assign the frequency deviation and the bit pattern as follows:

Frequency deviation	$\Delta f1max$	$\Delta f2max$
Bit pattern	**"11110000"**	**"10101010"**

The numeric suffixes <1|2> of CALCulate are irrelevant for this command.

Note: *This command is only available with active Modulation Characteristics measurement (see* CONFigure:BTOoth:MEASurement *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

```
CONF:BTO:MEAS MCH
```
Activates the Modulation Characteristics measurement.
```
CONF:BTO:SWE:COUN 20
```
Initiates the sweep counter with 20.

... EUT emits bit pattern 1111000
```
INIT:IMM;*WAI
```
Starts the measurement with synchronization and erase previous measurement results.
```
CALC:BTO:MCH:DF1:MAX? MIN
```
Queries minimum value "11110000".

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:MCHar:DF2:PERCent?

This command determines the percentage of measurements of the frequency deviation, for which the value of $\Delta f2_{max}$ is within the allowed range. Therefore only the numeric suffix 2 is allowed for DF.

The numeric suffixes <1|2> of CALCulate are irrelevant for this command.

Note: *This command is only available with active Modulation Characteristics measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.
```
CONF:BTO:MEAS MCH
```
Activates the Modulation Characteristics measurement.
```
CONF:BTO:SWE:COUN 20
```
Initiates the sweep counter with 20.

... EUT emits bit pattern 10101010
```
INIT;*WAI
```
Starts the measurement with synchronization.
```
CALC:BTO:MCH:DF2:PERC?
```
Queries the percentage of "in range" measurements.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:MCHar:RATio?

This command determines the ratio of the average frequency deviations for varying bit patterns of the payload.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Modulation Characteristics measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS MCH`

Activates the Modulation Characteristics measurement.

`CONF:BTO:SWE:COUN 20`

Initiates the sweep counter with 20.

... EUT emits bit pattern 1111000

`INIT:IMM;*WAI`

Starts the measurement with synchronization and erase previous measurement results.

... EUT emits bit pattern 10101010

`INIT:CONM;*WAI`

Starts additional measurement with synchronization.

`CALC:BTO:MCH:RAT? MIN`

Queries the minimum value.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:OPOWer[:PEAK]?

This command reads the peak value of the Output Power measurement according to the BLUETOOTH standard.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Output Power measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements it will lead to a query error.*

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS OPOW`

Activates the Output Power measurement.

`INIT;*WAI`

Starts the measurement with synchronization.

`CALC:BTO:OPOW?`

Queries the output power result.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:OPOWer:AVERage?

This command reads the average value of the Output Power measurement according to the Bluetooth standard.

With a sweep count value of ≥ 1 (`CONFigure:BTOoth:SWEep:COUNt`) and trace mode clear/write (`DISPlay[:WINDow<1|2>]:TRACe<1...6>:MODE`) the selected number of measurements is performed when a single sweep is started (`INITiate<1|2>[:IMMediate]`). During these measurements the minimum and maximum values are determined. If only a single measurement is performed, the minimum and maximum value will be identical.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Output Power measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements it will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

`CONF:BTO:MEAS OPOW`

Activates the Output Power measurement.

`CONF:BTO:SWE:COUN 20`

Activates measurement over 20 sweeps.

`INIT;*WAI`

Activates measurement over 20 sweeps.

`CALC:BTO:OPOW:AVER? MAX`

Queries the maximum average value of the Output Power measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:PLENgth?

This command reads the length of the packet analyzed by the preceding measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available, if a measurement was started via* `INITiate<1|2>[:IMMediate]` *before and if this measurement is completed. With a missing or incomplete measurement the command will cause a query error.*
This command is only available with the measurements Output Power, Modulation Characteristics, Initial Carrier Frequency Tolerance, and Carrier Frequency Drift (see `CONFigure:BTOoth:MEASurement` *command).*

Example

`INST:SEL BTO`

Activates the Bluetooth Measurements option

`INIT:CONT OFF`

Selects single sweep operation

`CONF:BTO:MEAS OPOW`

Activates the Output Power measurement

`INIT;*WAI`

Starts the measurement with synchronization

`CALC:BTO:PLEN?`

Queries the packet length

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:PTYPe?

This command determines the type of the packet analyzed by a preceding measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available, if a measurement was started via*
       `INITiate<1|2>[:IMMediate]` *before and if this measurement is completed. With a*
       missing or incomplete measurement the command will cause a query error.
       This command is only available with the measurements Output Power, Modulation
       Characteristics, Initial Carrier Frequency Tolerance, and Carrier Frequency Drift (see
       `CONFigure:BTOoth:MEASurement` *command).*

Response

The following packet types are recognized and returns as character data: AUX1, DH1, DH3, DH5, DM1, DM3, DM5, FHS, HV1, HV2, HV3, DV, NULL, POLL, UNDEF

Example

`INST:SEL BTO`

Activates the Bluetooth Measurements option

`INIT:CONT OFF`

Selects single sweep operation

`CONF:BTO:MEAS OPOW`

Activates the Output Power measurement

`INIT;*WAI`

Starts the measurement with synchronization

`CALC:BTO:PTYP?`

Queries the packet type

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:RTPower:[DPSK]?

This command reads the average transmission power for the DPSK sections of the packet in the Relative Transmission Power measurement. With a sweep count ≤ 1, the command returns the current value, irrespective of the parameter.

The numeric suffixes <1|2> are irrelevant for this command.

Note: This command is only available with active Relative Transmit Power measurement (see CONFigure:BTOoth:MEASurement *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

CONF:BTO:MEAS RTP

Activates the Relative Transmit Power measurement.

CONF:BTO:SWE:COUN 10

Initiates the sweep counter with 10.

INIT;*WAI

Starts the measurement with synchronization.

CALC:BTO:RTP? MIN

Reads the lowest recorded average power of the DPSK section of all packets.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:RTPower:GFSK?

This command reads the transmission power for the GFSK sections of the packet in the Relative Transmission Power measurement. With a sweep count ≤ 1, the command returns the current value, irrespective of the parameter.

The numeric suffixes <1|2> are irrelevant for this command.

Note: This command is only available with active Relative Transmit Power measurement (see CONFigure:BTOoth:MEASurement *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

CONF:BTO:MEAS RTP

Activates the Relative Transmit Power measurement.

CONF:BTO:SWE:COUN 10

Initiates the sweep counter with 10.

INIT;*WAI

Starts the measurement with synchronization.

```
CALC:BTO:RTP:GFSK? MIN
```
Reads the highest recorded average power of the GFSK section of all packets.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:RTPower:RATio?

This command reads the ratio of the transmission power for the GFSK and DPSK modulation in the Relative Transmission Power measurement (P_{DPSK}/P_{GFSK}). With a sweep count ≤ 1, the command returns the current value, irrespective of the parameter.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Relative Transmit Power measurement (see* `CONFigure:BTOoth:MEASurement` *command). With all other measurements this command will lead to a query error.*

Parameter

MINimum | MAXimum | AVERage

Example

For the first steps refer to "Example: Adapting the settings to the characteristics of the DUT" on page 4.231.

```
CONF:BTO:MEAS RTP
```
Activates the Relative Transmit Power measurement.

```
CONF:BTO:SWE:COUN 10
```
Initiates the sweep counter with 10.

```
INIT;*WAI
```
Starts the measurement with synchronization.

```
CALC:BTO:RTP:RAT? MIN
```
Queries the minimum value.

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate<1|2>:BTOoth:STATus?

This command queries the status of a preceding measurement.

Results: 0: PASS, 1: FAIL

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available, if a measurement was started via* `INITiate<1|2>[:IMMediate]` *before and if this measurement is completed. With a missing or incomplete measurement the command will cause a query error.*

Example

```
INST:SEL BTO
```
Activates the Bluetooth Measurements option

```
INIT:CONT OFF
```
Selects single sweep operation
```
CONF:BTO:MEAS OPOW
```
Activates Output Power measurement
```
INIT;*WAI
```
Starts the measurement with synchronization
```
CALC:BTO:STAT?
```
Queries the status

Characteristics

RST value: –

SCPI: device–specific

Mode

BT

CALCulate:DELTamarker Subsystem (BLUETOOTH, K8)

The CALCulate:DELTamarker subsystem controls the delta marker functions of the instrument.

Commands of the CALCulate:DELTamarker Subsystem

– CALCulate<1|2>:DELTamarker<1...4>:Y?

CALCulate<1|2>:DELTamarker<1...4>:Y?

Depending on the unit defined with CALCulate<1|2>:UNIT:POWer or on the activated measuring functions, the query result is output in the units below:

Result display	Output unit
OUTPUT POWER result display	**dB**
TX SPECTRUM ACP result display	**dB**
MODULATION CHARACTERISTICS result display	**Hz**
INITIAL CARR FREQ TOL result display	**Hz**
CARRIER FREQ DRIFT result display	**Hz**
RELATIVE TX POWER	**dB**
IN–BAND SPURIOUS EMISSIONS	**dB**
CARRIER FREQUENCY STABILITY	**–**
DIFF PHASE ENCODING	**–**

For further details refer to "CALCulate<1|2>:DELTamarker<1...4>:Y?" on page 4.15.

CALCulate:MARKer Subsystem (BLUETOOTH, K8)

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

Commands of the CALCulate:MARKer Subsystem

– CALCulate<1|2>:MARKer<1...4>:PEXCursion

– CALCulate<1|2>:MARKer<1...4>:Y?

CALCulate<1|2>:MARKer<1...4>:PEXCursion

The unit depends on the selected operating mode.

Example

CALC:MARK:PEXC 100 HZ
Defines peak excursion 100 Hz

Characteristics

RST value: 6dB

For further details refer to "CALCulate<1|2>:MARKer<1...4>:PEXCursion" on page 4.51.

CALCulate<1|2>:MARKer<1...4>:Y?

If the analog demodulator (option Analog Demodulation, R&S FSL–K7) is activated, the query result is output in the following units:

Result display	Output unit
AM	**%**
FM	**Hz**
PM	**rad/deg (defined with UNIT:ANGLe)**
RF	**output unit defined with CALCulate<1|2>:UNIT:POWer**

For further details refer to "

CALCulate<1|2>:MARKer<1...4>:Y?" on page 4.54.

CONFigure:BTOoth Subsystem (BLUETOOTH, K8)

The following commands are used for configuration of the BLUETOOTH analyzer operating mode.

Commands of the CONFigure:BTOoth Subsystem

– CONFigure:BTOoth:ACLR:ACPairs
– CONFigure:BTOoth:BANDwidth|BWIDth[:RESolution]
– CONFigure:BTOoth:BANDwidth|BWIDth[:RESolution]:AUTO
– CONFigure:BTOoth:BANDwidth|BWIDth:VIDeo
– CONFigure:BTOoth:BANDwidth|BWIDth:VIDeo:AUTO
– CONFigure:BTOoth:CFSTability:BCOunt
– CONFigure:BTOoth:CHANnel
– CONFigure:BTOoth:DETector<1...4>[:FUNCtion]
– CONFigure:BTOoth:IBSemissions:ACPairs
– CONFigure:BTOoth:IBSemissions:GATE:AUTO
– CONFigure:BTOoth:MEASurement
– CONFigure:BTOoth:PBSCo
– CONFigure:BTOoth:PCLass
– CONFigure:BTOoth:POWer:AVERage:STARt
– CONFigure:BTOoth:POWer:AVERage:STOP
– CONFigure:BTOoth:PRATe
– CONFigure:BTOoth:PTYPe
– CONFigure:BTOoth:RTPower:DAVerage:STARt
– CONFigure:BTOoth:RTPower:DAVerage:STOP
– CONFigure:BTOoth:RTPower:GAVerage:STARt
– CONFigure:BTOoth:RTPower:GAVerage:STOP
– CONFigure:BTOoth:SWEep:COUNt
– CONFigure:BTOoth:SWEep:TIME
– CONFigure:BTOoth:SWEep:TIME:AUTO
– CONFigure:BTOoth:TRACe<1...6>:MODE
– CONFigure:BTOoth:TRACe<1...6>:SELect

CONFigure:BTOoth:ACLR:ACPairs

This command selects the number of adjacent channel pairs during the Adjacent Channel Power measurement. The number of adjacent channels will be limited as soon as the border of the Bluetooth frequency band is reached.

Note: *This command is only available with active Adjacent Channel Power measurement (see* `CONFigure:BTOoth:MEASurement` *command).*

Parameter

1 to 78

Example

CONF:BTO:ACLR:ACP 10

Selects 10 adjacent channel pairs.

Characteristics

*RST value: 78

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:BANDwidth|BWIDth[:RESolution]

This command sets the resolution bandwidth of the analyzer for the currently selected Bluetooth measurement (see [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution] command).

For the measurements of modulation characteristics, initial carrier frequency tolerance, and carrier frequency drift (CONFigure:BTOoth:MEASurement), the resolution bandwidth corresponds to the IF bandwidth of the signal. If the resolution bandwidth is changed, its coupling to the settings according to the RF Test Specification is cancelled.

Note: *The settings for the measurements are valid for all three measurements.*
For all other Bluetooth measurements the setting is only valid for the currently active measurement (see CONFigure:BTOoth:MEASurement *command).*
This command is not available with active Adjacent Channel Power measurement.

Parameter

300kHz to 10MHz

Example

INST:SEL BTO

Activates the Bluetooth Measurements option.

CONF:BTO:MEAS OPOW

Activates the Output Power measurement.

CONF:BTO:BAND 1KHZ

Sets the resolution bandwidth to 1kHz.

Characteristics

*RST value: – (AUTO is set to ON)

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:BANDwidth|BWIDth[:RESolution]:AUTO

This command couples the resolution bandwidth to the settings according to the RF Test Specification.

Note: *The settings for the measurements of Modulation Characteristics, Initial Carrier Frequency Tolerance, and Carrier Frequency Drift are common to all three measurements.*
For all other Bluetooth measurements the setting is only valid for the currently active measurement (see CONFigure:BTOoth:MEASurement *command).*

Parameter

ON | OFF

Example

INST:SEL BTO
Activates the Bluetooth Measurements option.

CONF:BTO:MEAS MCH
Activates the Modulation Characteristics measurement.

CONF:BTO:BAND:AUTO ON
Activates the RBW coupling.

Characteristics

*RST value: ON

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:BANDwidth|BWIDth:VIDeo

This command sets the video bandwidth for the Adjacent Channel Power measurement (see CONFigure:BTOoth:MEASurement command).

The available filters have a bandwidth range of 1 Hz to 10 MHz. On a change in video bandwidth its link according to the RF Test Specification is switched off.

Note: *This setting is only available for Output Power measurements.*

Parameter

1 Hz to 10 MHz

Example

INST:SEL BTO
Activates the Bluetooth Measurements option.

CONF:BTO:MEAS ACLR
Activates the Adjacent Channel Power measurement.

CONF:BTO:BAND:VID 100HZ
Sets the video bandwidth to 100 Hz.

Characteristics

*RST value: – (AUTO is set to ON)

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:BANDwidth|BWIDth:VIDeo:AUTO

This command links the video bandwidth to the settings according to the RF Test Specification. It is only available for the Adjacent Channel Power measurement (see CONFigure:BTOoth:MEASurement command).

Note: *This setting is only valid for the currently active measurement (see CONFigure:BTOoth:MEASurement command) and it is independent of the other Bluetooth measurements.*

Parameter

ON | OFF

Example

`INST:SEL BTO`
Activates the Bluetooth Measurements option.

`CONF:BTO:MEAS ACLR`
Activates the Adjacent Channel Power measurement.

`CONF:BTO:BAND:VID:AUTO ON`
Switches the VBW coupling on.

Characteristics

*RST value: ON

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:CFSTability:BCOunt

This command sets the number of blocks to be measured.

Note: *This command is only available with active Carrier Frequency Stability and Modulation Accuracy measurement (see* `CONFigure:BTOoth:MEASurement` *command).*

Parameter

0 to 1,000,000

Example

`CONF:BTO:CFST:BCO 1000`
Selects 1000 blocks to be measured.

Characteristics

RST value: 200

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:CHANnel

This command selects the frequency channel for the measurements according to the Bluetooth standard.

Parameter

0 to 78

Example

`CONF:BTO:CHAN 20`
Selects channel 20

Characteristics

*RST value: 0

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:DETector<1...4>[:FUNCtion]

This command selects the detector for the currently selected Bluetooth measurement. The numeric suffix assigns the detector to a trace (1 to 4).

Note: *The RMS detector is not available for the measurements Modulation Characteristics, Initial Carrier Frequency Tolerance, and Carrier Frequency Drift (see* CONFigure:BTOoth:MEASurement *command).*
The setting is valid for the currently selected measurement (see CONFigure:BTOoth:MEASurement *command) and independent of other Bluetooth measurements.*

Parameter

APEak | NEGative | POSitive | SAMPle | RMS | AVERage

Example

`INST:SEL BTO`
Activates the Bluetooth Measurements option.

`CONF:BTO:MEAS OPOW`
Activates the Output Power measurement.

`CONF:BTO:DET2 RMS`
Sets the detector for trace 2 to RMS.

Characteristics

*RST value:

PEAK	Output Power
AVER	Adjacent Channel Power EDR Rel TX Power EDR In–band Spurious Emissions
APEAK	Modulation Characteristics Initial Carrier Frequency Tolerance Carrier Frequency Drift EDR Differential Phase Encoding EDR Carrier Frequency Stability and Modulation Accuracy

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:IBSemissions:ACPairs

This command selects the number of adjacent channel pairs during the In–band Spurious Emissions measurement. The number of adjacent channels will be limited as soon as the border of the Bluetooth frequency band is reached.

Note: *This command is only available with active In–band Spurious Emissions measurement (see* CONFigure:BTOoth:MEASurement *command).*

Parameter

1 to 78

Example

`CONF:BTO:IBS:ACP 20`
Selects 20 adjacent channel pairs.

Characteristics

*RST value: 78

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:IBSemissions:GATE:AUTO

This command adjusts the gate settings for the In–band Spurious Emissions automatically.

Note: *This command is only available with active In–band Spurious Emissions measurement (see* `CONFigure:BTOoth:MEASurement` *command).*

Parameter

ONCE

Example

`CONF:BTO:IBS:GATE:AUTO ONCE`
Adjusts the gate automatically once.

Characteristics

RST value: ONCE

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:MEASurement

This command selects the current measurement according to the Bluetooth standard.

Parameter

OPOWer	Output Power measurement
ACLR	Adjacent Channel Power measurement
MCHar	Modulation Characteristics measurement
ICFTolerance	Initial Carrier Frequency Tolerance measurement
CFDRift	Carrier Frequency Drift measurement
RTPower	Relative Transmit Power (EDR) measurement
IBSemissions	Spurious Emissions (EDR) measurement
DPENcoding	Differential Phase Encoding (EDR) measurement
CFSTability	Carrier Frequency Stability and Modulation Accuracy (EDR) measurement

Example

`CONF:BTO:MEAS ACLR`
Selects the measurement of the adjacent channel power.

Characteristics

*RST value: OPOWer

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:PBSCo

This command selects the number of payload bytes that are transmitted in a packet.

Parameter

1 – 1000

Example

`CONF:BTO:PBSC 50`
Selects the number of payload bytes.

Characteristics

RST value: 1
SCPI: device–specific

Mode

BT

CONFigure:BTOoth:PCLass

This command selects the power class for the Output Power measurement. The power class defines the limits for the output power measurement.

Parameter

1 to 3

Example

`CONF:BTO:PCL 3`
Selects power class 3

Characteristics

*RST value: 1
SCPI: device–specific

Mode

BT

CONFigure:BTOoth:POWer:AVERage:STARt

This command defines the start position for the calculation of the average power of a burst.

> *Note:* *Depending on the setting FIND SYNC ON or OFF*
> *(`[SENSe<1|2>:]DDEMod:SEARch:SYNC[:STATe]` command) the burst is either defined by the p0 bit and the packet length or the 3 dB points according to the RF Test Specification. As a result there are different areas within the burst for calculating the average power:*
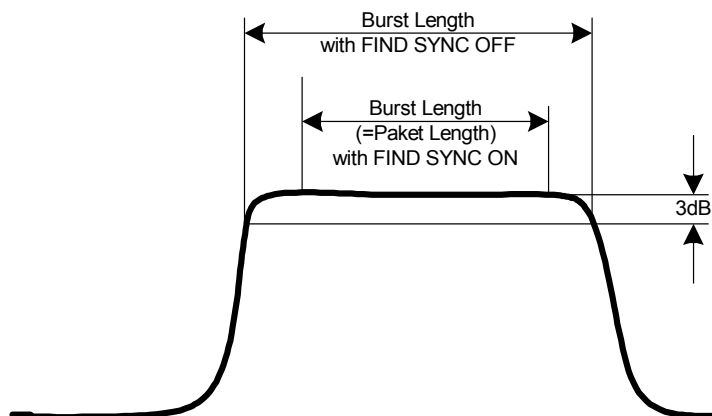
Parameter

0 to 100PCT

Example

`CONF:BTO:POW:AVER:STAR 10PCT`
Sets the starting point for the calculation to 10% of the burst length.

Characteristics

*RST value: 20%

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:POWer:AVERage:STOP

This command defines the end position for the calculation of the average power of a burst.

Note: *Depending on the setting FIND SYNC ON or OFF*
(`[SENSe<1|2>:]DDEMod:SEARch:SYNC[:STATe]` command) the burst is either
defined by the p0 bit and the packet length or the 3 dB points according to the RF Test
Specification. As a result there are different areas within the burst for calculating the
average power (see `CONFigure:BTOoth:POWer:AVERage:STARt` command).

Parameter

0 to 100PCT

Example

`CONF:BTO:POW:AVER:STAR 90PCT`
Sets the end point for the calculation to 90% of the burst length.

Characteristics

*RST value: 80%

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:PRATe

This command selects the number of measurement samples (points) per symbol for the measurement. This command is not avaiable for EDR measurements. For EDR measurements, this parameter is set to 4 points/symbol and cannot be changed.

Note: The RF Test Specification specifies an oversampling factor of at least 4.

Parameter

2 | 4 | 8 | 16 | 32

Example

```
CONF:BTO:PRAT 16
```
Selects 16 points/symbol.

Characteristics

*RST value: 4

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:PTYPe

This command selects the packet type to be measured.

Parameter

DH1   1 slot packet

DH3   3 slot packet

DH5   5 slot packet

AUTO   automatic selection of the packet type

Example

```
CONF:BTO:PTYP DH5
```
Selects type "5 slot packet".

Characteristics

*RST value: DH1

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:RTPower:DAVerage:STARt

This command sets the start time for the power measurement of the DPSK sections of the packet.

Note: This command is only available with active Relative Transmit Power measurement (see CONFigure:BTOoth:MEASurement *command).*

Parameter

0 to 100%

Example

CONF:BTO:RTP:DAV:STAR 20

Sets the start time for the power measurement of the DPSK sections of the packet.

Characteristics

RST value: 10%

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:RTPower:DAVerage:STOP

This command sets the stop time for the power measurement of the DPSK sections of the packet.

Note: This command is only available with active Relative Transmit Power measurement (see CONFigure:BTOoth:MEASurement *command).*

Parameter

0 to 100%

Example

CONF:BTO:RTP:DAV:STOP 80

Sets the stop time for the power measurement of the DPSK sections of the packet.

Characteristics

RST value: 90%

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:RTPower:GAVerage:STARt

This command sets the start time for the power measurement of the GFSK sections of the packet.

Note: This command is only available with active Relative Transmit Power measurement (see CONFigure:BTOoth:MEASurement *command).*

Parameter

0 to 100%

Example

CONF:BTO:RTP:GAV:STAR 20

Sets the start time for the power measurement of the GFSK sections of the packet.

Characteristics

RST value: 10%

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:RTPower:GAVerage:STOP

This command sets the stop time for the power measurement of the GFSK sections of the packet.

Note: *This command is only available with active Relative Transmit Power measurement (see* `CONFigure:BTOoth:MEASurement` *command).*

Parameter

0 to 100%

Example

`CONF:BTO:RTP:GAV:STOP 80`

Sets the stop time for the power measurement of the GFSK sections of the packet.

Characteristics

RST value: 90%

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:SWEep:COUNt

This command defines the number of sweeps for the currently selected Bluetooth measurement. This number will be started as a "single sweep". With trace mode setting clear/write (`CONFigure:BTOoth:TRACe<1...6>:MODE`) the measurement results will be calculated for each sweep and taken into account for the calculation of minimum, maximum and average values. For the remaining trace settings (AVER, MAXH, MINH) the measurement results will be calculated from the resulting trace. In average mode the value 0 defines the sliding average of the measurement data over 10 sweeps.

Note: *The setting is valid only for the currently active measurement (see* `CONFigure:BTOoth:MEASurement` *command) and independent of the other Bluetooth measurements.*

Parameter

0 to 32767

Example

`INST:SEL BTO`

Activates the Bluetooth Measurements option.

`CONF:BTO:MEAS OPOW`

Activates the Output Power measurement.

`INIT:CONT OFF`

Selects single sweep operation.

`CONF:BTO:SWE:COUN 20`

Sets the number of sweeps to 20.

`INIT;*OPC`

Starts a sweep with synchronization.

Characteristics

*RST value:

0	Output Power
10	Adjacent Channel Power
	Modulation Characteristics
	Initial Carrier Frequency Tolerance
	Carrier Frequency Drift
	EDR Relative TX Power
	EDR In–band Spurious Emissions
100	Differential Phase Encoding

Mode

BT

CONFigure:BTOoth:SWEep:TIME

This command defies the duration of a sweep sequence for the active Bluetooth measurement.

Parameter

<numeric_value>

(1us to 130560us) / (points per symbol)	Output Power
	Modulation Characteristics
	Initial Carrier Frequency Tolerance
	Carrier Frequency Drift
	EDR Relative TX Power
	EDR Differential Phase Encoding
	EDR Carrier Frequency Stability and Modulation Accuracy
10μs ... 16000s	Adjacent Channel Power

Direct programming using the [SENSe<1|2>:]SWEep:TIME command will cancel the coupling to the settings according to the RF Test Specification.

Note: *The setting is valid only for the currently active measurement (see* CONFigure:BTOoth:MEASurement *command) and independent of the other Bluetooth measurements.*

Example

INST:SEL BTO
Activates the Bluetooth Measurements option.

CONF:BTO:MEAS OPOW
Activates the Output Power measurement.

CONF:BTO:SWE:TIME 10MS
Sets a sweep time of 10 ms.

Characteristics

*RST value: – (AUTO is set to ON)

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:SWEep:TIME:AUTO

This command couples the sweep time to the settings according to the RF Test Specification.

Note: *The setting is valid only for the currently active measurement (see* CONFigure:BTOoth:MEASurement *command) and independent of the other Bluetooth measurements.*

Parameter

ON | OFF

Example

`INST:SEL BTO`
Activates the Bluetooth Measurements option.

`CONF:BTO:MEAS OPOW`
Activates the Output Power measurement.

`CONF:BTO:SWE:TIME:AUTO ON`
Switches the sweep time coupling on.

Characteristics

*RST value: ON
SCPI: device–specific

Mode

BT

CONFigure:BTOoth:TRACe<1...6>:MODE

This command defines the way of displaying and evaluating the measurement curves for the selected Bluetooth measurement. WRITe corresponds to manual operating mode Clr/Write.

The numeric suffix selects the trace related to this setting.

The number of measurement to be executed for AVERage, MAXHold and MINHold is defined with the CONFigure:BTOoth:SWEep:COUNt command. Please note that a synchronization to the end of the indicated number of measurements is only possible during single sweep operation.

Note: *The setting is valid only for the currently active measurement (see* CONFigure:BTOoth:MEASurement *command) and independent of the other Bluetooth measurements.*

Parameter

WRITe | VIEW | AVERage | MAXHold | MINHold | BLANk

Example

`INST:SEL BTO`
Activates the Bluetooth Measurements option.

`CONF:BTO:MEAS OPOW`
Activates the Output Power measurement.

`INIT:CONT OFF`
Selects single sweep operation.

`CONF:BTO:SWE:COUN 10`
Sets the sweep count to 10.

`CONF:BTO:TRAC2:MODE AVER`
Switches averaging for trace 2 on.

`INIT;*OPC`
Starts a measurement with synchronization.

Characteristics

*RST value: WRITe

SCPI: device–specific

Mode

BT

CONFigure:BTOoth:TRACe<1...6>:SELect

This command selects the measurement curve for evaluation of the modulation characteristics.

Example

`INST:SEL BTO`

Activates the Bluetooth Measurements option.

`CONF:BTO:MEAS ACLR`

Activates the Adjacent Channel Power measurement.

`INIT:CONT OFF`

Selects single sweep operation.

`CONF:BTO:TRAC2:SEL`

Selects trace 2 for measurement result queries.

Characteristics

*RST value: –

SCPI: device–specific

Mode

BT

DISPlay Subsystem (BLUETOOTH, K8)

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:PDIVision

– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RPOSition

– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RVALue

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:PDIVision

This command defines the scaling of the y–axis in the currently selected unit. The numeric suffix in TRACe<1...6> is irrelevant.

Parameter
<numeric_value>

Example
`DISP:TRAC:Y:PDIV 10kHz`
Sets the Y scale to 10 kHz/div.

Characteristics
*RST value: –
SCPI: conform

Mode
BT

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RPOSition

This command defines the position of the reference value. In **Bluetooth** mode, the selected reference position is valid for all measurements.

Characteristics
*RST value: 50 PCT

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RVALue

This command defines the result value assigned to the reference position on the graticule.

Example
`DISP:TRAC:Y:RVAL 0`
Sets the value assigned to the reference position to 0 Hz

Characteristics
*RST value: 0 Hz

INSTrument Subsystem (BLUETOOTH, K8)

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

Commands of the INSTrument Subsystem

– INSTrument[:SELect]
– INSTrument:NSELect

INSTrument[:SELect]

Parameter

BTOoth   Bluetooth mode (option Bluetooth Measurements, R&S FSL–K8)

For details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

INSTrument:NSELect

Parameter
<numeric value>

12   Bluetooth mode (option Bluetooth Measurements, R&S FSL–K8)

For details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

SENSe Subsystem (BLUETOOTH, K8)

The SENSe subsystem controls the essential parameters of the Bluetooth Measurements option. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The following subsystem is included:

-
-

[SENSe<1|2>:]CORRection:EGAin:INPut[:MAGNitude]

This command makes an external gain known to the analyzer, which will take it into account during the display of measurement results. With this function the gain of an antenna or of an external preamplifier can be taken into account for the measurement values.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

–200 to +200 dB

Example

```
CORR:EGA:INP 10DB
```
Takes 10 dB external gain into account

Characteristics

*RST value: 0 dB

SCPI: device–specific

Mode

BT

SENSe:ADEMod Subsystem (BLUETOOTH, K8)

The SENSe:ADEMod Subsystem contains commands to set up the instrument for the measurement of analog demodulated signals.

Commands of the SENSe:ADEMod Subsystem

- [SENSe:]ADEMod:ZOOM[:STATe]
- [SENSe:]ADEMod:ZOOM:STARt

[SENSe:]ADEMod:ZOOM[:STATe]

The command enables or disables the zoom function. Depending on the selected measurement time and the demodulation bandwidth, the number of recorded measurement points may be greater than that shown on the display.

If the zoom function is enabled, 501 test points of the result memory are displayed from the start time specified by the `[SENSe:]ADEMod:ZOOM:STARt` command.

If the zoom function is disabled, data reduction is used to adapt the measurement points to the number of points available on the display.

Note: *The zoom function is only available for the Output Power, Modulation Characteristics, Initial Carrier Frequency Tolerance, and Carrier Frequency Drift measurements.*

Parameter

ON | OFF

Example

ADEM:ZOOM ON
Switches on the zoom function

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

BT

[SENSe:]ADEMod:ZOOM:STARt

The command sets the start time for the display of individual measured values.

The zoom function is enabled or disabled by the [SENSe:]ADEMod:ZOOM[:STATe] command.

Note: *The zoom function is only available for the Output Power, Modulation Characteristics, Initial Carrier Frequency Tolerance, and Carrier Frequency Drift measurements.*

Parameter

0 s to (meas time – 500 / sampling rate)

Example

ADEM:ZOOM ON
Switches on the zoom function
ADEM:ZOOM:STAR 500us
Sets the starting point of the display to 500 μs.

Characteristics

*RST value: 0 s
SCPI: device–specific

Mode

BT

SENSe:DDEMod Subsystem (BLUETOOTH, K8)

This subsystem controls the parameters for digital demodulators.

Commands of the SENSe:DDEMod Subsystem

– [SENSe<1|2>:]DDEMod:FILTer:MEASurement
– [SENSe<1|2>:]DDEMod:SEARch:PULSe[:STATe]
– [SENSe<1|2>:]DDEMod:SEARch:PULSe:OFFSet
– [SENSe<1|2>:]DDEMod:SEARch:SYNC[:STATe]
– [SENSe<1|2>:]DDEMod:SEARch:SYNC:LAP
– [SENSe<1|2>:]DDEMod:SEARch:SYNC:OFFSet
– [SENSe<1|2>:]DDEMod:SEARch:TIME
– [SENSe<1|2>:]DDEMod:SEARch:TIME:AUTO

[SENSe<1|2>:]DDEMod:FILTer:MEASurement

This command selects the receive filter for the signal to measure.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *This command is only available with active Modulation Characteristics, Initial Carrier Frequency Tolerance, and Carrier Frequency Drift measurement (see* CONFigure:BTOoth:MEASurement *command). With all other measurements it will lead to a query error.*

Parameter

OFF | BTOoth

Example

```
DDEM:FILT:MEAS BTO
```
Activates the Bluetooth measurement filter.

Characteristics

*RST value: ON

SCPI: device–specific

Mode

BT

[SENSe<1|2>:]DDEMod:SEARch:PULSe[:STATe]

This command switches the search for a signal burst on or off.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

```
DDEM:SEAR:PULS OFF
```

Characteristics

*RST value: ON

SCPI: device–specific

Mode

BT

[SENSe<1|2>:]DDEMod:SEARch:PULSe:OFFSet

This command defines the time to be recorded before a signal burst is recognized. The valid value range is 0 to ± 10 ms.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to 10 ms

Example

DDEM:SEAR:PULS:OFFS 1MS

Sets the burst offset to 1ms before the start of the burst.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

BT

[SENSe<1|2>:]DDEMod:SEARch:SYNC[:STATe]

This command switches the search for a sync pattern on or off.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

DDEM:SEAR:SYNC ON

Switches the sync pattern search on.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

BT

[SENSe<1|2>:]DDEMod:SEARch:SYNC:LAP

This command determines the 24 least significant bits (LAP) of the DUT 'Bluetooth device address'. They are used to define the synchronization pattern to determine the start of a packet. The value range is 0 to FFFFFF hex.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<hex>

Example

DDEM:SEAR:SYNC:LAP #HA3F45B

Sets on LAP A3F45B Hex

Characteristics

*RST value: #H0

SCPI: device–specific

Mode

BT

[SENSe<1|2>:]DDEMod:SEARch:SYNC:OFFSet

This command defines the number of bits to be recorded before the first preamble bit is detected. The valid value range is 0 to ± 10000.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to 10,000

Example

```
DDEM:SEAR:SYNC:OFFS 10
```
Sets the sync offset to 10 bits before the preamble bits.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

BT

[SENSe<1|2>:]DDEMod:SEARch:TIME

This command selects manual setting of the record length and defines the record length to be used for the search of sync word and burst. The input of the record length is expected in seconds.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *For information on the correlation of trigger and record length refer to the* [SENSe<1|2>:]DDEMod:SEARch:TIME:AUTO *command.*

Parameter

$100\mu s$ to $130560\mu s$ / (points per symbol)

Points per Symbol	Maximum record length
2	**104.4 slots**
4	**52.2 slots**
8	**26.1 slots**
16	**13.1 slots**
32	**6.5 slots**

Example

```
DDEM:SEAR:TIME 100US
```
Sets the record length for sync word and burst search to $100\mu s$.

Characteristics

*RST value: $1875\mu s$

SCPI: device–specific

Mode

BT

[SENSe<1|2>:]DDEMod:SEARch:TIME:AUTO

This command activates the automatic setting of the record length for the sync word and burst search, depending on the selected packet type.

The automatic record length is determined a follows:

Trigger free run:

search length = 3 * packet length + | sync offset or burst offset |

All other trigger modes:

search length = 1 * packet length + 1 Slot + | sync offset or burst offset |

If the selected measurement time is higher than the packet length, the following difference is added to the search length:

measurement time – packet length

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

DDEM:SEAR:TIME:AUTO OFF
Selects manual input for the record length

Characteristics

*RST value: ON

SCPI: device–specific

Mode

BT

Remote Commands of the Power Meter Option (K9)

In this section all remote control commands for Power Meter option are described in detail. The abbreviation For details on conventions used in this chapter refer to section "Notation" on page 4.1 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in "Remote Control – Description of Analyzer Commands" on page 4.3.

Subsystems of the Power Meter option (K9)

– "CALCulate Subsystem (Power Meter, K9)" on page 4.273

– "CALibration Subsystem (Power Meter, K9)" on page 4.275

– "FETCh Subsystem (Power Meter, K9)" on page 4.276

– "READ Subsystem (Power Meter, K9)" on page 4.277

– "SENSe Subsystem (Power Meter, K9)" on page 4.278

– "UNIT Subsystem (Power Meter, K9)" on page 4.282

CALCulate Subsystem (Power Meter, K9)

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSe subsystem.

The following subsystems are included:

CALCulate:PMETer Subsystem (Power Meter, K9)

This subsystem controls the instrument settings for power sensor measurements.

Commands of the CALCulate:PMETer Subsystem

– CALCulate<1|2>:PMETer:RELative[:MAGNitude]

– CALCulate<1|2>:PMETer:RELative[:MAGNitude]:AUTO

– CALCulate<1|2>:PMETer:RELative:STATe

CALCulate<1|2>:PMETer:RELative[:MAGNitude]

This command sets the reference value for relative measurements.
The numeric suffixes <1|2> are irrelevant.

Parameter

–200 to 200

Example

`CALC:PMET:REL –30`
Sets the reference value for relative measurements to –30 dBm.

Characteristics

*RST value: 0
SCPI: device–specific

Mode

PSM

CALCulate<1|2>:PMETer:RELative[:MAGNitude]:AUTO

This command takes the current measurement value as reference value for relative measurements.
The numeric suffixes <1|2> are irrelevant.

Parameter

ONCE

Example

`CALC:PMET:REL:AUTO ONCE`
Takes the current measurement value as reference value for relative measurements.

Characteristics

*RST value: –

SCPI: device–specific

Mode

PSM

CALCulate<1|2>:PMETer:RELative:STATe

This command switches between relative and absolute display of the measured power.

The numeric suffixes <1|2> are irrelevant.

Parameter

ON | OFF

Example

```
CALC:PMET:REL:STAT ON
```
Activates the relative display of the measured value.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

PSM

CALibration Subsystem (Power Meter, K9)

The CALibration subsystem determines the data for system error correction in the instrument.

The following subsystem is included:

- "CALibration:PMETer Subsystem" on page 4.275

CALibration:PMETer Subsystem (Power Meter, K9)

The CALibration:PMETer Subsystem determines the error correction data for measurements in the power meter mode.

Commands of the CALibration:PMETer Subsystem

– CALibration:PMETer:ZERO:AUTO

CALibration:PMETer:ZERO:AUTO

This command starts zeroing of the power sensor.

Parameter
ONCE

Example
`:CAL:PMET:ZERO:AUTO ONCE;*WAI`
Starts zeroing and delays the execution of further commands until zeroing is concluded.

Characteristics
*RST value: –
SCPI: device–specific

Mode
PSM

FETCh Subsystem (Power Meter, K9)

The FETCh subsystem contains commands for reading out results of complex measurement tasks.

The following subsystem is included:

- "FETCh:PMETer Subsystem" on page 4.276

FETCh:PMETer Subsystem (Power Meter, K9)

The FETCh:PMETer subsystem contains commands to read measurement results of power sensor measurements without starting the measurement itself.

Commands of the FETCh:PMETer Subsystem

– FETCh<1|2>:PMETer?

FETCh<1|2>:PMETer?

This command reads the result of the power sensor measurement.

If no measurement has been performed, this command will lead to a query error. This command is a query and therefore has no *RST value.

Example

`FETC:PMET?`

Reads the result of the power sensor measurement.

Characteristics

*RST value: –

SCPI: device–specific

Mode

PSM

READ Subsystem (Power Meter, K9)

The READ subsystem contains commands for starting complex measurement tasks, and for querying the results subsequently.

The following subsystem is included:

-

READ:PMETer Subsystem

This subsystem contains commands to start power sensor measurements and to read the results after the measurement is concluded.

Commands of the READ:PMETer Subsystem

-

READ<1|2>:PMETer?

This command starts a power sensor measurement and reads the result after the measurement is concluded.

This command is a query and therefore has no *RST value.

Example

`READ:PMET?`

Starts a measurement and read the result.

Characteristics

*RST value: –

SCPI: device–specific

Mode

PSM

SENSe Subsystem (Power Meter, K9)

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device–specific settings, they do not refer to the signal characteristics of the measurement signal.

The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The following subsystems are included:

- "SENSe:PMETer Subsystem" on page 4.278

SENSe:PMETer Subsystem (Power Meter, K9)

This subsystem controls the device settings for power sensor measurements.

Commands of the SENSe:PMETer Subsystem

– [SENSe<1|2>:]PMETer[:STATe]

– [SENSe<1|2>:]PMETer:FREQuency

– [SENSe<1|2>:]PMETer:FREQuency:LINK

– [SENSe<1|2>:]PMETer:MTIMe

– [SENSe<1|2>:]PMETer:MTIMe:AVERage[:STATe]

– [SENSe<1|2>:]PMETer:MTIMe:AVERage:COUNt

– [SENSe<1|2>:]PMETer:ROFFset[:STATe]

[SENSe<1|2>:]PMETer[:STATe]

This command switches the power sensor measurements on or off.
The numeric suffixes <1|2> are irrelevant.

Parameter
ON | OFF

Example
PMET ON
Switches the power sensor measurements on.

Characteristics
*RST value: OFF
SCPI: device–specific

Mode
PSM

[SENSe<1|2>:]PMETer:FREQuency

This command sets the frequency of the power sensor. The limits f_{min} and f_{max} are defined by the power sensor.

The numeric suffixes <1|2> are irrelevant.

Parameter

f_{min} ... f_{max}

Example

`PMET:FREQ 1GHZ`

Sets the frequency of the power sensor to 1 GHz.

Characteristics

*RST value: 50 MHz

SCPI: device–specific

Mode

PSM

[SENSe<1|2>:]PMETer:FREQuency:LINK

This command sets the frequency coupling of the power sensor.

The numeric suffixes <1|2> are irrelevant.

Parameter

CENTer   couples the frequency to the center frequency of the analyzer

MARKer1   couples the frequency to the position of marker 1

OFF   switches the frequency coupling off

Example

`PMET:FREQ:LINK CENT`

Couples the frequency to the center frequency of the analyzer

Characteristics

*RST value: CENT

SCPI: device–specific

Mode

PSM

[SENSe<1|2>:]PMETer:MTIMe

This command sets the measurement duration of the power sensor.

The numeric suffixes <1|2> are irrelevant.

Parameter

SHORt | NORMal | LONG

Example

`PMET:MTIM SHOR`

Sets a short measurement duration for measurements of stationary high power signals.

Characteristics

*RST value: NORM

SCPI: device–specific

Mode

PSM

[SENSe<1|2>:]PMETer:MTIMe:AVERage[:STATe]

This command activates or deactivates manual averaging. The average count is set with the [SENSe<1|2>:]PMETer:MTIMe:AVERage:COUNt command.

Parameter

ON | OFF

Example

PMET:MTIM:AVER ON
Activates manual averaging.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

PSM

[SENSe<1|2>:]PMETer:MTIMe:AVERage:COUNt

This command defines the number of readings (averagings) to be performed after a single sweep has been started. This command is only available if the [SENSe<1|2>:]PMETer:MTIMe:AVERage[:STATe] command is set to ON.

Results become more stable with extended average, particularly if signals with low power are measured. This setting can be used to minimize the influence of noise in the power meter measurement.

Parameter

0 to 256 in binary steps (1, 2, 4, 8,…)
For average count = 0 or 1, one reading is performed.

Example

PMET:MTIM:AVER ON
Activates manual averaging.

PMET:MTIM:AVER:COUN 8
Sets the number of readings to 8.

Characteristics

RST value:

SCPI: device–specific

Mode

PSM

[SENSe<1|2>:]PMETer:ROFFset[:STATe]

This command defines whether the reference level offset set for the analyzer is taken into account for the measured power or not.

The numeric suffixes <1|2> are irrelevant.

Parameter

ON   Adds the offset defined by the DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel:OFFSet command to the measured level.

OFF   Takes no offset into account.

Example

PMET:ROFF OFF
Takes no offset into account for the measured power.

Characteristics

*RST value: ON
SCPI: device–specific

Mode

PSM

UNIT Subsystem (Power Meter, K9)

The UNIT subsystem sets the basic unit of the setting parameters.

The following subsystems are included:

- "UNIT:PMETer Subsystem" on page 4.282

UNIT:PMETer Subsystem (Power Meter, K9)

The UNIT:PMETer subsystem sets the basic unit for power sensor measurement.

Commands of the UNIT:PMETer Subsystem

- UNIT<1|2>:PMETer:POWer
- UNIT<1|2>:PMETer:POWer:RATio

UNIT<1|2>:PMETer:POWer

This command selects the unit for absolute power sensor measurement.

Parameter
DBM | WATT | W

Example
UNIT:PMET:POW DBM

Characteristics
*RST value: DBM
SCPI: conform

Mode
PSM

UNIT<1|2>:PMETer:POWer:RATio

This command selects the unit for relative power sensor measurement.

Parameter
DB | PCT

Example
UNIT:PMET:POW DB

Characteristics
*RST value: DB
SCPI: conform

Mode
PSM

Remote Commands of the Spectrogram Measurement Option (K14)

This chapter describes the remote commands for the Spectrogram Measurement option (K14). The abbreviation SPECM stands for the Spectrogram measurement mode. For details on conventions used in this chapter refer to section "Notation" on page 4.1 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in "Remote Control – Description of Analyzer Commands" on page 4.3.

Subsystems of the Spectrogram Measurement option (K14)

CALCulate Subsystem (SPECM, K14)

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSe subsystem.

The following subsystems are included:

Note: *For the search commands in x direction refer to the base unit, section "CALCulate:MARKer Subsystem" on page 4.43.*

CALCulate:DELTamarker:SPECtrogram Subsystem (SPECM, K14)

The CALCulate:DELTamarker:SPECtrogram subsystem controls the delta marker functions of the Spectrogram Measurement option.

Commands of the CALCulate:DELTamarker:SPECtrogram Subsystem

–   CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MINimum[:PEAK]

–   CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MINimum:ABOVe

–   CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MINimum:BELow

–   CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MINimum:NEXT

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:FRAMe

This command defines the frame number of the specified delta marker.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to <number of recorded frames>

If the maximum number of frames is recorded, the max. value depends on the history depth (for details refer to CALCulate<1|2>:SPECtrogram:HDEPth command)

Example

CALC:DELT3 ON

Switches on delta marker 3 or switches to delta marker mode.

CALC:DELT3:SPEC:FRAM –50

Positions delta marker 3 on frame number –50.

Characteristics

RST value: 0

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:SARea

This command defines the search area of the specified delta marker.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

VISible | MEMory

Example

CALC:DELT2 ON

Switches on delta marker 2 or switches to delta marker mode.

CALC:DELT2:SPEC:SAR MEM

Searches the whole data range stored in the history buffer.

Characteristics

RST value: VIS

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:XY:MAXimum[:PEAK]

This command positions the specified delta marker on the current maximum of the search area. The search area is defined via the CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:SARea command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`CALC:DELT2 ON`

Switches on delta marker 2 or switches to delta marker mode.

`CALC:DELT2:SPEC:XY:MAX`

Positions delta marker 2 on the current maximum.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:XY:MINimum[:PEAK]

This command positions the specified delta marker on the current minimum of the search area. The search area is defined via the

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:SARea command. .

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`CALC:DELT3 ON`

Switches on delta marker 3 or switches to delta marker mode.

`CALC:DELT3:SPEC:XY:MIN`

Positions delta marker 3 on the current minimum.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MAXimum[:PEAK]

This command positions the specified delta marker on the current maximum in y–axis direction (constant x–axis value). The corresponding search in x direction is performed via the

CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK] command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`CALC:DELT4 ON`

Switches on delta marker 4 or switches to delta marker mode.

`CALC:DELT4:SPEC:Y:MAX`

Positions delta marker 4 on the current maximum in y–axis direction.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MAXimum:ABOVe

This command positions the specified delta marker on the next maximum above its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT and CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt commands.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:DELT2 ON
Switches on delta marker 2 or switches to delta marker mode.

CALC:DELT2:SPEC:Y:MAX:ABOV
Positions delta marker 2 on the next maximum above its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MAXimum:BELow

This command positions the specified delta marker on the next maximum below its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT and CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt commands.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:DELT3 ON
Switches on delta marker 3 or switches to delta marker mode.

CALC:DELT3:SPEC:Y:MAX:BEL
Positions delta marker 3 on the next maximum below its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MAXimum:NEXT

This command positions the specified delta marker on the next maximum below or above its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:DELT4 ON
Switches on delta marker 4 or switches to delta marker mode.

```
CALC:DELT4:SPEC:Y:MAX:NEXT
```
Positions delta marker 4 on the next maximum below or above its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MINimum[:PEAK]

This command positions the specified delta marker on the current minimum in y–axis direction (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK] command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

```
CALC:DELT4 ON
```
Switches on delta marker 4 or switches to delta marker mode.
```
CALC:DELT4:SPEC:Y:MIN
```
Positions delta marker 4 on the current minimum in y–axis direction.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MINimum:ABOVe

This command positions the specified delta marker on the next minimum above its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT and CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt commands.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

```
CALC:DELT2 ON
```
Switches on delta marker 2 or switches to delta marker mode.
```
CALC:DELT2:SPEC:Y:MIN:ABOV
```
Positions delta marker 2 on the next minimum above its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MINimum:BELow

This command positions the specified delta marker on the next minimum below its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT and CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt commands.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:DELT3 ON
Switches on delta marker 3 or switches to delta marker mode.

CALC:DELT3:SPEC:Y:MIN:BEL
Positions delta marker 3 on the next minimum below its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:DELTamarker<1...4>:SPECtrogram:Y:MINimum:NEXT

This command positions the specified delta marker on the next minimum below or above its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:DELT4 ON
Switches on delta marker 4 or switches to delta marker mode.

CALC:DELT4:SPEC:Y:MIN:NEXT
Positions delta marker 4 on the next minimum below or above its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate:MARKer:SPECtrogram Subsystem (SPECM, K14)

The CALCulate:MARKer:SPECtrogram subsystem controls the marker functions of the Spectrogram Measurement option.

Commands of the CALCulate:MARKer:SPECtrogram Subsystem

– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:FRAMe
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:SARea
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:XY:MAXimum[:PEAK]
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:XY:MINimum[:PEAK]
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MAXimum[:PEAK]
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MAXimum:ABOVe
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MAXimum:BELow
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MAXimum:NEXT
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MINimum[:PEAK]
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MINimum:ABOVe
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MINimum:BELow
– CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MINimum:NEXT

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:FRAMe

This command defines the frame number of the specified marker.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to <number of recorded frames>

If the maximum number of frames is recorded, the max. value depends on the history depth (for details refer to CALCulate<1|2>:SPECtrogram:HDEPth command)

Example

```
CALC:MARK3:SPEC:FRAM –20
```
Positions marker 3 on frame number –20.

Characteristics

RST value: 0

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:SARea

This command defines the search area of the specified marker.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

VISible | MEMory

Example

```
CALC:MARK2:SPEC:SAR MEM
```
Searches the whole data range stored in the history buffer.

Characteristics

RST value: VIS

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:XY:MAXimum[:PEAK]

This command positions the specified marker on the current maximum of the search area. The search area is defined via the CALCulate<1|2>:MARKer<1...4>:SPECtrogram:SARea command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`CALC:MARK2:SPEC:XY:MAX`

Positions marker 2 on the current maximum.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:XY:MINimum[:PEAK]

This command positions the specified marker on the current minimum of the search area. The search area is defined via the CALCulate<1|2>:MARKer<1...4>:SPECtrogram:SARea command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`CALC:MARK3:SPEC:XY:MIN`

Positions marker 3 on the current minimum.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MAXimum[:PEAK]

This command positions the specified marker on the current maximum in y–axis direction (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK] command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *If no maximum value is found (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK:SPEC:Y:MAX

Positions marker 1 on the current maximum in y–axis direction.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MAXimum:ABOVe

This command positions the specified marker on the next maximum above its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT and CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt commands.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *If no next smaller maximum value is found (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:SPEC:Y:MAX

Positions marker 2 on the current maximum in y–axis direction.

CALC:MARK2:SPEC:Y:MAX:ABOV

Positions marker 2 on the next maximum above its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MAXimum:BELow

This command positions the specified marker on the next maximum below its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT and CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt commands.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *If no next smaller maximum value is found (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK3:SPEC:Y:MAX

Positions marker 3 on the current maximum in y–axis direction.

CALC:MARK3:SPEC:Y:MAX:BEL

Positions marker 3 on the next maximum below its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MAXimum:NEXT

This command positions the specified marker on the next maximum below or above its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *If no next smaller maximum value is found (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK:SPEC:Y:MAX

Positions marker 1 on the current maximum in y–axis direction.

CALC:MARK:SPEC:Y:MAX:NEXT

Positions marker 1 on the next maximum below or above its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MINimum[:PEAK]

This command positions the specified marker on the current minimum in y–axis direction (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK] command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *If no minimum value is found (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK:SPEC:Y:MIN

Positions marker 1 on the current minimum in y–axis direction.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MINimum:ABOVe

This command positions the specified marker on the next minimum above its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT and CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt commands.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Note:　*If no next higher minimum value is found (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:SPEC:Y:MIN

Positions marker 2 on the current minimum in y–axis direction.

CALC:MARK2:SPEC:Y:MIN:ABOV

Positions marker 2 on the next minimum above its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MINimum:BELow

This command positions the specified marker on the next minimum below its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT and CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt commands.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Note:　*If no next higher minimum value is found (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK3:SPEC:Y:MIN

Positions marker 3 on the current minimum in y–axis direction.

CALC:MARK3:SPEC:Y:MIN:BEL

Positions marker 3 on the next minimum below its current position.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:MARKer<1...4>:SPECtrogram:Y:MINimum:NEXT

This command positions the specified marker on the next minimum below or above its current position (constant x–axis value). The corresponding search in x direction is performed via the CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT command.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Note: *If no next higher minimum value is found (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK:SPEC:Y:MIN
Positions marker 1 on the current minimum in y–axis direction.

CALC:MARK:SPEC:Y:MIN:NEXT
Positions marker 1 on the next minimum below or above its current position.

Characteristics

RST value: –
SCPI: device–specific

Mode

SPECM

CALCulate:SPECtrogram Subsystem (SPECM, K14)

The CALCulate:SPECtrogram subsystem configures the Spectrogram Measurement option.

Commands of the CALCulate:SPECtrogram Subsystem

– CALCulate<1|2>:SPECtrogram[:STATe]
– CALCulate<1|2>:SPECtrogram:CLEar[:IMMediate]
– CALCulate<1|2>:SPECtrogram:COLor
– CALCulate<1|2>:SPECtrogram:CONTinuous
– CALCulate<1|2>:SPECtrogram:FRAMe:COUNt
– CALCulate<1|2>:SPECtrogram:FRAMe:SELect
– CALCulate<1|2>:SPECtrogram:HDEPth
– CALCulate<1|2>:SPECtrogram:SIZE
– CALCulate<1|2>:SPECtrogram:TSTamp[:STATe]
– CALCulate<1|2>:SPECtrogram:TSTamp:DATA

CALCulate<1|2>:SPECtrogram[:STATe]

This command activates or deactivates the Spectrogram Measurement option.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

```
CALC:SPEC ON
```
Activates the Spectrogram Measurement option.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:SPECtrogram:CLEar[:IMMediate]

This command deletes the spectrogram result display and the history buffer.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:SPEC ON
```
Activates the Spectrogram Measurement option.
```
CALC:SPEC:CLE
```
Deletes the spectrogram result display and the history buffer.

Characteristics

RST value: –

SCPI: device–specific

Mode
SPECM

CALCulate<1|2>:SPECtrogram:COLor

This command defines the frame color setting.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

COLor	RGB colors
RADar	black – green – white
GRAYscale	black and white

Example

`CALC:SPEC ON`
Activates the Spectrogram Measurement option.

`CALC:SPEC:COL RAD`
Sets the black–green–white color scheme for the frame coloring.

Characteristics

RST value: COL

SCPI: device–specific

Mode
SPECM

CALCulate<1|2>:SPECtrogram:CONTinuous

This command determines whether the results of the last measurement are deleted before starting a new measurement in single sweep mode.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

`CALC:SPEC ON`
Activates the Spectrogram Measurement option.

`INIT:CONT OFF`
Sets the single sweep mode.

`INIT;*WAI`
Starts the measurement and waits for the end of the single sweep measurement.

`CALC:SPEC:CONT ON`
Repeats the single sweep measurement without deleting the spectrogram results of the last measurement.

Characteristics

RST value: OFF

SCPI: device–specific

Mode
SPECM

CALCulate<1|2>:SPECtrogram:FRAMe:COUNt

This command sets the number of frames recorded in a single sweep measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

1 to <max value, depending on history depth (for details refer to
CALCulate<1|2>:SPECtrogram:HDEPth command)>

Example

CALC:SPEC ON
Activates the Spectrogram Measurement option.

INIT:CONT OFF
Sets the single sweep mode

CALC:SPEC:FRAM:COUN 200
Sets the number of frames to 200.

Characteristics

RST value: 1

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:SPECtrogram:FRAMe:SELect

This command selects the frame if no measurement is running. During a measurement, the value is fixed to 0 and this command is not available.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to <number of recorded frames>

If the maximum number of frames is recorded, the max. value depends on the history depth (for details refer to CALCulate<1|2>:SPECtrogram:HDEPth command)

Example

CALC:SPEC ON
Activates the Spectrogram Measurement option.

INIT:CONT OFF
Stops the measurement in continuous sweep mode.

CALC:SPEC:FRAM:SEL –10
Selects the frame number –10.

Characteristics

RST value: 0

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:SPECtrogram:HDEPth

This command sets the number of frames to be stored in the history buffer.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

282 to 20000

The maximum number of frames depends on the number of sweep points ([SENSe<1|2>:]SWEep:POINts command) and is determined as described in chapter 2, section Spectrogram Measurement (Option K14), Maximum number of frames.

Example

CALC:SPEC ON

Activates the Spectrogram Measurement option.

CALC:SPEC:HDEP 1000

Sets 1000 as number of frames to be stored in the history buffer.

Characteristics

RST value: 3000

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:SPECtrogram:SIZE

This command changes the screen layout.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

LARGe   Enlarges the spectrogram result display and scales down the spectrum analyzer result display.

SMALl   Divides the screen in two equally sized panes.

Example

CALC:SPEC ON

Activates the Spectrogram Measurement option.

CALC:SPEC:SIZE LARG

Enlarges the spectrogram result display.

Characteristics

RST value: SMAL

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:SPECtrogram:TSTamp[:STATe]

This command activates or deactivates the time stamp.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON | OFF

Example

`CALC:SPEC ON`
Activates the Spectrogram Measurement option.

`CALC:SPEC:TST ON`
Activates the time stamp.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

SPECM

CALCulate<1|2>:SPECtrogram:TSTamp:DATA?

This command queries the time stamp of the frames. All available frame results are returned via the `TRACe<1|2>[:DATA]?` command).

The numeric suffixes <1|2> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Parameter

CURRent   Returns the time stamp of the current frame.

ALL   Returns the time stamp of all frames sorted in a descending order, starting with the current frame.

Example

`CALC:SPEC ON`
Activates the Spectrogram Measurement option.

`CALC:SPEC:TST ON`
Activates the time stamp.

`CALC:SPEC:TST:DATA? ALL`
Returns the time stamp of all frames sorted in a descending order.

Characteristics

RST value: –

SCPI: device–specific

Mode

SPECM

INITiate Subsystem (SPECM, K14)

The INITiate subsystem is used to control the init–measurement function.

INITiate<1|2>:CONTinuous

This command starts a continuous sweep measurement or stops it and switches to single sweep mode.
The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON   Starts a continuous sweep measurement.

OFF   Stops the continuous sweep measurement and switches to single sweep mode.

Example

`INIT:CONT OFF`
Stops the continuous sweep measurement and switches to single sweep mode.

Characteristics

*RST value: ON

SCPI: conform

Mode

SPECM

MMEMory Subsystem (SPECM, K14)

The MMEMory (mass memory) subsystem provides commands which allow for access to the storage media of the instrument and for storing and loading various instrument settings.

Commands of the MMEMory Subsystem

–   MMEMory:SELect[:ITEM]:SPECtrogram

MMEMory:SELect[:ITEM]:SPECtrogram

This command adds the spectrogram data to the list of data subsets of a save/recall device setting.

Parameter

ON | OFF

Example

`MMEM:SEL:SPEC ON`
Adds the spectrogram data to the list of data subsets.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

SPECM

TRACe Subsystem (SPECM, K14)

The TRACe subsystem controls access to the instruments internal trace memory.

Commands of the TRACe Subsystem

– TRACe<1|2>[:DATA]?

TRACe<1|2>[:DATA]?

Parameter

SPECtrogram

Additional to the parameters of the base unit, the SPECtrogram parameter queries all available frame results.

Return values

All available frame results are returned. The frames are sorted according to their time stamp in descending order (starting with the current frame). The time stamp of the frames is returned via the CALCulate<1|2>:SPECtrogram:TSTamp:DATA command.

The returned values are scaled in the current level unit.

FORMat REAL,32 is used as format for binary transmission, and FORMat ASCii for ASCII transmission. For details on formats refer to "Formats for returned values: ASCII format and binary format" on page 4.201.

For further details refer to "TRACe<1|2>[:DATA]" on page 4.169.

Remote Commands of the Noise Figure Measurements Option (K30)

This chapter describes the remote commands for the Noise Figure Measurements option (K30). The abbreviation NF stands for the operating mode of noise figure measurements. For details on conventions used in this chapter refer to section "Notation" on page 4.1 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in section "Remote Control – Description of Analyzer Commands" on page 4.3.

Subsystems of the Noise Figure Measurements option (K30)

ABORt Subsystem (Noise Figure, K30)

The ABORt subsystem contains the commands for aborting triggered actions.

Commands of the ABORt Subsystem

– ABORt

ABORt

For details refer to "ABORt" on page 4.5.

CALCulate Subsystem (Noise Figure, K30)

The CALCulate subsystem checks the marker functions and contains commands for limit lines and their limit checks.

The following subsystems are included:

CALCulate:LIMit Subsystem (Noise Figure, K30)

The CALCulate:LIMit subsystem contains commands for the limit lines and the corresponding limit checks. Limit lines can be defined as upper or lower limit lines. The individual y values of the limit lines correspond to the values of the x–axis (CONTrol). The number of x and y values must be identical. For details on limit lines refer to chapter "Instrument Functions", section "Using Limit Lines and Display Lines – LINES Key".

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

The following subsystems are included:

Commands of the CALCulate:LIMit Subsystem

- CALCulate<1|2>:LIMit<1...6>:CLEar[:IMMediate]

- CALCulate<1|2>:LIMit<1...6>:COMMent

- CALCulate<1|2>:LIMit<1...6>:COPY

- CALCulate<1|2>:LIMit<1...6>:DELete

- CALCulate<1|2>:LIMit<1...6>:FAIL?

- CALCulate<1|2>:LIMit<1...6>:NAME

- CALCulate<1|2>:LIMit<1...6>:STATe

- CALCulate<1|2>:LIMit<1...6>:TRACe

CALCulate<1|2>:LIMit<1...6>:CLEar[:IMMediate]

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:CLEar[:IMMediate]" on page 4.20.

CALCulate<1|2>:LIMit<1...6>:COMMent

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:COMMent" on page 4.20.

CALCulate<1|2>:LIMit<1...6>:COPY

Parameter

1 to 6   number of the new limit line

<name>   name of the new limit line given as a string (max. 8 alphanumeric characters)

For further details refer to "CALCulate<1|2>:LIMit<1...8>:COPY" on page 4.21.

CALCulate<1|2>:LIMit<1...6>:DELete

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:DELete" on page 4.21.

CALCulate<1|2>:LIMit<1...6>:FAIL?

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:FAIL?" on page 4.22.

CALCulate<1|2>:LIMit<1...6>:NAME

This command assigns a name to a limit line. If it does not exist already, a limit line with this name is created.

The numeric suffixes <1...6> indicate the limit line.

Parameter

<name of limit line>, max. 8 alphanumeric characters

Example

```
CALC:LIM1:NAME FM1
```
Assigns the name FM1 to limit line 1.

Characteristics

*RST value: REM1 to REM6 for lines 1 to 6

SCPI: device–specific

Mode

NF

CALCulate<1|2>:LIMit<1...6>:STATe

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:STATe" on page 4.23.

CALCulate<1|2>:LIMit<1...6>:TRACe

This command assigns a limit line to a particular measurement type.

The numeric suffixes <1...6> indicate the limit line.

Parameter

NFIGure   noise figure

TEFFective   noise temperature

GAIN   gain

Example

```
CALC:LIM2:TRAC NFIG
```
Assigns limit line 2 to the noise figure measurement.
```
CALC:LIM3:TRAC GAIN
```
Assigns limit line 3 to the gain measurement.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

CALCulate:LIMit:CONTrol Subsystem (Noise Figure, K30)

The CALCulate:LIMit:CONTrol subsystem defines the x–axis (CONTrol axis).

Commands of the CALCulate:LIMit:CONTrol Subsystem

– CALCulate<1|2>:LIMit<1...6>:CONTrol[:DATA]

– CALCulate<1|2>:LIMit<1...6>:CONTrol:SHIFt

CALCulate<1|2>:LIMit<1...6>:CONTrol[:DATA]

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA]" on page 4.32.

CALCulate<1|2>:LIMit<1...6>:CONTrol:SHIFt

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt" on page 4.34.

CALCulate:LIMit:LOWer Subsystem (Noise Figure, K30)

The CALCulate:LIMit:LOWer subsystem defines the lower limit line. If a set command is issued in this subsystem the limit line effected is automatically converted to a lower limit line

Commands of the CALCulate:LIMit:LOWer Subsystem

–   CALCulate<1|2>:LIMit<1...6>:LOWer[:DATA]

–   CALCulate<1|2>:LIMit<1...6>:LOWer:SHIFt

–   CALCulate<1|2>:LIMit<1...6>:LOWer:STATe

CALCulate<1|2>:LIMit<1...6>:LOWer[:DATA]

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA]" on page 4.35.

CALCulate<1|2>:LIMit<1...6>:LOWer:SHIFt

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt" on page 4.37.

CALCulate<1|2>:LIMit<1...6>:LOWer:STATe

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:LOWer:STATe" on page 4.35.

CALCulate:LIMit:UPPer Subsystem (Noise Figure, K30)

The CALCulate:LIMit:UPPer subsystem defines the upper limit line. If a set command is issued in this subsystem the limit line effected is automatically converted to an upper limit line.

Commands of the CALCulate:LIMit:UPPer Subsystem

–   CALCulate<1|2>:LIMit<1...6>:UPPer[:DATA]

–   CALCulate<1|2>:LIMit<1...6>:UPPer:SHIFt

–   CALCulate<1|2>:LIMit<1...6>:UPPer:STATe

CALCulate<1|2>:LIMit<1...6>:UPPer[:DATA]

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA]" on page 4.39.

CALCulate<1|2>:LIMit<1...6>:UPPer:SHIFt

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt" on page 4.41.

CALCulate<1|2>:LIMit<1...6>:UPPer:STATe

Different to the basic unit, only 6 limit lines can be active at the same time (indicated by LIMIT1 to LIMIT6).

For further details refer to "

CALCulate<1|2>:LIMit<1...8>:UPPer:STATe"

CALCulate:MARKer Subsystem (Noise Figure, K30)

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

Commands of the CALCulate:MARKer Subsystem

– CALCulate:MARKer[:STATe]

– CALCulate:MARKer:AOFF

– CALCulate:MARKer:TRACe

– CALCulate:MARKer:X

– CALCulate:MARKer:Y?

– CALCulate:MARKer:MAXimum[:PEAK]

– CALCulate:MARKer:MiNimum[:PEAK]

CALCulate:MARKer[:STATe]

This command switches on or off the marker 1 for the selected trace. It is only available if measurement results are displayed.

If the selected trace is switched off (`DISPlay[:WINDow<1>]:TRACe<1|2>[:STATe]`), the marker is also switched off. If the marker is switched on again, the marker is set to the active trace. If both noise and gain traces are switched off, the marker can not be switched on again.

Parameter

ON | OFF

Example

`CALC:MARK ON`

Marker 1 is switched on.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

NF

CALCulate:MARKer:AOFF

This command switches off the marker 1.

This command is an event and therefore has no *RST value and no query.

Example

`CALC:MARK:AOFF`
Marker 1 is switched off.

Characteristics

RST value: –
SCPI: device–specific

Mode

NF

CALCulate:MARKer:TRACe

This command assigns the marker1 to the indicated trace.

Parameter

NOISe | GAIN

Example

`CALC:MARK:TRAC GAIN`
Assigns marker 1 to the gain trace.

Characteristics

RST value: NOIS
SCPI: device–specific

Mode

NF

CALCulate:MARKer:X

This command positions the marker1 to the indicated frequency measurement point. If the marker is off, it is switched on first.

Parameter

0 to MAX (frequency | sweep time)

Example

`CALC:MARK:X 550 MHZ`
Positions marker 1 to frequency 550 MHz.

Characteristics

RST value: –
SCPI: device–specific

Mode

NF

CALCulate:MARKer:Y?

This command queries the measured value of the marker 1. If the marker is off, it is switched on first. To obtain a valid query result, a complete sweep with synchronization to the sweep end must be performed before the query of the y value. The query result is output in the unit determined with the selected trace (see also `DISPlay:DATA:TRACe<1>` command).

This command is only a query and therefore has no *RST value.

Example

`CALC:MARK:Y?`
Outputs the measured value of marker 1.

Characteristics

RST value: –

SCPI: device–specific

Mode

NF

CALCulate:MARKer:MAXimum[:PEAK]

This command positions the marker to the current maximum value of the selected trace (`CALCulate:MARKer:TRACe` command). If the marker is off, it is switched on first.

This command is an event and therefore has no *RST value and no query.

Example

`CALC:MARK:MAX`
Positions marker 1 to the maximum of the selected trace.

Characteristics

RST value: –

SCPI: device–specific

Mode

NF

CALCulate:MARKer:MiNimum[:PEAK]

This command positions the marker to the current mininum value of the selected trace (`CALCulate:MARKer:TRACe` command). If the marker is off, it is switched on first.

This command is an event and therefore has no *RST value and no query.

Example

`CALC:MARK:MIN`
Positions marker 1 to the minimum of the selected trace.

Characteristics

RST value: –

SCPI: device–specific

Mode

NF

CONFigure Subsystem (Noise Figure, K30)

The CONFigure subsystem contains commands for configuring complex measurement tasks.

Commands of the CONFigure Subsystem

– CONFigure:ARRay:MEMory<1...3>

– CONFigure:CORRection

– CONFigure:LIST:CONTinuous

– CONFigure:LIST:SINGle

– CONFigure:SINGle

CONFigure:ARRay:MEMory<1...3>

This command saves the current trace results (noise figure, noise temperature and noise gain traces) to trace memory <n>.

This command is an event and therefore has no *RST value and no query.

Parameter

ONCE

Example

`INIT`
Starts a new measurement, if no measurement sequence is already in progress.

`CONF:ARR:MEM2 ONCE`
Copies the last recorded measurement result into the memory 2.

Characteristics

RST value: –

SCPI: device–specific

Mode

NF

CONFigure:CORRection

This command configures for a second stage correction measurement.

This command is an event and therefore has no *RST value and no query.

Example

`CONF:CORR`
Configures to run second stage correction measure measurements.

`INIT`
Starts a new measurement, if no measurement sequence is already in progress.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

CONFigure:LIST:CONTinuous

This command configures for a frequency list measurement in continuous sweep mode.

This command is an event and therefore has no *RST value and no query.

Example

`CONF:LIST:CONT`

Configures to run a frequency list measurement in continuous sweep mode.

`INIT`

Starts a new measurement, if no measurement sequence is already in progress.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

CONFigure:LIST:SINGle

This command configures for a frequency list measurement in single sweep mode.

This command is an event and therefore has no *RST value and no query.

Example

`CONF:LIST:SING`

Configures to run frequency list measurement in single sweep modes.

`INIT`

Starts a new measurement, if no measurement sequence is already in progress.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

CONFigure:SINGle

This command configures for a fixed frequency measurement.

This command is an event and therefore has no *RST value and no query.

Example

`CONF:SING`

Configures to run fixed frequency measurements.

`INIT`

Starts a new measurement, if no measurement sequence is already in progress.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

DISPlay Subsystem (Noise Figure, K30)

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

– DISPlay:ARRay:MEMory<1...3>[:STATe]
– DISPlay:CURRent:DATA[:STATe]
– DISPlay:DATA:TRACe<1>
– DISPlay:FORMat
– DISPlay[:WINDow<1>]:TABLe
– DISPlay[:WINDow<1>]:TRACe<1|2>[:STATe]
– DISPlay[:WINDow<1>]:TRACe<1|2>:SYMBols
– DISPlay[:WINDow<1>]:TRACe<1|2>:X[:SCALe]
– DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:AUTO
– DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:BOTTom
– DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:RLEVel
– DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:RLEVel:AUTO
– DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:TOP

DISPlay:ARRay:MEMory<1...3>[:STATe]

This command switches the display of trace memory <n> on or off.

Parameter
ON | OFF

Example
```
DISP:ARR:MEM2 ON
```
Switches on the display of memory 2.

Characteristics
RST value: OFF
SCPI: device–specific

Mode
NF

DISPlay:CURRent:DATA[:STATe]

This command switches the display of the current measurement results on or off.

Parameter

ON | OFF

Example

`DISP:CURR:DATA OFF`
Removes the current result traces from display.

Characteristics

RST value: ON

SCPI: device–specific

Mode

NF

DISPlay:DATA:TRACe<1>

This command specifies the type of noise results to be displayed in trace 1.

Only the numeric suffix <1> for noise results is valid.

Parameter

NFIGure   noise figure results in dB

TEFFective   noise temperature in K

Example

`DISP:DATA:TRAC1 NFIG`
Displays the noise figure results in trace 1.

Characteristics

*RST value: NFIGure

SCPI: device–specific

Mode

NF

DISPlay:FORMat

This command activates or deactivates the combined trace display of noise and gain results.

Parameter

SPLit | SINGle

Example

`DISP:FORM SPL`
Displays noise and gain results in separate graphs.

Characteristics

*RST value: SING

SCPI: device–specific

Mode

NF

DISPlay[:WINDow<1>]:TABLe

This command activates or deactivates the tabular result display.

Parameter

ON | OFF

Example

`DISP:TABL ON`
Displays the table of results.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

NF

DISPlay[:WINDow<1>]:TRACe<1|2>[:STATe]

This command activates or deactivates the display of the corresponding trace and related information.

The numeric suffixes <1|2> indicate the measurement results: Trace 1 is always used for noise results, and trace 2 is always used for gain results.

Parameter

ON | OFF

Example

`DISP:TRAC OFF`
Switches off the display of trace 1 (noise results).

`DISP:TRAC2 OFF`
Switches off the display of trace 2 (gain results).

Characteristics

*RST value: ON for both traces

SCPI: conform

Mode

NF

DISPlay[:WINDow<1>]:TRACe<1|2>:SYMBols

This command activates or deactivates the display of the symbols to mark the measurement points for the specified trace.

The numeric suffixes <1|2> indicate the measurement results: Trace 1 is always used for noise results, and trace 2 is always used for gain results.

Parameter

ON | OFF

Example

`DISP:TRAC ON`
Switches on the display of trace 1 (noise results).

`DISP:TRAC:SYMB ON`
Switches on the display of symbols for trace 1 (noise results)

Characteristics

*RST value: OFF for both traces

SCPI: device–specific

Mode

NF

DISPlay[:WINDow<1>]:TRACe<1|2>:X[:SCALe]

This command selects the frequency to be displayed on the x–axis if the DUT is not an amplifier, i.e. in a frequency–converting measurement mode.

The numeric suffixes <1|2> indicate the measurement results: Trace 1 is always used for noise results, and trace 2 is always used for gain results.

Parameter

IF | RF

Example

```
CONF:MODE:DUT DOWN
```
The DUT converts the input frequency to a lower output frequency.

```
DISP:TRAC:X IF
```
The IF frequency is displayed on x–axis.

Characteristics

*RST value: RF

SCPI: device–specific

Mode

NF

DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:AUTO

This command activates or deactivates the automatic scaling of the Y–axis for the specified trace display. Automatic scaling provides best fit of the Y–axis to the measurement results.

The numeric suffixes <1|2> indicate the measurement results: Trace 1 is always used for noise results, and trace 2 is always used for gain results.

Parameter

ON | OFF

Example

```
DISP:TRAC2 ON
```
Switches on the display of trace 2 (gain results).

```
DISP:TRAC2:Y:AUTO ON
```
Switches on automatic scaling of the Y–axis for trace 2.

Characteristics

*RST value: ON for both traces

SCPI: conform

Mode

NF

DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:BOTTom

This command sets the minimum (bottom) Y–axis display value for the specified trace display. It has no affect if automatic scaling of the Y–axis is enabled (`DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:AUTO` command).

The numeric suffixes <1|2> indicate the measurement results: Trace 1 is always used for noise results, and trace 2 is always used for gain results.

Parameter

noise figure:	–75 dB to 75 dB
noise temperature:	–999990000 K to 999990000 K
gain:	–75 dB to 75 dB

Example 1

`DISP:DATA:TRAC1 NFIG`
Sets the noise figure to trace1.

`DISP:TRAC ON`
Switches on the display of trace 1 (noise results).

`DISP:TRAC:Y:BOTT –30`
Sets the minimum Y–axis display to –30 dB for trace 1.

Example 2

`DISP:DATA:TRAC1 TEFF`
Sets the noise temperature to trace1.

`DISP:TRAC ON`
Switches on the display of trace 1 (noise results).

`DISP:TRAC:Y:BOTT 100`
Sets the minimum Y–axis display to 100 K for trace 1.

Example 3

`DISP:TRAC2 ON`
Switches on the display of trace 2 (gain results).

`DISP:TRAC2:Y:BOTT 1`
Sets the minimum Y–axis display to 1 dB for trace 2.

Characteristics

*RST value: 0 dB
SCPI: conform

Mode

NF

DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:RLEVel

This command sets the reference level for the Y–axis display value for all trace displays. This command has no affect if automatic reference level detection is enabled (`DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:RLEVel:AUTO` command).

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

<numeric_value> in dBm, range specified in data sheet

Example

`DISP:TRAC:Y:RLEV 0`
Sets the reference level 0 dBm

Characteristics
*RST value: –30 dBm
SCPI: conform

Mode
NF

DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:RLEVel:AUTO

This command enables or disables the automatic reference level detection.
The numeric suffixes <1|2> are irrelevant for this command.

Parameter
ON | OFF

Example
`DISP:TRAC:Y:RLEV:AUTO ON`
Turns on automatic reference level detection.

Characteristics
*RST value: ON
SCPI: conform

Mode
NF

DISPlay[:WINDow<1>]:TRACe<1|2>:Y[:SCALe]:TOP

This command sets the maximum (top) Y–axis display value for the specified trace display. It has no affect if automatic scaling of the Y–axis is enabled or the specified trace is not currently active.

The numeric suffixes <1|2> indicate the measurement results: Trace 1 is always used for noise results, and trace 2 is always used for gain results.

Parameter

noise figure:	–75 dB to 75 dB
noise temperature:	–999990000 K to 999990000 K
gain:	–75 dB to 75 dB

Example 1
`DISP:DATA:TRAC1 NFIG`
Sets the noise figure to trace1.
`DISP:TRAC:Y:TOP 30`
Sets the maximum Y–axis display to 30 dB for trace 1.

Example 2
`DISP:DATA:TRAC1 TEFF`
Sets the noise temperature to trace1.
`DISP:TRAC:Y:TOP 100`
Sets the maximum Y–axis display to 100 K for trace 1.

Example 3
`DISP:TRAC2:Y:TOP 10`
Sets the maximum Y–axis display to 10 dB for trace 2.

Characteristics

*RST value: 20 dB for noise and gain figure, 10000K for noise temperature

SCPI: conform

Mode

NF

FETCh Subsystem (Noise Figure, K30)

The FETCh subsystem retrieves results for the most recently completed fixed frequency or frequency list measurements. Frequency list results are returned as a list of results where the result is that requested in the specific fetch command. Single frequency results are single numbers in the described units.

Note: *Corrected measurements are only accessible after a calibration has been performed.*

Commands of the FETCh Subsystem

– FETCH:ARRay:MEMory<1...3>:NOISe:FIGure?

– FETCH:ARRay:MEMory<1...3>:NOISe:GAIN?

– FETCH:ARRay:MEMory<1...3>:NOISe:TEMPerature?

– FETCH:ARRay:NOISE:FIGure?

– FETCH:ARRay:NOISE:GAIN?

– FETCH:ARRay:NOISE:TEMPerature?

– FETCH:SCALar:NOISE:FIGure?

– FETCH:SCALar:NOISE:GAIN?

– FETCH:SCALar:NOISE:TEMPerature?

FETCh:ARRay:MEMory<1...3>:NOISe:FIGure?

This command queries the noise measurement results of the selected memory. The results are returned as an array of up to 100 elements of noise figure results. This command produces an error if no data is held in the selected trace memory.

This command is only a query and therefore has no *RST value.

Example

INIT

Starts a new measurement, if no measurement sequence is already in progress.

CONF:ARR:MEM2 ONCE

Copies the last recorded measurement result into the memory 2.

FETC:ARR:MEM2:NOIS:FIG?

Returns an array of 100 noise figure results from the selected memory 2.

Characteristics

RST value: –

SCPI: device–specific

Mode

NF

FETCh:ARRay:MEMory<1...3>:NOISe:GAIN?

This command queries the noise measurement results of the selected memory. The results are returned as an array of up to 100 elements of noise gain results. This command produces an error if no data is held in the selected trace memory.

This command is only a query and therefore has no *RST value.

Example

`INIT`

Starts a new measurement, if no measurement sequence is already in progress.

`CONF:ARR:MEM2 ONCE`

Copies the last recorded measurement result into the memory 2.

`FETC:ARR:MEM2:NOIS:GAIN?`

Returns an array of 100 noise gain results from the selected memory 2.

Characteristics

RST value: –

SCPI: device–specific

Mode

NF

FETCh:ARRay:MEMory<1...3>:NOISe:TEMPerature?

This command queries the noise measurement results of the selected memory. The results are returned as an array of up to 100 elements of noise temperature results. This command produces an error if no data is held in the selected trace memory.

This command is only a query and therefore has no *RST value.

Example

`INIT`

Starts a new measurement, if no measurement sequence is already in progress.

`CONF:ARR:MEM2 ONCE`

Copies the last recorded measurement result into the memory 2.

`FETC:ARR:MEM2:NOIS:TEMP?`

Returns an array of 100 noise temperature results from the selected memory 2.

Characteristics

RST value: –

SCPI: device–specific

Mode

NF

FETCh:ARRay:NOISE:FIGure?

This command queries the last recorded noise figure measurement results. The results are returned as an array of up to 100 elements of noise figure results.

This command is only a query and therefore has no *RST value.

Example

FETCh:ARRay:NOISE:FIGure?
Returns an array of 100 measured elements associated with the last noise figure measurement.

Characteristics

*RST value: –
SCPI: device–specific

Mode

NF

FETCh:ARRay:NOISE:GAIN?

This command queries the last recorded noise gain measurement results. The results are returned as an array of up to 100 elements of noise gain results.

This command is only a query and therefore has no *RST value.

Example

FETCh:ARRay:NOISE:GAIN?
Returns an array of 100 measured elements associated with the last noise gain measurement.

Characteristics

*RST value: –
SCPI: device–specific

Mode

NF

FETCh:ARRay:NOISE:TEMPerature?

This command queries the last recorded noise temperature measurement results. The results are returned as an array of up to 100 elements of noise temperature results.

This command is only a query and therefore has no *RST value.

Example

FETCh:ARRay:NOISE:TEMPerature?
Returns an array of 100 measured elements associated with the last noise temperature measurement.

Characteristics

*RST value: –
SCPI: device–specific

Mode

NF

FETCh:SCALar:NOISE:FIGure?

This command queries the last recorded noise figure measurement result for a fixed frequency measurement.

This command is only a query and therefore has no *RST value.

Example

FETCh:SCAL:NOISE:FIGure?
Returns the last noise figure measurement obtained from a fixed frequency measurement.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

FETCh:SCALar:NOISE:GAIN?

This command queries the last recorded noise gain measurement result for a fixed frequency measurement.

This command is only a query and therefore has no *RST value.

Example

FETCh:SCAL:NOISE:GAIN?
Returns the last noise gain measurement obtained from a fixed frequency measurement.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

FETCh:SCALar:NOISE:TEMPerature?

This command queries the last recorded noise temperature measurement result for a fixed frequency measurement.

This command is only a query and therefore has no *RST value.

Example

FETCh:SCAL:NOISE:TEMPerature?
Returns the last noise temperature measurement obtained from a fixed frequency measurement.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

INITiate Subsystem (Noise Figure, K30)

The INITiate subsystem configures the instrument prior to a measurement being carried out. It is basically used to tell the instrument which measurement is to be performed and takes any necessary step to set up the instrument for the measurement.

Commands of the INPut Subsystem

– INITiate[:IMMediate]

INITiate[:IMMediate]

This command initiates the start of a new measurement sequence. If a measurement sequence is already in progress, the command is ignored.

This command is an event and therefore has no *RST value and no query.

Example

```
INIT
```
Starts a new measurement, if no measurement sequence is already in progress.

Characteristics

*RST value: –
SCPI: conform

Mode

NF

INPut Subsystem (Noise Figure, K30)

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

Commands of the INPut Subsystem

– INPut<1|2>:ATTenuation
– INPut<1|2>:GAIN:STATe (option RF Preamplifier, B22)

INPut<1|2>:ATTenuation

For details refer to "INPut<1|2>:ATTenuation" on page 4.112.

INPut<1|2>:GAIN:STATe (option RF Preamplifier, B22)

For details refer to "INPut<1|2>:GAIN:STATe" on page 4.113.

INSTrument Subsystem (Noise Figure, K30)

Commands of the INSTrument Subsystem

– INSTrument[:SELect]

– INSTrument:NSELect

INSTrument[:SELect]

Parameter

NOISe (Noise Figure Measurements option, R&S FSL–K30)

For further details refer to section "INSTrument Subsystem".

INSTrument:NSELect

Parameter

19 (Noise Figure Measurements option, R&S FSL–K30)

For further details refer to section "INSTrument Subsystem".

SENSe Subsystem (Noise Figure, K30)

The SENSe subsystem is used to set and query the values of parameters in the remote instrument.

:DEFault	If a parameter has a default a value, the command parameter can be substituted with :DEFault which loads the default (reset) value of the parameter.
:UP/DOWN	In addition, all numeric values are able to take :UP or :DOWN in place of the parameter. This will increment or decrement the numeric value.
:MIN/MAX	In addition, all numeric values are able to take either :MINimum or :MAXimum as arguments to determine the minimum or maximum range available for the command.

The SENSe subsystem is divided into equipment settings and measurement settings:

- "equipment settings" on page 4.323

- "measurement settings" on page 4.329

Equipment Settings

Commands of the equipment settings

– [SENSe:]CORRection[:STATe]

– [SENSe:]CORRection:ENR:MODE

– [SENSe:]CORRection:ENR:SPOT

– [SENSe:]CORRection:ENR[:MEASurement]:TABLe:DATA

- [SENSe:]CORRection:IREJection
- [SENSe:]CORRection:LOSS:INPut:MODE
- [SENSe:]CORRection:LOSS:INPut:SPOT
- [SENSe:]CORRection:LOSS:INPut:TABLe
- [SENSe:]CORRection:LOSS:OUTPut:MODE
- [SENSe:]CORRection:LOSS:OUTPut:SPOT
- [SENSe:]CORRection:LOSS:OUTPut:TABLe
- [SENSe:]CORRection:TEMPerature

[SENSe:]CORRection[:STATe]

This command activates or deactivates the second stage correction.

Parameter

ON | OFF

Example

```
CORR ON
```
Activates the second stage correction.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

NF

[SENSe:]CORRection:ENR:MODE

This command specifies whether a constant ENR value applies for all measured frequencies or an ENR table (ENR values specified at specific input frequencies). The constant ENR value is specified by the [SENSe:]CORRection:ENR:SPOT command.

Parameter

TABLe   ENR table is used.

SPOT   Constant ENR value is used.

Example

```
CORR:ENR:MODE SPOT
```
Uses the configured constant ENR value for all measured frequencies.

Characteristics

*RST value: SPOT

SCPI: device–specific

Mode

NF

[SENSe:]CORRection:ENR:SPOT

This command sets the constant ENR value of the noise source that is used throughout the entire frequency range.

Parameter

–999.99 to 999.99 dB

Example

`CORR:ENR:MODE SPOT`
Uses the configured constant ENR value for all measured frequencies.

`CORR:ENR:SPOT 30`
Sets the constant ENR value to 30 dB for all input frequencies to be measured.

Characteristics

*RST value: 15 dB

SCPI: device–specific

Mode

NF

[SENSe:]CORRection:ENR[:MEASurement]:TABLe:DATA

This command specifies a new ENR table to determine the correct ENR (excess noise ratio) figure to be used for the input frequencies. This new list completely overwrites all current ENR frequency list entries regardless of how many entries are present and how many entries are being supplied for the new list.

Parameter

<numeric_value>,<numeric_value>, ... (maximum of 100 argument pairs)

numeric value = a frequency ENR pair of arguments

frequency: 0 Hz to 999.99 GHz.

ENR figure: –999.99 to 999.99 (value in dB, accurate to two decimal places)

Example

`CORR:ENR:MODE TABL`
Uses the ENR table.

`CORR:ENR:MEAS:TABL:DATA 1MHZ,10,2MHZ,12`
Specifies a new ENR table and overwrites the current ENR table with the two entry pairs specified.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

[SENSe:]CORRection:IREJection

This command specifies an image rejection value for the selected DUT ([SENSe:]CONFigure:MODE:DUT command) which will be effective throughout the entire frequency range.

Parameter

0 dB to 999.99 dB

Example

`CONF:MODE:DUT DOWN`
The DUT converts the input frequency to a lower output frequency.

CORR:IREJ 100
Sets an image rejection value of 100 dB.

Characteristics
*RST value: 999.99 dB
SCPI: device–specific

Mode
NF

[SENSe:]CORRection:LOSS:INPut:MODE

This command specifies whether a constant input loss value applies for all measured frequencies or an input loss list (loss input values specified at specific input frequencies). The constant loss input value is specified by the [SENSe:]CORRection:LOSS:INPut:SPOT command.

Parameter

SPOT   The constant loss input value for all measurement frequencies is used.

TABLe   The loss input table is used.

Example
CORR:LOSS:INP:MODE SPOT
Uses the configured constant loss input value for all input frequencies to be measured.

Characteristics
*RST value: SPOT
SCPI: device–specific

Mode
NF

[SENSe:]CORRection:LOSS:INPut:SPOT

This command specifies the loss input constant for all input frequencies to be measured.

Parameter
–999.99 to 999.99 dB, accurate to two decimal places

Example
CORR:LOSS:INP:MODE SPOT
Uses the configured constant loss input value for all input frequencies to be measured.
CORR:LOSS:INP:SPOT 10
Sets the internal input loss constant value to 10 dB for all input frequencies to be measured.

Characteristics
*RST value: 0 dB
SCPI: device–specific

Mode
NF

[SENSe:]CORRection:LOSS:INPut:TABLe

This command specifies a new input loss table to determine the correct input loss to be used for the input frequencies. This new list completely overwrites all current input loss list entries regardless of how many entries are present and how many entries are being supplied for the new list.

Parameter

<numeric_value>,<numeric_value>,... (maximum of 100 argument pairs)

<numeric_value>,<numeric_value> = a frequency loss pair of arguments

frequency: 0 Hz to 999.99 GHz (max. two decimal places)

loss figure: −999.99 to 999.99 (value in dB, accurate to two decimal places)

Example

`CORR:LOSS:INP:MODE TABL`
Uses the loss input table.

`CORR:LOSS:INP:TABL 1MHz,10,2MHz,12`
Specifies a new input loss table and overwrites the current input loss table with the two entry pairs specified.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

[SENSe:]CORRection:LOSS:OUTPut:MODE

This command specifies whether a constant output loss value applies for all measured frequencies or an output loss list (loss output values specified at specific input frequencies). The constant loss output value is specified by the [SENSe:]CORRection:LOSS:OUTPut:SPOT command.

Parameter

SPOT　　　The constant loss input value for all measurement frequencies is used.

TABLe　　　The loss input table is used.

Example

`CORR:LOSS:OUTP:MODE SPOT`
Uses the configured constant loss output value for all input frequencies to be measured.

Characteristics

*RST value: SPOT

SCPI: device–specific

Mode

NF

[SENSe:]CORRection:LOSS:OUTPut:SPOT

This command specifies the loss output constant for all input frequencies to be measured.

Parameter

–999.99 to 999.99 dB, accurate to two decimal places

Example

```
CORR:LOSS:OUTP:MODE SPOT
```
Uses the configured constant loss output value for all input frequencies to be measured.
```
CORR:LOSS:OUTP:SPOT 10
```
Sets the internal output loss constant value to 10 dB for all input frequencies to be measured.

Characteristics

*RST value: 0 dB

SCPI: device–specific

Mode

NF

[SENSe:]CORRection:LOSS:OUTPut:TABLe

This command specifies a new output loss table to determine the correct output loss to be used for the input frequencies. This new list completely overwrites all current output loss list entries regardless of how many entries are present and how many entries are being supplied for the new list.

Parameter

<numeric_value>,<numeric_value>,... (maximum of 100 argument pairs)

<numeric_value>,<numeric_value> = a frequency loss pair of arguments

frequency: 0 Hz to 999.99 GHz (max. two decimal places)

loss figure: –999.99 to 999.99 (value in dB, accurate to two decimal places)

Example

```
CORR:LOSS:OUTP:MODE TABL
```
Uses the loss output table.
```
CORR:LOSS:OUTP:TABL 1MHz,10,2MHz,12
```
Specifies a new output loss table and overwrites the current output loss table with the two entry pairs specified.

Characteristics

*RST value: –

SCPI: device–specific

Mode

NF

[SENSe:]CORRection:TEMPerature

This command specifies the room temperature of the operating environment. This value is taken into account when calculating noise results.

Parameter

278.15 to 318.15 K; up to 2 decimal places can be specified.

Example

`CORR:TEMP 291.50`
Specifies the room temperature to 291.50 Kelvin (18.5 C).

Characteristics

*RST value: 293 K

SCPI: device–specific

Mode

NF

Measurement Settings

Commands of the measurement settings

– [SENSe:]BANDwidth|BWIDth[:RESolution]

– [SENSe:]CONFigure:MODE:DUT

– [SENSe:]CONFigure:MODE:SYSTem:LOSCillator:FREQuency

– [SENSe:]FREQuency[:CW|:FIXed]

– [SENSe:]FREQuency:LIST:DATA

– [SENSe:]FREQuency:STARt

– [SENSe:]FREQuency:STEP

– [SENSe:]FREQuency:STOP

– [SENSe:]SWEep:COUNt

– [SENSe:]SWEep:TIME

[SENSe:]BANDwidth|BWIDth[:RESolution]

For details refer to "[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]" on page 4.120.

[SENSe:]CONFigure:MODE:DUT

This command defines the type of DUT. This setting determines the method that is used to create the frequency measurement list. Fixed local oscillator frequencies are taken from the settings supplied by `[SENSe:]CONFigure:MODE:SYSTem:LOSCillator:FREQuency`.

Parameter

AMPLifier   The DUT is an amplifier and not a frequency converting device.

DOWNconv   The DUT converts the input frequency to a lower output frequency:
             Fixed LO, IF=RF+LO

UPConv   The DUT converts the input frequency to a higher output frequency:
             Fixed LO, IF=abs(RF–LO).

Example

SENS:CONF:MODE:DUT DOWN
The DUT converts the input frequency to a lower output frequency.

Characteristics

*RST value: AMPLifier

SCPI: device–specific

Mode

NF

[SENSe:]CONFigure:MODE:SYSTem:LOSCillator:FREQuency

This command specifies a fixed local oscillator frequency for a new frequency measurement list in frequency–converting measurement mode. If this value is altered, a new frequency list is generated.

Parameter

0 Hz to 999.99 GHz

Example

SENS:CONF:MODE:DUT DOWN
The DUT converts the input frequency to a lower output frequency.

SENS:CONF:MODE:SYST:LOSC:FREQ 1MHZ
Specifies the fixed local oscillator frequency for a new list to a value of 1 MHz.

Characteristics

*RST value: – 0 Hz

SCPI: device–specific

Mode

NF

[SENSe:]FREQuency[:CW|:FIXed]

This command specifies a fixed frequency to measure noise and gain continuously (fixed frequency measurement).

Parameter

<numeric value>

Example

CONF:SING
Configures to run fixed frequency measurements.

FREQ 10MHZ
Sets a fixed frequency of 10 MHz.

Characteristics

*RST value: 550 MHz

SCPI: conform

Mode

NF

[SENSe:]FREQuency:LIST:DATA

This command specifies a new frequency list (for frequency list measurement). Each list entry consists of three separate frequency entities: a receive frequency (RF), a local oscillator frequency (LO), and an intermediate frequency (IF). The new list completely overwrites all the current frequency list entries regardless of how many entries are present and how many entries are being supplied for the new list. The new list is the active list until a new list is automatically created.

The values specified in this command are not used for a fixed frequency measurement (CONFigure:SINGle command).

Parameter

<numeric_value>,<numeric_value>, ... (max. of 100 argument)

numeric value = set of three frequency measurements in the following order: fixed frequency, local oscillator frequency, and intermediate frequency. The frequency range depends on the selected measurement mode:

direct measurement	RF: 0 Hz to f_{max}
frequency–converting measurement	RF, LO: 0 Hz to 999.99 GHz IF: 0 Hz to f_{max}

Example

FREQ:LIST:DATA 550MHz,300MHz,900MHz
Specifies one entry frequency list with a receive frequency of 550 MHz, a local oscillator frequency of 300 MHz, and an intermediate frequency of 900 MHz.

Characteristics

*RST value: 550 MHz | 0 Hz | 550 MHz

SCPI: device–specific

Mode

NF

[SENSe:]FREQuency:STARt

This command specifies the start frequency for a new frequency measurement list. If this value is altered, a new frequency list is generated.

Parameter

<numeric value>

Example

FREQ:STAR 500MHZ
Sets the start frequency for a new list to a value of 500 MHz.

Characteristics

*RST value: 550 MHz

SCPI: conform

Mode

NF

[SENSe:]FREQuency:STEP

This command specifies the step frequency for a new frequency measurement list. If this value is altered, a new frequency list is generated.

Parameter

<numeric value>

Example

FREQ:STEP 10MHZ

Sets the step frequency for a new list to a value of 10 MHz.

Characteristics

*RST value: 2 MHz

SCPI: device–specific

Mode

NF

[SENSe:]FREQuency:STOP

This command specifies the stop frequency for a new frequency measurement list. If this value is altered, a new frequency list is generated.

Parameter

<numeric value>

Example

FREQ:STOP 700MHZ

Sets the stop frequency for a new list to a value of 700 MHz.

Characteristics

*RST value: 560 MHz

SCPI: conform

Mode

NF

[SENSe:]SWEep:COUNt

This command specifies the number of sweeps over which the measurement results are averaged. The higher the number of sweeps, the more accurate the results. However, a high number of sweeps requires a longer measurement time.

Parameter

1 to 32767

Example

SWE:COUN 10

Sets the number of sweeps for averaging to 10.

Characteristics

*RST value: 1

SCPI: conform

Mode

NF

[SENSe:]SWEep:TIME

For details refer to "[SENSe<1|2>:]SWEep:TIME" on page 4.155.

STATus Subsystem (Noise Figure, K30)

The STATus subsystem contains the commands for the status reporting system (See Section ""). *RST does not influence the status registers.

Commands of the STATus subsystem

– STATus:QUESionable:CORRection[:EVENt]?

– STATus:QUESionable:CORRection:CONDition?

– STATus:QUESionable:CORRection:ENABle

– STATus:QUESionable:CORRection:NTRansition

– STATus:QUESionable:CORRection:PTRansition

– STATus:QUEStionable:FREQuency[:EVENt]?

– STATus:QUEStionable:FREQuency:CONDition?

– STATus:QUEStionable:FREQuency:ENABle

– STATus:QUEStionable:FREQuency:NTRansition

– STATus:QUEStionable:FREQuency:PTRansition

– STATus:QUEStionable:LIMit<1|2> [:EVENt]?

– STATus:QUEStionable:LIMit<1|2>:CONDition?

– STATus:QUEStionable:LIMit<1|2>:ENABle

– STATus:QUEStionable:LIMit<1|2>:NTRansition

– STATus:QUEStionable:LIMit<1|2>:PTRansition

STATus:QUESionable:CORRection[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:CORRection register. Readout deletes the contents of the EVENt section.

Example

STAT:QUES:CORR?

Characteristics

*RST value: –

SCPI: conform

Mode

NF

STATus:QUESionable:CORRection:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:CORRection register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:CORR:COND?

Characteristics

*RST value: –

SCPI: conform

Mode

NF

STATus:QUESionable:CORRection:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:CORRection register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:CORR:ENAB 65535

All events bits are represented in the CORRection summary bit.

Characteristics

*RST value: –

SCPI: conform

Mode

NF

STATus:QUESionable:CORRection:NTRansition

This command determines what bits in the STATus:QUESionable:CORRection Condition register set the corresponding bit in the STATus:QUESionable:CORRection Event register if that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:CORR:NTR 65535

All condition bits are summarized in the Event register if a positive transition occurs.

Characteristics

*RST value: –

SCPI: conform

Mode

NF

STATus:QUESionable:CORRection:PTRansition

This command determines what bits in the STATus:QUESionable:CORRection Condition register set the corresponding bit in the STATus:QUESionable:CORRection Event register if that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:CORR:PTR 65535

All condition bits are summarized in the Event register if a positive transition occurs.

Characteristics

*RST value: –

SCPI: conform

Mode

NF

STATus:QUEStionable:FREQuency[:EVENt]?

For details refer to "STATus:QUEStionable:FREQuency[:EVENt]?" on page 4.159.

STATus:QUEStionable:FREQuency:CONDition?

For details refer to "STATus:QUEStionable:FREQuency:CONDition?" on page 4.160.

STATus:QUEStionable:FREQuency:ENABle

For details refer to "STATus:QUEStionable:FREQuency:ENABle" on page 4.160.

STATus:QUEStionable:FREQuency:NTRansition

This command determines what bits in the STATus:QUESionable:FREQuency Condition register set the corresponding bit in the STATus:QUESionable:FREQuency Event register if that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:FREQ:NTR 65535

All condition bits are summarized in the Event register if a positive transition occurs.

Characteristics

*RST value: –

SCPI: conform

Mode

NF

STATus:QUEStionable:FREQuency:PTRansition

This command determines what bits in the STATus:QUESionable:FREQuency Condition register set the corresponding bit in the STATus:QUESionable:FREQuency Event register if that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:FREQ:PTR 65535
All condition bits are summarized in the Event register if a positive transition occurs.

Characteristics

*RST value: –
SCPI: conform

Mode

NF

STATus:QUEStionable:LIMit<1|2> [:EVENt]?

For details refer to "STATus:QUEStionable:LIMit<1|2> [:EVENt]?" on page 4.161.

STATus:QUEStionable:LIMit<1|2>:CONDition?

For details refer to "STATus:QUEStionable:LIMit<1|2>:CONDition?" on page 4.161.

STATus:QUEStionable:LIMit<1|2>:ENABle

For details refer to "STATus:QUEStionable:LIMit<1|2>:ENABle" on page 4.162.

STATus:QUEStionable:LIMit<1|2>:NTRansition

This command determines what bits in the STATus:QUESionable:LIMit Condition register set the corresponding bit in the STATus:QUESionable:LIMit Event register if that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:NTR 65535
All condition bits are summarized in the Event register if a positive transition occurs.

Characteristics

*RST value: –
SCPI: device–specific

Mode

NF

STATus:QUEStionable:LIMit<1|2>:PTRansition

This command determines what bits in the STATus:QUESionable:LIMit Condition register set the corresponding bit in the STATus:QUESionable:LIMit Event register if that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

`STAT:QUES:PTR 65535`
All condition bits are summarized in the Event register if a positive transition occurs.

Characteristics

*RST value: –
SCPI: device–specific

Mode

NF

SYSTem Subsystem (Noise Figure, K30)

This subsystem contains a series of commands for general functions.

Commands of the SYSTem subsystem

- SYSTem:CONFigure:DUT:GAIN
- SYSTem:CONFigure:DUT:STIMe

SYSTem:CONFigure:DUT:GAIN

This command specifies the maximum gain of the DUT.

Parameter

10 dB to 999.99 dB

Example

SYST:CONF:DUT:GAIN 10
Specifies the gain of the DUT to be 10 dB.

Characteristics

*RST value: 30 dB
SCPI: device–specific

Mode

NF

SYSTem:CONFigure:DUT:STIMe

This command spcifies the DUT settling time. It represents the time to wait for the DUT to settle after a noise source has been turned on or off.

Parameter

0 to 20 s

Example

SYST:CONF:DUT:STIM 1000MS
Specifies a period of one second for the DUT to settle down after exposure to the noise source has been removed.

Characteristics

*RST value: 50 milliseconds
SCPI: device–specific

Mode

NF

Remote Commands of the 3GPP Base Station Measurements Option (K72)

This chapter describes the remote commands for the 3GPP Base Station Measurements option (K72). The abbreviation WCDMA stands for the operating mode of this option. For details on conventions used in this chapter refer to section "Notation" on page 4.1 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in section "Remote Control – Description of Analyzer Commands" on page 4.3.

Subsystems of the 3GPP Base Station Measurements option (K72)

ABORt Subsystem (WCDMA, K72)

The ABORt subsystem contains the commands for aborting triggered actions.

Commands of the ABORt Subsystem

– ABORt

ABORt

For details refer to "ABORt" on page 4.5.

CALCulate Subsystem (WCDMA, K72)

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSe subsystem.

The following subsystems are included:

CALCulate:DELTamarker Subsystem (WCDMA, K72)

The CALCulate:DELTamarker subsystem controls the delta marker functions of the instrument.

Commands of the CALCulate:DELTamarker Subsystem

- CALCulate<1|2>:DELTamarker<1...4>[:STATe]
- CALCulate<1|2>:DELTamarker<1...4>:AOFF
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:CPICh
- CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PCCPch
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt
- CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt
- CALCulate<1|2>:DELTamarker<1...4>:X
- CALCulate<1|2>:DELTamarker<1...4>:X:RELative?
- CALCulate<1|2>:DELTamarker<1...4>:Y?

CALCulate<1|2>:DELTamarker<1...4>[:STATe]

For details refer to "CALCulate<1|2>:DELTamarker<1...4>[:STATe]" on page 4.7.

CALCulate<1|2>:DELTamarker<1...4>:AOFF

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:AOFF" on page 4.7.

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:CPICh

This command sets the active delta marker on the common pilot channel.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:DELT1:FUNC:CPIC

Sets the active delta marker on the common pilot channel.

Characteristics

RST value: –

SCPI: device–specific

Mode

WCDMA

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PCCPch

This command sets the active delta marker on the primary common control physical channel.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

CALC:DELT1:FUNC:PCCP

Sets the active delta marker on the primary common control physical channel.

Characteristics

RST value: –

SCPI: device–specific

Mode

WCDMA

CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]" on page 4.11.

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT" on page 4.11.

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT" on page 4.11.

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt" on page 4.12.

CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]" on page 4.12.

CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT" on page 4.12.

CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT" on page 4.13.

CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt" on page 4.13.

CALCulate<1|2>:DELTamarker<1...4>:X

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:X" on page 4.14.

CALCulate<1|2>:DELTamarker<1...4>:X:RELative?

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:X:RELative?" on page 4.15.

CALCulate<1|2>:DELTamarker<1...4>:Y?

For details refer to "CALCulate<1|2>:DELTamarker<1...4>:Y?" on page 4.15.

CALCulate:FEED Subsystem (WCDMA, K72)

The CALCulate:FEED subsystem selects the evaluation method of the measured code domain power data. This corresponds to the selection of the result display in manual mode.

Commands of the CALCulate:FEED Subsystem

– CALCulate<1|2>:FEED

CALCulate<1|2>:FEED

This command selects the result display for the Code Domain Power Diagram measurement.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

	Result display	Display format
XPOWer:CDP	**Code Domain Power Diagram in relative scaling**	**bar graph**
XPOWer:CDP:ABSolute	**Code Domain Power Diagram in absolute scaling**	**bar graph**
XTIMe:CDPower:ERRor:CTABle	**Code Domain Channel Table**	**channel assignment table**
XTIMe:CDPower:ERRor:SUMMary	**Code Domain Result Summary (default setting)**	**results in table format**

Example

```
CALC:FEED 'XPOW:CDP'
```
Selects the Code Domain Power Diagram result display in absolute scaling.

Characteristics
RST value: –
SCPI: device–specific

Mode
WCDMA

CALCulate:LIMit:ESPectrum (WCDMA, K72)

The CALCulate:LIMit:ESPectrum subsystem defines limit checking for RF measurements.

Commands of the CALCulate:LIMit:ESPectrum Subsystem

– CALCulate<1|2>:LIMit<1...8>:ESPectrum:MODE

– CALCulate<1|2>:LIMit<1...8>:ESPectrum:RESTore

– CALCulate<1|2>:LIMit<1...8>:ESPectrum:TRANsition

– CALCulate<1|2>:LIMit<1...8>:ESPectrum:VALue

CALCulate<1|2>:LIMit<1...8>:ESPectrum:MODE

This command activates or deactivates automatic selection of the limit line in the spectrum emission mask measurement.
The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

Parameter

AUTO   Sets the limit line automatically according to the power determined in the useful channel.

MANual   Activates the selected predefined limit lines.
The selection is made with the
CALCulate<1|2>:LIMit<1...8>:ESPectrum:VALue command.

USER   Activates the user–defined limit lines.
(for details refer to "Using Limit Lines and Display Lines – LINES Key").

Example
CONF:WCDP:MEAS ESP
Selects the spectrum emission mask measurement.
CALC:LIM:ESP:MODE MAN
Activates the selected predefined limit lines.

Characteristics
RST value: AUTO
SCPI: device–specific

Mode
WCDMA

CALCulate<1|2>:LIMit<1...8>:ESPectrum:RESTore

This command restores the standard limit lines for the spectrum emission mask measurement. All modifications made to the standard limit lines are lost and the factory–set values are restored.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

`CONF:WCDP:MEAS ESP`
Selects the spectrum emission mask measurement.

`CALC:LIM:ESP:REST`
Sets the spectrum emission mask limit lines back to the factory–set values.

Characteristics

RST value: –
SCPI: device–specific

Mode

WCDMA

CALCulate<1|2>:LIMit<1...8>:ESPectrum:TRANsition

This command defines the offset frequency at which the resolution bandwidth is changed.
The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

Parameter

30 kHz to 1 MHz

Example

`CONF:WCDP:MEAS ESP`
Selects the spectrum emission mask measurement.

`CALC:LIM:ESP:TRAN 5MHZ`
Defines the offset frequency at which the resolution bandwidth is changed.

Characteristics

RST value: 4.0 MHz
SCPI: device–specific

Mode

WCDMA

CALCulate<1|2>:LIMit<1...8>:ESPectrum:VALue

This command selects one of the following predefined limit lines. As a prerequisite, the predefined limit lines must be activated using the CALCulate<1|2>:LIMit<1...8>:ESPectrum:MODE command.

The numeric suffixes <1|2> and <1...8> are irrelevant for this command.

Parameter

43	P $\geq$ 43 dBm
39	39 dBm $\leq$ P < 43 dBm
31	31 dBm $\leq$ P < 39 dBm
0	P < 31 dBm

P stands for the expected power value.

Example

`CONF:WCDP:MEAS ESP`
Selects the spectrum emission mask measurement.

`CALC:LIM:ESP:MODE MAN`
Activates the selected predefined limit lines.

`CALC:LIM:ESP:VAL 39`
Selects the predefined limit line **39 dBm** $\leq$ **P < 43 dBm**.

Characteristics

RST value: 0
SCPI: device–specific

Mode

WCDMA

CALCulate:MARKer Subsystem (WCDMA, K72)

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

Commands of the CALCulate:MARKer Subsystem

– CALCulate<1|2>:MARKer<1...4>[:STATe]
– CALCulate<1|2>:MARKer<1...4>:AOFF
– CALCulate<1|2>:MARKer<1...4>:FUNCtion:CPICh
– CALCulate<1|2>:MARKer<1...4>:FUNCtion:PCCPch
– CALCulate<1|2>:MARKer<1...4>:FUNCtion:WCDPower[:BTS]:RESult?
– CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]
– CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT
– CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT
– CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt
– CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK]
– CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT
– CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT
– CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt
– CALCulate<1|2>:MARKer<1...4>:X
– CALCulate<1|2>:MARKer<1...4>:Y?

CALCulate<1|2>:MARKer<1...4>[:STATe]

For details refer to "

CALCulate<1|2>:MARKer<1...4>:AOFF

For details refer to "CALCulate<1|2>:MARKer<1...4>:AOFF" on page 4.44.

CALCulate<1|2>:MARKer<1...4>:FUNCtion:CPICh

This command sets the active marker on the common pilot channel.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`CALC:MARK1:FUNC:CPIC`
Sets the active marker on the common pilot channel.

Characteristics

RST value: –
SCPI: device–specific

Mode

WCDMA

CALCulate<1|2>:MARKer<1...4>:FUNCtion:PCCPch

This command sets the active marker on the primary common control physical channel.

This command is an event and therefore has no *RST value and no query.

The numeric suffixes <1|2> are irrelevant for this command.

Example

`CALC:MARK1:FUNC:PCCP`
Sets the active marker on the primary common control physical channel.

Characteristics

RST value: –
SCPI: device–specific

Mode

WCDMA

CALCulate<1|2>:MARKer<1...4>:FUNCtion:WCDPower[:BTS]:RESult?

This command queries the measured and calculated results of the code domain power measurement. The results are calculated from the recorded IQ data set.

This command is only a query and therefore has no *RST value.

The numeric suffixes <1|2> and <1...4> are irrelevant for this command.

Parameter

CDPabsolute	channel power absolute
CDPRelative	channel power relative
CERRor	chip rate error
CHANnel	channel number
CSLot	channel slot number
EVMRms	error vector magnitude RMS

FERRor	frequency error in Hz
IQIMbalance	I/Q imbalance
IQOFfset	I/Q offset
MACCuracy	composite EVM
MTYPe	modulation type
PCDerror	peak code domain error
PTOTal	total power
RHO	rho value for every slot
SRATe	symbol rate
TFRame	trigger to frame
TOFFset	timing offset

Example

CALC:MARK:FUNC:WCDP:RES? CDP
Queries the absolute channel power.

Characteristics

RST value: –

SCPI: device–specific

Mode

WCDMA

CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]

For details refer to "CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]" on page 4.47.

CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT

For details refer to "CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT" on page 4.47.

CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT

For details refer to "CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT" on page 4.48.

CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt

For details refer to "CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt" on page 4.48.

CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK]

For details refer to "CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK]" on page 4.49.

CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT

For details refer to "CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT" on page 4.49.

CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT

CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt

For details refer to "CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt" on page 4.50.

CALCulate<1|2>:MARKer<1...4>:X

For details refer to "CALCulate<1|2>:MARKer<1...4>:X" on page 4.51.

CALCulate<1|2>:MARKer<1...4>:Y?

For details refer to "CALCulate<1|2>:MARKer<1>:Y" on page 4.54.

CONFigure:WCDPower Subsystem (WCDMA, K72)

The CONFigure subsystem contains commands for configuring the measurements.

Commands of the CONFigure:WCDPower Subsystem

– CONFigure:WCDPower:[BTS]:MEASurement

CONFigure:WCDPower:[BTS]:MEASurement

This command selects the measurements with their predefined settings according to the 3GPP standard.

Parameter

ACLR	adjacent–channel power measurement
ESPectrum	measurement of spectrum emission mask
POWer	channel power measurement
WCDPower	code domain power measurement

Example

```
CONF:WCDP:MEAS POW
```
Selects the channel power measurement.

Characteristics

RST value: WCDP

SCPI: device–specific

Mode

WCDMA

DISPlay Subsystem (WCDMA, K72)

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

– DISPlay[:WINDow<1|2>]:TRACe<1...6>[:STATe]

– DISPlay[:WINDow<1|2>]:TRACe<1...6>:MODE

– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:PDIVision

– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel

– DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel:OFFSet

– **Error! Reference source not found.**

DISPlay[:WINDow<1|2>]:TRACe<1...6>[:STATe]

For details refer to "DISPlay[:WINDow<1|2>]:TRACe<1...6>[:STATe]" on page 4.104.

DISPlay[:WINDow<1|2>]:TRACe<1...6>:MODE

Parameter

WRITe | VIEW | AVERage | MAXHold | MINHold

For details on trace modes refer to chapter "Instrument Functions", section "Trace mode overview".

For further details refer to "DISPlay[:WINDow<1|2>]:TRACe<1...6>:MODE" on page 4.105.

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:PDIVision

This command defines the scaling of the y–axis in dB.

The numeric suffixes <1|2> and <1...6> are irrelevant.

Parameter

0.01 to 100 dB

Example

`DISP:TRAC:Y:PDIV +10DB`
Sets the Y scale to 10 dB/div.

Characteristics

*RST value: 7

SCPI: conform

Mode

WCDMA

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel

For details refer to "DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel" on page 4.107.

DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel:OFFSet

For details refer to "DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel:OFFSet" on page 4.107.

INITiate Subsystem (WCDMA, K72)

The INITiate subsystem is used to control the init–measurement function.

Commands of the INITiate Subsystem

– INITiate<1|2>[:IMMediate]

– INITiate<1|2>:CONTinuous

INITiate<1|2>[:IMMediate]

For details refer to "INITiate<1|2>[:IMMediate]" on page 4.109.

INITiate<1|2>:CONTinuous

For details refer to "
INITiate<1|2>:CONTinuous" on page 4.110.

INPut Subsystem (WCDMA, K72)

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

Commands of the INPut Subsystem

– INPut:ATTenuation

– INPut:ATTenuation:AUTO

– INPut:GAIN:STATe

INPut:ATTenuation

For details refer to "INPut<1|2>:ATTenuation" on page 4.112.

INPut:ATTenuation:AUTO

For details refer to "INPut<1|2>:ATTenuation:AUTO" on page 4.112.

INPut:GAIN:STATe

For details refer to "INPut<1|2>:GAIN:STATe" on page 4.113.

INSTrument Subsystem (WCDMA, K72)

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

Commands of the INSTrument Subsystem

– INSTrument[:SELect]

– INSTrument:NSELect

INSTrument[:SELect]

Parameter

BWCD (3GPP Base Station Measurements option, R&S FSL–K72)

For further details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

INSTrument:NSELect

Parameter

8 (3GPP Base Station Measurements option, R&S FSL–K72)

For further details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

SENSe Subsystem (WCDMA, K72)

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device–specific settings, they do not refer to the signal characteristics of the measurement signal.

The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The following subsystems are included:

- "SENSe:AVERage Subsystem (WCDMA, K72)" on page 4.355
- "SENSe:CDPower Subsystem (WCDMA, K72)" on page 4.355
- "SENSe:FREQuency Subsystem (WCDMA, K72)" on page 4.362
- "SENSe:SWEep Subsystem (WCDMA, K72)" on page 4.363

SENSe:AVERage Subsystem (WCDMA, K72)

The SENSe:AVERage subsystem calculates the average of the acquired data. A new test result is obtained from several successive measurements.

Commands of the SENSe:AVERage Subsystem

– [SENSe<1|2>:]AVERage:COUNt

[SENSe<1|2>:]AVERage:COUNt

For details refer to "[SENSe<1|2>:]AVERage:COUNt" on page 4.118.

SENSe:CDPower Subsystem (WCDMA, K72)

The SENSe:CDPower subsystem controls the parameters for the code domain mode. The numeric suffix in SENSe<1|2> is not significant in this subsystem.

Commands of the SENSe:CDPower Subsystem

– [SENSe<1|2>:]CDPower:ANTenna
– [SENSe<1|2>:]CDPower:ASEQuence
– [SENSe<1|2>:]CDPower:CODE
– [SENSe<1|2>:]CDPower:HSDPamode
– [SENSe<1|2>:]CDPower:ICTReshold
– [SENSe<1|2>:]CDPower:LCODe[:VALue]
– [SENSe<1|2>:]CDPower:LCODe:DVALue
– [SENSe<1|2>:]CDPower:LCODe:SEARch[:IMMediate]
– [SENSe<1|2>:]CDPower:LCODe:SEARch:LIST?
– [SENSe<1|2>:]CDPower:LEVel:ADJust
– [SENSe<1|2>:]CDPower:NORMalize
– [SENSe<1|2>:]CDPower:PREFerence

- – [SENSe<1|2>:]CDPower:QINVert
- – [SENSe<1|2>:]CDPower:RSUMmary
- – [SENSe<1|2>:]CDPower:SLOT
- – [SENSe<1|2>:]CDPower:STYPe

[SENSe<1|2>:]CDPower:ANTenna

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

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

OFF   The antenna diversity mode is switched off.

1 | 2   The antenna diversity mode is switched on, and the signal from antenna 1 or antenna 2 is used for code domain power analysis.

Example

`CDP:ANT 1`
The signal from antenna 1 is used for code domain power analysis.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:ASEQuence

This command starts the following sequence:

- – Adjusts the reference level.
- – Searches automatically the scrambling code that leads to the highest signal power and stores it as new scrambling code.
- – Changes into the Result Summary result display.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

`CDP:ASEQ`

Characteristics

RST value: –

SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:CODE

This command sets the code number. The code number refers to code class 9 (spreading factor 512).

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to 511

Example

CDP:CODE 30

Sets code number 30.

Characteristics

RST value: 0

SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:HSDPamode (K74)

This command activates or deactivates the HSUPA/DPA channel detection.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON　　　The high speed channels can be detected.

　　　　The modulation type (QPSK /16QAM) is detected.

OFF　　The high speed channel can not be detected.

　　　　Pilot symbols are detected.

Example

CDP:HSDP OFF

Deactivates the HSUPA/DPA channel detection.

Characteristics

RST value: ON

SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:ICTReshold

This command sets the minimum power threshold for a single channel (channel power compared to total signal power). Only channels with a signal power above this value are recognized as active channels.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

–100 dB to 10 dB

Example

CDP:ICTR –10

Sets the minimum power threshold to –10 dB.

Characteristics

RST value: –60 dB

SCPI: device–specific

Mode
WCDMA

[SENSe<1|2>:]CDPower:LCODe[:VALue]

This command defines the scrambling code in hexadecimal format.
The numeric suffixes <1|2> are irrelevant for this command.

Parameter
0x0 … 0x5FFF

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

Characteristics
RST value: 0
SCPI: device–specific

Mode
WCDMA

[SENSe<1|2>:]CDPower:LCODe:DVALue

This command defines the scrambling code in decimal format.
The numeric suffixes <1|2> are irrelevant for this command.

Parameter
0 to 24575

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

Characteristics
RST value: 0
SCPI: device–specific

Mode
WCDMA

[SENSe<1|2>:]CDPower:LCODe:SEARch[:IMMediate]

This command searches automatically the scrambling code that leads to the highest signal power and stores it as new scrambling code for further measurements.
The numeric suffixes <1|2> are irrelevant for this command.
This command is an event and therefore has no *RST value and no query.

Example
CDP:LCOD:SEAR

Characteristics
RST value: –
SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:LCODe:SEARch:LIST?

This command returns a comma separated result table of the automatic search sequence containing the highest power values calculated and the corresponding scrambling codes.

The numeric suffixes <1|2> are irrelevant for this command.

This command is only a query and therefore has no *RST value.

Returned value

Each found scrambling code consists of the following line:

<decimal scrambling code value>, <hexadecimal scrambling code value>, <power in dBm>

Example:

16,0x10,–18.04,32,0x20,–22.87,48,0x30,–27.62,64,0x40,–29.46

in table format:

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

Example

`CDP:LCOD:SEAR`
Starts the automatic scrambling code search.

`CDP:LCOD:SEAR:LIST?`
Lists the result table of the automatic search sequence.

Characteristics

RST value: –

SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:LEVel:ADJust

This command adjusts the reference level to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S ZVL or limiting the dynamic range by an S/N ratio that is too small.

The numeric suffixes <1|2> are irrelevant for this command.

This command is an event and therefore has no *RST value and no query.

Example

`CDP:LEV:ADJ`
Adjusts the reference level to the measured channel power.

Characteristics

RST value: –

SCPI: device–specific

Mode
WCDMA

[SENSe<1|2>:]CDPower:NORMalize

This command activates and deactivates the elimination of the I/Q offset.
The numeric suffixes <1|2> are irrelevant for this command.

Parameter
ON | OFF

Example
`CDPower:NORMalize ON`
Activates the elimination of the I/Q offset.

Characteristics
RST value: OFF
SCPI: device–specific

Mode
WCDMA

[SENSe<1|2>:]CDPower:PREFerence

This command sets the power reference for the relative power displays.
The numeric suffixes <1|2> are irrelevant for this command.

Parameter

TOT   total power

CPICH   power of the common pilot channel

Example
`CDP:PREF TOT`
Sets the total power as power reference.

Characteristics
RST value: CPICH
SCPI: device–specific

Mode
WCDMA

[SENSe<1|2>:]CDPower:QINVert

This command activates or deactivates the Q inversion.
The numeric suffixes <1|2> are irrelevant for this command.

Parameter

ON   The sign of the Q–component of the signal is inverted.

OFF   The sign of the Q–component of the signal remains unchanged.

Example
`CDP:QINV ON`
Activates the Q inversion.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:RSUMmary

This command sets the view of the Code Domain Result Summary.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

NORmal   Some of the most important results are shown in the table on the R&S ZVL display.

EXTended   All available result are shown in the table on the R&S ZVL display.

Example

```
CDP:RSUM EXT
```
Sets the extended view of the Code Domain Result Summary.

Characteristics

RST value: NOR

SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:SLOT

This command selects the slot that is evaluated in the Code Domain Power Diagram and is used for slot–based evaluations in the Code Domain Result Summary.

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

0 to 14

Example

```
CDP:SLOT 3
```
Selects slot 3.

Characteristics

RST value: 0

SCPI: device–specific

Mode

WCDMA

[SENSe<1|2>:]CDPower:STYPe

This command defines the synchronization..

The numeric suffixes <1|2> are irrelevant for this command.

Parameter

CPICh   A synchronization to the CPICH control channel is performed. As a prerequisite, the CPICH control channel must be present in the signal.

SCHannel   A synchronization without assuming the presence of a CPICH channel is performed.

                While this setting can also be used with other channel configurations, but the probability of synchronization failure increases with the number of data channels.

Example

CDP:STYP SCH

A synchronization without assuming the presence of a CPICH channel is performed.

Characteristics

RST value: CPICH

SCPI: device–specific

Mode

WCDMA

SENSe:FREQuency Subsystem (WCDMA, K72)

The SENSe:FREQuency subsystem defines the frequency axis of the active display. The frequency axis can either be defined via the start/stop frequency or via the center frequency and span.

Commands of the SENSe:FREQuency Subsystem

–   [SENSe<1|2>:]FREQuency:CENTer
–   [SENSe<1|2>:]FREQuency:CENTer:STEP
–   [SENSe<1|2>:]FREQuency:OFFSet

[SENSe<1|2>:]FREQuency:CENTer

For details refer to "[SENSe<1|2>:]FREQuency:CENTer" on page 4.127.

[SENSe<1|2>:]FREQuency:CENTer:STEP

For details refer to "[SENSe<1|2>:]FREQuency:CENTer:STEP" on page 4.127.

[SENSe<1|2>:]FREQuency:OFFSet

For details refer to "[SENSe<1|2>:]FREQuency:OFFSet" on page 4.129.

SENSe:SWEep Subsystem (WCDMA, K72)

The SENSe:SWEep subsystem controls the sweep parameters.

Commands of the SENSe:SWEep Subsystem

–   [SENSe<1|2>:]SWEep:COUNt

[SENSe<1|2>:]SWEep:COUNt

STATus:QUEStionable Subsystem (WCDMA, K72)

The STATus:QUEStionable subsystem contains information about the error situation in the code domain power analysis.

Commands of the STATus:QUEStionable Subsystem

–   STATus:QUEStionable:SYNC[:EVENt?]

–   STATus:QUEStionable:SYNC:CONDition?

STATus:QUEStionable:SYNC[:EVENt?]

For details refer to "STATus:QUEStionable:SYNC[:EVENt]?" on page 4.166.

STATus:QUEStionable:SYNC:CONDition?

For details refer to "STATus:QUEStionable:SYNC:CONDition?" on page 4.166.

TRACe Subsystem (WCDMA, K72)

The TRACe subsystem controls access to the instruments internal trace memory.

Commands of the TRACe Subsystem

– TRACe<1|2>[:DATA]

– TRACe1:DATA? LIST

TRACe<1|2>[:DATA]

Parameter for code domain power measurements
TRACE1 | PWCDp | CWCDp | CTABle

Transmitted values for code domain power measurements
The transmitted values depend on the parameter selection.

Value	Description	Range	Unit
<code class>	**code class of the channel**	{–1, 2 ... 9}	
	–1 indicates that the channel does not have a code class (e.g. for PSCH)		
<class>	**spreading factor of the channel**		
	code class 9 corresponds to the highest spreading factor (512, symbol rate 7.5 ksps), code class 2 to the lowest admissible spreading factor (4, symbol rate 960 ksps)		
	–1 indicates that the channel does not have a valid spreading factor (e.g. for PSCH)		
<channel number>	**code number of the channel**		
	–1 indicates that the channel does not have a regular channel number (e.g. for PSCH)		
<absolute level>	**absolute level of the code channel at the selected channel slot**	{–∞ ... ∞ }	dBm
<relative level>	**relative level of the code channel at the selected channel slot referenced to CPICH or total power**	{–∞ ... ∞ }	dB
<timing offset>	**timing offset of the code channel to the frame start**	{0 ... 38400}	chips
	step width is 256 chips for code class 2 to 8, 512 chips for code class 9		
<pilot length>	**pilot length of the code channel**	{0,2,4,8,16}	symbols
	According to the 3GPP standard, the pilot length range depends on the code class.		
<active flag>	**Flag to indicate whether a channel is active (1) or not active (0)**	{0,1}	
<channel type>	**channel type indication**	{0 ... 16}	
	0 = DPCH, 1 = PICH, 2 = CPICH, 3 = PSCH, 4 = SSCH, 5 = PCCPCH6 = SCCPCH, 7 = HS_SCCH, 8 = HS_PDSCH, 9 = CHAN, 10 = CPRSD, 11 = CPR–TPC, 12 = CPR–SF/2, 13 = CPR–SF/2–TPC, 14 = EHICH–ERGCH, 15 = EAGCH, 16 = SCPICH		
<modulation type>	**modulation type of the code channel at the selected channel slot**	{2,4,15}	
	2 = QPSK, 4 = 16QAM, 15 = NONE		
<reserved>	**reserved for future functionality**	{0}	

TRACE1

5 values are transmitted for each channel:

<class>,<channel number>,<absolute level>,<relative level>,<timing offset>, ...

For the Code Dom Power Diagram result display, the channels are output in ascending order sorted by code number, i.e. in the same sequence they are displayed on screen.

For the Code Dom Channel Table result display, the channels are sorted by code class, i.e. the unassigned channels are transmitted last.

PWCDp

6 values are transmitted for each channel:

< class>,<channel number>,<absolute level>,<relative level>,<timing offset> or <I/Q–mapping>, <pilot length>,...

CWCDp

10 values are transmitted for each channel:

<code class>,<channel number>,<absolute level>,<relative level>, <timing offset>, <pilot length>, <active flag>, <channel type>, <modulation type>, <reserved>, ...

The channels are output in ascending order sorted by code number, i.e. in the same sequence they are displayed on screen.

CTABle

7 values are transmitted for each channel:

< class>,<channel number>,<absolute level>,<relative level>,<timing offset>,<pilot length>, <active|inactive>...

Parameter for RF measurements

TRACE1 | TRACE2 | TRACE3 | TRACE4 | LIST,<block> | <numeric_value>

TRACE1 to TRACE4	trace memory to be read out
LIST	peak list data
<block> or <numeric_value>	data to be transferred

(For further details refer to "TRACe<1|2>[:DATA]" on page 4.169.

TRACe1:DATA? LIST

This command queries the list evaluation results. All results are float values.

This command is only a query and therefore has no *RST value.

Returned values

<no>, <start>, <stop>, <rbw>, <freq>, <power abs>, <power rel>, <delta>, <limit check>, <unused1>, <unused2>

Value	Description
<no>	**range number**
<start>	**start frequency**
<stop>	**stop frequency**
<rbw>	**resolution bandwidth of range**
<freq>	**frequency of peak**
<power abs>	**absolut power in dBm of peak**
<power rel>	**relative power in dBc (related to the channel power) of peak**
<delta>	**distance to the limit line in dB (positive indicates value above the limit, fail)**
<limit check>	**limit fail (pass = 0, fail =1)**
<unused1>	**reserved (0.0)**
<unused2>	**reserved (0.0)**

Example

```
CONF:WCDP:MEAS ESP
```
Selects the spectrum emission mask measurement.

```
TRACe1:DATA? LIST
```
Queries the list evaluation results.

Characteristics

RST value: –

SCPI: device–specific

Mode

WCDMA

TRIGger Subsystem (WCDMA, K72)

The TRIGger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep.

Commands of the TRIGger Subsystem

– TRIGger<1|2>[:SEQuence]:SOURce

TRIGger<1|2>[:SEQuence]:SOURce

> **Parameter**
> IMMediate (Free Run) | EXTernal | IFPower
> For further details refer to "TRIGger<1|2>[:SEQuence]:SOURce" on page 4.182.

Remote Commands of the WLAN TX Measurements Option (K91)

This chapter describes the remote commands for the WLAN TX Measurements option (K91). The abbreviation WLAN stands for the Wireless LAN operating mode. For details on conventions used in this chapter refer to section "Notation" on page 4.1 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in section "Remote Control – Description of Analyzer Commands" on page 4.3 .

Subsystems of the WLAN TX Measurements option (K91)

ABORt Subsystem (WLAN, K91)

The ABORt subsystem contains the commands for aborting triggered actions.

Commands of the ABORt Subsystem

– ABORt

ABORt

For details refer to "ABORt" on page 4.5.

CALCulate:BURSt Subsystem (WLAN, K91)

The CALCulate:BURSt subsystem checks the IQ measurement results.

Commands of the CALCulate:BURSt Subsystem

–   CALCulate<1|2>:BURSt[:IMMediate]

CALCulate<1|2>:BURSt[:IMMediate]

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

This command is an event and therefore has no *RST value and no query.

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate:LIMit Subsystem (WLAN, K91)

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

Commands of the CALCulate:LIMit Subsystem

– CALCulate<1|2>:LIMit<1...8>:FAIL?

– CALCulate<1|2>:LIMit<1>:ACPower:ACHannel?

– CALCulate<1|2>:LIMit<1>:ACPower:ACHannel:RESult?

– CALCulate<1|2>:LIMit<1>:ACPower:ALTernate?

– CALCulate<1|2>:LIMit<1>:ACPower:ALTernate:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:ALL

– CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESUlt?

– CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:TFALl[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:TFALl[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:TFALl:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:TFALl:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERage]

– CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERage]:RESult?

– CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum

– CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum:RESult?

– CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECk:X?

– CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECk:Y?

CALCulate<1|2>:LIMit<1...8>:FAIL?

For option WLAN TX Measurements, K91, the numeric suffixes <1...8> specify 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**

For further details refer to "CALCulate<1|2>:LIMit<1...8>:FAIL?" on page 4.22.

CALCulate<1|2>:LIMit<1>:ACPower:ACHannel?

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

This command is a query only and thus has no *RST value.

Parameter

numeric value in dB

Example

CALC:LIM:ACP:ACH?
Returns the IEEE 802.11j ACP adjacent channel limit.

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:ACPower:ACHannel:RESult?

For details refer to "CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:RESult?" on page 4.28.

CALCulate<1|2>:LIMit<1>:ACPower:ALTernate?

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

Parameter

numeric value in dB

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:ACPower:ALTernate:RESult?

For details refer to "CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1...11>:RESult?" on page 4.31.

CALCulate<1|2>:LIMit<1>:BURSt:ALL

This command sets or returns all the limit values.

Parameter

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 >

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

Example

CALC:LIM:BURS:ALL?
All limit values are returned

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESUlt?

This command returns all the limit results.

This command is a query only and thus has no *RST value.

Parameter

For details on formats refer to "CALCulate<1|2>:LIMit<1>:BURSt:ALL" on page 4.373.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERage]

This command sets the average Error Vector Magnitude Limit for the IEEE 802.11b standard.

Parameter

numeric value in dB

Example

CALC:LIM:BURS:EVM −25.0
Average EVM limit is set to −25 dB

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERage]:RESult?

This command returns the average Error Vector Magnitude Limit result for the IEEE 802.11b standard.

This command is a query only and thus has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage]

This command sets the average Error Vector Magnitude Limit. This is a combined figure that represents the pilot, data and the free carrier.

Parameter

numeric value in dB

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>: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.

This command is a query only and thus has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum

This command sets the maximum Error Vector Magnitude Limit. This is a combined figure that represents the pilot, data and the free carrier.

Parameter

numeric value in dB

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>: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.? (K91)"

This command is a query only and thus has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage]

This command sets the average Error Vector Magnitude limit summary for the data carrier.

Parameter

numeric value in dB

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage]:RESult?

This command returns the average Error Vector Magnitude limit result summary for the data carrier.? (K91)"

This command is a query only and thus has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum

This command sets the maximum Error Vector Magnitude limit summary for the data carrier.

Parameter

numeric value in dB

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum:RESult?

This command returns the maximum Error Vector Magnitude limit result summary for the data carrier.? (K91)"

This command is a query only and thus has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum

This command sets the maximum Error Vector Magnitude Limit for the IEEE 802.11b standard.

Parameter

numeric value in dB

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum:RESult?

This command returns the maximum Error Vector Magnitude Limit result for the IEEE 802.11b standard.

This command is a query only and thus has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage]

This command sets the average Error Vector Magnitude limit summary for the pilot carriers.

Parameter

numeric value in dB

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage]:RESult?

This command returns the average Error Vector Magnitude limit result summary for the pilot carriers.? (K91)"

This command is a query only and thus has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:EVM:PIL:RES?

Average EVM for pilot carrier limit result is returned

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum

This command sets the maximum Error Vector Magnitude limit summary for the pilot carriers.

Parameter

numeric value in dB

Example

CALC:LIM:BURS:EVM:PIL:MAX?

Maximum EVM for pilot carrier limit is returned

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum:RESult?

This command returns the maximum Error Vector Magnitude limit result summary for the pilot carriers.? (K91)"

This command is a query only and thus has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:EVM:PIL:MAX:RES?

Maximum EVM for pilot carrier limit result is returned

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]

This command sets the average frequency error limit.

Parameter

numeric value in Hertz

Example

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

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]:RESult?

This command returns the average frequency error limit result.
This command is a query only and thus has no *RST value.

Example

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

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum

This command sets the maximum frequency error limit.

Parameter

numeric value in Hertz

Example

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

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESult?

This command returns the maximum frequency error limit result.
This command is a query only and thus has no *RST value.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage]

This command sets the average IQ Offset error limit.

Parameter

numeric value in dB: –1000000 to 1000000

Example

`CALC:LIM:BURS:IQOF –10.0`
Average IQ Offset error limit is set to –10.0 dB

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage]:RESult?

This command returns the average IQ Offset error limit result.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum

This command sets the maximum IQ Offset error limit.

Parameter

numeric value in dB: –1000000 to 1000000

Example

`CALC:LIM:BURS:IQOF:MAX 15.0`
Maximum IQ Offset error limit is set to –15.0 dB

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum:RESult?

This command returns the maximum IQ Offset error limit result.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage]

This command sets the average symbol error limit.

Parameter

numeric value in Hertz

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage]:RESult?

This command returns the average symbol error limit result.

This command is a query only and thus has no *RST value.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum

This command sets the maximum symbol error limit.

Parameter
numeric value in Hertz

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

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum:RESult?

This command returns the maximum symbol error limit result.
This command is a query only and thus has no *RST value.

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

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

CALCulate<1|2>:LIMit<1>:BURSt:TFALl[:AVERage]

This command sets the average fall time limit.

Parameter
numeric value in seconds

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

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

CALCulate<1|2>:LIMit<1>:BURSt:TFALl[:AVERage]:RESult?

This command returns the average fall time limit result.
This command is a query only and thus has no *RST value.

Example

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

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:TFALl:MAXimum

This command sets the maximum fall time limit.

Parameter

numeric value in seconds

Example

CALC:LIM:BURS:TFALl:MAX 0.000001
The maximum fall time limit set to 1 μs.

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:TFALl:MAXimum:RESult?

This command returns the maximum fall time limit result.
This command is a query only and thus has no *RST value.

Example

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

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERage]

This command sets the average rise time limit.

Parameter

numeric value in seconds

Example

CALC:LIM:BURS:TRIS 0.000001
The average rise time limit is set to 1 μs

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERage]:RESult?

This command returns the average rise time limit result.

This command is a query only and thus has no *RST value.

Example

CALC:LIM:BURS:TRIS:RES?

The average rise time limit result is returned

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum

This command sets the maximum rise time limit.

Parameter

numeric value in seconds

Example

CALC:LIM:BURS:TRIS:MAX 0.000001

Maximum rise time limit is set to 1 μs

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum:RESult?

This command returns the maximum rise time limit result.

This command is a query only and thus has no *RST value.

Example

CALC:LIM:BURS:TRIS:MAX:RES?

Maximum rise time limit result is returned

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECk:X?

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

This command is a query only and thus has no *RST value.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECk:Y?

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

This command is a query only and thus has no *RST value.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate:MARKer Subsystem (WLAN, K91)

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

The following subsystem is included:

- "CALCulate:MARKer:FUNCtion Subsystem (WLAN, K91)" on page 4.392

Commands of the CALCulate:MARKer Subsystem

– CALCulate<1|2>:MARKer<1>[:STATe]

– CALCulate<1|2>:MARKer<1>:AOFF

– CALCulate<1|2>:MARKer<1>:BSYMbol

– CALCulate<1|2>:MARKer<1>:CARRier

– CALCulate<1|2>:MARKer<1>:MAXimum

– CALCulate<1|2>:MARKer<1>:MINimum

– CALCulate<1|2>:MARKer<1>:SYMBol

– CALCulate<1|2>:MARKer<1>:TRACe

– CALCulate<1|2>:MARKer<1>:X

– CALCulate<1|2>:MARKer<1>:Y

CALCulate<1|2>:MARKer<1>[:STATe]

This command switches the markers on or off.

Parameter

ON | OFF

Example

```
CALC1:MARK1:STATE ON
```
Switches the screen A marker ON.
```
CALC2:MARK1:STATE OFF
```
Switches the screen B marker OFF.

Characteristics

RST value: ON

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:MARKer<1>:AOFF

This command switches off all active markers in the specified measurement window. The window is set by the numeric suffix of CALCulate<1|2>.

Example

```
CALC1:MARK:AOFF
```
Switches off all markers in the screen A window.
```
CALC2:MARK:AOFF
```
Switches off all markers in the screen B window.

Characteristics
RST value: –
SCPI: device–specific

Mode
WLAN

CALCulate<1|2>:MARKer<1>:BSYMbol

This command positions the selected marker to the indicated symbol in the indicated burst. The first numeric value is the burst number and the second numeric value is the symbol number.

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

– Constellation vs Symbol

– EVM vs Symbol

This command is a query only and thus has no *RST value.

Parameter
<numeric_value>,<numeric_value>

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.

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

CALCulate<1|2>:MARKer<1>: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

Parameter
<numeric_value>

Example
CALC:MARK:CARR –7
Positions marker 1 to carrier –7.

CALC:MARK:CARR?
Outputs the carrier value of marker 1.

Characteristics
*RST value: –
SCPI: device–specific

Mode

WLAN

CALCulate<1|2>: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.

This command is an event and therefore has no *RST value and no query.

Example

`CALC2:MARK:MAX`

Set marker 1 in screen B to maximum value in trace.

Characteristics

RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>: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.

This command is an event and therefore has no *RST value and no query.

Example

`CALC2:MARK:MIN`

Set marker 1 in screen B to minimum value in trace.

Characteristics

RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:MARKer<1>: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

Parameter

<numeric_value>

Example

`CALC:MARK:SYMB 2`

Positions marker 1 to symbol 2.

`CALC:MARK:SYMB?`

Outputs the symbol value of marker 1.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:MARKer<1>:TRACe

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

Example

`"CALC2:MARK:TRAC 2`

Assigns marker 1 in screen B to trace 2.

Characteristics

*RST value: 1

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:MARKer<1>:X

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

Parameter

<numeric_value> in Hz, s, dB

Example

`CALC:MARK:X 2ms`

Positions marker 1 to time 2ms.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:MARKer<1>:Y

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

Parameter

<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.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate:MARKer:FUNCtion Subsystem (WLAN, K91)

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

Commands of the CALCulate:MARKer:FUNCtion Subsystem

– CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]?

– CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult:MAXHold?

– CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM

CALCulate<1|2>: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.

This command is a query only and thus has no *RST value.

Example

CALC:MARK:FUNC:POW:RES?

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>: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<1|2>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]?" on page 4.392.

This command is a query only and thus has no *RST value.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM

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

Parameter

<numeric_value>

Example

`INIT:CONT OFF`
Switches to single sweep mode

`CALC:MARK:FUNC:ZOOM 3;*WAI`
Activates zooming and waits for its end.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CONFigure Subsystem (WLAN, K91)

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.

Commands of the CONFigure Subsystem

– CONFigure:BURSt:CONSt:CARRier:SELect

– CONFigure:BURSt:CONSt:CCARrier[:IMMediate]

– CONFigure:BURSt:CONSt:CSYMbol[:IMMediate]

– CONFigure:BURSt:EVM:ECARrier[:IMMediate]

– CONFigure:BURSt:EVM:ESYMbol[:IMMediate]

– CONFigure:BURSt:PREamble[:IMMediate]

– CONFigure:BURSt:PREamble:SELect

– CONFigure:BURSt:PVT[:IMMediate]

– CONFigure:BURSt:PVT:AVERage

– CONFigure:BURSt:PVT:RPOWer

– CONFigure:BURSt:PVT:SELect

– CONFigure:BURSt:SPECtrum:ACPR[:IMMediate]

– CONFigure:BURSt:SPECtrum:FFT[:IMMediate]

– CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]

– CONFigure:BURSt:SPECtrum:MASK[:IMMediate]

– CONFigure:BURSt:SPECtrum:MASK:SELect

– CONFigure:BURSt:STATistics:BSTReam[:IMMediate]

– CONFigure:BURSt:STATistics:CCDF[:IMMediate]

– CONFigure:BURSt:STATistics:SFIeld[:IMMediate]

– CONFigure:CHANnel

– CONFigure:POWer:AUTO

– CONFigure:POWer:AUTO:SWEep:TIME

– CONFigure:POWer:EXPected:RF

– CONFigure:STANdard

CONFigure:BURSt:CONSt:CARRier:SELect

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.

Parameter
–26 to 26 | ALL | PILOTS

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.

Characteristics

*RST value: ALL

SCPI: device–specific

Mode

WLAN

CONFigure:BURSt:CONSt: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[:IMMediate]` command.

Example

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

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CONFigure:BURSt:CONSt: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[:IMMediate]` command

Example

```
CONF:BURS:CONS:CSYM
```
Configures the Constellation versus Symbol measurement type.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate]` command.

Example

CONF:BURS:EVM:ECAR

Configures the EVM vs Carrier measurement type.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate] command.

Example

CONF:BURS:EVM:ESYM

Configures the EVM vs Symbol measurement type.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate] command.

Example

CONF:BURS:PRE

Configures the preamble measurement type.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CONFigure:BURSt:PREamble:SELect

This remote control command configures the interpretation of the preamble measurement results.

Parameter

PHASe | FREQuency

Example

CONF:BURS:PRE:SEL PHAS

Configures the Phase vs Preamble measurement type.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate]` command.

Example

`CONF:BURS:PVT`
Configures the Power vs Time measurement type.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CONFigure:BURSt:PVT:AVERage

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.

Parameter

<numeric_value>

Example

`CONF:BURS:PVT:AVER 31`
Configures the burst power average length of 31.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CONFigure:BURSt:PVT:RPOWer

This remote control command configures the use of either mean or maximum burst power as a reference power for the 802.11b PVT measurement.

Parameter

MEAN | MAXimum

Example

`CONF:BURS:PVT:RPOW MEAN`
Configures to use mean burst power as a reference power.

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

CONFigure:BURSt:PVT:SELect

This remote control configures how to interpret the Power vs Time measurement results.

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), 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

Characteristics
*RST value: –
SCPI: device–specific

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[:IMMediate] command.

Example
CONF:BURS:SPEC:ACPR
Configures the ACPR measurement type.

Characteristics
*RST value: –
SCPI: device–specific

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[:IMMediate] command.

Example

CONF:BURS:SPEC:FFT
Configures the FFT measurement type.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate] command.

Example

CONF:BURS:SPEC:FLAT
Configures the Spectrum Flatness measurement type.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate] command

Example

CONF:BURS:SPEC:MASK
Configures the Spectrum Mask measurement type.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CONFigure:BURSt:SPECtrum:MASK:SELect

This remote control configures the interpretation of the Spectrum Mask measurement results. This command is only available for IEEE 802.11a.

Parameter

IEEE | ETSI

Example

CONF:BURS:SPEC:MASK:SEL ETSI
Interprets the measurement results using the ETSI standard.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate]` command.

Example

`CONF:BURS:STAT:BSTR`
Configures the Bitstream measurement type.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate]` command.

Example

`CONF:BURS:STAT:CCDF`
Configures the CCDF measurement type.

Characteristics

*RST value: –

SCPI: device–specific

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[:IMMediate]` command.

Example

`CONF:BURS:STAT:SFIeld`
Configures the Signal Field measurement type.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

CONFigure: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.

Parameter

<numeric_value>

Example

`CONF:CHAN 9`
Specifies channel 9 as frequency measurement.

Characteristics

*RST value: 0
SCPI: device–specific

Mode

WLAN

CONFigure:POWer:AUTO

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.

Parameter

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.

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

CONFigure:POWer:AUTO:SWEep:TIME

This remote control command is used to specify the sweep time for the automatic power level detection.

Parameter

numeric value in seconds

Example

`CONF:POW:AUTO:SWE:TIME 200MS`
Configures a 200 ms sweep time for the auto–level detection.

Characteristics
*RST value: 100ms
SCPI: device–specific

Mode
WLAN

CONFigure:POWer:EXPected:RF

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.

Parameter
<numeric_value> in dBm

Example
`CONF:POW:EXP:RF 9`
Assumes an input signal strength of 9 dBm.

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

CONFigure:STANdard

This remote control command specifies which Wireless LAN standard the option is configured to measure.

Parameter

0   IEEE 802.11a

1   IEEE 802.11b

2   IEEE 802.11j (10 MHz)

3   IEEE 802.11j (20 MHz)

4   IEEE 802.11g

Example
`CONF:STAN 0`
Selects the IEEE 802.11a standard for the measurement.

Characteristics
*RST value: 0
SCPI: device–specific

Mode
WLAN

DISPlay Subsystem (WLAN, K91)

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.

Commands of the DISPlay Subsystem

– DISPlay:FORMat
– DISPlay[:WINDow<1|2>]:SSELect
– DISPlay[:WINDow<1|2>]:TABLe
– DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:AUTO
– DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:PDIVision
– DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel
– DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet

DISPlay:FORMat

This command sets the visible screen display type to full or split screen.

Parameter
SPLit | SINGle

Example
DISP:FORM SINGle
Sets the display to full screen.

Characteristics
*RST value: SPL
SCPI: device–specific

Mode
WLAN

DISPlay[:WINDow<1|2>]:SSELect

This command selects whether screen A or screen B is active. SSELect means Screen SELect.

Example
DISP:WIND1:SSEL
Sets the screen A active.

Characteristics
*RST value: 1
SCPI: device–specific

Mode
WLAN

DISPlay[:WINDow<1|2>]:TABLe

This command selects whether the results table is displayed.

Parameter

ON | OFF

Example

`DISP:WIND1:TABL ON`
Hides the results table

Characteristics

*RST value: ON
SCPI: device–specific

Mode

WLAN

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:AUTO

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

The numeric suffix at WINDow<1|2> must be 2 as the relevant results are always displayed in screen B. The numeric suffix at TRACe<1...3> must be 1.

Parameter

ON | OFF

Example

`DISP:WIND2:TRAC:Y:SCAL:AUTO ON`
switches on automatic scaling of the Y–axis for the active trace

Characteristics

*RST value: ON

Mode

WLAN

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:PDIVision

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

The numeric suffix at WINDow<1|2> must be 2 as the relevant results are always displayed in screen B. The numeric suffix at TRACe<1...3> must be 1.

Parameter

<numeric_value>

Example

`DISP:WIND2:TRAC:Y:SCAL:DPIV 2`
Sets the Y scale division to size to 2.

Characteristics

*RST value: 3

Mode

WLAN

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel

This remote control command can be used to set the current internal instrument reference level used when performing measurements. The numeric suffix at WINDow<1|2> and TRACe<1...3> are irrelevant.

Parameter

numeric value in dB

Example

`DISP:TRAC:Y:RLEV?`
returns the current reference level in use

Characteristics

*RST value: –

Mode

WLAN

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet

FETCh Subsystem (WLAN, K91)

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFigure and SENSe subsystems.

Commands of the DISPlay Subsystem

– FETCh:BURSt:ALL?

– FETCh:BURSt:COUNt?

– FETCh:BURSt:CRESt[:AVERage?]

– FETCh:BURSt:CRESt:MAXimum?

– FETCh:BURSt:CRESt:MINimum?

– FETCh:BURSt:EVM:[IEEE]:AVERage?

– FETCh:BURSt:EVM:[IEEE]:MAXimum?

– FETCh:BURSt:EVM:[IEEE]:MINimum?

– FETCh:BURSt:EVM:ALL:AVERage?

– FETCh:BURSt:EVM:ALL:MAXimum?

– FETCh:BURSt:EVM:ALL:MINimum?

– FETCh:BURSt:EVM:DATA:AVERage?

– FETCh:BURSt:EVM:DATA:MAXimum?

– FETCh:BURSt:EVM:DATA:MINimum?

– FETCh:BURSt:EVM:DIRect:AVERage?

– FETCh:BURSt:EVM:DIRect:MAXimum?

– FETCh:BURSt:EVM:DIRect:MINimum?

– FETCh:BURSt:EVM:PILot:AVERage?

– FETCh:BURSt:EVM:PILot:MAXimum?

– FETCh:BURSt:EVM:PILot:MINimum?

– FETCh:BURSt:FERRor:AVERage?

– FETCh:BURSt:FERRor:MAXimum?

– FETCh:BURSt:FERRor:MINimum?

– FETCh:BURSt:GIMBalance:AVERage?

– FETCh:BURSt:GIMBalance:MAXimum?

– FETCh:BURSt:GIMBalance:MINimum?

– FETCh:BURSt:IQOFfset:AVERage?

– FETCh:BURSt:IQOFfset:MAXimum?

– FETCh:BURSt:IQOFfset:MINimum?

– FETCh:BURSt:PAYLoad?

– FETCh:BURSt:PEAK?

– FETCh:BURSt:PREamble?

– FETCh:BURSt:QUADoffset:AVERage?

Further information

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) & 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 >

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 "ASCII formats for returned values" on page 4.407. The units for the EVM results are specified with the `UNIT:EVM` command.

Example
`FETC:BURS:ALL?`
All calculated results are returned

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

FETCh:BURSt:COUNt?

This command returns the number of analyzed bursts.
This command is a query only and thus has no *RST value.

Example
`FETC:BURS:COUN?`
The analyzed number of bursts are returned

Characteristics
*RST value: –
SCPI: device–specific

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.]

This command is a query only and thus has no *RST value.

Example

FETC:BURS:CRES:MAX?

The maximum calculated crest factor from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device–specific

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.???

This command is a query only and thus has no *RST value.

Example

FETC:BURS:EVM:MAX?

The maximum EVM recorded before filtering.

Characteristics

*RST value: –

SCPI: device–specific

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.

This command is a query only and thus has no *RST value.

Example

FETC:BURS:EVM:ALL:MAX?

The maximum EVM recorded for all measurement carrier is returned.

Characteristics

*RST value: –

SCPI: device–specific

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.

This command is a query only and thus has no *RST value.

Example

`FETC:BURS:EVM:DATA:MAX?`
The maximum EVM recorded for the data carrier is returned.

Characteristics

*RST value: –

SCPI: device–specific

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.???

This command is a query only and thus has no *RST value.

Example

`FETC:BURS:EVM:DIR:MAX?`
The maximum EVM recorded after filtering.

Characteristics

*RST value: –

SCPI: device–specific

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.???

This command is a query only and thus has no *RST value.

Example

`FETC:BURS:EVM:PIL:MAX?`
The maximum EVM recorded for the EVM pilot carrier is returned.

Characteristics

*RST value: –

SCPI: device–specific

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.???

This command is a query only and thus has no *RST value.

Example

FETC:BURS:FERR:MAX?

The maximum frequency error from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device–specific

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.???

This command is a query only and thus has no *RST value.

Example

FETC:BURS:GIMB:MAX?

The maximum IQ Imbalance error from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device–specific

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.???

This command is a query only and thus has no *RST value.

Example

FETC:BURS:IQOF:MAX?

The maximum IQ Offset error from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

FETCh:BURSt:PAYLoad?

This command returns the measured power in the payload of the burst.

This command is a query only and thus has no *RST value.

Example

`FETC:BURS:PAYL?`
The burst payload power is returned

Characteristics

*RST value: –
SCPI: device–specific

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.

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

FETCh:BURSt:PREamble?

This command returns the measured power in the burst preamble.
This command is a query only and thus has no *RST value.

Example

`FETC:BURS:PRE?`
The burst preamble power is returned

Characteristics

*RST value: –
SCPI: device–specific

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.???
This command is a query only and thus has no *RST value.

Example

`FETC:BURS:QUAD:MAX?`
The maximum angle error recorded for a symbol during the measurement.

Characteristics

*RST value: –

SCPI: device–specific

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.]

This command is a query only and thus has no *RST value.

Example

`FETC:BURS:RMS:MAX?`
The maximum calculated RSM burst power from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device–specific

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.

Characteristics

*RST value: –

SCPI: device–specific

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.

This command is a query only and thus has no *RST value.

Example

`FETC:BURS:TFAL:MAX?`
The maximum calculated fall time from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device–specific

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.

This command is a query only and thus has no *RST value.

Example

FETC:BURS:TRIS:MAX?

The maximum calculated rise time from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

FETCh:SYMBol:COUNt?

This command returns the number of symbols for each analyzed burst as a comma separated list.

This command is a query only and thus has no *RST value.

Example

FETC:SYMB:COUN?

The analyzed number of symbols for each burst are returned

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

FORMat Subsystem (WLAN, K91)

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

Commands of the FORMat Subsystem

–   FORMat[:DATA]

FORMat[:DATA]

For details refer to section "Remote Control – Description of Basic Settings Commands", FORMat Subsystem.

INITiate Subsystem (WLAN, K91)

The INITiate subsystem configures the instrument prior to a measurement being carried out. It is basically used to tell the instrument which measurement is to be performed and takes any necessary step to set up the instrument for the measurement.

Commands of the INITiate Subsystem

– INITiate[:IMMediate]

– INITiate:CONTinuous

INITiate[:IMMediate]

For details refer to "INITiate<1|2>[:IMMediate]" on page 4.109.

INITiate:CONTinuous

For details refer to "
INITiate<1|2>:CONTinuous" on page 4.110.

INPut Subsystem (WLAN, K91)

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

Commands of the INPut Subsystem

–   INPut<1|2>:ATTenuation

INPut:ATTenuation

For details refer to "INPut<1|2>:ATTenuation" on page 4.112.

INSTrument Subsystem (WLAN, K91)

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

Commands of the INSTrument Subsystem

– INSTrument[:SELect]

– INSTrument:NSELect

INSTrument[:SELect]

Parameter

WLAN (WLAN TX Measurements option, R&S FSL–K91)

For further details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

INSTrument:NSELect

Parameter

16 (WLAN TX Measurements option, R&S FSL–K91)

For further details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

MMEMory Subsystem (WLAN, K91)

The MMEMory (mass memory) subsystem provides commands to store and load IQ data.

Commands of the MMEMory Subsystem

– MMEMory:LOAD:IQ:STATe
– MMEMory:STORe:IQ:STATe

MMEMory:LOAD:IQ:STATe

This command loads the IQ data from the specified .iqw file.

Parameter
1,<file_name>

Example
MMEM:LOAD:IQ:STAT 1,'C:\R_S\Instr\user\data.iqw'
Loads IQ data from the specified file.

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

MMEMory:STORe:IQ:STATe

This command stores the IQ data to the specified .iqw file.

Parameter
1,<file_name>

Example
MMEM:STOR:IQ:STAT 1,'C:\R_S\Instr\user\data.iqw'
Stores IQ data to the specified file.

Characteristics
*RST value: –
SCPI: device–specific

Mode
WLAN

SENSe Subsystem (WLAN, K91)

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.

Commands of the SENSe Subsystem

– [SENSe:]BURSt:COUNt

– [SENSe:]BURSt:COUNt:STATe

– [SENSe:]DEMod:BANalyze:DURation:EQUal

– [SENSe:]DEMod:BANalyze:DURation:MAX

– [SENSe:]DEMod:BANalyze:DURation:MIN

– [SENSe:]DEMod:CESTimation

– [SENSe:]DEMod:FILTer:CATalog?

– [SENSe:]DEMod:FILTer:MODulation

– [SENSe:]DEMod:FORMat[:BCONtent]:AUTo

– [SENSe:]DEMod:FORMat:BANalyze

– [SENSe:]DEMod:FORMat:BANalyze:BTYPe

– [SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal

– [SENSe:]DEMod:FORMat:BANalyze:DBYTes:MAX

– [SENSe:]DEMod:FORMat:BANalyze:DBYTes:MIN

– [SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal

– [SENSe:]DEMod:FORMat:BANalyze:SYMBols:MAX

– [SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN

– [SENSe:]DEMod:FORMat:BTRate

– [SENSe:]DEMod:FORMat:SIGSymbol

– [SENSe:]FREQuency:CENTer

– [SENSe:]POWer:ACHannel:MODE

– [SENSe:]SWAPiq

– [SENSe:]SWEep:COUNt

– [SENSe:]SWEep:EGATe

– [SENSe:]SWEep:EGATe:HOLDoff[:TIMe]

– [SENSe:]SWEep:EGATe:HOLDoff:SAMPle

– [SENSe:]SWEep:EGATe:LENGth[:TIMe]

– [SENSe:]SWEep:EGATe:LENGth:SAMPle

– [SENSe:]SWEep:EGATe:LINK

– [SENSe:]SWEep:TIME

– [SENSe:]TRACking:LEVel

– [SENSe:]TRACking:PHASe

– [SENSe:]TRACking:TIME

Further information

– Analysis modulation format

Analysis modulation format

Parameter	Standard	Description
BPSK3	**IEEE 802.11j (10 MHz)**	**BI Phase shift keying at 3 Mbps**
BPSK45	**IEEE 802.11j (10 MHz)**	**BI Phase shift keying at 6 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**
BPSK	**Alias for BI**	**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**
QPSK18	**IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo**	**Quadrature phase shift keying at 18 Mbps**
QPSK	**Alias for Quadrature phase shift keying 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**
QAM1636	**IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo**	**Quadrature Amplitude Modulation at 36 Mbps**
QAM16	**Alias for Quadrature Amplitude Modulation at higher data rate for selected standard**	
QAM6424	**IEEE 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 Modulation at 48 Mbps**
QAM6454	**IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo**	**Quadrature Amplitude Modulation at 54 Mbps**
QAM64	**Alias for Quadrature Amplitude Modulation at higher data rate for selected standard**	
DBPSK	**IEEE 802.11b & g (Single Carrier)**	**Differential BI Phase shift keying**
DQPSK	**IEEE 802.11b & g (Single Carrier)**	**Differential Quadrature phase shift keying**
CCK55	**IEEE 802.11b & g (Single Carrier)**	**Complimentary Code Keying at 5.5 Mbps**
CCK11	**IEEE 802.11b & g (Single Carrier)**	**Complimentary Code Keying at 11 Mbps**
PBCC55	**IEEE 802.11b & g (Single Carrier)**	**PBCC at 5.5 Mbps**
PBCC11	**IEEE 802.11b & g (Single Carrier)**	**PBCC at 11 Mbps**
PBCC22	**IEEE 802.11g (Single Carrier)**	**PBCC at 11 Mbps**

[SENSe:]BURSt:COUNt

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` parameter is off.

Parameter

Example

BURS:COUN 16

Sets the number of bursts to 16.

Characteristics

*RST value: 1

SCPI: device–specific

Mode

WLAN

[SENSe:]BURSt:COUNt: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.

Parameter

ON | OFF

Example

BURS:COUN:STAT ON

Sets the burst count state to ON

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:BANalyze:DURation:EQUal

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:BANalyze:DURation:MIN command specifies the duration that a burst must last in order to take part in measurement analysis.

Parameter

ON | OFF

Example

DEM:BAN:DUR:EQU ON

Only bursts of equal length will take part in the measurement analysis.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:BANalyze:DURation:MAX

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:BANalyze:DURation:EQUal` 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:BANalyze:DURation:MIN` command shall take part in measurement
analysis

Parameter

<numeric_value>

Example

DEM:BAN:DUR:MAX 1300
Only bursts which have a maximum duration of 1300 microseconds are analyzed.

Characteristics

*RST value: 5464
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:BANalyze:DURation:MIN

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. When the `[SENSe:]DEMod:BANalyze:DURation:EQUal` command has been set
to true then this command specifies the exact duration required for a burst to take part in
measurement analysis. When the `[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal`
command is set to false this command specifies the minimum duration required for a burst to
take part in measurement analysis.

Parameter

<numeric_value>

Example

DEM:BAN:DUR:MIN 45
Only bursts which last 48 microseconds are analyzed.

Characteristics

*RST value: 1
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:CESTimation

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.

Parameter

ON | OFF

Example

DEMod:CEST ON
Specifies that the IQ measurement results will use channel estimation in preamble & payload.

Characteristics

*RST value: OFF

SCPI: device–specific

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.

This command is a query only and thus has no *RST value.

Example

```
DEM:FILT:CAT?
```
Reads all filter names

Characteristics

*RST value: 0

SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FILTer:MODulation

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? command.

Parameter

<string>,<string>

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

Characteristics

*RST value: AUTO,AUTO

SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat[:BCONtent]:AUTo

When this command is set to ON then the signal symbol field of the burst is analyzed to determine the modulation scheme of the first burst. When this field is set to ON only bursts which match the modulation scheme are considered in results analysis.

Parameter

ON | OFF

Example

DEM:FORM:AUT ON
Specifies that the signal symbol field should be decoded.

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BANalyze

The remote control command sets the analysis modulation format that will be assumed when the measurement is performed. If the [SENSe:]DEMod:FORMat:SIGSymbol parameter has been set to ON, this command can be used to measure only certain burst types within a measurement sequence.

Parameter

For details refer to "Analysis modulation format" on page 4.422.

Example

DEM:FORM:BAN 'QAM16'
Only bursts that are of the QAM16 modulation format are analyzed.

Characteristics

*RST value: QAM64
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BANalyze:BTYPe

This remote control command specifies the type of burst to be analyzed. Only bursts of the specified type take part in measurement analysis.

Parameter

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

Example

`DEM:FORM:BAN:BTYPe 'DIRECT'`
Only DIRECT bursts are analyzed.

Characteristics

*RST value: DIRECT
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal

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 command.

Parameter

ON | OFF

Example

`DEM:FORM:BAN:DBYTes:EQU ON`
Only bursts of equal length will take part in the measurement analysis.

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MAX

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 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 command shall take part in measurement analysis.

Parameter

Example

DEM:FORM:BAN:DBYTes:MAX 1300
Only bursts which contain a maximum of 1300 data bytes are analyzed.

Characteristics

*RST value: 64
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MIN

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 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 command is set to OFF, this command specifies the minimum number of data bytes required for a burst to take part in measurement analysis.

Parameter

<numeric_value>

Example

DEM:FORM:BAN:DBYTes:MIN 16
Only bursts which contain 16 data bytes are analyzed.

Characteristics

*RST value: 1
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal

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:MIN command specifies the number of symbols that a burst must have in order to take part in analysis.

Parameter

ON | OFF

Example

DEM:FORM:BAN:SYM:EQU ON
Only bursts of equal length will take part in analysis.

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MAX

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.

Parameter

<numeric_value>

Example

DEM:FORM:BAN:SYM:MAX 1300
Only bursts which contain a maximum symbol count of 1300 are analyzed.

Characteristics

*RST value: 64
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN

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.

Parameter

<numeric_value>

Example

DEM:FORM:BAN:SYM:MIN 16
Only bursts which contain a symbol count of 16 are analyzed.

Characteristics

*RST value: 1
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:BTRate

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. The bit rate can be set as follows:

Parameter

10	1 Mbit/s
20	2 Mbit/s
55	5.5 Mbit/s
110	11 Mbit/s

Example

DEM:FORM:BTR 20
Configures to demodulate 2 Mbit/s signals

Characteristics

*RST value: 10 (= 1mbit)
SCPI: device–specific

Mode

WLAN

[SENSe:]DEMod:FORMat:SIGSymbol

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.

Parameter

ON | OFF

Example

DEM:FORM:SIGS ON
Specifies that the signal symbol field should be decoded.

Characteristics

*RST value: –
SCPI: device–specific

Mode

WLAN

[SENSe:]FREQuency:CENTer

[SENSe:]POWer:ACHannel:MODE

This command sets the ACP measurement mode for the IEEE 802.11j standard to either absolute or relative.

Parameter

ABS	Absolute measurement
REL	Relative measurement

Example

POW:ACH:MODE ABS

Sets the ACP measurement to absolute mode

Characteristics

*RST value: REL

SCPI: device–specific

Mode

WLAN

[SENSe:]SWAPiq

This command defines whether or not the recorded IQ pairs should be swapped (I<–>Q) before being processed.

Parameter

ON | OFF

Example

SWAP ON

Specifies that IQ values should be swapped.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

WLAN

[SENSe:]SWEep:COUNt

This command specifies the number of sweeps for Spectrum Mask and Spectrum ACPR measurements.

Parameter

<numeric_value>

Example

SWEep:COUNt 64

Sets the number of sweeps to 64.

Characteristics

*RST value: 1

SCPI: conform

Mode

WLAN

[SENSe:]SWEep:EGATe

For details refer to "[SENSe<1|2>:]SWEep:EGATe" on page 4.152.

[SENSe:]SWEep:EGATe:HOLDoff[: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.

Parameter

<numeric_value>

Example

`SWE:EGAT:HOLD 125us`
Sets a delay of 125μs in the capture buffer.

Characteristics

*RST value: 100μs
SCPI: device–specific

Mode

WLAN

[SENSe:]SWEep:EGATe:HOLDoff:SAMPle

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.

Parameter

<numeric_value>

Example

`SWE:EGAT:HOLD:SAMP 2500`
Sets a delay of 2500 samples in the capture buffer.

Characteristics

*RST value: 2000
SCPI: device–specific

Mode

WLAN

[SENSe:]SWEep:EGATe:LENGth[: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.

Parameter

<numeric_value>

Example

`SWE:EGAT:LENG 20ms`
Sets a gate length of 20 milliseconds between sweeps.

Characteristics

*RST value: 400μs

SCPI: device–specific

Mode

WLAN

[SENSe:]SWEep:EGATe:LENGth:SAMPle

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.

Parameter

<numeric_value>

Example

`SWE:EGAT:LENG:SAMP 200000`
Sets a gate length of 200000 samples in the capture buffer.

Characteristics

*RST value: 8000

SCPI: device–specific

Mode

WLAN

[SENSe:]SWEep:EGATe:LINK

This command links together the movement of the gating lines and the capture buffer marker.

Parameter

ON | OFF

Example

`SWE:EGAT:LINK ON`
Links the gating lines as marker with the gating line delay and length are changed gate position.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

WLAN

[SENSe:]SWEep:TIME

The RST value for the WLAN TX Measurements option (K91) is 1 ms.

For further details refer to "[SENSe<1|2>:]SWEep:TIME" on page 4.155.

[SENSe:]TRACking:LEVel

This command defines whether or not the measurement results should be compensated for level.

Parameter

ON | OFF

Example

`TRAC:LEV ON`
Specifies that the measurement results should be compensated for level.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

WLAN

[SENSe:]TRACking:PHASe

This command defines whether or not the measurement results should be compensated for phase.

Parameter

ON | OFF

Example

`TRAC:PHAS ON`
Specifies that the measurement results should be compensated for phase.

Characteristics

*RST value: ON

SCPI: device–specific

Mode

WLAN

[SENSe:]TRACking:TIME

This command defines whether or not the measurement results should be compensated for time.

Parameter

ON | OFF

Example

`TRAC:TIME ON`
Specifies that the measurement results should be compensated for time.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

WLAN

STATus Subsystem (WLAN, K91)

The STATus subsystem contains the commands for the status reporting system. For the STATus:QUEStionable:LIMit register, the measurement window is selected by LIMit 1 (screen A) or 2 (screen B). *RST does not influence the status registers.

Commands of the STATus Subsystem

– STATus:QUEStionable:ACPLimit[:EVENt]?

– STATus:QUEStionable:ACPLimit:CONDition?

– STATus:QUEStionable:ACPLimit:ENABle

– STATus:QUEStionable:ACPLimit:PTRansition

– STATus:QUEStionable:ACPLimit:NTRansition

– STATus:QUEStionable:LIMit<1|2> [:EVENt]?

– STATus:QUEStionable:LIMit<1|2>:CONDition?

– STATus:QUEStionable:LIMit<1|2>:ENABle

– STATus:QUEStionable:LIMit<1|2>:PTRansition

– STATus:QUEStionable:LIMit<1|2>:NTRansition

– STATus:QUEStionable:POWer[:EVENt]?

– STATus:QUEStionable:POWer:CONDition?

– STATus:QUEStionable:POWer:ENABle

– STATus:QUEStionable:POWer:PTRansition

– STATus:QUEStionable:POWer:NTRansition

– STATus:QUEStionable:SYNC[:EVENt]?

– STATus:QUEStionable:SYNC:CONDition?

– STATus:QUEStionable:SYNC:ENABle

– STATus:QUEStionable:SYNC:PTRansition

– STATus:QUEStionable:SYNC:NTRansition

STATus:QUEStionable:ACPLimit[:EVENt]?

For details refer to "STATus:QUEStionable:ACPLimit[:EVENt]?" on page 4.158.

STATus:QUEStionable:ACPLimit:CONDition?

For details refer to "STATus:QUEStionable:ACPLimit:CONDition?" on page 4.158.

STATus:QUEStionable:ACPLimit:ENABle

For details refer to "STATus:QUEStionable:ACPLimit:ENABle" on page 4.158.

STATus:QUEStionable:ACPLimit:PTRansition

For details refer to "STATus:QUEStionable:LIMit<1|2>:PTRansition" on page 4.162.

STATus:QUEStionable:ACPLimit:NTRansition

For details refer to "STATus:QUEStionable:ACPLimit:NTRansition" on page 4.159.

STATus:QUEStionable:LIMit<1|2> [:EVENt]?

For details refer to "STATus:QUEStionable:LIMit<1|2> [:EVENt]?" on page 4.161.

STATus:QUEStionable:LIMit<1|2>:CONDition?

For details refer to "STATus:QUEStionable:LIMit<1|2>:CONDition?" on page 4.161.

STATus:QUEStionable:LIMit<1|2>:ENABle

For details refer to "STATus:QUEStionable:LIMit<1|2>:ENABle" on page 4.162.

STATus:QUEStionable:LIMit<1|2>:PTRansition

For details refer to "STATus:QUEStionable:LIMit<1|2>:PTRansition" on page 4.162.

STATus:QUEStionable:LIMit<1|2>:NTRansition

For details refer to "STATus:QUEStionable:LIMit<1|2>:NTRansition" on page 4.162.

STATus:QUEStionable:POWer[:EVENt]?

For details refer to "STATus:QUEStionable:POWer[:EVENt]?" on page 4.164.

STATus:QUEStionable:POWer:CONDition?

For details refer to "STATus:QUEStionable:POWer:CONDition?" on page 4.164.

STATus:QUEStionable:POWer:ENABle

For details refer to "STATus:QUEStionable:POWer:ENABle" on page 4.165.

STATus:QUEStionable:POWer:PTRansition

For details refer to "STATus:QUEStionable:POWer:PTRansition" on page 4.165.

STATus:QUEStionable:POWer:NTRansition

For details refer to "STATus:QUEStionable:POWer:NTRansition" on page 4.165.

STATus:QUEStionable:SYNC[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:SYNC register. Readout does not delete the contents of the EVENt section.

Example

STAT:QUES:SYNC?

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

STATus:QUEStionable:SYNC:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:SYNC register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:SYNC:COND?

Characteristics

*RST value: –

SCPI: conform

Mode

WLAN

STATus:QUEStionable:SYNC:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:SYNC register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:ENAB 65535

All events bits will be represented in the SYNC summary bit.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

STATus:QUEStionable:SYNC:PTRansition

This command determines what bits in the STATus:QUEStionable:SYNC Condition register will set the corresponding bit in the STATus:QUEStionable:SYNC Event register when that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:PTR 65535

All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

STATus:QUEStionable:SYNC:NTRansition

This command determines what bits in the STATus:QUEStionable:SYNC Condition will set the corresponding bit in the STATus:QUEStionable:SYNC Event register when that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:NTR 65535 –

All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

TRACe Subsystem (WLAN, K91)

The TRACe subsystem controls access to the instrument's internal trace memory.

Commands of the TRACe Subsystem

– TRACe[:DATA]

– TRACe:IQ:DATA:MEMory?

– TRACe:IQ:SRATe

Further information

– IQ Measurements

– Constellation vs Symbol

– Constellation vs Carrier

– Power vs Time – Full Burst and Rising /Falling Data

– Spectrum Flatness

– Spectrum FFT

– Statistics Bitstream data

– Statistics CCDF – Complementary cumulative distribution function

– Statistics Signal Field data

– EVM vs Carrier

– EVM vs Symbol

– Error vs Preamble

– Frequency Sweep Measurements

– Spectrum Mask

– Spectrum ACPR

IQ Measurements

There are a number of measurements that can be performed in IQ mode. No data will be returned for any of the following measurements, should it be requested, until such time as a measurement belonging to the IQ group has been previously run.

Running a frequency sweep measurement for example, Spectrum Mask, will not generate results for this measurement group.

Constellation vs Symbol

This measurement represents I and Q data. For IEEE 802.11a and j the data will be returned as a repeating array of interleaved I and Q data in groups of selected carriers, until all the data is exhausted. For IEEE 802.11b the data will be returned as a repeating array of interleaved I and Q data in symbol order until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

IEEE 802.11a & j only

- If "All Carriers" is selected, it will return 52 per of I and Q data per symbol.

- If "Pilots Only" is selected, it will return 4 per of I and Q per symbol in the following order: Carrier – 21, Carrier –7, Carrier 7, Carrier 21.

- If a single carrier is selected, it will return 1 per of I and Q data per symbol.

Constellation vs Carrier

This measurement represents I and Q data. Data will be returned as a repeating array of interleaved I and Q data in groups of 53 channels including the channel 0, until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

Power vs Time – Full Burst and Rising /Falling Data

Both measurement results are once again simply slightly different views of the same results data.

All fully complete bursts within the capture time are analyzed into 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 to the user on a per sample basis. Each sample will in some way relate to an analysis of each corresponding sample within each processed burst.

The type of PVT data returned will be 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

For IEEE 802.11b only

- If the graphic type selected is RISing or FALLing then 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 will depend on the modulation type and will typically be 5000.

- The number of samples returned when the rising and falling graphic type is selected will be less than what is returned for full burst and will be approximately 400 samples.

- The samples will be returned in floating point format as a single sequence of comma delimited values.

Spectrum Flatness

There are four separate traces that are available with this measurement. Trace data for a particular trace will only be returnable by querying the appropriate trace

Spectrum flatness provides two basic graph types. These are an absolute power value graph (ABS) and a relative group delay graph, which are both 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 will allow all the data points to be returned as one trace and an average of all the channels as the other trace.

E.g. the return data will either be one single group of 53 carriers if the average trace is selected or a repeating group of 53 carriers if all the data is requested.

TRACE1	ABS	(all analyzed trains)
TRACE2	Group Delay	(all analyzed trains)
TRACE3	ABS	(average trace)
TRACE4	Group Delay	(average trace)

Absolute power results are returned in dB and group delay results are returned in ns.

Spectrum FFT

All FFT points will be returned if the data for this measurement is requested. This will be 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 will be returned in floating point format in dBm. TRACE1 is used for this measurement results.

Statistics Bitstream data

IEEE 802.11a & j only

Data will be returned in repeating groups of 52 data channels where each symbol value will be represented by an integer value within one byte. Channel 0 is unused and will therefore not have any data associated with it, with no return data being provided.

The number of repeating groups that are returned will be equal to the number of measured symbols.

Currently, 64QAM has the highest data rate and it contains symbol values up to 63, making the proposal of one byte sufficient in size to represent all symbol data values, regardless of the modulation type in use.

Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.

IEEE 802.11b only

Data will be returned in burst order. Each burst will be represented as a series of bytes. For each burst the first 9 or 18 bytes represents the PLCP Preamble for Short and Long burst types respectively. The next 6 bytes represents the PLCP Header. The remaining bytes represent the PSDU.

Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.

Statistics CCDF – Complementary cumulative distribution function

Up to a maximum of 201 data points will be returned in addition to a data count value. The first value in the return data will represent the quantity of probability values that follow. Each of the potential 201 data points will be returned as probability value and will represent the total number of samples that are equal to or exceed the corresponding power level. Probability data will be 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 will be returned as a floating point number, with a value less than 1.

Statistics Signal Field data

IEEE 802.11a & j only

Data will be returned as an array of hexadecimal values, with each hexadecimal value representing the 24 bit long signal field for a single burst.

IEEE 802.11b only

Data will be returned as an array of hexadecimal values, with each hexadecimal value representing the 48 bit long signal field for a single burst

EVM vs Carrier

Two trace types are provided with this measurement. There is an average EVM value for each of the 53 channels or a repeating group of EVM values for each channel. The number of repeating groups will correspond to the number of fully analyzed trains.

Each EVM value will be returned as a floating point number, expressed in units of dBm.

TRACE1	Average EVM values per channel
TRACE2	All EVM values per channel for each full train of the capture period

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 will be equal to the number of measured symbols.

Each EVM value will be returned as a floating point number, expressed in units of dBm.

IEEE 802.11a & j only

TRACE1	Minimum EVM values
TRACE2	Mean EVM values
TRACE3	Maximum EVM values

IEEE 802.11b only

TRACE1	EVM IEEE values
TRACE2	EVM Direct values

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.

Frequency Sweep Measurements

No data will be returned for this type of measurement, should it be requested, until such time as a measurement has been previously run.

Running an IQ measurement will not generate results for this type of measurement.

Spectrum Mask

Result data will be returned as 501 measurement 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 will be returned. TRACE1 is used for this measurement results.

Spectrum ACPR

Result data will be returned as 501 measurement 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 will be returned. TRACE1 is used for this measurement results.

TRACe[:DATA]

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:

- "IQ Measurements" on page 4.439
- "Constellation vs Symbol" on page 4.439
- "Constellation vs Carrier" on page 4.440
- "Power vs Time – Full Burst and Rising /Falling Data" on page 4.440
- "Spectrum Flatness" on page 4.441
- "Spectrum FFT" on page 4.441
- "Statistics Bitstream data" on page 4.441
- "Statistics CCDF – Complementary cumulative distribution function" on page 4.442
- "Statistics Signal Field data" on page 4.442
- "EVM vs Carrier" on page 4.442
- "EVM vs Symbol" on page 4.442
- "Error vs Preamble" on page 4.443
- "Frequency Sweep Measurements" on page 4.443
- "Spectrum Mask" on page 4.443
- "Spectrum ACPR" on page 4.443

This command is a query only and thus has no *RST value.

Parameter
TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

Example

`TRAC? TRACE2`

The measurement data for the selected graph is returned.

Characteristics

*RST value: –

SCPI: conform

Mode

WLAN

TRACe:IQ:DATA:MEMory?

For details refer to "TRACe<1|2>:IQ:DATA:MEMory?" on page 4.177.

TRACe:IQ:SRATe

This command allows the sample rate for IQ measurements to be specified.

Example

`TRACe:IQ:SRAT 20000`

Specifies a sample rate of 20 MHz.

Characteristics

*RST value: –

SCPI: device–specific

Mode

WLAN

TRIGger Subsystem (WLAN, K91)

The trigger subsystem is used to synchronize device action(s) with events.

Commands of the TRIGger Subsystem

– TRIGger[:SEQuence]:HOLDoff
– TRIGger[:SEQuence]:MODE
– TRIGger[:SEQuence]:LEVel:POWer
– TRIGger[:SEQuence]:LEVel:POWer:AUTO

TRIGger[:SEQuence]:HOLDoff

This command defines the length of the trigger delay. A negative delay time (pretrigger) can be set.

Parameter

<numeric_value>

Example

`TRIG:HOLD 500us`
Configures to use a holdoff period of 500 µs after the trigger condition has been met.

Characteristics

*RST value: –10 µs
SCPI: Conform

Mode

WLAN

TRIGger[:SEQuence]:MODE

This command configures how triggering is to be performed.

Parameter

IMMediate   automatically triggers the next measurement at the end of the previous measurement. This corresponds to the FREE RUN setting.

EXTernal   the next measurement is triggered by the signal at the external trigger input e.g. a gated trigger

POWer   triggering of the measurement via signals which are the measurement channel.

Example

`TRIG:MODE IMM`
AUTO triggering will occur for the next measurement at the specified video percentage value.

Characteristics

*RST value: IMMediate
SCPI: device–specific

Mode

WLAN

TRIGger[:SEQuence]:LEVel:POWer

This command accepts the level of the input signal for which triggering will occur.

Parameter

<numeric_value>

Example

`TRIG:LEV:POW 10 DBM`
Set to 10 dBm for RF measurement.

Characteristics

*RST value: 0 DBM
SCPI: device–specific

Mode

WLAN

TRIGger[:SEQuence]:LEVel:POWer:AUTO

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` command is not POWer.

Parameter

ON | 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.

Characteristics

*RST value: OFF
SCPI: device–specific

Mode

WLAN

UNIT Subsystem (WLAN, K91)

The unit subsystem specifies the units for specific result types.

Commands of the UNIT Subsystem

– UNIT:EVM

– UNIT:GIMBalance

– UNIT:PREamble

UNIT:EVM

This command specifies the units for EVM results.

Parameter

DB   EVM results returned in dB

PCT   EVM results returned in %

Example

UNIT:EVM PCT
EVM results to be returned in %.

Characteristics

*RST value: DB

SCPI: device–specific

Mode

WLAN

UNIT:GIMBalance

This command specifies the units for Gain Imbalance results.

Parameter

DB   Gain Imbalance results returned in dB

PCT   Gain Imbalance results returned in %

Example

UNIT:GIMB PCT
Gain Imbalance results to be returned in %.

Characteristics

*RST value: DB

SCPI: device–specific

Mode

WLAN

UNIT:PREamble

This command specifies the units for Preamble error results.

Parameter

HZ   Preamble error results returned in Hz

PCT   Preamble error results returned in %

Example

`UNIT:PRE PCT`
Preamble error results to be returned in %.

Characteristics

*RST value: DB
SCPI: device–specific

Mode

WLAN

Remote Commands of the WiMAX, WiBro Measurements Option (K93)

This chapter describes the remote commands for the WiMAX IEEE 802.16 OFDM, OFDMA Measurements option (R&S FSL–K93).

For details on conventions used in this chapter refer to section "Notation" on page 4.1 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in section "Remote Control – Description of Analyzer Commands" on page 4.3 .

Subsystems of the WiMAX, WiBro Measurements option (K93)

ABORt Subsystem (WiMAX, K93)

Commands of the ABORt Subsystem

– ABORt

ABORt

For details refer to "ABORt" on page 4.5.

CALCulate:BURSt Subsystem (WiMAX, K93)

The CALCulate:BURSt subsystem checks the IQ measurement results.

Commands of the CALCulate:BURSt Subsystem

– CALCulate<1|2>:BURSt[:IMMediate]

CALCulate<1|2>:BURSt[:IMMediate]

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

The numeric suffixes <1|2> sets the measurement window for the calculation.

This command is an event and therefore has no *RST value and no query.

Example

`CALC1:BURS`

Starts the recalculation of the IQ measurement results.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate:LIMit Subsystem (WiMAX, K93)

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

Commands of the CALCulate:LIMit Subsystem

– CALCulate<1|2>:LIMit<1...8>:FAIL?
– CALCulate<1|2>:LIMit<1...8>:BURSt:ALL
– CALCulate<1|2>:LIMit<1...8>:BURSt:ALL:RESult?
– CALCulate<1|2>:LIMit<1..8>:BURSt:BERPilot[:AVERage]
– CALCulate<1|2>:LIMit<1...8>:BURSt:BERPilot[:AVERage]:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:BERPilot:MAXimum
– CALCulate<1|2>:LIMit<1...8>:BURSt:BERPilot:MAXimum:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:ALL[:AVERage]
– CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:ALL[:AVERage]:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:ALL:MAXimum
– CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:ALL:MAXimum:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:DATA[:AVERage]
– CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:DATA[:AVERage]:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:DATA:MAXimum
– CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:DATA:MAXimum:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:FERRor[:AVERage]
– CALCulate<1|2>:LIMit<1...8>:BURSt:FERRor[:AVERage]:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:FERRor:MAXimum
– CALCulate<1|2>:LIMit<1...8>:BURSt:FERRor:MAXimum:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:IQOFfset[:AVERage]
– CALCulate<1|2>:LIMit<1...8>:BURSt:IQOFfset[:AVERage]:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:IQOFfset:MAXimum
– CALCulate<1|2>:LIMit<1...8>:BURSt:IQOFfset:MAXimum:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:SSTiming[:AVERage]
– CALCulate<1|2>:LIMit<1...8>:BURSt:SSTiming[:AVERage]:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:SSTiming:MAXimum
– CALCulate<1|2>:LIMit<1...8>:BURSt:SSTiming:MAXimum:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:SYMBolerror[:AVERage]
– CALCulate<1|2>:LIMit<1...8>:BURSt:SYMBolerror[:AVERage]:RESult?
– CALCulate<1|2>:LIMit<1...8>:BURSt:SYMBolerror:MAXimum
– CALCulate<1|2>:LIMit<1...8>:BURSt:SYMBolerror:MAXimum:RESult?
– CALCulate<1|2>:LIMit<1...8>:SPECtrum:MASK:CHECk:X?
– CALCulate<1|2>:LIMit<1...8>:SPECtrum:MASK:CHECk:Y?

CALCulate<1|2>:LIMit<1...8>:FAIL?

This command queries the limit check result of the limit line indicated in the selected measurement window. To obtain a valid result, a complete sweep must be performed. A synchronization with `*OPC`, `*OPC?` or `*WAI` is therefore recommended.

The numeric suffixes <1|2> sets the measurement window for the calculation. The numeric suffixes <1...8> specify the limit lines as follows:

1 to 2	not used
3	ETSI Spectrum Mask limit line
4	IEEE Spectrum Mask limit line
5	Spectrum Flatness (Upper) limit line
6	Spectrum Flatness (Lower) limit line
7	Spectrum Flatness Difference (Upper) limit line
8	Spectrum Flatness Difference (Lower) limit line

Note: No limit lines are displayed in screen A. Therefore all commands with the suffix 1 for CALCulate will return 0.

This command is only a query and therefore has no *RST value.

Return values

0	PASSED
1	FAILED

Example

`INIT;*WAI`
Starts a new sweep and waits for its end.
`CALC2:LIM1:FAIL?`
Queries the result of the check for limit line 1 in screen B.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:ALL

This command sets or returns all the limit values.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see `CALCulate<1|2>:LIMit<1...8>:FAIL?` command).

Parameter

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

Result input/output in ASCII format	Description
\<average EVM all bursts\>, **\<max EVM all bursts\>**	**dB or % depending on selected units (UNIT:TABLe)**
\<average EVM data carriers \>, **\<max EVM data carriers \>**	**dB or % depending on selected units (UNIT:TABLe)**
\<average Frequency Error\>, **\<max Frequency Error\>**	**Down Link Mode: Hz; .Up Link Mode: %**
\<average Symbol Error\>, **\<max Symbol Error\>**	**Down Link Mode: ppm; Up Link Mode: %**
\<average SS Timing\>, **\<maximum SS Timing \>**	**only returned in Up Link mode**
\<average IQ Offset\>, **\<max IQ Offset\>**	**dB or % depending on selected units (UNIT:TABLe)**

Example

CALC:LIM:BURS:ALL?

All limit values are returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate\<1|2\>:LIMit\<1...8\>:BURSt:ALL:RESult?

This command returns all the limit results.

The numeric suffixes \<1|2\> sets the measurement window for the calculation and the suffixes \<1...8\> specify the limit lines (see CALCulate\<1|2\>:LIMit\<1...8\>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

The results are output as a list of result strings separated by commas. For the output order see CALCulate\<1|2\>:LIMit\<1...8\>:BURSt:ALL command.

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate\<1|2\>:LIMit\<1..8\>:BURSt:BERPilot[:AVERage]

This command sets the average Bit Error Rate for pilot carriers limit.

Parameter

–1000000 to 1000000 %

Example

CALC:LIM:BURS:BERP -25.0

Average Bit Error Rate for pilot carriers limit is set to –25.0 dB.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:BERPilot[:AVERage]:RESult?

This command returns the Bit Error Rate for pilot carriers limit result.

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:BERP:RES?

Average EVM for all carrier limit result is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:BERPilot:MAXimum

This command sets the maximum Bit Error Rate Limit.

Parameter

–1000000 to 1000000 %

Example

CALC:LIM:BURS:EVM:ALL:MAX?

Maximum EVM for all carrier limit is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:BERPilot: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.

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:EVM:ALL:MAX:RES?

Maximum EVM for all carrier limit result is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:ALL[:AVERage]

This command sets the average Error Vector Magnitude Limit. This is a combined figure that represents the pilot, data and the free carrier.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

–1000000 to 1000000 dB or %

If no unit is specified the unit specified by the UNIT:TABLe command is used.

Example

CALC:LIM:BURS:EVM:ALL –25.0

Average EVM for all carrier limit is set to –25.0 dB.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>: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.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:EVM:ALL:RES?

Average EVM for all carrier limit result is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:ALL:MAXimum

This command sets the maximum Error Vector Magnitude Limit. This is a combined figure that represents the pilot, data and the free carrier.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

–1000000 to 1000000 dB or %

If no unit is specified the unit specified by the UNIT:TABLe command is used.

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>: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.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:DATA[:AVERage]

This command sets the average Error Vector Magnitude Limit for the data carrier.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

–1000000 to 1000000 dB or %

If no unit is specified the unit specified by the UNIT:TABLe command is used.

Example

CALC:LIM:BURS:EVM:DATA –30.0
Average EVM for data carrier limit is set to –30.0 dB.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:DATA[:AVERage]:RESult?

This command returns the average Error Vector Magnitude limit result summary for the data carrier in dB.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:DATA:MAXimum

This command sets the maximum Error Vector Magnitude Limit for the data carrier.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

–1000000 to 1000000 dB or %

If no unit is specified the unit specified by the UNIT:TABLe command is used.

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:EVM:DATA:MAXimum:RESult?

This command returns the maximum Error Vector Magnitude limit result summary for the data carrier in dB.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:FERRor[:AVERage]

This command sets the average frequency error limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

–1000000 to 1000000 Hz or %

If no unit is specified the unit depends on the current Up/Down Link Mode: Hz in Down Link mode, % in Up Link mode.

Note: *There is no relationship between the Down Link and Up Link values. Setting a Down Link value in Up Link mode does not change the displayed limit value.*

Example

CALC:LIM:BURS:FERR 10000
The average frequency error limit is set to 10000 Hz.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:FERRor[:AVERage]:RESult?

This command returns the average frequency error limit result.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:FERRor:MAXimum

This command sets the maximum frequency error limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

–1000000 to 1000000 Hz or %

If no unit is specified the unit depends on the current Up/Down Link Mode: Hz in Down Link mode, % in Up Link mode.

Note: *There is no relationship between the Down Link and Up Link values. Setting a Down Link value in Up Link mode does not change the displayed limit value.*

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:FERRor:MAXimum:RESult?

This command returns the maximum frequency error limit result.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:IQOFfset[:AVERage]

This command sets the average IQ offset error limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

–1000000 to 1000000 dB or %

If no unit is specified the unit specified by the UNIT:TABLe command is used.

Example

CALC:LIM:BURS:IQOF –10.0
Average IQ offset error limit is set to –10.0 dB.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:IQOFfset[:AVERage]:RESult?

This command returns the average IQ offset error limit result.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:IQOF:RES?

Average IQ offset error limit result is returned.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:IQOFfset:MAXimum

This command sets the maximum IQ offset error limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

–1000000 to 1000000 dB or %

If no unit is specified the unit specified by the UNIT:TABLe command is used.

Example

CALC:LIM:BURS:IQOF:MAX 15.0DB

Maximum IQ offset error limit is set to 15.0 dB.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:IQOFfset:MAXimum:RESult?

This command returns the maximum IQ offset error limit result.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:IQOF:MAX:RES?

Maximum IQ offset error limit result is returned.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:SSTiming[:AVERage]

This command is only supported for reasons of compatibility with the FSP family. It sets the average Subscriber Station Timing limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

0PCT

Example

CALC:LIM:BURS:SST 0
The average SS Timing limit is set to 0%.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:SSTiming[:AVERage]:RESult?

This command returns the average Subscriber Station Timing limit result.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:SST:RES?
Average SS Timing limit result is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:SSTiming:MAXimum

This command is only supported for reasons of compatibility with the FSP family. It sets the maximum Subscriber Station Timing limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

0PCT

Example

CALC:LIM:BURS:SST:MAX?
Maximum SS Timing limit is returned.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:SSTiming:MAXimum:RESult?

This command returns the maximum Subscriber Station Timing limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:SST:MAX:RES?
Maximum SS Timing limit result is returned.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:SYMBolerror[:AVERage]

This command sets the average symbol error limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

<numeric_value> in ppm or %: –1000000 to 1000000

If no unit is specified the unit depends on the current Up/Down Link Mode: ppm in Down Link mode, % in Up Link mode.

Note: *There is no relationship between the Down Link and Up Link values. Setting a Down Link value in Up Link mode does not change the displayed limit value.*

Example

CALC:LIM:BURS:SYMB 10000
The average symbol error limit is set to 10000 Hz.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:SYMBolerror[:AVERage]:RESult?

This command returns the average symbol error limit result.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:SYMB:RES?

Average symbol error limit result is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:SYMBolerror:MAXimum

This command sets the maximum symbol error limit.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

Parameter

<numeric_value> in ppm or %: –1000000 to 1000000

If no unit is specified the unit depends on the current Up/Down Link Mode: ppm in Down Link mode, % in Up Link mode.

Note: *There is no relationship between the Down Link and Up Link values. Setting a Down Link value in Up Link mode does not change the displayed limit value.*

Example

CALC:LIM:BURS:SYMB:MAX?

Maximum symbol error limit is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:BURSt:SYMBolerror:MAXimum:RESult?

This command returns the maximum symbol error limit result.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Return values

0   PASSED

1   FAILED

Example

CALC:LIM:BURS:SYMB:MAX:RES?

Maximum symbol error limit result is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:SPECtrum:MASK:CHECk:X?

This command returns the x–value at the maximum overstepping of the spectrum mask limits.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Example

CALC:LIM:SPEC:MASK:CHEC:X?

Returns the frequency at the maximum overstepping.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:LIMit<1...8>:SPECtrum:MASK:CHECk:Y?

This command returns the y–value at the maximum overstepping of the spectrum mask limits.

The numeric suffixes <1|2> sets the measurement window for the calculation and the suffixes <1...8> specify the limit lines (see CALCulate<1|2>:LIMit<1...8>:FAIL? command).

This command is only a query and therefore has no *RST value.

Example

CALC:LIM:SPEC:MASK:CHEC:Y?

Returns the power at the maximum overstepping.

Characteristics

RST value: –

SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

CALCulate:MARKer Subsystem (WiMAX, K93)

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

Note: *Currently there is only marker 1 available and it is always on.*

The following subsystem is included:

- "CALCulate:MARKer:FUNCtion Subsystem (WiMAX, K93)" on page 4.473

Commands of the CALCulate:MARKer Subsystem

– CALCulate<1|2>:MARKer<1>[:STATe]

– CALCulate<1|2>:MARKer<1>:AOFF

– CALCulate<1|2>:MARKer<1>:BURSt

– CALCulate<1|2>:MARKer<1>:CARRier

– CALCulate<1|2>:MARKer<1>:MAXimum[:PEAK]

– CALCulate<1|2>:MARKer<1>:MINimum[:PEAK]

– CALCulate<1|2>:MARKer<1>:SYMBol

– CALCulate<1|2>:MARKer<1>:TRACe

– CALCulate<1|2>:MARKer<1>:TTCapture?

– CALCulate<1|2>:MARKer<1>:X

– CALCulate<1|2>:MARKer<1>:Y?

CALCulate<1|2>:MARKer<1>[:STATe]

This command switches the markers in the specified measurement window on or off.

Parameter
ON | OFF

Example
`CALC1:MARK1 ON`
Switches the screen A marker ON.

Characteristics
RST value: ON
SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:AOFF

This command switches off all active markers in the specified measurement window. The window is set by the numeric suffix of CALCulate<1|2>.

Example
`CALC1:MARK:AOFF`
Switches off all markers in the screen A window.

```
CALC2:MARK:AOFF
```
Switches off all markers in the screen B window.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:BURSt

This command positions the selected marker in the specified measurement window to the indicated burst. This command is only available for the Constellation vs Symbol result display.

Parameter

1 to <number of captured bursts in capture buffer>

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:CARRier

This command positions the selected marker in the specified measurement window to the indicated carrier.

This command is only available for the following result displays:

– Constellation vs Symbol

– Constellation vs Carrier

Parameter

–100 to 100

Example

```
CALC2:MARK:CARR –7
```
Positions marker 1 in screen B to carrier –7.
```
CALC2:MARK:CARR?
```
Outputs the carrier value of marker 1 in screen B.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:MAXimum[:PEAK]

This command sets the selected marker in the specified measurement window to the maximum peak value in the current trace.

This command is only available for the following result display:

– Spectrum Flatness

This command is an event and therefore has no *RST value and no query.

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

Characteristics
RST value: –
SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:MINimum[:PEAK]

This command sets the selected marker in the specified measurement window to the minimum peak value in the current trace.

This command is only available for the following result display:

– Spectrum Flatness

This command is an event and therefore has no *RST value and no query.

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

Characteristics
RST value: –
SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:SYMBol

This command positions the selected marker in the specified measurement window to the indicated symbol.

This command is only available for the following result displays:

– Constellation vs Symbol

– Constellation vs Carrier

Parameter
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.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:TRACe

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 vs Carrier

– EVM vs Symbol

– EVM vs Carrier

– Frequency Error vs Preamble

– Phase Error vs Preamble

– PVT Rising / Falling

– Spectrum Flatness

– Spectrum Flatness Difference

– Spectrum Mask – if Max Hold trace mode is activated

– Spectrum ACP/ACPR – if Max Hold trace mode is activated

Parameter

1 to 3

Example

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

Characteristics

RST value: 1

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:TTCapture?

This command returns the time to the start of the first frame in the capture buffer.

This command is only a query and therefore has no *RST value.

Example

```
CALC:MARK:TTC?
```
Returns the time to the start of the first frame in the capture buffer.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:X

This command positions the selected marker to the indicated in phase (Constellation vs Symbol), frequency (Spectrum FFT, Spectrum Mask), 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.

For the following result displays, this command is a query only:

– Constellation vs Symbol

– Constellation vs Carrier

Parameter

1 to <maximum range for selected measurement>

Example

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

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:Y?

This command queries the marker value of 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 only a query and therefore has no *RST value.

This command is only available 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 FFT

- CCDF

Example

`CALC2:MARK:Y –2`
Positions marker 1 in screen B to –2.

`CALC:MARK:Y?`
Outputs the measured value of marker 1 in screen A.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate:MARKer:FUNCtion Subsystem (WiMAX, K93)

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

Commands of the CALCulate:MARKer:FUNCtion Subsystem

– CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]?

– CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult:MAXHold?

– CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM

CALCulate<1|2>: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 to provide the summary data.

The numeric suffix <1|2> at CALCulate specifies the measurement window.

This command is only a query and therefore has no *RST value.

Results are output separated by commas. Adjacent channel power values are output in dB. The order is as follows:

- 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

- Power of lower alternate adjacent channel 3

- Power of upper alternate adjacent channel 3

- Power of lower alternate adjacent channel 4

- Power of upper alternate adjacent channel 4

Example

CALC2:MARK:FUNC:POW:RES?

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>: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 to provide the summary data.

For details on the result output refer to
CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]?

The numeric suffix <1|2> at CALCulate specifies the measurement window.

Example

CALC2:MARK:FUNC:POW:RES:MAXH?

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM

This command defines the ratio to be zoomed around the marker 1 in the selected measurement window. The default value is 1, where the full trace is shown.

This command is only available for the following result displays:

– Constellation vs Carrier

– Constellation vs Symbol

– PVT Full Burst

– PVT Rising / Falling

– Magnitude Capture Buffer

Parameter

1 to 1000000

Example

CALC:MARK:FUNC:ZOOM 2
Zooms 50% in screen A.

CALC:MARK:FUNC:ZOOM 4
Zooms 25% in screen A.

CALC:MARK:FUNC:ZOOM 1
Deactivates zooming in screen A.

Characteristics

RST value: 1

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure Subsystem (WiMAX, K93)

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.

Commands of the CONFigure Subsystem

– CONFigure:BURSt:BSTReam:BURSt:SELect

– CONFigure:BURSt:BSTReam:FORMat:SELect

– CONFigure:BURSt:BSTReam:SYMBol:SELect

– CONFigure:BURSt:CONSt:BURSt:SELect

– CONFigure:BURSt:CONSt:CARRier:SELect

– CONFigure:BURSt:CONSt:CCARrier[:IMMediate]

– CONFigure:BURSt:CONSt:CSYMbol[:IMMediate]

– CONFigure:BURSt:CONSt:FORMat:SELect

– CONFigure:BURSt:CONSt:SYMBol:SELect

– CONFigure:BURSt:EVM:ECARrier[:IMMediate]

– CONFigure:BURSt:EVM:ESYMbol[:IMMediate]

– CONFigure:BURSt:PREamble[:IMMediate]

– CONFigure:BURSt:PREamble:SELect

– CONFigure:BURSt:PVT[:IMMediate]

– CONFigure:BURSt:PVT:BURSt

– CONFigure:BURSt:PVT:SELect

– CONFigure:BURSt:SPECtrum:ACPR[:IMMediate]

– CONFigure:BURSt:SPECtrum:ACPR:SELect

– CONFigure:BURSt:SPECtrum:FFT[:IMMediate]

– CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]

– CONFigure:BURSt:SPECtrum:FLATness:SELect

– CONFigure:BURSt:SPECtrum:MASK[:IMMediate]

– CONFigure:BURSt:SPECtrum:MASK:SELect

– CONFigure:BURSt:STATistics:BSTReam[:IMMediate]

– CONFigure:BURSt:STATistics:BSUMmary[:IMMediate]

– CONFigure:BURSt:STATistics:CCDF[:IMMediate]

– CONFigure:CHANnel

– CONFigure:POWer:AUTO

– CONFigure:POWer:AUTO:SWEep:TIME

– CONFigure:POWer:EXPected:RF

– CONFigure:STANdard

– CONFigure:WIMax:AVERaging

CONFigure:BURSt:BSTReam:BURSt:SELect

This command selects bursts and pilots. It is only available if the Bitstream measurement is selected (see `CONFigure:BURSt:STATistics:BSTReam[:IMMediate]` command). (K93)

Parameter

0 to 9999	burst number
ALL	all bursts

PILOTS   only pilots

Example

`CONF:BURS:STAT:BSTR`
Configures the Bitstream measurement type.

`CONF:BURS:BSTR:BURS:SEL 1`
Selects burst 1.

`INIT`
Starts a Bitstream measurement. The results of the selected burst (1) are calculated.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:BURSt:BSTReam:FORMat:SELect

This command selects the modulation format. It is only available if the Bitstream measurement is selected (see CONFigure:BURSt:STATistics:BSTReam[:IMMediate] command).

Parameter

ALL |QPSK | QAM16 | QAM64

Example

`CONF:BURS:STAT:BSTR`
Configures the Bitstream measurement type.

`CONF:BURS:BSTR:FORM:SEL QPSK`
Selects the QPSK modulation formats.

`INIT`
Starts a Bitstream measurement. The results of the selected modulation formats (QPSK) are calculated.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:BURSt:BSTReam:SYMBol:SELect

This command selects the symbol. It is only available if the Bitstream measurement is selected (see CONFigure:BURSt:STATistics:BSTReam[:IMMediate] command).

Parameter

0 to 9999   symbol number

ALL   all symbols

Example

`CONF:BURS:STAT:BSTR`
Configures the Bitstream measurement type.

```
CONF:BURS:BSTR:SYMB:SEL 1
```
Selects symbol 1.
```
INIT
```
Starts a Bitstream measurement. The results of the selected symbol (1) are calculated.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:BURSt:CONSt:BURSt:SELect

This command selects bursts and pilots. It is only available if the Constellation vs Symbol measurement is selected (see `CONFigure:BURSt:CONSt:CSYMbol[:IMMediate]` command).

Parameter

0 to 9999	burst number
ALL	all bursts
PILOTS	only pilots

Example

```
CONF:BURS:CONS:CSYM
```
Configures the Constellation vs Symbol measurement type.
```
CONF:BURS:CONS:BURS:SEL 1
```
Selects burst 1.
```
INIT
```
Starts a Constellation vs Symbol measurement. The results of the selected burst (1) are calculated.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:BURSt:CONSt:CARRier:SELect

This command selects carriers and pilots. It is only available if the Constellation vs Symbol measurement is selected (see `CONFigure:BURSt:CONSt:CSYMbol[:IMMediate]` command).

Parameter

–100 to 100	carrier number
ALL	all carriers
PILOTS	only pilots

Example

```
CONF:BURS:CONS:CSYM
```
Configures the Constellation vs Symbol measurement type.

CONF:BURS:CONS:CARR:SEL –26
Carrier –26 is selected.

INIT
Starts a Constellation vs Symbol measurement. The results of the selected carrier (–26) are calculated.

Characteristics

RST value: ALL

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:CONSt:CCARrier[:IMMediate]

This command configures the Constellation vs Carrier measurement type.

This command is an event and therefore has no *RST value and no query.

Example

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

INIT
Starts a Constellation vs Carrier measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM

CONFigure:BURSt:CONSt:CSYMbol[:IMMediate]

This command configures the Constellation vs Symbol measurement type.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:CONS:CSYM
Configures the Constellation vs Symbol measurement type.

INIT
Starts a Constellation vs Symbol measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:CONSt:FORMat:SELect

This command selects the modulation format. It is only available if the Constellation vs Symbol measurement is selected (see CONFigure:BURSt:CONSt:CSYMbol[:IMMediate] command).

Parameter

ALL |QPSK | QAM16 | QAM64

Example

CONF:BURS:CONS:CSYM

Configures the Constellation vs Symbol measurement type.

CONF:BURS:CONS:FORM:SEL QPSK

Selects the QPSK modulation formats.

INIT

Starts a Constellation vs Symbol measurement. The results of the selected modulation formats (QPSK) are calculated.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:BURSt:CONSt:SYMBol:SELect

This command selects the symbol. It is only available if the Constellation vs Symbol measurement is selected (see CONFigure:BURSt:CONSt:CSYMbol[:IMMediate] command).

Parameter

0 to 9999   symbol number

ALL   all symbols

Example

CONF:BURS:CONS:CSYM

Configures the Constellation vs Symbol measurement type.

CONF:BURS:CONS:SYMB:SEL 1

Selects symbol 1.

INIT

Starts a Constellation vs Symbol measurement. The results of the selected symbol (1) are calculated.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:BURSt:EVM:ECARrier[:IMMediate]

This command configures the EVM vs Carrier measurement type.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:EVM:ECAR

Configures the EVM vs Carrier measurement type.

INIT

Starts a EVM vs Carrier measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:EVM:ESYMbol[:IMMediate]

This command configures the EVM vs Symbol measurement type.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:EVM:ESYM

Configures the EVM vs Symbol measurement type.

INIT

Starts a EVM vs Symbol measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:PREamble[:IMMediate]

This command configures the Phase or Frequency vs Preamble measurement type. The selection between the both measurements is made via the CONFigure:BURSt:PREamble:SELect command.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:PRE

Configures the Phase or Frequency vs Preamble measurement type.

CONF:BURS:PRE:SEL FREQ

The measurement results are interpreted as Frequency Error vs Preamble.

INIT

Starts a Frequency Error vs Preamble measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:PREamble:SELect

This command configures the interpretation of the preamble measurement results.

Parameter

PHASe | FREQuency

Example

CONF:BURS:PRE
Configures the Phase or Frequency vs Preamble measurement type.

CONF:BURS:PRE:SEL FREQ
The measurement results are interpreted as Frequency Error vs Preamble.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:PVT[:IMMediate]

This command configures the Power vs Time (PVT) measurement type. For further settings of the Power vs Time measurement see the CONFigure:BURSt:PVT:BURSt and CONFigure:BURSt:PVT:SELect commands.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:PVT
Configures the Power vs Time measurement type.

INIT
Starts a Power vs Time measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:PVT:BURSt

This command specifies the burst that is used for the Power vs Time measurement results.

Parameter

1 to 10922

Example

CONF:BURS:PVT
Configures the Power vs Time measurement type.

CONF:BURS:PVT:BURS 1
Uses burst 1 for the Power vs Time measurement results.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM

CONFigure:BURSt:PVT:SELect

This command configures the interpretation of the Power vs Time (PVT) measurement results. The available measurement types depend on the selected standard.

Parameter

FULL	PVT Start and End	OFDM
	PVT Rsing / Falling	OFDMA/WiBro
EDGE	PVT Full Burst	OFDM
	PVT Full Subframe	OFDMA/WiBro

Example

`CONF:BURS:PVT`
Configures the Power vs Time measurement type.

`CONF:BURS:PVT:SEL FULL`
The measurement results are interpreted as full burst.

Characteristics

RST value: FULL

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:SPECtrum:ACPR[:IMMediate]

This command configures the ACPR (adjacent channel power relative) measurement type.

This command is an event and therefore has no *RST value and no query.

Example

`CONF:BURS:SPEC:ACPR`
Configures the ACPR measurement type.

`INIT`
Starts an ACPR measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:SPECtrum:ACPR:SELect

This command specifies the type of ACP measurement to be performed.

Parameter

ABSolute | RELative

Example

CONF:BURS:SPEC:ACPR:SEL ABS
Specifies the ACP measurement type absolute.

Characteristics

RST value: REL

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:SPECtrum:FFT[:IMMediate]

This command configures the FFT (Fast Fourier Transform) measurement type.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:SPEC:FFT
Configures the FFT measurement type.

INIT
Starts an FFT measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]

This command configures the Spectrum Flatness measurement type. For settings for the Spectrum Flatness measurement see CONFigure:BURSt:SPECtrum:FLATness:SELect command.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:SPEC:FLAT
Configures the Spectrum Flatness measurement type.

INIT
Starts a Spectrum Flatness measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:SPECtrum:FLATness:SELect

This command configures the interpretation of the Spectrum Flatness measurement results.

Parameter

FLATness   spectrum flatness

GRDelay   group delay

DIFFerence   flatness difference

Example

CONF:BURS:SPEC:FLAT

Configures the Spectrum Flatness measurement type.

CONF:BURS:SPEC:FLAT:SEL GRD

Configures the group delay for the Spectrum Flatness measurement.

Characteristics

RST value: FLAT

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:SPECtrum:MASK[:IMMediate]

This command configures the Spectrum Mask measurement type. For settings for the Spectrum Mask measurement see CONFigure:BURSt:SPECtrum:MASK:SELect command.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:SPEC:MASK

Configures the Spectrum Mask measurement type.

INIT

Starts a Spectrum Mask measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:SPECtrum:MASK:SELect

This command configures the interpretation of the Spectrum Mask measurement results..

Parameter

IEEE   interpretation according to IEEE standard

ETSI   interpretation according to ETSI standard

Example

CONF:BURS:SPEC:MASK

Configures the Spectrum Mask measurement type.

CONF:BURS:SPEC:MASK:SEL ETSI

The measurement results are interpreted using the ETSI standard.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:STATistics:BSTReam[:IMMediate]

This command configures the Bitstream measurement type.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:STAT:BSTR

Configures the Bitstream measurement type.

INIT

Starts a Bitstream measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:STATistics:BSUMmary[:IMMediate]

This command configures the Burst Summary measurement type.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:STAT:BSUM

Configures the Burst Summary measurement type.

INIT

Starts a the Burst Summary measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:BURSt:STATistics:CCDF[:IMMediate]

This command configures the CCDF (conditional cumulative distribution functions) measurement type.

This command is an event and therefore has no *RST value and no query.

Example

CONF:BURS:STAT:CCDF
Configures the CCDF measurement type.

INIT
Starts a CCDF measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:CHANnel

This command specifies the measurement input channel. This command will automatically cause the internal measurement frequency to be recalculated.

Parameter

0 to 3153

Example

CONF:CHAN 9
Defines the frequency of channel 9 as measurement range.

Characteristics

RST value: 0

SCPI: device–specific

Mode

OFDM

CONFigure:POWer:AUTO

This command switches on or off the automatic power level detection.

Parameter

ON | OFF | ONCE

Example

CONF:POW:AUTO ON
At the start of every measurement sweep the input power level is detected automatically.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:POWer:AUTO:SWEep:TIME

This command specifies the sweep time for the automatic power level detection.

Parameter

1ms to 1s

Example

`CONF:POW:AUTO ON`
At the start of every measurement sweep the input power level is detected automatically.

`CONF:POW:AUTO:SWE:TIME 200MS`
The sweep time is set to 200 ms power level.

Characteristics

RST value: 100 ms
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:POWer:EXPected:RF

This command specifies the input power level of the source signal that will be supplied at the analyzer RF input.

Parameter

–999.99 dBm to 999.99 dBm

Example

`CONF:POW:EXP:RF –20`
Assumes an input signal strength of –20 dBm.

Characteristics

RST value: –30 dBm
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:STANdard

This command specifies the Wireless LAN standard to be measured.

Parameter

0	IEEE 802.16–2004	OFDM
1	IEEE 802.16e–2005	OFDMA
2	IEEE 802.16e–2005	WiBro

Example

`CONF:STAN 0`
The measurements will be performed according to IEEE 802.16–2004.

Characteristics

RST value: 1
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:WIMax:AVERaging

This command specifies the RSSI, CINR averaging parameter.

Parameter

0.000001 to 0.999999

Example

CONF:WIM:AVER 0.1
Sets the value to 0.1

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:DLSFrame:IDCell

This command specifies the downlink IDCell number. The downlink IDCell number is used as DL_PermBase parameter for the permutation equations to partly set the sub carrier randomizer initialization vector.

Parameter

0 to 31

Example

CONF:WIM:DLSF:IDC 0
Sets the downlink IDCell number to 0.

Characteristics

RST value: 0

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:DLSFrame:PMODe

This command specifies how the preamble index is calculated.

Parameter

AUTO   The preamble index is automatically calculated according to the parameters set by the CONFigure:WIMax:DLSFrame:IDCell and CONFigure:WIMax:DLSFrame:SEGMent<1…3> commands.

USER   The preamble index can be specified manually, i.e. the preamble pattern is chosen by the CONFigure:WIMax:DLSFrame:PINDex command according to the standard.

Example

CONF:WIM:DLSF:PMOD AUTO
Activates the automatic calculation of the preamble index.

Characteristics

RST value: USER

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:DLSFrame:PINDex

This command specifies the preamble pattern (according to the standard) to be used.

Parameter

integer from 0 to 113

Example

`CONF:WIM:DLSF:PMOD USER`
Deactivates the automatic calculation of the preamble index.

`CONF:WIM:DLSF:PIND 31`
Specifies the preamble pattern.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:DLSFrame:SEGMent<1…3>

This command specifies the allowable logical subchannel usage of the transmission spectrum for one of the three downlink PUSC segments.

Note that the indexes specified on the instrument are 0, whereas based under remote control they are 1 based. This means, the first segment on the instrument is labeled segment 0 and would be accessed with the command `CONF:WIM:DLSF:SEGM1`.

Parameter

0 to 63

Example

`CONF:WIM:DLSF:SEGM1 63`
Specifies the logical subchannel usage of the transmission spectrum for the first downlink PUSC segment to 63.

Characteristics

RST value: 0

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:FBANd

This command configures the Phase or Frequency vs Preamble measurement type.

Parameter

The suffix 1 can be omitted in the input (see list below) and is omitted in the output (see example).

Selection	Value	Range in GHz	Description
UNSPecified	**Unspecified**		
ETSI or ETSI1	**ETSI**	**3.410–4.200**	**Licensed Band**
ETSI2	**ETSI**	**10.000–10.680**	**Licensed Band**
MMDS or MMDS1	**MMDS**	**2.150–2.162**	**Licensed Band**
MMDS2	**MMDS**	**2.500–2.690**	**Licensed Band**
WCS or WCS1	**WCS**	**2.305–2.320**	**Licensed Band**
WCS2	**WCS**	**2.345–2.360**	**Licensed Band**
CEPT or CEPT1	**CEPT**	**5.470–5.725**	**License Exempt Band**
CEPT2	**CEPT**	**5.725–5.875**	**License Exempt Band**
UNII or UNII1	**U–NII**	**5.250–5.350**	**License Exempt Band**
UNII2	**U–NII**	**5.725–5.825**	**License Exempt Band**

Example

`CONF:WIM:FBAN ETSI`
Configures the frequency band to be ETSI 3.41GHz – 4.2GHz.

`CONF:WIM:FBAN?`
After frequency band is set to ETSI this will return "ETSI" as the current frequency band.

`CONF:WIM:FBAN ETSI1`
Configures the frequency band to be ETSI 3.41GHz – 4.2GHz.

`CONF:WIM:FBAN?`
After frequency band is set to ETSI1 this will return "ETSI" as the current frequency band.

`CONF:WIM:FBAN ETSI2`
Configures the frequency band to be ETSI 10.0GHz – 10.68GHz.

`CONF:WIM:FBAN?`
After frequency band is set to ETSI2 this will return "ETSI2" as the current frequency band.

`INIT`
Starts a Phase or Frequency vs Preamble measurement.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

CONFigure:WIMax:IGRatio

This command specifies the number of guard samples.

Parameter

valid range: $\frac{T_g}{T_b} \in \{1/32,\ 1/16,\ 1/8,\ 1/4\}$

The ration can be set to one of four values – 4, 8, 16 or 32. The table below shows the relationship between these values and the number of guard samples.

Value	Guard samples (T_g/T_b)
4	**1/4**
8	**1/8**
16	**1/16**
32	**1/32**

Example
CONF:WIM:IGR 16
Sets the number of guard samples to 1/16.

Characteristics
RST value: –
SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

CONFigure:WIMax:LMODe

This command specifies only to analyze the Down Link or Up Link bursts during a measurement.

Parameter
UL | DL

Example
CONF:WIM:LMOD UL
Only the Up Link bursts are analyzed.

Characteristics
RST value: –
SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

CONFigure:WIMax:NFFT

This command specifies the current FFT size.

Parameter

FFT128	FFT size of 128 carriers
FFT512	FFT size of 512 carriers
FFT1024	FFT size of 1024 carriers
FFT2048	FFT size of 2048 carriers

Example
CONF:WIM:NFFT FFT2048
Sets the FFT size to 2048 carriers.

Characteristics
RST value: FFT1024
SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:TDDFrame:TTG

This command specifies the TDD frame TX Transition Gap (TTG).

Parameter

0 to 2 seconds

Example

CONF:WIM:TDDF:TTG 10us

Specifies the TDD frame TX Transition Gap as 10 µs.

Characteristics

RST value: 5us

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ULSFrame:FRAMe

This command selects the frame number of the uplink frame in which the UL map that specifies the uplink burst was transmitted.

Parameter

0 to 10

Example

CONF:WIM:ULSF:FRAM 0

Selects frame number 0.

Characteristics

RST value: 0

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>[:ANALyze]:STATe

This command sets a zone for analysis. This will come into effect when the next measurement is executed.

Parameter

ON | OFF

Example

CONF:WIM:ZONE1:ANAL ON

Sets zone 1 for analysis.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:CONTrol[:DATA]

This command associates a burst definition with a specific zone. A zone may have up to 32 bursts defined within it.

New bursts can only be appended to the end of the existing burst list. For example if 4 bursts are already defined, then the suffix required to enter a new burst is 5.

Parameter

<Modulation>,<Subchannels>,<Symbols>,<Slot Duration>,<Subchannel Offset>,<Symbol Offset>,<Burst Power>,<Burst Type>

with:

<Modulation>	**QPSK_1_2 | QPSK_3_4 | QAM16_1_2 | QAM16_3_4 | QAM64_1_2 | QAM64_2_3 | QAM64_3_4**	modulation scheme
<Subchannels>	**<numeric_value>**	number of subchannels used by the burst
<Symbols>	**<numeric_value>**	number of symbols used by the burst
<Slot Duration>	**<numeric_value>**	slot duration (only applies to uplink and ignored by downlink bursts)
<Subchannel Offset>	**<numeric_value>**	subchannel offset of the burst
<Symbol Offset>	**<numeric_value>**	symbol offset of the burst
<Burst Power>	**<numeric_value>**	Defines the boosting power of the burst.
<Burst Type>	**FCH | DLMAP | ULMAP | DATA**	burst type

For further details refer to chapter "Instrument Functions", section "WiMAX, WiBro Measurements (Options K93)", **Burst List** description.

Example

```
CONF:WIM:ZONE1:BURS1:CONT QAM16_1_2,1D2,5,10,20,0,0,0, DATA
```
Defines a 16 QAM 1/2 burst using 5 subchannels and 10 symbols.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:COUNt?

This command returns the current count of user defined bursts within the specified zone.

This command is only a query and therefore has no *RST value.

Example

```
CONF:WIM:ZONE1:BURS1:COUN?
```
Returns the user defined bursts within zone 1.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:DELete

This command deletes a specific burst from within the specified zone.

Example

CONF:WIM:ZONE1:BURS1:DEL

Deletes burst 1 from zone 1.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:FORMat

This command specifies the burst modulation format for the specified zone.

Parameter

QPSK1D2   QPSK code rate 1/2

QPSK3D4   QPSK code rate 3/4

QAM16_1D2   16 QAM code rate 1/2

QAM16_3D4   16 QAM code rate 3/4

QAM64_1D2   64 QAM code rate 1/2

QAM64_2D3   64 QAM code rate 2/3

QAM64_3D4   64 QAM code rate 3/4

Example

CONF:WIM:ZONE1:BURS1:FORM QAM64_3D4

Sets the burst modulation format to QAM64_3D4.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:OFFSet:AUTO

This command allows, for the specified zone and burst, the logical subchannel and symbol offsets to be automatically calculated so that they are contiguous. The command only applies to uplink bursts.

Parameter

ON | OFF

Example

CONF:WIM:ZONE1:BURS1:OFFS:AUTO ON

Activates the automatic calculation of the logical subchannel and symbol offsets.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:POWer

This command specifies, for the specified zone and burst, the boosting power associated with the burst.

Parameter

–80 to 10

Example

CONF:WIM:ZONE1:BURS1:POW 0

Sets the boosting power associated with the burst to 0.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SLOT:DURation

This command defines, for the specified zone and burst, the duration of an uplink burst in slots in seconds. The command has no effect on downlink bursts.

Parameter

1 to 3000

Example

CONF:WIM:ZONE1:BURS1:SLOT:DUR 10

Sets the duration of uplink burst 1 to 10.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SUBChannel:COUNt

This command defines, for the specified zone and burst, the number of logical subchannels used by the burst.

Parameter

1 to 60

Example

CONF:WIM:ZONE1:BURS1:SUBC:COUN 5
Sets the number of logical subchannels used by burst 1 to 5.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SUBChannel:OFFSet

This command defines, for the specified zone and burst, the logical subchannels offset for the burst. This, together with the symbol offset, can be used to specify the frequency bandwidth in use by specific bursts.

Parameter

0 to 60

Example

CONF:WIM:ZONE1:BURS1:SUBC:OFFS 5
Sets the subchannels offset for burst 1 to 5.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SYMBol:COUNt

This command defines, for the specified zone and burst, the number of symbols used by the burst.

Parameter

1 to 1000

Example

CONF:WIM:ZONE1:BURS1:SYMB:COUN 5
Sets the number of symbols used by burst 1 to 5.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SYMBol:OFFSet

This command defines, for the specified zone and burst, the symbol offset for the burst. This, together with the logical subchannel offset, can be used to specify the frequency bandwidth in use by specific bursts.

Parameter

0 to 1000

Example

`CONF:WIM:ZONE1:BURS1:SYMB:OFFS 5`
Sets the symbol offset for burst 1 to 5.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WiMax:ZONE<1…26>:BURSt<1...32>:TYPE

For the specified zone and burst, this command specifies the type of burst from the protocol layer perspective, i.e. if the burst contains signaling information or if it is just a data burst.

Parameter

FCH	frame control header
DLMAP	downlink map
ULMAP	uplink map
DATA	data burst

Example

`ONF:WIM:ZONE1:BURS1:TYPE DATA`
Burst 1 is a data burst.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WiMax:ZONE<1…26>:CONTrol[:DATA]

This command adds a new zone. Up to 26 user zones can be defined.

New zones can only be appended to the end of the existing defined zones. For example, if 4 zones are already defined, then the suffix required to enter a new zone is 5.

Parameter

<Analyze>,<Type>,<Segment>,<Length>,<Offset>,<Permbase>,<PRBS_ID>
with:

\<Analyze\>	**ON	OFF**	Specifies whether the zone is too be marked for analysis.
\<Type\>	**DLFUSC	DLPUSC	ULPUSC**	zone type: downlink FUSC (Fully Used Subchanneliziation) zone, downlink PUSC (Partial Used Subchanneliziation) zone, or uplink PUSC zone
\<Segment\>	**0	1	2**	downlink PUSC zone segment
\<Length\>	**\<numeric_value\>**	zone symbol length
\<Offset\>	**\<numeric_value\>**	zone symbol offset
\<Permbase\>	**\<numeric_value\>**	permbase to be used for channel decoding
\<PRBS_ID\>	**\<numeric_value\>**	PRBS to be used for channel decoding

For further details refer to chapter "Instrument Functions", "WiMAX, WiBro Measurements (Options K93)", **Zone/Segment List** description.

Example

CONF:WIM:ZONE1:CONT ON,DLFUSC,0,10,0,0,0
Adds a DL_PUSC zone with a length of 10 symbols.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE\<1…26\>:COUNt?

This command returns the current count of the specified zone.

This command is only a query and therefore has no *RST value.

Example

CONF:WIM:ZONE1:COUN?
Returns the count of zone 1.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE\<1…26\>:DELete

This command deletes a specific zone. If the specified zone is within a larger list of zones, then all following zones will be shuffled down to take up the space occupied by the deleted zone.

This command is an event and therefore has no *RST value and no query.

Example

CONF:WIM:ZONE1:DEL
Deletes zone 1.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:IDSegment

This command specifies the segment number associated with the zone. This is only valid for PUSC zones and will have no effect on other zone types.

Parameter

0 | 1 | 2

Example

`CONF:WIM:ZONE1:IDS 0`
Sets the segment number for zone 1 to 0.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:PERMbase

This command specifies the perm base which is used in the permutation equations for the specified zone.

Parameter

0 to 31

Example

`CONF:WIM:ZONE1:PERM 0`
For zone 1, perm base 0 is used in the permutation equations.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:PRBS

This command specifies a known PRBS (pseudo random binary sequence) modulated data sequence that is in use by the DUT of the specified zone.

Parameter

0, 1, 2, 3

Example

`CONF:WIM:ZONE1:PRBS 0`
Sets the PRBS to 0.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:SYMB:OFFSet

This command specifies the symbol offset associated with the specified zone. This is used to analyze signals which contain multiple zones and allows any zone in a subframe to be set up for analysis.

Parameter

1 to 1000

Example

`CONF:WIM:ZONE1:SYMB:OFFS 0`
Sets the symbol offset for zone 1 to 0.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:SYMB:COUNt

This command specifies the number of symbols defined to the specified zone.

Parameter

1 to 1000

Example

`CONF:WIM:ZONE1:SYMB:COUNT 10`
Sets the number of symbols for zone 1 to 10.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

CONFigure:WIMax:ZONE<1…26>:TYPE

This command specifies the zone type of the specified zone.

Parameter

DLFUSC   downlink FUSC zone

DLPUSC   downlink PUSC zone

ULPUSC   uplink PUSC zone

Example

`CONF:WIM:ZONE1:TYPE DLPUSC`
Specifies zone 1 as downlink PUSC zone.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

DISPlay Subsystem (WiMAX, K93)

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 WiMAX IEEE 802.16 OFDM, OFDMA Measurements option supports the split screen modus.

Commands of the DISPlay Subsystem

– DISPlay:FORMat

– DISPlay[:WINDow<1|2>]:SELect

– DISPlay[:WINDow<1|2>]:SSELect

– DISPlay[:WINDow<1|2>]:TABLe

– DISPlay[:WINDow<1|2>]:TABLe:UNIT

– DISPlay[:WINDow<1|2>]:TRACe1:Y[:SCALe]:AUTO

– DISPlay[:WINDow<1|2>]:TRACe1:Y[:SCALe]:PDIVision

– DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel[:RF]

– DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel?

– DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet

DISPlay:FORMat

This command sets the screen display type to full or split screen.

Parameter
SPLit | SINGle

Example
DISP:FORM SING
Sets the display to full screen.

Characteristics
RST value: SPLit
SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

DISPlay[:WINDow<1|2>]:SELect

This command selects whether screen A or screen B is active (see also
DISPlay[:WINDow<1|2>]:SSELect)

Example
DISP:WIND1 SEL
Sets screen A active.

Characteristics
RST value: –
SCPI: device–specific

Mode

OFDMA/WiBro

DISPlay[:WINDow<1|2>]:SSELect

This command selects whether screen A or screen B is active. The numeric suffix <1|2> defines the active window.

Example

DISP:WIND1:SSEL
Sets screen A active.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

DISPlay[:WINDow<1|2>]:TABLe

This command shows or hides the results table.

The numeric suffix <1|2> defines the active window.

Parameter

ON | OFF

Example

DISP:TABL OFF
Hides the results table.

Characteristics

RST value: OFF

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

DISPlay[:WINDow<1|2>]:TABLe:UNIT

This command specifies the unit for the parameters listed in the results table.

The numeric suffix <1|2> defines the active window.

Parameter

DB   results returned in dB

PCT   results returned in percent

Example

DISP:TABL:UNIT DB
Results are returned in dB.

Characteristics

RST value: DB

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

DISPlay[:WINDow<1|2>]:TRACe1:Y[:SCALe]:AUTO

This command switches on or off automatic scaling of the y–axis for trace 1. If switched on, the y–axis is scaled to best fit the measurement results automatically.

The numeric suffix <1|2> defines the active window.

This command is only available for the following result displays:

– EVM vs Carrier

– EVM vs Symbol

Parameter

ON | OFF

Example

`DISP:WIND2:TRAC1:Y:AUTO ON`
Switches on automatic scaling of the y–axis for the active trace.

Characteristics

RST value: ON

SCPI: conform

Mode

OFDM, OFDMA/WiBro

DISPlay[:WINDow<1|2>]:TRACe1:Y[:SCALe]:PDIVision

This command sets the size of each y scale division for trace 1. It has no affect if automatic scaling of the y–axis is enabled.

The numeric suffix <1|2> defines the active window.

This command is only available for the following result displays:

– EVM vs Carrier

– EVM vs Symbol

Parameter

1E–6 to 10E12

Example

`DISP:WIND2:TRAC1:Y:AUTO OFF`
Switches off automatic scaling of the y–axis for the active trace.
`DISP:WIND2:TRAC1:Y:PDIV 2`
Sets the y scale division to size 2.

Characteristics

RST value: 3

SCPI: conform

Mode

OFDM, OFDMA/WiBro

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel[:RF]

This command specifies the reference level applied to an RF measurements.

The numeric suffixes of WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Parameter

<numeric_value> in dBm, range specified in data sheet

Example

`DISP:TRAC:Y:RLEV 10`
Reference level of the analyzer is 10 dB

`DISP:TRAC:Y:RLEV:RF –10`
Reference level of the analyzer is –10 dB

Characteristics

RST value: 0 dB

SCPI: conform

Mode

OFDM, OFDMA/WiBro

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel?

This command queries the current internal instrument reference level used when performing measurements.

The numeric suffixes of WINDow<1|2> and TRACe<1 to 3> are irrelevant.

This command is only a query and therefore has no *RST value.

Example

`DISP:TRAC:Y:RLEV?`
Returns the current reference level in use.

Characteristics

RST value: –

SCPI: conform

Mode

OFDM, OFDMA/WiBro

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet

This command specifies the external attenuation/gain applied to measurements. The value corresponds to the reference level offset in spectrum analyzer mode (see DISPlay[:WINDow<1|2>]:TRACe<1...6>:Y[:SCALe]:RLEVel:OFFSet command).

The numeric suffixes of WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Parameter

–200 to 200 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

Characteristics

RST value: 0 dB

SCPI: conform

Mode

OFDM, OFDMA/WiBro

FETCh Subsystem (WiMAX, K93)

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFigure and SENSe subsystems.

Commands of the FETCh Subsystem

– FETCh:BURSt:ALL?

– FETCh:BURSt:CINR?

– FETCh:BURSt:CINR:AVERage?

– FETCh:BURSt:CINR:MAXimum?

– FETCh:BURSt:CINR:MINimum?

– FETCh:BURSt:COUNt?

– FETCh:BURSt:CRESt:AVERage?

– FETCh:BURSt:CRESt:MAXimum?

– FETCh:BURSt:CRESt:MINimum?

– FETCh:BURSt:EVM:ALL:AVERage?

– FETCh:BURSt:EVM:ALL:MAXimum?

– FETCh:BURSt:EVM:ALL:MINimum?

– FETCh:BURSt:EVM:DATA:AVERage?

– FETCh:BURSt:EVM:DATA:MAXimum?

– FETCh:BURSt:EVM:DATA:MINimum?

– FETCh:BURSt:EVM:PILot:AVERage?

– FETCh:BURSt:EVM:PILot:MAXimum?

– FETCh:BURSt:EVM:PILot:MINimum?

– FETCh:BURSt:FERRor:AVERage?

– FETCh:BURSt:FERRor:MAXimum?

– FETCh:BURSt:FERRor:MINimum?

– FETCh:BURSt:GIMBalance:AVERage?

– FETCh:BURSt:GIMBalance:MAXimum?

– FETCh:BURSt:GIMBalance:MINimum?

– FETCh:BURSt:IQOFfset:AVERage?

– FETCh:BURSt:IQOFfset:MAXimum?

– FETCh:BURSt:IQOFfset:MINimum?

– FETCh:BURSt:QUADoffset:AVERage?

– FETCh:BURSt:QUADoffset:MAXimum?

– FETCh:BURSt:QUADoffset:MINimum?

– FETCh:BURSt:RMS:ALL:AVERage?

– FETCh:BURSt:RMS:ALL:MAXimum?

– FETCh:BURSt:RMS:ALL:MINimum?

- FETCh:BURSt:RMS:AVERage?

- FETCh:BURSt:RMS:DATA:AVERage?

- FETCh:BURSt:RMS:DATA:MAXimum?

- FETCh:BURSt:RMS:DATA:MINimum?

- FETCh:BURSt:RMS:DLPReamble:AVERage?

- FETCh:BURSt:RMS:DLPReamble:MAXimum?

- FETCh:BURSt:RMS:DLPReamble:MINimum?

- FETCh:BURSt:RMS:MAXimum?

- FETCh:BURSt:RMS:MINimum?

- FETCh:BURSt:RMS:PILot:AVERage?

- FETCh:BURSt:RMS:PILot:MAXimum?

- FETCh:BURSt:RMS:PILot:MINimum?

- FETCh:BURSt:RSSI?

- FETCh:BURSt:RSSi:AVERage?

- FETCh:BURSt:RSSi:MAXimum?

- FETCh:BURSt:RSSi:MINimum?

- FETCh:BURSt:SYMBolerror:AVERage?

- FETCh:BURSt:SYMBolerror:MAXimum?

- FETCh:BURSt:SYMBolerror:MINimum?

- FETCh:BURSt:TDOMain:PREamble?

- FETCh:BURSt:TDOMain:SUBFrame?

- FETCh:BURSt:TDOMain:ZONE?

- FETCh:SYMBol:COUNt?

- FETCh:ZONE:COUNt?

Further information

ASCII formats for returned values

The results are output as a list of result strings separated by commas.

OFDM results

<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>

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

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

<min burst power>,<average burst power>,<max burst power>

<min crest factor>,<average crest factor>,<max crest factor>

<min SS timing>,<average SS timing>,<max SS timing>

<min RSSI>,<average RSSI>,<max RSSI>

<min RSSI Standard Deviation>,<average RSSI Standard Deviation>,<max RSSI Standard Deviation>

<min CINR>,<average CINR>,<max CINR>

<min CINR Standard Deviation>,<average CINR Standard Deviation>,<max CINR Standard Deviation>

OFMDA Uplink results

<min BER pilots>,<average BER pilots>,<max BER pilots>

<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>

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

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

<min power all>,<average power all>,<max power all>

<min power data>,<average power data>,<max power data>

<min power pilots>,<average power pilots>,<max power pilots>

<min crest factor>,<average crest factor>,<max crest factor>

OFDMA Downlink results

<min BER pilots>,<average BER pilots>,<max BER pilots>

<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>

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

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

<min power DL preamble>,<average power DL preamble>,<max power DL preamble>

<min power all>,<average power all>,<max power all>

<min power data>,<average power data>,<max power data>

<min power pilots>,<average power pilots>,<max power pilots>

<min crest factor>,<average crest factor>,<max crest factor>

<min RSSI>,<average RSSI>,<max RSSI>,<RSSI Standard Deviation>

<min CINR>,<average CINR>,<max CINR>,<CINR Standard Deviation>

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 "ASCII formats for returned values" on page 4.509. The units for the EVM results are specified with the `UNIT:EVM` command.

This command is only a query and therefore has no *RST value.

Example
`FETC:BURS:ALL?`
All calculated results are returned.

Characteristics
RST value: –
SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

FETCh:BURSt:CINR?

This command returns all the CINR results separated by commas. For details on the format refer to "ASCII formats for returned values" on page 4.509.

This command is only a query and therefore has no *RST value.

Example
`FETC:BURS:CINR?`
The calculated CINR results from the most recent measurement are returned.

Characteristics
RST value: –
SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

FETCh:BURSt:CINR:AVERage? / FETCh:BURSt:CINR:MINimum? / FETCh:BURSt:CINR:MAXimum?

This command returns the determined CINR (carrier to interference and noise ratio) standard deviation value (average, minimum or maximum value). The result is returned in ASCII format.

This command is only a query and therefore has no *RST value.

Example
`FETC:BURS:RSS:MAX?`
The calculated maximum CINR value is returned.

Characteristics
RST value: –
SCPI: device–specific

Mode

OFDMA/WiBro

FETCh:BURSt:COUNt?

This command returns the number of bursts analyzed in the last sweep.

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:COUN?

The number of analyzed bursts in the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

FETCh:BURSt:CRESt:AVERage? / FETCh:BURSt:CRESt:MAXimum? / FETCh:BURSt:CRESt:MINimum?

This command returns the determined crest factor (average, minimum or maximum value) in dBm. The crest factor is the ratio of peak power to average power.

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:CRES:MAX?

The calculated maximum crest factor from the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

FETCh:BURSt:EVM:ALL:AVERage? / FETCh:BURSt:EVM:ALL:MAXimum? / FETCh:BURSt:EVM:ALL:MINimum?

This command returns the Error Vector Magnitude (EVM) measurement results summary (average, minimum or maximum value) in dB. The results summary is a combined figure that represents the pilot, data and the free carrier.

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:EVM:ALL:MIN?

The minimum Error Vector Magnitude value is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

**FETCh:BURSt:EVM:DATA:AVERage? / FETCh:BURSt:EVM:DATA:MAXimum? /
FETCh:BURSt:EVM:DATA:MINimum?**

This command returns the Error Vector Management measurement results summary (average, minimum or maximum value) for the data carrier in dB.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:EVM:DATA:MAX?`
The maximum EVM recorded for the data carrier is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

**FETCh:BURSt:EVM:PILot:AVERage? / FETCh:BURSt:EVM:PILot:MAXimum? /
FETCh:BURSt:EVM:PILot:MINimum?**

This command returns the Error Vector Management measurement results summary for the EVM pilot carrier in dB.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:EVM:PIL:MAX?`
The maximum EVM recorded for the EVM pilot carrier is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

**FETCh:BURSt:FERRor:AVERage? / FETCh:BURSt:FERRor:MAXimum? /
FETCh:BURSt:FERRor:MINimum?**

This command returns the measured average, minimum or maximum frequency errors in Hz.???

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:FERR:MAX?`
The maximum frequency error from the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

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.

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:GIMB:MAX?

The maximum IQ Imbalance error from the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

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.

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:IQOF:MAX?

The maximum IQ Offset error from the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

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.

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:QUAD:MAX?

The maximum angle error recorded for a symbol during the measurement.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

**FETCh:BURSt:RMS:ALL:AVERage? / FETCh:BURSt:RMS:ALL:MAXimum? /
FETCh:BURSt:RMS:ALL:MINimum?**

This command returns the average, minimum or maximum RMS burst power in dBm for all
carriers measured during the measurement.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:RMS:ALL:MAX?`

The maximum RMS burst power for all carriers recorded during the most recent measurement is
returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM

**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.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:RMS:MAX?`

The maximum burst power recorded for the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM

**FETCh:BURSt:RMS:DATA:AVERage? / FETCh:BURSt:RMS:DATA:MAXimum? /
FETCh:BURSt:RMS:DATA:MINimum?**

This command returns the average, minimum or maximum RMS burst power in dBm for data
carriers measured during the measurement.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:RMS:DATA:MAX?`

The maximum RMS burst power for data carriers from the most recent measurement is
returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM

FETCh:BURSt:RMS:DLPReamble:AVERage? / FETCh:BURSt:RMS:DLPReamble:MAXimum? / FETCh:BURSt:RMS:DLPReamble:MINimum?

This command returns the average, minimum or maximum RMS burst power in dBm for the downlink preamble measured during the measurement.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:RMS:DLPR:MAX?`
The maximum RMS burst power for the downlink preamble from the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM

FETCh:BURSt:RMS:PILot:AVERage? / FETCh:BURSt:RMS:PILot:MAXimum? / FETCh:BURSt:RMS:PILot:MINimum?

This command returns the average, minimum or maximum RMS burst power in dBm for pilot carriers measured during the measurement.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:RMS:PIL:MAX?`
The maximum RMS burst power for pilot carriers from the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM

FETCh:BURSt:RSSI?

This command returns all the received signal strength indicator (RSSI) results separated by commas. For details on the format refer to "ASCII formats for returned values" on page 4.509.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:RSSI?`
The calculated RSSI results from the most recent measurement is returned.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

FETCh:BURSt:RSSi:AVERage? / FETCh:BURSt:RSSi:MAXimum? / FETCh:BURSt:RSSi:MINimum?

This command returns the average, minimum or maximum RSSI (received signal strength indicator) standard deviation value. This is an estimate of the total received power of the frame preamble of the segment of the connected BS. For details on the format refer to "ASCII formats for returned values" on page 4.509.

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:RSS:MAX?
The maximum RSSI deviation value from the most recent measurement is returned.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

FETCh:BURSt:SYMBolerror:AVERage? / FETCh:BURSt:SYMBolerror:MAXimum? / FETCh:BURSt:SYMBolerror:MINimum?

This command returns the percentage of symbols that were outside permissible demodulation range within a burst..

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:SYMB:MAX?
The maximum number of symbols that were out of range per burst is returned.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

FETCh:BURSt:TDOMain:PREamble?

This command returns the minimum, average and maximum preamble time domain values. The result is returned in (ASCII) format.

This command is only a query and therefore has no *RST value.

Example

FETC:BURS:TDOM:PRE?
Returns the minimum, average and maximum preamble time domain values.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDMA/WiBro

FETCh:BURSt:TDOMain:SUBFrame?

This command returns the minimum, average and maximum subframe time domain values. The result is returned in (ASCII) format.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:TDOM:SUBF?`
Returns the minimum, average and maximum subframe time domain values.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDMA/WiBro

FETCh:BURSt:TDOMain:ZONE?

This command returns the minimum, average and maximum zone time domain values. The result is returned in (ASCII) format.

This command is only a query and therefore has no *RST value.

Example

`FETC:BURS:TDOM:ZONE?`
Returns the minimum, average and maximum zone time domain values.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDMA/WiBro

FETCh:SYMBol:COUNt?

This command returns the number of symbol in each analyzed burst found in the last measurement sweep. The results are output as a list of result strings separated by commas in the following (ASCII) format:
<Symbols in 1st burst>,< Symbols in 2nd burst >,…, < Symbols in last burst >

This command is only a query and therefore has no *RST value.

Example

`FETC:SYMB:COUN?`
The calculated symbols in the analyzed bursts for the most recent measurement are returned.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

FETCh:ZONE:COUNt?

This command returns the current number of zones found during measurement analysis.

This command is only a query and therefore has no *RST value.

Example

FETC:ZONE:COUN?
The current number of zones found during analysis is returned.

Characteristics

RST value: –
SCPI: device–specific

Mode

OFDMA/WiBro

FORMat Subsystem (WiMAX, K93)

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

Commands of the FORMat Subsystem

–   FORMat[:DATA]

FORMat[:DATA]

> **Parameter**
>
> ASCii | REAL| UINT [,8 | 32]
>
> For details refer to section "Remote Control – Description of Basic Settings Commands", FORMat Subsystem.

INITiate Subsystem (WiMAX, K93)

The INITiate subsystem configures the instrument prior to a measurement being carried out. It is basically used to tell the instrument which measurement is to be performed and takes any necessary step to set up the instrument for the measurement.

Commands of the INITiate Subsystem

– INITiate[:IMMediate]

– INITiate:CONTinuous

– INITiate:REFResh

INITiate[:IMMediate]

For further details refer to "INITiate<1|2>[:IMMediate]" on page 4.109.

INITiate:CONTinuous

For further details refer to "
INITiate<1|2>:CONTinuous" on page 4.110.

INITiate:REFResh

This command updates the current IQ measurement results to reflect the current measurement settings. Note that no new IQ data is captured, i.e. the measurement settings apply to the IQ data being currently in the capture buffer. The command applies exclusively to IQ measurements. It requires available IQ data.

Example

```
INIT:REFR
```
Updates the IQ measurement results according to the current settings.

Characteristics

RST value: –

SCPI: conform

Mode

OFDM, OFDMA/WiBro

INPut Subsystem (WiMAX, K93)

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

Commands of the INPut Subsystem

– INPut:ATTenuation

– INPut:SELect

INPut:ATTenuation

For details refer to "INPut<1|2>:ATTenuation" on page 4.112.

INPut:SELect

This command specifies the RF input as currently selected signal input.

Parameter

RF

Example

```
INPut:SEL RF
```
Selects RF input.

Characteristics

RST value: RF

SCPI: conform

Mode

OFDM, OFDMA/WiBro

INSTrument Subsystem (WiMAX, K93)

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

Commands of the INSTrument Subsystem

– INSTrument[:SELect]
– INSTrument:NSELect

INSTrument[:SELect]

Parameter

WiMAX (WiMAX 802.16 OFDM Measurements option and WiMAX IEEE 802.16 OFDM, OFDMA Measurements option, R&S FSL–K93)

For further details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

INSTrument:NSELect

Parameter

23 (WiMAX 802.16 OFDM Measurements option, R&S FSL–K93)

6 (WiMAX IEEE 802.16 OFDM, OFDMA Measurements option, R&S FSL–K93)

For further details refer to section "Remote Control – Description of Basic Settings Commands", INSTrument subsystem.

MMEMory Subsystem (WiMAX, K93)

The MMEMory (mass memory) subsystem provides commands to store and load IQ data.

Commands of the MMEMory Subsystem

– MMEMory:LOAD:FRAMe:STATe

– MMEMory:LOAD:IQ:STATe

– MMEMory:STORe:IQ:STATe

MMEMory:LOAD:FRAMe:STATe

This command loads a zone frame setup from the specified *.xml file. This file is created by a R&S SMU signal generator in accordance to the IEEE 80216e–2005 standard.

Parameter

1,<file_name>

Example

`MMEM:STOR:FRAM:STAT 1,'C:\R_S\Instr\user\data.xml'`
Loads the zone frame setup from the specified file.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

MMEMory:LOAD:IQ:STATe

This command loads the IQ data from the specified *.iqw file.

Parameter

1,<file_name>

Example

`MMEM:LOAD:IQ:STAT 1,'C:\R_S\Instr\user\data.iqw'`
Loads IQ data from the specified file.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

MMEMory:STORe:IQ:STATe

This command stores the IQ data to the specified *.iqw file.

Parameter

1,<file_name>

Example

MMEM:STOR:IQ:STAT 1,'C:\R_S\Instr\user\data.iqw'
Stores IQ data to the specified file.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

SENSe Subsystem (WiMAX, K93)

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.

Commands of the SENSe Subsystem

- [SENSe:]BANDwidth:CHANnel
- [SENSe:]BURSt:COUNt
- [SENSe:]BURSt:COUNt:STATe
- [SENSe:]DEMod:CESTimation
- [SENSe:]DEMod:FILTer:CATalog?
- [SENSe:]DEMod:FILTer:MODulation
- [SENSe:]DEMod:FORMat[:BCONtent]:AUTo
- [SENSe:]DEMod:FORMat:BANalyze
- [SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal
- [SENSe:]DEMod:FORMat:BANalyze:SYMBols:MAX
- [SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN
- [SENSe:]FFT:OFFSet
- [SENSe:]FREQuency:CENTer
- [SENSe:]POWer:ACHannel:ACPairs
- [SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]
- [SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel
- [SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|4>
- [SENSe:]POWer:ACHannel:MODE
- [SENSe:]POWer:ACHannel:SPACing[:ACHannel]
- [SENSe:]POWer:ACHannel:SPACing:ALTernate<1|4>
- [SENSe:]POWer:NCORrection
- [SENSe:]POWer:SEM:CLASs
- [SENSe:]POWer:SEM:MODe
- [SENSe:]POWer:SEM:TTA
- [SENSe:]SUBChannel
- [SENSe:]SUBChannel:STATe
- [SENSe:]SUBChannel:ULPHysmod
- [SENSe:]SWAPiq
- [SENSe:]SWEep:ACPR:TIME
- [SENSe:]SWEep:ACPR:TIME:AUTO
- [SENSe:]SWEep:COUNt
- [SENSe:]SWEep:EGATe

- [SENSe:]SWEep:EGATe:HOLDoff[:TIMe]

- [SENSe:]SWEep:EGATe:HOLDoff:SAMPle

- [SENSe:]SWEep:EGATe:LENGth[:TIMe]

- [SENSe:]SWEep:EGATe:LENGth:SAMPle

- [SENSe:]SWEep:EGATe:LINK

- [SENSe:]SWEep:TIME

- [SENSe:]TRACking:LEVel

- [SENSe:]TRACking:PHASe

- [SENSe:]TRACking:PILot

- [SENSe:]TRACking:TIME

[SENSe:]BANDwidth:CHANnel

This command specifies the channel bandwidth for the signal to be measured. The channel is selected via the CONFigure:CHANnel command.

Parameter

1.25 MHz to 28 MHz

Example

CONF:CHAN 9
Defines the frequency of channel 9 as measurement range.

BAND:CHAN 7MHZ
Sets a channel bandwidth value of 7 MHz.

Characteristics

RST value: 1.75 MHz

SCPI: conform

Mode

OFDM

[SENSe:]BURSt:COUNt

This command defines the number of bursts that will be analyzed by the measurement.

Parameter

1 to 10922

Example

BURS:COUN 16
Sets the number of bursts to 16.

Characteristics

*RST value: 1

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]BURSt:COUNt: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.

Parameter

ON | OFF

Example

`BURS:COUN:STAT ON`
Sets the burst count state to ON

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]DEMod:CESTimation

This command defines how channel estimation is performed.

IEEE 802.16–2004 OFDM: The improved channel estimation is used for IQ measurements. The effect of this is most noticeable for the EVM measurement results, where the results will be improved if this feature is enabled. However, this functionality is not supported by the IEEE 802.16–2004 standard and must be disabled if the results are to be strictly measured against the standard.

IEEE 802.16e–2005 OFDMA/WiBro: The channel estimation is performed for downlink signals.

Parameter

Standard	Parameter	Description
IEEE 802.16–2004 OFDM	**ON**	**Improved channel estimation is performed.**
	OFF	**Improved channel estimation is not performed.**
IEEE 802.16e–2005 OFDMA	**PAYLONLY**	**Channel estimation is performed in the payload only.**
	PREAMONLY	**Channel estimation is performed in the preamble only.**
	PREAMPAYL	**Channel estimation is performed in both the preamble and the payload.**

Example

`DEM:CEST ON`
Specifies that the IQ measurement results will use improved channel estimation.

Characteristics

*RST value:

IEEE 802.16–2004 OFDM	OFF
IEEE 802.16e–2005 OFDMA	PREAMPAYL

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[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.

This command is a query only and thus has no *RST value.

Example

DEM:FILT:CAT?
Reads all filter names

Characteristics

*RST value: 0
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]DEMod:FILTer:MODulation

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? command.

Parameter

<string>,<string>
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

Characteristics

*RST value: AUTO,AUTO
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]DEMod:FORMat[:BCONtent]:AUTo

This command specifies how the signal should be demodulated.

Parameter

NONE   Demodulation off (Brute force mode), the specified modulation is used for all bursts.

FIRSt   Retrieves the first valid payload modulation and analyzes all bursts with same modulation.

USER   Analyzes all bursts carrying the modulation specified.

ALL   Retrieves all bursts individual payload modulation and analyzes accordingly.

Example

DEM:FORM:AUTO FIRS
Specifies that the first symbol field should be decoded.

Characteristics

*RST value: ALL

SCPI: device–specific

Mode

OFDM

[SENSe:]DEMod:FORMat:BANalyze

The remote control command sets the analysis modulation format that will be assumed for the measurement.

If the standard is IEEE 802.16e–2005 OFDMA or WiBro, this command is query only and returns the highest detected modulation format from the last measurement sweep.

Parameter

BPSK1/2	BI–Phase shift keying (OFDM only)
QPSK1/2	Quadrature phase shift keying
QPSK3/4	Quadrature phase shift keying
16QAM1/2	Quadrature Amplitude Modulation
16QAM3/4	Quadrature Amplitude Modulation
64QAM2/3	Quadrature Amplitude Modulation
64QAM3/4	Quadrature Amplitude Modulation

Example

`DEM:FORM:BAN '16QAM1/2'`
Only bursts that are of the QAM16 modulation format are analyzed.

Characteristics

*RST value: 16QAM1/2

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal

If this command is activated only bursts of equal length will take part in the PVT analysis. The number of symbols that a burst must have in order to take part in the PVT analysis are specified by the [SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN command.

Parameter

ON | OFF

Example

`DEM:FORM:BAN:SYMB:EQU ON`
Only bursts of equal length will take part in the PVT analysis.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

OFDM

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MAX

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 ON. 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.

Parameter

1 to 2425

Example

DEM:FORM:BAN:SYMB:MAX 1300
Only bursts which contain a maximum symbol count of 1300 are analyzed.

Characteristics

*RST value: 64
SCPI: device–specific

Mode

OFDM

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN

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.

If the [SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal command has been set to ON, this command specifies the exact number of symbols required for a burst to take part in measurement analysis. If the [SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal command is set to OFF, this command specifies the minimum number of symbols required for a burst to take part in measurement analysis.

Parameter

1 to 2425

Example

DEM:FORM:BAN:SYMB:MIN 16
Only bursts which contain a symbol count of 16 are analyzed.

Characteristics

*RST value: 1
SCPI: device–specific

Mode

OFDM

[SENSe:]FFT:OFFSet

This command specifies the FFT start offset relative to the GP centre.

Parameter

–100 to 100

Example

`FFT:OFF 0`
Sets the FFT start offset to 0.

Characteristics

RST value: 0

SCPI: conform

Mode

OFDMA/WiBro

[SENSe:]FREQuency:CENTer

This command defines the center frequency of the analyzer or the measuring frequency for IQ measurements.

Characteristics

RST value: 5 GHz

For further details refer to "[SENSe<1|2>:]FREQuency:CENTer" on page 4.127.

[SENSe:]POWer:ACHannel:ACPairs

This command sets the number of adjacent channels pairs (upper and lower channel pairs).

Parameter

0 to 3

0 stands for pure channel power measurement

Example

`POW:ACH:ACP 3`
Sets the number of adjacent channels to 3, i.e. the adjacent channel and alternate adjacent channels 1 and 2 are switched on.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]

This command sets the channel bandwidth of the system. The bandwidths of adjacent channels are not influenced by this modification.

Parameter

0 Hz to 100 GHz

Example

`POW:ACH:BAND 30kHz`
Sets the bandwidth of the TX channel to 30 kHz.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel

This command defines the channel bandwidth of the adjacent channel of the system.

Parameter

0 Hz to 100 GHz

Example

`POW:ACH:BAND:ACH 30kHz`
Sets the bandwidth of the adjacent channel to 30 kHz.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|4>

This command defines the channel bandwidth of the first to fourth alternate adjacent channel of the system.

Parameter

0 Hz to 100 GHz

Example

`POW:ACH:BAND:ALT2 30kHz`
Sets the bandwidth of the second alternate adjacent channel to 30 kHz.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]POWer:ACHannel:MODE

This command sets the ACP measurement mode to either absolute or relative.

Parameter

ABS   Absolute measurement

REL   Relative measurement

Example

`POW:ACH:MODE ABS`
Sets the ACP measurement to absolute mode.

Characteristics

*RST value: REL

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]POWer:ACHannel:SPACing[:ACHannel]

This command defines the channel spacing of the adjacent channel to the TX channel.

Parameter

0 Hz to 100 GHz

Example

`POW:ACH:SPAC 33kHz`
Sets the spacing between the carrier signal and the adjacent channel to 33 kHz

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]POWer:ACHannel:SPACing:ALTernate<1|4>

This command defines the channel spacing of the first to fourth alternate adjacent channel to the TX channel..

Parameter

0 Hz to 100 GHz

Example

`POW:ACH:SPAC:ALT1 100kHz`
Sets the spacing between TX channel and first alternate adjacent channel to 100 kHz.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]POWer:NCORrection

This command activates or deactivates the noise correction for future spectrum ACP measurements.

Parameter

ON | OFF

Example

`POW:NCOR ON`
Activates the noise correction.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]POWer:SEM:CLASs

This command sets the Spectrum Emission Mask (SEM) power class.

Parameter

0   automatic selection

1   (–INF, 23) dBm for uplink, (–INF, 29) dBm for downlink

2   (23, INF) dBm for uplink, (29, 40) dBm for downlink

3   (40, INF) dBm for downlink

Example

POW:SEM:CLAS 0

Sets the SEM power class to automatic.

Characteristics

RST value: 0

SCPI: device–specific

Mode

WiBro

[SENSe:]POWer:SEM:MODe

This command sets the Spectrum Emission Mask (SEM) analysis to be UL or DL (uplink or downlink).This command only available for WiBro standard.

Parameter

DL | UL

Example

POW:SEM:MOD UL

Sets the Spectrum Emission Mask analysis to be UL.

Characteristics

RST value: –

SCPI: device–specific

Mode

WiBro

[SENSe:]POWer:SEM:TTA

This command sets the Spectrum Emission Mask (SEM) analysis according to TTA standard or a user defined mask.

Parameter

USER | STANDARD

Example

POW:SEM:TTA STANDARD

Sets the SEM analysis according to TTA standard.

Characteristics

RST value: STANDARD

SCPI: device–specific

Mode

WiBro

[SENSe:]SUBChannel

This command sets the subchannel to be used in the measurement. It is only available in Up Link mode.

Parameter

1 to 31

Example

SUBC 12

Sets the subchannel to 12.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

[SENSe:]SUBChannel:STATe

This command enables or disables the use of subchannels in the measurement analysis. It is only available in Up Link mode.

Parameter

ON | OFF

Example

SUBC:STAT ON

Specifies that the measurement will be analyzed using the specified SUBChannel.

Characteristics

RST value: OFF

SCPI: conform

Mode

OFDMA/WiBro

[SENSe:]SUBChannel:ULPHysmod

This command sets the Up Link Physical Modifier to be used in the measurement. It is only available in Up Link mode.

Parameter

0 to 255

Example

SUBC:ULPH 1

Sets the UL Physical Modifier to 1.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

[SENSe:]SWAPiq

This command defines whether or not the recorded IQ pairs should be swapped (I<–>Q) before being processed.

Parameter

ON | OFF

Example

`SWAP ON`

Specifies that IQ values should be swapped.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:ACPR:TIME

This command specifies the sweep time for the Spectrum Mask and Spectrum ACP/ACPR measurements.

Parameter

10 ms to 16000 s

Example

`SWE:ACPR:TIME:AUTO OFF`

Deactivates the automatic calculation of the sweep time.

`SWE:ACPR:TIME 100S`

Sets the sweep time to 100 s.

Characteristics

RST value: 2s

SCPI: conform

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:ACPR:TIME:AUTO

This command activates or deactivates the automatic calculation of the sweep time for the Spectrum Mask and Spectrum ACP/ACPR measurements.

Parameter

ON | OFF

Example

`SWE:ACPR:TIME:AUTO OFF`
Deactivates the automatic calculation of the sweep time.

Characteristics

RST value: ON

SCPI: conform

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:COUNt

This command specifies the number of sweeps for Spectrum Mask and Spectrum ACPR measurements.

Parameter

1 to 32767

Example

`SWE:COUNt 64`
Sets the number of sweeps to 64.

Characteristics

*RST value: 1

SCPI: conform

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:EGATe

For details refer to "[SENSe<1|2>:]SWEep:EGATe" on page 4.152.

[SENSe:]SWEep:EGATe:HOLDoff[:TIMe]

This command defines the gate delay in the capture buffer in time units.

Parameter

0 to 262.14 ms

Example

`SWE:EGAT:HOLD 125us`
Sets a delay of 125 µs in the capture buffer.

Characteristics

*RST value: 0 s

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:EGATe:HOLDoff:SAMPle

This command defines the gate delay in the capture buffer as a number of samples.

Parameter

0 to 50E6

Example

```
SWE:EGAT:HOLD:SAMP 2500
```
Sets a delay of 2500 samples in the capture buffer.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:EGATe:LENGth[:TIMe]

This command defines the gate time in the capture buffer in time units.

Parameter

0 to 262.14 ms

Example

```
SWE:EGAT:LENG 100ms
```
Sets a gate length of 100 milliseconds between sweeps.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:EGATe:LENGth:SAMPle

This command defines the gate time in the capture buffer as a number of samples.

Parameter

0 to 50E6

Example

```
SWE:EGAT:LENG:SAMP 2000000
```
Enforces a gate length of 2000000 samples in the capture buffer.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:EGATe:LINK

This command links together the movement of the gating lines and the capture buffer marker.

Parameter

ON | OFF

Example

SWE:EGAT:LINK ON
Keeps the capture buffer marker on the centre of the gating lines if the gating line delay and length are changed.

Characteristics

*RST value: 0

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

[SENSe:]SWEep:TIME

Parameter

24 µs to 15.5 ms

Characteristics

*RST value: 24 µs

[SENSe:]TRACking:LEVel

This command defines whether or not the measurement results should be compensated for level.

Parameter

ON | OFF

Example

TRAC:LEV ON
Specifies that the measurement results should be compensated for level.

Characteristics

*RST value: OFF

SCPI: conform

Mode

OFDM

[SENSe:]TRACking:PHASe

This command defines whether or not the measurement results should be compensated for phase.

Parameter

ON | OFF

Example

`TRAC:PHAS ON`

Specifies that the measurement results should be compensated for phase.

Characteristics

*RST value: ON

SCPI: conform

Mode

OFDM, OFDMA/WiBro

[SENSe:]TRACking:PILot

This command defines whether the measurement results should have predefined pilot tracking or whether the tracking should be determined when the measurement is run.

Parameter

PRED   Predefined pilot tracking is used.

DET   Pilot tracking is determined when
            the measurement is run.

Example

`TRAC:PIL DET`

Pilot tracking is determined when the measurement is run.

Characteristics

RST value: PRED

SCPI: conform

Mode

OFDMA/WiBro

[SENSe:]TRACking:TIME

This command defines whether or not the measurement results should be compensated for time.

Parameter

ON | OFF

Example

`TRAC:TIME ON`

Specifies that the measurement results should be compensated for time.

Characteristics

*RST value: OFF

SCPI: conform

Mode

OFDM, OFDMA/WiBro

STATus Subsystem (WiMAX, K93)

The STATus subsystem contains the commands for the status reporting system. For the STATus:QUEStionable:LIMit register, the measurement window is selected by LIMit 1 (screen A) or 2 (screen B). *RST does not influence the status registers.

Commands of the STATus Subsystem

– STATus:QUEStionable:LIMit<1|2> [:EVENt]?
– STATus:QUEStionable:LIMit<1|2>:CONDition?
– STATus:QUEStionable:LIMit<1|2>:ENABle
– STATus:QUEStionable:LIMit<1|2>:PTRansition
– STATus:QUEStionable:LIMit<1|2>:NTRansition
– STATus:QUEStionable:POWer[:EVENt]?
– STATus:QUEStionable:POWer:CONDition?
– STATus:QUEStionable:POWer:ENABle
– STATus:QUEStionable:POWer:PTRansition
– STATus:QUEStionable:POWer:NTRansition
– STATus:QUEStionable:SYNC[:EVENt]?
– STATus:QUEStionable:SYNC:CONDition?
– STATus:QUEStionable:SYNC:ENABle
– STATus:QUEStionable:SYNC:PTRansition
– STATus:QUEStionable:SYNC:NTRansition

STATus:QUEStionable:LIMit<1|2> [:EVENt]?

For details refer to "STATus:QUEStionable:LIMit<1|2> [:EVENt]?" on page 4.161.

STATus:QUEStionable:LIMit<1|2>:CONDition?

For details refer to "STATus:QUEStionable:LIMit<1|2>:CONDition?" on page 4.161.

STATus:QUEStionable:LIMit<1|2>:ENABle

For details refer to "STATus:QUEStionable:LIMit<1|2>:ENABle" on page 4.162.

STATus:QUEStionable:LIMit<1|2>:PTRansition

For details refer to "STATus:QUEStionable:LIMit<1|2>:PTRansition" on page 4.162.

STATus:QUEStionable:LIMit<1|2>:NTRansition

For details refer to "STATus:QUEStionable:LIMit<1|2>:NTRansition" on page 4.162.

STATus:QUEStionable:POWer[:EVENt]?

For details refer to "STATus:QUEStionable:POWer[:EVENt]?" on page 4.164.

STATus:QUEStionable:POWer:CONDition?

For details refer to "STATus:QUEStionable:POWer:CONDition?" on page 4.164.

STATus:QUEStionable:POWer:ENABle

For details refer to "STATus:QUEStionable:POWer:ENABle" on page 4.165.

STATus:QUEStionable:POWer:PTRansition

For details refer to "STATus:QUEStionable:POWer:PTRansition" on page 4.165.

STATus:QUEStionable:POWer:NTRansition

For details refer to "STATus:QUEStionable:POWer:NTRansition" on page 4.165.

STATus:QUEStionable:SYNC[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:SYNC register. Readout does not delete the contents of the EVENt section.

Example

STAT:QUES:SYNC?

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

STATus:QUEStionable:SYNC:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:SYNC register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:SYNC:COND?

Characteristics

*RST value: –

SCPI: conform

Mode

OFDM, OFDMA/WiBro

STATus:QUEStionable:SYNC:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:SYNC register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:ENAB 65535
All events bits will be represented in the SYNC summary bit.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

STATus:QUEStionable:SYNC:PTRansition

This command determines what bits in the STATus:QUEStionable:SYNC Condition register will set the corresponding bit in the STATus:QUEStionable:SYNC Event register when that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:PTR 65535
All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

STATus:QUEStionable:SYNC:NTRansition

This command determines what bits in the STATus:QUEStionable:SYNC Condition will set the corresponding bit in the STATus:QUEStionable:SYNC Event register when that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

STAT:QUES:SYNC:NTR 65535
All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

SYSTEM Subsystem (WiMAX, K93)

This subsystem contains a series of commands for general functions.

Commands of the SYSTEM Subsystem

– SYSTem:COMMunicate:TCPip:ADDRess

SYSTem:COMMunicate:TCPip:ADDRess

This command sets the lookup TCP/IP address of an external R&S SMU signal generator connected via TCP/IP. This enables the instrument to download the frame zone setup directly.

Parameter

<string>

Example

```
SYST:COMM:TCP:ADDR 192.168.1.1
```
Sets the lookup TCP/IP address of the SMU to 192.168.1.1.

Characteristics

RST value: –

SCPI: device–specific

Mode

OFDMA/WiBro

TRACe Subsystem (WiMAX, K93)

The TRACe subsystem controls access to the instrument's internal trace memory.

Commands of the TRACe Subsystem

–   TRACe[:DATA]

–   TRACe:IQ:DATA:MEMory?

–   TRACe:IQ:SRATe

Further information

–   Constellation vs Symbol

–   Constellation vs Carrier

–   Power vs Time – Full Burst and Start / End Data

–   Power vs Time – Full Subframe and Rising/Falling Subframe

–   Spectrum Flatness/Group Delay/Flatness Difference

–   Spectrum FFT

–   Statistics Bitstream data

–   Statistics Burst Summary data

–   Statistics CCDF – Complementary cumulative distribution function

–   EVM vs Carrier

–   EVM vs Symbol

–   Frequency Sweep Measurements

–   Spectrum Mask

–   Spectrum ACPR

Constellation vs Symbol

This measurement represents I and Q data. Data will be returned as a repeating array of interleaved I and Q data in groups of selected carriers, until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

*   If **All Carriers** is selected, it will return 52 per of I and Q data per symbol.

*   If **Pilots Only** is selected, it will return 4 per of I and Q per symbol in the following order:
    Carrier –21, Carrier –7, Carrier 7, Carrier 21.

*   If a single carrier is selected, it will return 1 per of I and Q data per symbol.

For the IEEE 802.16e–2005 OFDMA standard, the following rule applies: For all symbols, the results are returned in repeating groups of the FFT size. For example, if the FFT size was 1024 and 12 symbols were found, then 12288 I/Q pairs worth of data would be returned. Carriers that do not exist or are filtered out by the current filter settings are denoted by the keyword **NAN**.

Constellation vs Carrier

This measurement represents I and Q data. Data will be returned as a repeating array of interleaved I and Q data in groups of 53 channels including the channel 0, until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

Power vs Time – Full Burst and Start / End Data

This description applies to measurement results from the IEEE 802.16–2004 OFDM standard.

Both measurement results are once again simply slightly different views of the same results data.

All fully complete bursts within the capture time are analyzed. This data is returned in dBm values on a per sample basis. Each sample will in some way relate to an analysis of each corresponding sample within each processed burst.

The type of PVT data returned will be 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, burst data values

If the graphic type selected is rising/falling, then the return data is as follows.

TRACE1	start, burst data values
TRACE2	end, burst data values

The number of samples returned during full burst analysis will depend on the modulation type and will typically be 5000.

The number of samples returned when the rising and falling graphic type is selected will be less than what is returned for full burst and will be approximately 400 samples. The samples will be returned in floating point format as a single sequence of comma delimited values.

Power vs Time – Full Subframe and Rising/Falling Subframe

This description applies to measurement results from the IEEE 802.16e–2005 standard.

Both measurement results are once again simply slightly different views of the same results data.

All fully complete frames within the capture time are analyzed into three master frames. The three master frames relate to the minimum, maximum and average values across all complete frames. This data is returned in dBm values on a per sample basis. Each sample will in some way relate to an analysis of each corresponding sample within each processed frame.

The type of PVT data returned will be 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 subframe, minimum frame data values
TRACE2	full subframe, mean frame data values
TRACE3	full subframe, maximum frame data values

If the graphic type selected is rising/falling, then the return data is as follows.

TRACE1	rising edge, minimum frame data values
TRACE2	rising edge, mean frame data values

TRACE3	rising edge, maximum frame data values
TRACE4	falling edge, minimum frame data values
TRACE5	falling edge, mean frame data values
TRACE6	falling edge, maximum frame data values

The number of samples returned during full frame analysis will depend on the modulation type and will typically be 5000.

The number of samples returned when the start/end graphic type is selected will be less than what is returned for full burst and will be approximately 400 samples. The samples will be returned in floating point format as a single sequence of comma delimited values.

Spectrum Flatness/Group Delay/Flatness Difference

There are three separate traces that are available with this measurements. Trace data for a particular trace will only be returnable by querying the appropriate trace.

The graph data returned is as follows:

- Spectrum Flatness

  absolute power value (ABS)

- Group Delay

  relative group delay

- Spectrum Difference

  adjacent carrier power difference in the preamble part of the burst

All traces are all plotted on a per carrier basis. All carriers are drawn in addition to the unused 0 carrier.

The number of carriers depends on the measured standard:

- For the IEEE 802.16–2004 ODFM standard the number of carriers is 200.

- For the IEEE 802.16e–2005 ODFMA standard the number of carriers depends on the FFT size.

Carriers that are not used are denoted by the keyword **NAN**.

For example, the return data will be a repeating group of 201 carriers for the IEEE 802.16–2004 ODFM standard.

TRACE1	Minimum absolute power value (ABS) or
	Minimum group delay values
TRACE2	Mean absolute power value (ABS) or
	Mean group delay values or
TRACE3	Maximum absolute power value (ABS) or
	Maximum group delay values or

Absolute power results are returned in dB or dB difference and group delay results are returned in ns.

Spectrum FFT

All FFT points will be returned if the data for this measurement is requested. This will be 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 will be returned in floating point format in dBm. TRACE1 is used for this measurement results.

Statistics Bitstream data

Data will be returned depending on the selected standard from which the measurement was executed:

- For the IEEE 802.16–2004 OFDM standard, data is returned in repeating groups of 200 data channels where each symbol value will be represented by an integer value within one byte. Channel 0 is unused and will therefore not have any data associated with it, with no return data being provided.

- For the IEEE 802.16e–2005 OFDMA standard, the data is returned in groups of the selected FFT size, where each symbol value will be represented by an integer value within one byte. The FFT size is either 128, 512, 1024, or 2048 sub carriers. Unused carriers, including the zero carrier, are also returned. They are denoted by the string value **NAN**.

The number of repeating groups that are returned will be equal to the number of measured symbols.

64QAM has the highest data rate and it contains symbol values up to 63, making one byte sufficient in size to represent all symbol data values, regardless of the modulation type in use.

Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.

Statistics Burst Summary data

The return data depends on the current standard and measurement results.

For the IEEE 802.16–2004 OFDM standard, the data will be returned in repeating groups of 6 comma separated values as follows:

- 1st value – burst number

    If this value is 0 then it is an FCH burst.

- 2nd value – area with:

    0 = preamble

    1 = data

- 3rd value – modulation with:

    0 = BPSK

    1 = QPSK

    2 = 16QAM

    3 = 64QAM

- 4th value – symbol length

    This is an integer value giving the number of symbols in the current area.

- 5th value – power in dBm for the current area

    This is returned as a float

- 6th value – EVM in dB for the current area

    This is returned as a float.

Example:

Burst	Area	Modulation	Length	Power	EVM
FCH	Preamble	QPSK	1	–1.96	–43.75
	Data	BPSK	1	–2.96	–33.75
Burst 2	Preamble	QPSK	1	–3.96	–23.75
	Data	64QAM	26	–4.96	–13.75

SCPI would return the following:

```
B|A|M|L |P    |E
u|r|o|e |o    |V
r|e|d|n |w    |M
s|a| | |e     |
t| | | |r     |


0,0,1, 1,-1.96,-43.75,
0,1,0, 1,-2.96,-33.75,
2,0,1, 1,-3.96,-23.75,
2,1,3,26,-4.96,-13.75
```

The number of repeating groups that are returned will be equal to the number of rows in the Burst Summary results.

For the IEEE 802.16e–2005 OFDMA standard, the data will be returned in repeating groups of 7 comma separated values as follows:

- 1st value – subframe number

- 2nd value – burst number

- 3rd value – burst type:

    1 = FCH

    2 = DL map

    3 = UL map

    4 = data

- 4th value – modulation where:

    1 = QPSK

    2 = 16QAM

    3 = 64QAM

- 5th value – number of slots

    This is an integer value giving the number of slots associated with the burst.

- 6th value – power in dBm for the current area

    This is returned as a float.

- 7th value – EVM in dB for the current area

    This is returned as a float.

The number of repeating groups that are returned will be equal to the number of rows in the Burst Summary results.

Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.

Statistics CCDF – Complementary cumulative distribution function

Up to a maximum of 201 data points will be returned in addition to a data count value. The first value in the return data will represent the quantity of probability values that follow. Each of the potential 201 data points will be returned as probability value and will represent the total number of samples that are equal to or exceed the corresponding power level. Probability data will be 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 will be returned as a floating point number, with a value less than 1.

EVM vs Carrier

Two trace types are provided with this measurement. There is an average EVM value for each of the 53 channels or a repeating group of EVM values for each channel. The number of repeating groups will correspond to the number of fully analyzed trains.

Each EVM value will be returned as a floating point number, expressed in units of dBm.

TRACE1	Average EVM values per channel
TRACE2	All EVM values per channel for each full train of the capture period

For the IEEE 802.16e–2005 standard, the number of sub carriers returned varies according to the FFT size.

Each EVM value will be returned as a floating point number, expressed in units of dBm or percentage.

TRACE1	Minimum EVM values
TRACE2	Mean EVM values
TRACE3	Maximum EVM values

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 will be equal to the number of measured symbols.

Each EVM value will be returned as a floating point number, expressed in units of dBm.

TRACE1	Minimum EVM values
TRACE2	Mean EVM values
TRACE3	Maximum EVM values

Frequency Sweep Measurements

Currently, there is only one measurement that is performed in frequency sweep mode. This is the Spectrum Mask measurement. No data will be returned for this measurement, should it be requested, until such time as a measurement has been previously run.

Running an IQ measurement will not generate results for this type of measurement.

Spectrum Mask

Result data will be returned as 501 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 will be returned.

TRACE1	Clear write values
TRACE2	Max hold values
LIST	Spectrum Emission Mask (SEM) summary results (in WiBro standard only):

SEM summary results formats:

1st value	index into table of results (1 – 9)

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)

There are 5 rows of results for downlink, and 9 rows for uplink.

Spectrum ACPR

Result data will be returned as 501 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 will be returned.

TRACE1	Clear write values
TRACE2	Max hold values

TRACe[:DATA]

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 4.547

– "Constellation vs Carrier" on page 4.547

– "Power vs Time – Full Burst and Start / End Data" on page 4.548

– "Power vs Time – Full Subframe and Rising/Falling Subframe" on page 4.548

– "Spectrum Flatness/Group Delay/Flatness Difference" on page 4.549

– "Spectrum FFT" on page 4.550

– "Statistics Bitstream data" on page 4.550

– "Statistics Burst Summary data" on page 4.550

This command is a query only and thus has no *RST value.

Parameter

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.

Characteristics

*RST value: –

SCPI: conform

Mode

OFDM, OFDMA/WiBro

TRACe:IQ:DATA:MEMory?

For details refer to "TRACe<1|2>:IQ:DATA:MEMory?" on page 4.177.

TRACe:IQ:SRATe

This command allows the sample rate for IQ measurements to be specified.

Parameter

1440000 to 32.248E6 Hz

Example

TRAC:IQ:SRAT 2000000

Specifies a sample rate of 20 MHz.

Characteristics

*RST value: –

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

TRIGger Subsystem (WiMAX, K93)

The trigger subsystem is used to synchronize device action(s) with events.

Commands of the TRIGger Subsystem

– TRIGger[:SEQuence]:HOLDoff
– TRIGger[:SEQuence]:MODE
– TRIGger[:SEQuence]:LEVel[:EXTernal]
– TRIGger[:SEQuence]:LEVel:POWer
– TRIGger[:SEQuence]:LEVel:POWer:AUTO

TRIGger[:SEQuence]:HOLDoff

This command defines the length of the trigger delay. A negative delay time (pretrigger) can be set in zero span only.

Parameter

–3.25 ms to 837.33 ms

Example

`TRIG:HOLD 500us`
A holdoff period of 500 µs is used after the trigger condition has been met.

Characteristics

*RST value: 0 s
SCPI: conform

Mode

OFDM, OFDMA/WiBro

TRIGger[:SEQuence]:LEVel[:EXTernal]

This command defines the level of the external trigger input for which triggering will occur.

Parameter

0.5 V to 3.5 V

Example

`TRIG:MODE EXT`
Sets the power trigger mode.
`TRIG:LEV 1 V`
Sets the triggering level to 1 V.

Characteristics

RST value: 1.4 V
SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

TRIGger[:SEQuence]:MODE

This command configures how triggering is to be performed.

Parameter

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.

Example

TRIG:MODE IMM
No triggering is performed.

Characteristics

*RST value: IMMediate

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

TRIGger[:SEQuence]:LEVel:POWer

This command sets the level of the input signal for which triggering will occur.

Parameter

–50 to 20 dBm

Example

TRIG:MODE POW
Sets the external trigger mode.

TRIG:LEV:POW 10 DBM
Sets the level to 10 dBm for RF measurement.

Characteristics

*RST value: –20 DBM

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

TRIGger[:SEQuence]:LEVel:POWer:AUTO

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]:LEVel[:EXTernal] command is not POWer.

Parameter

ON | 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.

Characteristics

*RST value: OFF

SCPI: device–specific

Mode
OFDM, OFDMA/WiBro

UNIT Subsystem (WiMAX, K93)

The unit subsystem specifies the units for specific result types.

Commands of the UNIT Subsystem

– UNIT:EVM

– UNIT:PREamble

– UNIT:TABLe

UNIT:EVM

This command specifies the units for EVM results.

Parameter

DB   EVM results returned in dB

PCT   EVM results returned in %

Example

```
UNIT:EVM PCT
```
EVM results to be returned in %.

Characteristics

RST value: DB

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

UNIT:PREamble

This command specifies the units for Preamble error results.

Parameter

HZ   Preamble error results returned in Hz

DEG   Preamble error results returned in degrees

Example

```
UNIT:PRE HZ
```
Preamble error results to be returned in Hz.

Characteristics

RST value: Hz

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

UNIT:TABLe

This command specifies the parameters of the result summary that can be displayed as dB or degrees.

Parameter

DB   results returned in dB

PCT   results returned in %

Example

UNIT:TABL DB
Results to be returned in dB.

Characteristics

RST value: DB

SCPI: device–specific

Mode

OFDM, OFDMA/WiBro

Contents of Chapter 5

5   Remote Control – Programming Examples

The following programming examples have a hierarchical structure, i.e. subsequent examples are based on previous ones. It is thus possible to compile very easily an operational program from the modules of the given examples. VISUAL BASIC has been used as programming language. However, the programs can be translated into other languages.

> *Note:*   *In progamming languages as C, C++ or programmes as MATLAB, NI Interactive Control, a backslash starts an escape sequence (e.g. "\n" is used to start a new line). In these progamming languages and programms, two backslashes instead of one must be used in remote commands.*

Analyzer Measurements - Programming Examples

In this chapter, more complex programming examples are given.

Service Request

The service request routine requires an extended initialization of the instrument in which the relevant bits of the transition and enable registers are set. In addition the service request event must be enabled in the VISA session.

Initiate Service Request

```
REM ---- Example of initialization of the SRQ in the case of errors -------

PUBLIC SUB SetupSRQ()
CALL InstrWrite(analyzer, "*CLS")           'Reset status reporting system
CALL InstrWrite(analyzer,"*SRE 168")        'Enable service request for
                                            'STAT:OPER,STAT:QUES and ESR
                                            'register
CALL InstrWrite(analyzer,"*ESE 60")         'Set event enable bit for
                                            'command, execution, device-
                                            'dependent and query error
CALL InstrWrite(analyzer,"STAT:OPER:ENAB 32767")
                                            'Set OPERation enable bit for
                                            'all events
CALL InstrWrite(analyzer,"STAT:OPER:PTR 32767")
                                            'Set appropriate OPERation
                                            'Ptransition bits
CALL InstrWrite(analyzer,"STAT:QUES:ENAB 32767")
                                            'Set questionable enable bits
                                            'for all events
CALL InstrWrite(analyzer,"STAT:QUES:PTR 32767")
                                            'Set appropriate questionable
                                            'Ptransition bits
CALL viEnableEvent(analyzer, VI_EVENT_SERVICE_REQ, VI_QUEUE, 0)
                                            'Enable the event for service
                                            'request
```

```
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout,
                                 VI_NULL, VI_NULL)
IF (status = VI_SUCCESS) THEN CALL Srq     'If SRQ is recognized =>
                                           'subroutine for evaluation

END SUB

REM ********************************************************************
```

Waiting for the Arrival of a Service Request

There are basically two methods of waiting for the arrival of a service request:

1. **Blocking (user inputs not possible):**
    This method is appropriate if the waiting time until the event to be signalled by an SRQ is short (shorter than the selected timeout), if no response to user inputs is required during the waiting time, and if – as the main criterion – the event is absolutely certain to occur.
    Reason:
    From the time the viWaitOnEvent() function is called until the occurrence of the expected event, it does not allow the program to respond to mouse clicks or key entries during the waiting time. Moreover, it returns an error if the SRQ event does not occur within the predefined timeout period. The method is, therefore, in many cases not suitable for waiting for measurement results, especially when using triggered measurements.

    The following function calls are required:

```
 Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout,
                                  VI_NULL, VI_NULL)
                                  'Wait for service request user
                                  'inputs are not possible during
                                  'the waiting time!
 IF (status = VI_SUCCESS) THEN CALL Srq
                                  'If SRQ is recognized =>
                                  'subroutine for evaluation
```

2. **Non–blocking (user inputs possible):**
    This method is recommended if the waiting time until the event to be signalled by an SRQ is long (longer than the selected timeout), and user inputs should be possible during the waiting time, or if the event is not certain to occur. This method is, therefore, the preferable choice for waiting for the end of measurements, i.e. the output of results, especially in the case of triggered measurements.

    The method necessitates a waiting loop that checks the status of the SRQ line at regular intervals and returns control to the operating system during the time the expected event has not yet occurred. In this way, the system can respond to user inputs (mouse clicks, key entries) during the waiting time.

    It is advisable to employ the Hold() auxiliary function, which returns control to the operating system for a selectable waiting time (see section "Waiting Without Blocking the Keyboard and Mouse"), so enabling user inputs during the waiting time.

```
 result% = 0
 For i = 1 To 10                        'Abort after max. 10 loop
                                        'iterations
 Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ,
                                  VI_TMO_IMMEDIATE, VI_NULL,
                                  VI_NULL)
                                  'Check event queue
```

```
      If (status = VI_SUCCESS) Then

        result% = 1

        CALL Srq                           'If SRQ is recognized =>
                                           'subroutine for evaluation

      Else

        CALL Hold(20)                      'Call hold function with
                                           '20 ms 'waiting time. User inputs
                                           'are possible.

      Endif

   Next i

   If result% = 0 Then

      Debug.Print "Timeout Error; Program aborted"
                                           'Output error message

      STOP                                 'Stop software

   Endif
```

Waiting Without Blocking the Keyboard and Mouse

A frequent problem with remote control programs using Visual Basic is to insert waiting times without blocking the keyboard and the mouse.

If the program is to respond to user inputs also during a waiting time, control over the program events during this time must be returned to the operating system. In Visual Basic, this is done by calling the *DoEvents* function. This function causes keyboard– or mouse–triggered events to be executed by the associated elements. For example, it allows the operation of buttons and input fields while the user waits for an instrument setting to be completed.

The following programming example describes the *Hold()* function, which returns control to the operating system for the period of the waiting time selectable in milliseconds.

```
Rem ********************************************************************

Rem The waiting function below expects the transfer of the desired

Rem waiting time in milliseconds. The keyboard and the mouse remain

Rem operative during the waiting period, thus allowing desired elements

Rem to be controlled

Rem ********************************************************************
```

```
Public Sub Hold(delayTime As Single)
   Start = Timer                          'Save timer count on calling the
                                          'function

   Do While Timer < Start + delayTime / 1000  'Check timer count

     DoEvents                             'Return control to operating
                                          'system to enable control of
                                          'desired elements as long as
                                          'timer has not elapsed

   Loop
End Sub
Rem *********************************************************************
```

The waiting procedure is activated simply by calling *Hold(<Waiting time in milliseconds>)*.

Service Request Routine

A service request is processed in the service request routine.
Note: *The variables userN% and userM% must be pre–assigned usefully!*

```
REM ------------ Service request routine -------------------------------
Public SUB Srq()
ON ERROR GOTO noDevice                    'No user existing
CALL viReadSTB(analyzer, STB%)            'Serial poll, read status byte
IF STB% > 0 THEN                          'This instrument has bits set in
                                          'the STB

   SRQFOUND% = 1

   IF (STB% AND 16)  > 0 THEN CALL Outputqueue

   IF (STB% AND 4)   > 0 THEN CALL ErrorQueueHandler

   IF (STB% AND 8)   > 0 THEN CALL Questionablestatus

   IF (STB% AND 128) > 0 THEN CALL Operationstatus

   IF (STB% AND 32)  > 0 THEN CALL Esrread

  END IF
noDevice:
END SUB                                   'End of SRQ routine
REM *********************************************************************
```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

Reading Out the Output Buffer

```
REM -------- Subroutine for the individual STB bits -----------------------
Public SUB Outputqueue()                        'Reading the output buffer
result$ = SPACE$(100)                           'Make space for response
CALL InstrRead(analyzer, result$)
Debug.Print "Contents of Output Queue : "; result$
END SUB
REM ***********************************************************************
```

Reading Error Messages

```
REM -------- Subroutine for reading the error queue ----------------------
Public SUB ErrorQueueHandler()
ERROR$ = SPACE$(100)                            'Make space for error variable
CALL InstrWrite(analyzer, "SYSTEM:ERROR?")
CALL InstrRead(analyzer, ERROR$)
Debug.Print "Error Description : "; ERROR$
END SUB
REM ***********************************************************************
```

Evaluation of SCPI Status Registers

```
REM ------ Subroutine for evaluating Questionable Status Register ---------
Public SUB Questionablestatus()
Ques$ = SPACE$(20)                              'Preallocate blanks to text
                                                'variable
CALL InstrWrite(analyzer, "STATus:QUEStionable:EVENt?")
CALL InstrRead(analyzer, Ques$)
Debug.Print "Questionable Status: "; Ques$
END SUB
REM ***********************************************************************

REM ------ Subroutine for evaluating Operation Status Register -----------
Public SUB Operationstatus()
Oper$ = SPACE$(20)                              'Preallocate blanks to text
                                                'variable
CALL InstrWrite(analyzer, "STATus:OPERation:EVENt?")
CALL InstrRead(analyzer, Oper$)
Debug.Print "Operation Status: "; Oper$
END SUB
REM ***********************************************************************
```

Evaluation of Event Status Register

```
REM ------ Subroutine for evaluating the Event Status Register ------------
Public SUB Esrread()
Esr$ = SPACE$(20)                          'Preallocate blanks to text
                                           'variable
CALL InstrWrite(analyzer, "*ESR?")         'Read ESR
CALL InstrRead(analyzer, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN Debug.Print "Operation complete"
IF (VAL(Esr$) AND 2) > 0 THEN Debug.Print "Request Control"
IF (VAL(Esr$) AND 4) > 0 THEN Debug.Print "Query Error"
IF (VAL(Esr$) AND 8) > 0 THEN Debug.Print "Device dependent error"
IF (VAL(Esr$) AND 16) > 0 THEN
  Debug.Print "Execution Error; Program aborted"
                                           'Output error message
  STOP                                     'Stop software
  END IF
IF (VAL(Esr$) AND 32) > 0 THEN
  Debug.Print "Command Error; Program aborted"
                                           'Output error message
  STOP                                     'Stop software
  END IF
IF (VAL(Esr$) AND 64) > 0 THEN Debug.Print "User request"
IF (VAL(Esr$) AND 128) > 0 THEN Debug.Print "Power on"
END SUB
REM *******************************************************************
```

Using Marker and Delta Marker

Shape Factor Measurement (using n dB down)

The n–dB–down function of the R&S ZVL is used twice to determine the shape factor of a filter (ratio of bandwidths at 60 dB and 3 dB below the filter maximum).

The following example is again based on a signal with a level of –30 dBm at 100 MHz. The shape factor is determined for the 30 kHz resolution bandwidth. The default setting of the R&S ZVL is used for measurements (SetupInstrument).

```
REM ************************************************************************

Public Sub ShapeFactor()
result$ = Space$(100)
'--------- R&S ZVL default setting ---------------------------------------
CALL SetupInstrument                        'Default setting
CALL InstrWrite(analyzer,"INIT:CONT OFF")  'Single sweep
'--------- Set frequency -------------------------------------------------
CALL InstrWrite(analyzer,"FREQ:SPAN 1MHz")
                                           'Span
CALL InstrWrite(analyzer,"BAND:RES 30kHz")
                                           'Resolution bandwidth
CALL InstrWrite(analyzer,"INIT;*WAI")       'Perform sweep with sync
'--------- Measure 60 dB value -------------------------------------------
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                           'Peak excursion
CALL InstrWrite(analyzer,"CALC:MARK:STAT ON")
                                           'Marker1 on
CALL InstrWrite(analyzer,"CALC:MARK:TRAC 1")
                                           'Assign marker1 to trace1
CALL InstrWrite(analyzer,"CALC:MARK:MAX")  'Set marker1 to 100 MHz
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NDBD 45dB")
                                           'Read out bandwidth measured at
                                           '45 dB
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NDBD:RES?")
CALL InstrRead(analyzer,result$)
result60 = Val(result$)
'--------- Measure 3 dB down value----------------------------------------
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NDBD 3dB")
                                           'Read out bandwidth measured at
                                           '3 dB
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NDBD:RES?")
CALL InstrRead(analyzer,result$)
result3 = Val(result$)
```

```
'--------- Read out shape factor-----------------------------------------------
Print "Shapefaktor 60dB/3dB: ";result60/result3
END SUB
```

```
REM ********************************************************************
```

Measuring the Third Order Intercept Point

The third order intercept point (TOI) is the (virtual) level of two adjacent useful signals at which the intermodulation products of third order have the same level as the useful signals.

The intermodulation product at f_{S2} is obtained by mixing the first harmonic of the useful signal P_{N2} with signal P_{N1}, the intermodulation product at f_{S1} by mixing the first harmonic of the useful signal P_{N1} with signal P_{N2}.

$$f_{s1} = 2 \times f_{n1} - f_{n2} \qquad (1)$$

$$f_{s2} = 2 \times f_{n2} - f_{n1} \qquad (2)$$

The following example is based on two adjacent signals with a level of –30 dBm at 100 MHz and 110 MHz. The intermodulation products lie at 90 MHz and 120 MHz according to the above formula. The frequency is set so that the examined mixture products are displayed in the diagram. Otherwise, the default setting of the R&S ZVL is used for measurements (SetupInstrument).

```
REM ********************************************************************

Public Sub TOI()

result$ = Space$(100)

'--------- R&S ZVL default setting ----------------------------------------
CALL SetupStatusReg                        'Set status registers

CALL InstrWrite(analyzer,"*RST")           'Reset instrument

CALL InstrWrite(analyzer,"INIT:CONT OFF")  'Single sweep

CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                           'ON: display on
                                           'OFF: off

'--------- Set frequency --------------------------------------------------
CALL InstrWrite(analyzer,"FREQ:STARt 85MHz;STOP 125 MHz")
                                           'Span

'--------- Set level ------------------------------------------------------
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV –20dBm")
                                           'Reference level

CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync

'--------- TOI measurement ------------------------------------------------
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                           'Peak excursion

CALL InstrWrite(analyzer,"CALC:MARK:FUNC:TOI ON")
                                           'Switch on TOI measurement

CALL InstrWrite(analyzer,"CALC:MARK:FUNC:TOI:RES?")
                                           'and read out results

CALL InstrRead(analyzer,result$)
```

```
'--------- Read out result ------------------------------------------------
Print "TOI [dBm]: ";result$

END SUB

REM ***********************************************************************
```

Measuring the AM Modulation Depth

The example below is based on an AM–modulated signal at 100 MHz with the following characteristics:
- Carrier signal level: –30 dBm
- AF frequency: 100 kHz
- Modulation depth: 50 %

The default setting of the analyzer for measurements can be used for the measurements described below (SetupInstrument).

```
REM ***********************************************************************
Public Sub AMMod()
result$ = Space$(100)
CALL SetupInstrument                        'Default setting
CALL InstrWrite(analyzer,"BAND:RES 30kHz") 'Set appropriate RBW
'--------- Peak search --------------------------------------------------
CALL InstrWrite(analyzer,"INIT:CONT OFF")  'Single sweep
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                           'Peak excursion
CALL InstrWrite(analyzer,"CALC:MARK:STAT ON")
                                           'Marker 1 on
CALL InstrWrite(analyzer,"CALC:MARK:TRAC 1")
                                           'Assign marker1 to trace1
'--------- Measure modulation depth-------------------------------------
CALL InstrWrite(analyzer,"CALC:MARK:MAX;FUNC:MDEP ON")
                                           'Marker to Peak;
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:MDEP:RES?")
                                           'Measure mod. depth
CALL InstrRead(analyzer, result$)          'Read out result
'--------- Read out result ------------------------------------------------
Print "AM Mod Depth [%]: ";result$

END SUB

REM ***********************************************************************
```

Limit Lines and Limit Test

The example below shows the definition and use of a new limit line 5 for trace 1 with the following characteristics:

- Upper limit line
- Absolute x–axis in the frequency range
- 5 reference values:

    120 MHz / –70 dB, 126 MHz/–40 dB, 127 MHz/–40 dB, 128 MHz/–10 dB,
    129 MHz/–40 dB, 130 MHz/–40 dB, 136 MHz / –70 dB

- Relative y–axis with unit dB
- Absolute threshold at –75 dBm
- No margin

The signal of the integrated calibration source (128 MHz, –30 dBm) is used to check the limit test.

```
REM ************************************************************************

Public Sub LimitLine()

result$ = Space$(100)

'--------- R&S ZVL default setting ---------------------------------------

CALL SetupInstrument                              'Default setting
CALL InstrWrite(analyzer,"FREQUENCY:CENTER 128MHz;Span 10MHz")
                                                  'Span
CALL InstrWrite(analyzer,"Diag:Serv:Inp Cal;CSO -30dBm")
                                                  'Cal signal on

'--------- Definition of limit lines -------------------------------------

CALL InstrWrite(analyzer,"CALC:LIM5:NAME 'TEST1'")
                                                  'Define name
CALL InstrWrite(analyzer,"CALC:LIM5:COMM 'Upper limit'")
                                                  'Define comment
CALL InstrWrite(analyzer,"CALC:LIM5:TRAC 1")
                                                  'Assign trace
CALL InstrWrite(analyzer,"CALC:LIM5:CONT:DOM FREQ")
                                                  'Define x-axis range
CALL InstrWrite(analyzer,"CALC:LIM5:CONT:MODE ABS")
                                                  'Define x-axis scaling
CALL InstrWrite(analyzer,"CALC:LIM5:UNIT DB")
                                                  'Define y-axis unit
CALL InstrWrite(analyzer,"CALC:LIM5:UPP:MODE REL")
                                                  'Define y-axis scaling

'--------- Definition of data points and threshold -----------------------

xlimit$ = "CALC:LIM5:CONT 120MHZ,126MHZ,127MHZ,128MHZ,129MHZ,130MHz,136MHz"

CALL InstrWrite(analyzer, xlimit$)          'Set values for x-axis
CALL InstrWrite(analyzer,"CALC:LIM5:UPP -70,-40,-40,-20,-40,-40,-70")
                                                  'Set values for y-axis
CALL InstrWrite(analyzer,"CALC:LIM5:UPP:THR -75DBM")
                                                  'Set y threshold (only
                                                  'possible for relative
                                                  'y-axis)
```

```
'--------- Definition of margin or x /y offset----------------------------
'A margin or an x /y offset can be defined here.

'----------- Activate and evaluate the limit line -------------
CALL InstrWrite(analyzer,"CALC:LIM5:UPP:STAT ON")
                                        'Activate line 5
CALL InstrWrite(analyzer,"CALC:LIM5:STAT ON")
                                        'Activate limit check
CALL InstrWrite(analyzer,"INIT;*WAI")     'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:LIM5:FAIL?")
                                        'Query result of limit check
CALL InstrRead(analyzer, result$)         'Result: 1 (= FAIL)
'--------- Read out result ------------------------------------------
Print "Limit Result Line 5: ";result$
'------ Evaluate limit line by means of status register -------
CALL InstrWrite(analyzer,"*CLS")          'Reset status register
'--------- Measure ------------------------------------------------
CALL InstrWrite(analyzer,"INIT;*OPC")     'Perform sweep with sync
CALL viEnableEvent(analyzer, VI_EVENT_SERVICE_REQ, VI_QUEUE, 0)
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout,
VI_NULL, VI_NULL)
IF (status = VI_SUCCESS) THEN CALL Srq   'If SRQ is recognized =>
                                        'subroutine for evaluation
'--------- Read out result ------------------------------------------
IF (status% = 1) THEN
  CALL InstrWrite(analyzer,"STAT:QUES:LIM1:COND?")
                                        'Read out STAT:QUES:LIMit
                                        'register
  CALL InstrRead(analyzer, result$)
  IF ((Val(result$) And 16) <> 0) THEN
    Print "Limit5 failed"
  ELSE
    Print "Limit5 passed"
  END IF
END IF
END SUB
REM *******************************************************************
```

Measuring the Channel and Adjacent Channel Power

In the following example, the channel and adjacent channel power is first measured on a signal with a level of 0 dBm at 800 MHz to IS95. Then the channel and adjacent channel power is measured on a GSM signal at 935.2 MHz with fast ACP measurement (FAST ACP).

In addition, the limit test is activated.

```
REM ************************************************************************

Public Sub ACP()
result$ = Space$(100)
'--------- R&S ZVL default setting ---------------------------------------
CALL SetupStatusReg                         'Set status register
CALL InstrWrite(analyzer,"*RST")            'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF")   'Single sweep
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                            'ON: display on
                                            'OFF: off

'--------- Set frequency -------------------------------------------------
CALL InstrWrite(analyzer,"FREQ:CENT 800MHz")
                                            'Set frequency

'--------- Set level -----------------------------------------------------
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV 10dBm")
                                            'Reference level

'--------- Example 1: Configure CP/ACP for CDMA--------------------------
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:SEL ACP")
                                            'ACP measurement on
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:PRES F8CDMA")
                                            'Select CDMA800 FWD
CALL InstrWrite(analyzer,"SENS:POW:ACH:ACP 2")
                                            'Select 2 adjacent channels
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES ACP")
                                            'Optimize settings
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES:RLEV")
                                            'Optimize reference level
CALL InstrWrite(analyzer,"SENS:POW:ACH:MODE ABS")
                                            'Absolute measurement
CALL InstrWrite(analyzer,"SENS:POW:HSP ON")
                                            'Fast ACP measurement

'--------- Perform measurement and query results -------------------------
CALL InstrWrite(analyzer,"INIT;*WAI")       'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:RES? ACP")    'Query result
                                            CALL InstrRead(analyzer, result$)
```

```
'--------- Read out result -------------------------------------------------
Print "Result (CP, ACP low, ACP up, Alt low, Alt up): "
Print result$
'--------- Example 2: Configure CP/ACP manually for GSM--------------------
result$ = Space$(100)
CALL InstrWrite(analyzer,"FREQ:CENT 935.2MHz")
                                    'Set frequency
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:SEL ACP")
                                    'ACP measurement on
CALL InstrWrite(analyzer,"SENS:POW:ACH:ACP 1")
'1 adjacent channel
CALL InstrWrite(analyzer,"SENS:POW:ACH:BAND 200KHZ")
'Channel bandw. 200 kHz
CALL InstrWrite(analyzer,"SENS:POW:ACH:BAND:ACH 200KHZ")
                                    'Adjacent channel band-
                                    'width 200 kHz
CALL InstrWrite(analyzer,"SENS:POW:ACH:SPAC 200KHZ")
                                    'Channel spacing 200 kHz
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES ACP")
                                    'Optimize settings
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES:RLEV")
                                    'Optimize reference level
CALL InstrWrite(analyzer,"SENS:POW:ACH:MODE ABS")
                                    'Absolute measurement
'--------- Start measurement and query result -----------------------------
CALL InstrWrite(analyzer,"INIT;*WAI")       'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:RES? ACP")
                                    'Query result
CALL InstrRead(analyzer, result$)
'--------- Read out result -------------------------------------------------
Print "Result (CP, ACP low, ACP up): "
Print result$
'--------- Active limit check ----------------------------------------------
result$ = Space$(100)
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH 30DB, 30DB")
                                    'Set relative limit
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH:ABS −35DBM,−35DBM")
                                    'Set absolute limit
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH:STAT ON")
                                    'Rel. limit check on
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH:ABS:STAT ON")
                                    'Abs. limit check on
CALL InstrWrite(analyzer,"CALC:LIM:ACP ON")
                                    'Limit check on
```

```
'--------- Start measurement and query result -----------------------------
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH:RES?")
                                           'Query result of limit check
CALL InstrRead(analyzer, result$)
'--------- Read out result -------------------------------------------------
Print "Result Limit Check: ";result$
END SUB
REM ***********************************************************************
```

Occupied Bandwidth Measurement

In the following example, the bandwidth is to be found in which 95% of the power of a GSM signal is contained. Signal frequency is 935.2 MHz; channel bandwidth is 200 kHz.

```
REM ***********************************************************************
Public Sub OBW()
result$ = Space$(100)
'--------- R&S ZVL default setting -----------------------------------------
CALL SetupStatusReg                        'Set status register
CALL InstrWrite(analyzer,"*RST")           'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF")  'Single sweep
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                           'ON: display on
                                           'OFF: off
'--------- Configure R&S ZVL for OBW for GSM--------------------------------
CALL InstrWrite(analyzer,"FREQ:CENT 935.2MHz")
                                           'Set frequency
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:SEL OBW")
                                           'OBW measurement on
CALL InstrWrite(analyzer,"SENS:POW:ACH:BAND 200KHZ")
                                           'Channel bandw. 200 kHz
CALL InstrWrite(analyzer,"SENS:POW:BWID 95PCT")
                                           'Percentage of power
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES OBW")
                                           'Set frequency and optimize
                                           reference level
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES:RLEV")
CALL InstrWrite(analyzer,"SENS:POW:NCOR OFF")
                                           'Noise correction
                                           'OFF: switch off
                                           'ON:  switch on
```

```
'--------- Perform measurement and query results ---------------------------
CALL InstrWrite(analyzer,"INIT;*WAI")        'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:RES? OBW")
                                             'Query result
CALL InstrRead(analyzer, result$)
Print result$
END SUB
REM ************************************************************************
```

Time Domain Power Measurement

In the following example, the mean carrier power of a signal with 300 kHz bandwidth at 100 MHz is to be determined. In addition, the peak power, the rms value and the standard deviation are measured. To do this, the time–domain–power measurement functions are used.

```
REM ************************************************************************
Public Sub TimeDomainPower()
result$ = Space$(100)
'--------- R&S ZVL default setting --------------------------------------
CALL SetupStatusReg                          'Set status register
CALL InstrWrite(analyzer,"*RST")             'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF")    'Single sweep
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                             'ON: display on
                                             'OFF: off
'--------- Configure R&S ZVL for time domain power measurement -----------
CALL InstrWrite(analyzer,"FREQ:CENT 100MHz;SPAN 0Hz")
                                             'Set frequency
CALL InstrWrite(analyzer,"BAND:RES 300kHz")
                                             'Resolution bandwidth
CALL InstrWrite(analyzer,"SWE:TIME 200US")   'Sweep time
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:SUMM:PPE ON")
                                             'Peak measurement on
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:SUMM:MEAN ON")
                                             'Mean measurement on
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:SUMM:RMS ON")
                                             'RMS measurement on
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:SUMM:SDEV ON")
                                             'Standard deviation on
```

```
'-------------------- Perform measurement and query results ----------------
CALL InstrWrite(analyzer,"INIT;*WAI")       'Perform sweep with sync
                                            'Query results:
query$ = " CALC:MARK:FUNC:SUMM:PPE:RES?;"   'Peak measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:MEAN:RES?;"
                                            'Mean measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:RMS:RES?;"
                                            'RMS measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:SDEV:RES?"
                                            'Standard deviation
CALL InstrWrite(analyzer, query$)
CALL InstrRead(analyzer, result$)
Print result$
END SUB
REM ***********************************************************************
```

Fast Power Measurement on Power Ramps

A frequent task in mobile radio tests is measurement of a DUT at various power control levels at the highest possible speed. The R&S ZVL offers two test functions for this task, which can be used depending on the signal characteristics.

In the following, the two methods are presented by means of two examples.

Power Measurement with Multi–Summary Marker

The multi–summary marker function is suitable for measuring the power of a sequence of pulses with the following characteristics:

- The pulses occur at identical time intervals, which is typical of GSM transmission in slots, for example.
- The level of the first signal is reliably above threshold.
- The subsequent pulses may have any levels.

The function uses the first pulse as a trigger signal. The power of the subsequent pulses is determined exclusively via the timing pattern selected for the pulse sequence. The function is, therefore, suitable for adjustments where the DUT output power varies considerably and is not reliably above the trigger threshold.

The measurement accuracy is determined by the ratio of pulse duration to total measurement time; this should not be below 1:50.

The function always uses TRACE 1.
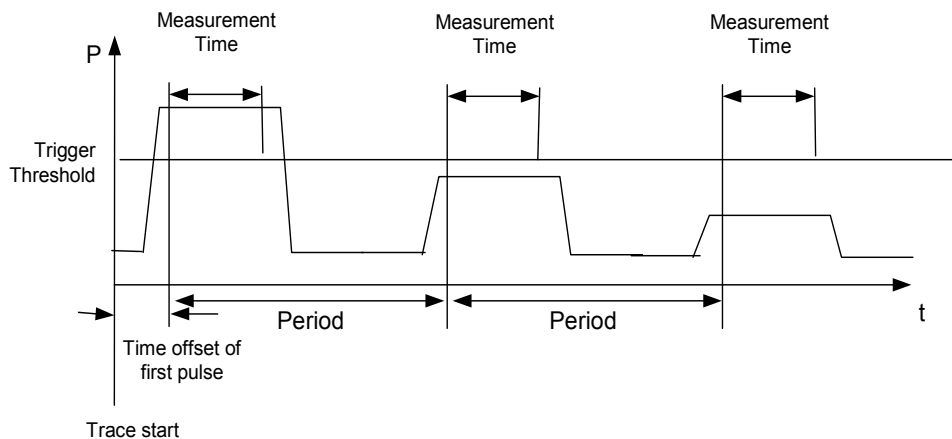
Fig. 5–1   Block diagram illustrating signal processing in analyzer

In the example below, a GSM puls sequence of 8 pulses is measured with an offset of 50 µs of the first pulse, 450 µs measurement time/pulse and 576.9 µs pulse period.

```
REM ********************************************************************

Public Sub MultiSumMarker()

result$ = Space$(200)

'--------- R&S ZVL default setting---------------------------------------

CALL SetupStatusReg                      'Configure status register

CALL InstrWrite(analyzer,"*RST")         'Reset instrument

CALL InstrWrite(analyzer,"INIT:CONT OFF")  'Single sweep mode

CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                         'ON:  switch display on
                                         'OFF: switch display off

'--------- Configure R&S ZVL for power measurement in time domain ---------

CALL InstrWrite(analyzer,"FREQ:CENT 935.2MHz;SPAN 0Hz")
                                         'Frequency setting

CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV 10dBm")
                                         'Set reference level to 10 dB

CALL InstrWrite(analyzer,"INP:ATT 30 dB")  'Set input attenuation to 30 dB

CALL InstrWrite(analyzer,"BAND:RES 1MHz;VID 3MHz")
                                         'Bandwidth setting

CALL InstrWrite(analyzer,"DET RMS")      'Select RMS detector

CALL InstrWrite(analyzer,"TRIG:SOUR VID")  'Trigger source: video

CALL InstrWrite(analyzer,"TRIG:LEV:VID 50 PCT")
                                         'Trigger threshold: 50%

CALL InstrWrite(analyzer,"SWE:TIME 50ms")  'Sweep time ≥ 1 frame
```

```
'-------- Perform measurement and query results ------------------------
CALL InstrWrite(analyzer,"INIT;*WAI")       'Perform sweep with sync
                                            'Query results:
cmd$ = "CALC:MARK:FUNC:MSUM? "
cmd$ = cmd$ + "50US,"                       'Offset of first pulse
cmd$ = cmd$ + "450US,"                      'Measurement time
cmd$ = cmd$ + "576.9US,"                    'Pulse period
cmd$ = cmd$ + "8"                           'Number of bursts
CALL InstrWrite(analyzer,cmd$)
CALL InstrRead(analyzer, result$)           'Read results
Print result$
END SUB
REM ********************************************************************
```

Multi–Burst Power Measurement

The multi–burst power measurement function is suitable for measuring the power of a sequence of pulses with the following characteristics:

- The pulses occur at variable time intervals.
- The levels of all pulses of the sequence are reliably above the trigger threshold, or an external trigger signal is used.

The function requires one trigger event per pulse. This means that if the video trigger or the IF power trigger is used, the levels of all pulses must be above the trigger threshold.

The function is, therefore, particularly suitable for re–measuring DUTs already adjusted and whose output power is within the specified range. The measurement is optimized for minimum overhead relative to the actual measurement time.
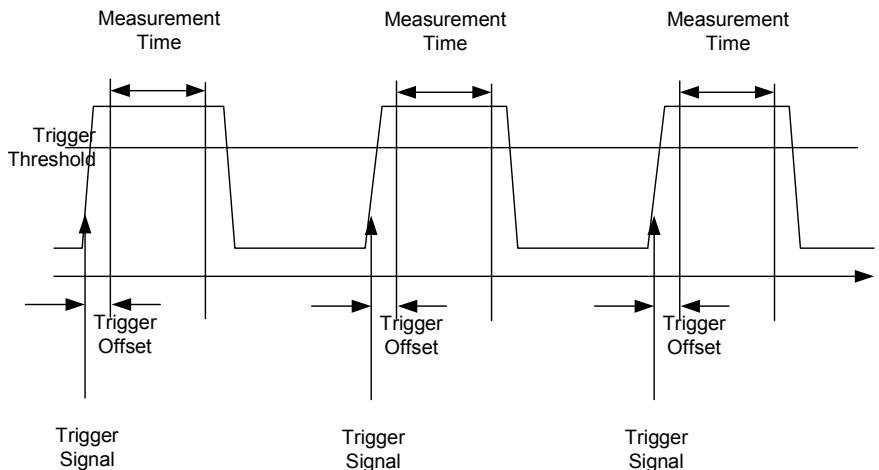
Fig. 5–2   Block diagram illustrating signal processing in analyzer

Either the root–mean–square power or the peak power is measured, depending on whether the RMS detector or the PEAK detector is selected. The function always uses TRACE 1.

The following parameters are to be set for this measurement:
- Analyzer frequency
- Resolution bandwidth
- Measurement time per single pulse
- Trigger source
- Trigger threshold
- Trigger offset
- Type of power measurement (PEAK, MEAN)
- Number of pulses to be measured

During the measurement, each pulse is mapped into a pixel of the screen, i.e. any change of the trace can be detected only at the left–hand edge of the screen. Maximum measurement speed is as usual achieved with the display switched off.

In the example below, a GSM pulse sequence of 8 pulses is measured with 5 µs trigger offset, 434 µs measurement time/pulse, video trigger with 50% trigger threshold, and peak detection:

```
REM *************************************************************************

Public Sub MultiBurstPower()

result$ = Space$(200)

'--------- R&S ZVL default setting ----------------------------------------

CALL SetupStatusReg                          'Configure status register

CALL InstrWrite(analyzer,"*RST")             'Reset instrument

CALL InstrWrite(analyzer,"INIT:CONT OFF")    'Single sweep mode

CALL InstrWrite(analyzer,"SYST:DISP:UPD OFF")
                                             'OFF: display off

'--------- Perform measurement and query results --------------------

cmd$ = "MPOW? "

cmd$ = cmd$ + "935.2 MHZ,"                    'Center frequency

cmd$ = cmd$ + "1MHZ,"                         'Resolution bandwidth

cmd$ = cmd$ + "434US,"                        'Measurement time

cmd$ = cmd$ + "VID,"                          'Trigger source

cmd$ = cmd$ + "50PCT,"                        'Trigger threshold

cmd$ = cmd$ + "1US,"                          'Trigger offset, must be > 125 ns

cmd$ = cmd$ + "PEAK,"                         'Peak detector

cmd$ = cmd$ + "8"                             'Number of bursts

CALL InstrWrite(analyzer, cmd$)

CALL InstrRead(analyzer, result$)            'Read results

Print result$

END SUB

REM *************************************************************************
```

Fast Level Measurement Using Frequency Lists

A typical task for the R&S ZVL is power measurement at a number of frequency points, e.g. at multiples of the fundamental (harmonics measurement), or at frequencies defined by a mobile radio standard (e.g. spectrum due to transients at ± 200 kHz, ± 400 kHz, etc about the carrier frequency of a GSM signal). In many cases, different level and/or bandwidth settings are required for the different frequency points to match the channel spacing and meet the requirements of dynamic range.

Especially for this application, the R&S ZVL offers a number of remote–control functions (commands available in SENSe:LIST subsystem) that allow level measurement based on a frequency list with different instrument settings assigned to different frequencies. Not only the frequency list can be programmed, but also the measurement types (PEAK, RMS, AVG) to be performed simultaneously can be selected.

The example below describes a harmonics measurement on a dual–band amplifier. The harmonics level in general decreases as the frequency increases. To boost measurement sensitivity, therefore, the reference level is lowered by 10 dB from the third harmonic.

The following settings are used:

Reference level:	10.00 dBm up to first harmonic, 0 dBm from 2nd harmonic
RF attenuation:	20 dB
Electronic attenuation:	0 dB (OFF)
Filter type:	NORMal
RBW:	1 MHz
VBW:	3 MHz
Measurement time:	300 µs
Trigger delay:	100 µs
Trigger:	video, 45 %

Frequency	Type
935.2 MHz	GSM 900 fundamental
1805.2 MHz	GSM 1800 fundamental
1870.4 MHz	GSM 900 2nd harmonic
2805.6 MHz	GSM 900 3rd harmonic
3610.4 MHz	GSM 1800 2nd harmonic
3740.8 MHz	GSM 900 4th harmonic
5815.6 MHz	GSM 1800 3rd Harmonic

The frequencies are selected in ascending order to minimize system–inherent waiting times resulting from frequency changes.

At each frequency point the peak power and the rms power are measured. The peak power and the rms power values are stored alternately in the results memory.

```
REM ******************************************************************************

Public Sub FrequencyList()

result$ = Space$(500)

'--------- R&S ZVL default setting -------------------------------------

CALL SetupStatusReg                          'Configure status register

CALL InstrWrite(analyzer,"*RST")             'Reset instrument

CALL InstrWrite(analyzer,"INIT:CONT OFF")    'Single sweep mode

CALL InstrWrite(analyzer,"SYST:DISP:UPD OFF")
                                             'Display off
```

```
'---------Configure R&S ZVL for power measurement based on frequency list -
CALL InstrWrite(analyzer, "TRIG:LEV:IFP -20dBm")
                                        'Set IF power trigger level
CALL InstrWrite(analyzer, "LIST:POWer:SET ON,ON,OFF,IFP,POS,100us,0")
'--------- Perform measurement and query results -------------------------
cmd$ = "LIST:POWer?"
cmd$ = cmd$ + "935.2MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "1805.2MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "1870.4MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "2805.6MHZ,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "3610.4MHz,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "3740.8MHz,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "5815.6MHz,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0"
CALL InstrWrite(analyzer, cmd$)
CALL InstrRead(analyzer, result$)
Print result$
END SUB
REM ****************************************************************************
```

Level Correction of Transducers (Definition of Transducer Factors)

In more complex test systems, the frequency response of the test setup must be taken into account in all power measurements to avoid any measurement errors being introduced from sources other than the DUT.

The R&S ZVL offers the possibility of defining a frequency–dependent attenuation correction factor (transducer factor).

In the example below, a factor with the following characteristics is defined:

Name: Transtest
Unit: dB
Scaling: lin
Comment: simulated cable correction

Frequency   Level
10 MHz   0 dB
100 MHz   3 dB
1 GHz   7 dB
3 GHz   10 dB

The factor is defined and can be activated as required.

```
REM ********************************************************************
Public Sub TransducerFactor()
'--------- Define transducer factor -------------------------------------
CALL InstrWrite(analyzer,"CORR:TRAN:SEL 'TRANSTEST'")
                                          'Define "Transtest"
                                          'transducer factor
CALL InstrWrite(analyzer,"CORR:TRAN:UNIT 'DB'")
                                          'Unit 'dB'
CALL InstrWrite(analyzer,"CORR:TRAN:SCAL LIN")
                                          'Linear frequency-axis
CALL InstrWrite(analyzer,"CORR:TRAN:COMM  'Simulated cable correction'")
cmd$ = "CORR:TRAN:DATA "                  'Enter frequency and level
cmd$ = cmd$ + "10MHz, 0,"                 'values. Level values without
cmd$ = cmd$ + "100MHz, 3,"                'unit!
cmd$ = cmd$ + "1GHz, 7,"
cmd$ = cmd$ + "3GHz, 10"
CALL InstrWrite(analyzer,cmd$)            'Enter frequency and level values
'--------- Activate transducer -------------------------------------
CALL InstrWrite(analyzer,"CORR:TRAN:STAT ON")
                                          'Activate transducer factor
END SUB
REM ********************************************************************
```

Measuring the Magnitude and Phase of a Signal (I/Q Data Acquisition)

Due to the R&S ZVL's internal architecture, it is capable of measuring and outputting the magnitude and phase of a signal in addition to its power values. This opens up a variety of possibilities for more in–depth analysis (FFT, demodulation, etc).

I/Q data is stored in memory areas each containing 512 k words. Hardware triggering controls the memory.
The following example shows the steps necessary to collect data at a predefined sampling rate and read it from the I/Q memory.

Data is output in the form of voltage values referred to the analyzer input. Data can be read in binary or ASCII format.

In binary format, the length information carried in the message header is evaluated and used for calculating the x–axis values.

In ASCII format, only a list of voltage values is output.

Binary data is read in three steps:

1. The number of digits carrying the length information is read.

2. The length information itself is read.

3. The trace data is read.

R&S ZVL-K1Measuring the Magnitude and Phase of a Signal (I/Q Data Acquisition)

This procedure is necessary with programming languages like Visual Basic which support only structures of identical data types (arrays), whereas the binary data format uses different data types in the header and the data section.

Note: *The arrays for measured data are dimensioned in such a way that they can accommodate the I/Q data of the R&S ZVL (2 x 512 k).*

```
REM ******************************************************************

Public Sub ReadIQData()
'--------- Create variables -----------------------------------------
Dim IData(131072) As Single         'Buffer for floating-point
                                    'I data (= 512*1024 bytes)
Dim QData(131072) As Single         'Buffer for floating-point
                                    'Q data (= 512*1024 bytes)

                                    'Note:
                                    'Visual Basic cannot read in
                                    'data volumes larger than
                                    '512 k words!
Dim digits As Byte                  'No. of digits as length
Dim IQBytes As Long                 'Length of trace data in bytes
Dim IQValues As Long                'No. of meas. values in buffer
Dim retCount As Integer             'Return count from read
asciiResult$ = Space$(6553600)      'Buffer for ASCII I/Q data
                                    '(= 25*2*1024 bytes)
result$ = Space$(100)               'Buffer for simple results
'--------- Default setting ----------------------------------
CALL SetupInstrument                'Default setting
CALL InstrWrite(analyzer,"TRAC:IQ:STAT ON")
                                    'Activate I/Q data
                                    'acquisition mode; must be
                                    'done before TRAC:IQ:SET !

                                    'Select number of test points
                                    '(= 512 * 1024 - 512) at
                                    'RBW 10 MHz, 'sample rate 32 MHz,
                                    'trigger free run, pos. trigger
                                    'edge and 0 s trigger delay.
CALL InstrWrite(analyzer,"TRAC:IQ:SET NORM,10MHz,32MHz,IMM,POS,0,130560")
'--------- Read-out in binary format---------------------------------------
CALL InstrWrite(analyzer, "FORMAT REAL,32")
                                    'Set binary format
CALL InstrWrite(analyzer, "TRAC:IQ:DATA?")
                                    'Measure + read out I/Q data
CALL viRead(analyzer, result$, 2, retCount)
                                    'Read and store length for
digits = Val(Mid$(result$, 2, 1))   'number of digits
result$ = Space$(100)               'Re-initialize buffer
CALL viRead(analyzer, result$, digits, retCount)
                                    'Read and store length
IQBytes = Val(Left$(result$, digits))
```

```
IQBytes = IQBytes / 2                        'Divide no. per buffer in half
CALL viRead(analyzer, IData(0), IQBytes, retCount)
                                             'Read I data in buffer
CALL viRead(analyzer, QData(0), IQBytes, retCount)
                                             'Read Q data in buffer
CALL viRead(analyzer, result$, 1, retCount)
                                             'Read in end character <NL>
'--------- Output of binary data as frequency/level pair -----------------
IQValues = IQBytes/4                         'Single Precision = 4 Bytes
For i = 0 To IQValues – 1
  Print "I-Value["; i; "] = "; IData(i)
  Print "Q-Value["; i; "] = "; QData(i)
Next i
'--------- Read–out in ASCII format --------------------------------------
CALL InstrWrite(analyzer,"FORMAT ASCII")   'Set ASCII format
CALL InstrWrite(analyzer, "TRAC:IQ:DATA?")
                                             'Re-measure and read out
                                             'I/Q data
CALL InstrRead(analyzer, asciiResult$)
CALL InstrWrite(analyzer,"TRAC:IQ:STAT OFF")
                                             'Stop I/Q data aquisition
                                             'mode if no further
                                             'measurements are to be
                                             'done
END SUB
REM ***********************************************************************
```

Averaging I/Q Data

The R&S ZVL has averaging capability also for I/Q measurements, i.e. I/Q data can be averaged over several test runs. This is subject to the following conditions:

1. An external trigger signal must be available for data measurement, and the trigger signal must be phase–locked to the signal measured.

2. The same reference–frequency signal must be used for the DUT and the R&S ZVL.

3. The sampling rate must be 32 MHz, since only with this sampling frequency will the measurement be performed phase–synchronous with the trigger signal.

If all of the above conditions are fulfilled, no phase shift will occur between consecutive test runs. Phase shift may falsify the measured average so that in extreme cases a value of 0 is obtained.

The default setting of the instrument for data measurement without averaging has to be changed as follows:

```
REM ************************************************************************
'--------- R&S ZVL default setting -------------------------------------
CALL SetupInstrument                            'Default setting
CALL InstrWrite(analyzer,"TRAC:IQ:STAT ON")
                                                'Activate I/Q data acquisition
                                                'mode; this must be
                                                'done before TRAC:IQ:SET!
'Select max. number of test points (= 512 * 1024 – 512) at 10 MHz RBW,
                                                '32 MHz sampling rate, external
                                                'trigger, pos. trigger edge and
                                                '0 s trigger delay.
CALL InstrWrite(analyzer,"TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,130560")
CALL InstrWrite(analyzer,"TRAC:IQ:AVER ON")   'Switch on I/Q averaging
CALL InstrWrite(analyzer,"TRAC:IQ:AVER:COUN 10")      'Set 10 test runs
'--------- Read data in binary format ----------------------------------
...
REM ************************************************************************
```

WLAN TX Measurements – Programming Examples (Option K91)

The following section provides some examples of commonly performed operations when using the WLAN TX Measurements option (K91). For more general remote control examples refer to the programming examples in this chapter.

Synchronization Entry of Option

The following example shows how to synchronize entering the WLAN TX Measurements option.

```
analyzer = 20                           'Instrument address
CALL InstrWrite(analyzer, "INST:SEL WLAN;*OPC?")
                                        'waits for 1 from *OPC?
```

Selecting Measurements

Measurements are selected using the command `CONFigure:BURSt:<Meas Type>` where <Meas Type> is as follows:

<Meas Type>	Measurement Type
PVT	Power vs Time (PVT)
PVT:SELect EDGE	PVT rising and falling edge
PVT:SELect FULL	PVT full burst (802.11a only)
PVT:SELect RISE	PVT rising burst (802.11b only)
PVT:SELect FALL	PVT falling burst (802.11b only)
EVM:ECARrier	EVM vs Carrier
EVM:ESYMbol	EVM vs Symbol
SPECtrum:MASK	Spectrum Mask
SPECtrum:MASK:SELect IEEE	Spectrum Mask IEEE
SPECtrum:MASK:SELect ETSI	Spectrum Mask ETSI
SPECtrum:FLATness	Spectrum Flatness
SPECtrum:FFT	Spectrum FFT
SPECtrum:ACPR	Spectrum ACPR
CONstellation:CCARrier	Constellation vs Carrier
CONstellation:CSYMbol	Constellation vs Symbol

<Meas Type>	Measurement Type
STATistics:CCDF	CCDF
STATistics:BSTReam	Bit Steam
STATistics:SFIeld	Signal Field

The following example shows how to select a Spectrum Mark ETSI measurement:

```
REM select Spectrum Mask Select ETSI
CALL InstrWrite(analyzer, "SPECtrum:MASK:SELect:ETSI")
```

Running Synchronized Measurements

The following examples show how measurements can be synchronized. Synchronization is necessary to ensure that the measurement has completed before the measurement results and markers are requested.

```
PUBLIC SUB SweepSync()
REM The command INITiate[:IMMediate] starts a single sweep if the
REM command INIT:CONT OFF was previously sent. It should be ensured that
REM the next command is only then executed when the entire sweep is
REM complete.
CALL InstrWrite(analyzer, "INIT:CONT OFF")
REM ------ First possibility: Use of *WAI -----------------------------
CALL InstrWrite(analyzer, "INIT:IMM;*WAI")
REM ------ Second possibility: Use of *OPC? ---------------------------
OpcOk$ = SPACE$(2) 'Space for *OPC?        'Provide response
CALL InstrWrite(analyzer, "INIT:IMM;*OPC?")
REM ------ Here the controller can service other instrument------------
CALL InstrRead(analyzer, OpcOk$)          'Wait for "1" from *OPC?
REM ------- Third possibility: Use of *OPC ----------------------------
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM the GPIB configuration
REM (e.g. Windows Start menu: Settings -> Control Panel -> GPIB)!
CALL InstrWrite(analyzer, "*SRE 32")      'Permit service request for ESR
CALL InstrWrite(analyzer, "*ESE 1")       'Set event-enable bit for
                                          'operation-complete bit
CALL InstrWrite(analyzer, "INIT:IMM;*OPC") 'Start sweep and
                                          'synchronize with OPC
status = viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
VI_NULL)                                  'Wait for service request
```

```
REM ------- Fourth possibility: Use of INIT:IMM ----------------------
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM the GPIB configuration
REM (e.g. Windows Start menu: Settings -> Control Panel -> GPIB)!
CALL InstrWrite(analyzer, "*SRE 128")        'Permit service request for ESR
CALL InstrWrite(analyzer, "*ESE 0")          'Set event-enable bit for
                                             'operation-complete bit
CALL InstrWrite(analyzer, "STATus:OPERation:ENABle 16")
                                             'Enable bit 4 of status operation
                                             'register'
CALL InstrWrite(analyzer, "STAT:OPERation:NTRansition 16")
                                             'Set Negative transition to 1
CALL InstrWrite(analyzer, "STATus:OPERation:PTRansition 0")
                                             'Set Positive transition to 0
CALL InstrWrite(analyzer, "INIT:IMM")        'Start sweep and synchronize with
                                             'OPC
status = viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
VI_NULL)                                     'Wait for service request
REM Continue main program here.
END SUB
REM *********************************************************************
```

WiMAX, WiBro Measurements – Programming Examples (Option 93)

The following section provides some examples of commonly performed operations when using the WiMAX IEEE 802.16 OFDM, OFDMA Measurements option (R&S FSL–K93). For more general remote control examples refer to the other programming examples in this chapter.

Synchronization Entry of Option

The following example shows how to synchronize entering the WiMAX IEEE 802.16 OFDM, OFDMA Measurements option.

```
analyzer = 20                           'Instrument address
CALL InstrWrite(analyzer, "INST:SEL WLAN;*OPC?")
                                        'waits for 1 from *OPC?
```

Selecting Measurements

Measurements are selected using the command `CONFigure:BURSt:<Meas Type>` where <Meas Type> is as follows:

<Meas Type>	Measurement Type
PVT	Power vs Time (PVT)
PVT:SELect EDGE	PVT Start and End (OFDM) PVT Rsing / Falling (OFDMA & WiBro)
PVT:SELect FULL	PVT Full Burst (OFDM) PVT Full Subframe (OFDMA & WiBro)
EVM:ECARrier	EVM vs Carrier
EVM:ESYMbol	EVM vs Symbol
SPECtrum:MASK	Spectrum Mask
SPECtrum:MASK:SELect IEEE	Spectrum Mask IEEE
SPECtrum:MASK:SELect ETSI	Spectrum Mask ETSI
SPECtrum:FLATness	Spectrum Flatness
SPECtrum:FLATness:SELect FLATNESS	Spectrum Flatness
SPECtrum:FLATness:SELect GRDELAY	Spectrum Flatness – Group Delay
SPECtrum:FLATness:SELect DIFFERENCE	Spectrum Flatness – Difference
SPECtrum:FFT	Spectrum FFT
SPECtrum:ACPR	Spectrum ACPR

<Meas Type>	Measurement Type
SPECtrum:ACPR:SELect ABS	Spectrum ACPR (Absolute)
SPECtrum:ACPR:SELect REL	Spectrum ACPR (Relative)
CONSt:CCARrier	Constellation vs Carrier
CONSt:CSYMbol	Constellation vs Symbol
STATistics:CCDF	CCDF
STATistics:BSTReam	Bit Steam
STATistics:BSUMmary	Burst Summary
PREamble	Preamble Error
PREamble:SELect FREQ	Frequency Error vs Preamble
PREamble:SELect PHASE	Phase Error vs Preamble

The following example shows how to select a Spectrum Mask ETSI measurement:

```
REM select Spectrum Mask Select ETSI
CALL InstrWrite(analyzer, "SPECtrum:MASK:SELect:ETSI")
```

Running Synchronized Measurements

The following examples show how measurements can be synchronized. Synchronization is necessary to ensure that the measurement has completed before the measurement results and markers are requested.

```
PUBLIC SUB SweepSync()
REM The command INITiate[:IMMediate] starts a single sweep if the
REM command INIT:CONT OFF was previously sent. It should be ensured that
REM the next command is only then executed when the entire sweep is
REM complete.
CALL InstrWrite(analyzer, "INIT:CONT OFF")
REM ------ First possibility: Use of *WAI ----------------------------
CALL InstrWrite(analyzer, "INIT:IMM;*WAI")
REM ------ Second possibility: Use of *OPC? --------------------------
OpcOk$ = SPACE$(2) 'Space for *OPC?        'Provide response
CALL InstrWrite(analyzer, "INIT:IMM;*OPC?")
```

REM ------ Here the controller can service other instrument------------

```
CALL InstrRead(analyzer, OpcOk$)          'Wait for "1" from *OPC?
```

REM ------- Third possibility: Use of *OPC --------------------------

```
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM the GPIB configuration
REM (e.g. Windows Start menu: Settings -> Control Panel -> GPIB)!
CALL InstrWrite(analyzer, "*SRE 32")      'Permit service request for ESR
CALL InstrWrite(analyzer, "*ESE 1")       'Set event-enable bit for
                                          'operation-complete bit
CALL InstrWrite(analyzer, "INIT:IMM;*OPC") 'Start sweep and
                                          'synchronize with OPC
status = viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
VI_NULL)                                  'Wait for service request
```

REM ------- Fourth possibility: Use of INIT:IMM ----------------------

```
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM the GPIB configuration
REM (e.g. Windows Start menu: Settings -> Control Panel -> GPIB)!
CALL InstrWrite(analyzer, "*SRE 128")     'Permit service request for ESR
CALL InstrWrite(analyzer, "*ESE 0")       'Set event-enable bit for
                                          'operation-complete bit
CALL InstrWrite(analyzer, "STATus:OPERation:ENABle 16")
                                          'Enable bit 4 of status operation
                                          'register'
CALL InstrWrite(analyzer, "STAT:OPERation:NTRansition 16")
                                          'Set Negative transition to 1
CALL InstrWrite(analyzer, "STATus:OPERation:PTRansition 0")
                                          'Set Positive transition to 0
CALL InstrWrite(analyzer, "INIT:IMM")     'Start sweep and synchronize with
                                          'OPC
status = viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
VI_NULL)                                  'Wait for service request
REM Continue main program here.
```

END SUB

REM **

Contents of Chapter 6

6 Error Messages

Error messages are entered in the error/event queue of the status reporting system in the remote control mode and can be queried with the command `SYSTem:ERRor?`. The answer format of R&S ZVL to the command is as follows:

<error code>, "<error text with queue query>;
<remote control command concerned>"

The indication of the remote control command with prefixed semicolon is optional.

The subsequent lists contain the description of the device-specific error messages displayed on the instrument.

The right–hand column in the following tables contains the error text in bold which is entered in the error/event queue and can be read out by means of query `SYSTem:ERRor?`. A short explanation of the error cause is given below. The left–hand column contains the associated error code.

Device-Specific Messages

Error code	Error text in the case of queue poll Error explanation
1052	**Frontend LO is Unlocked** This message is displayed when the phase regulation of the local oscillator fails in the RF front–end.
1060	**Trigger–Block Gate Delay Error– gate length < Gate Delay** This message is displayed when the gate signal length is not sufficient for the pull–in delay with a predefined gate delay.
2028	**Hardcopy not possible during measurement sequence** This message is displayed when a printout is started during scan sequences that cannot be interrupted. Such sequences are for example: • Recording the system error correction data (alignment) • Instrument self test In such cases synchronization to the end of the scan sequence should be performed prior to starting the printout.
2033	**Printer Not Available** This message is displayed when the selected printer is not included in the list of available output devices. A possible cause is that the required printer driver is missing or incorrectly installed.
2034	**CPU Temperature is too high** This message is displayed when the temperature of the processor exceeds 70 °C.

Noise Figure Measurements Option Messages (K30)

The list of possible warning & error messages for the Noise Figure Measurements option (K30) is shown below.

Status bar message	Description
Frequency list truncated, max 100 entries	The settings for start, stop and step frequencies would require a frequency list greater than 100 entries. The list calculated is terminated at the 100th entry. Try using a larger step size of splitting the test up into a series of frequency list tests.
Missing [ENR][,|&][LossIn][,|&][LossOut] for meas.freq.	No ENR, loss input and/or loss output can be determined for one or all of the measurement frequencies. This occurs when using tables of ENR, loss input and/or loss output values. Check that the frequency ranges of the tables covers the range of frequencies to be measured. For each measurement frequency, where ENR, loss input or loss output cannot be determined, 0 is used.

3GPP Base Station Measurements Option Messages (K72)

The list of possible warning & error messages is shown below.

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

WLAN TX Measurements Option Messages (K91)

The list of possible warning & error messages is shown below.

Status bar message	Description
Gate length too small – must be greater than 1	This message is only displayed for the FFT measurement. This message indicates that there are no samples contained within the gating lines. Increase the Gate length and then, in the sweep menu, press the **Refresh** softkey to remove this error.
No valid analyzed bursts within gating lines	This message is only displayed for the PVT measurement. This message indicates that there are no complete & valid bursts contained within the gating lines. Increase the Gate length and then, in the sweep menu, press the **Refresh** softkey to remove this error.
No bursts found	This message is displayed if no valid burst was detected in the input data. To correct this problem check the following: The connections between the DUT and analyzer are correct. The input signal is of a sufficient level. The capture time is long enough to capture at least one complete burst. If running with a Free Run trigger then the capture time must be greater than the burst length (ideally at least twice the burst length) to ensure that a complete burst is recorded. Check that the demod settings are correct.
No bursts of desired type to analyze	This message is displayed if bursts are found, but none of desired type to analyse. Check that the setting for Burst Type is correct.
No signal found	This message is displayed when an automatic level detection measurement is executed and the measured signal level is lower the permitted minimum value.
No power trigger for Spectrum Mask ETSI	This message is displayed when the Spectrum Mask ETSI measurement is selected whilst the trigger is set to power. No action is required as the trigger is automatically set to Free Run in this case.
Signal overload detected	This message is displayed when the OVLD enhancement label is displayed and indicates that the input mixer is overloaded. If this message is displayed then try increasing the setting for the Signal Level parameter (or settings Auto Level). If this does not clear the problem then an external attenuation may need to be applied.

WiMAX IEEE 802.16 OFDM, OFDMA Measurements Option Messages (K93)

The list of possible warning & error messages for the WiMAX IEEE 802.16 OFDM, OFDMA Measurements option (R&S FSL–K93) is shown below.

Status bar message	Description
Gate length too small – must be greater than 1	This message is only displayed for the FFT measurement. This message indicates that there are no samples contained within the gating lines. Increase the Gate length and then, in the sweep menu, press the **Refresh** softkey to remove this error.
No valid analyzed bursts within gating lines	This message is only displayed for the PVT measurement. This message indicates that there are no complete & valid bursts contained within the gating lines. Increase the Gate length and then, in the sweep menu, press the **Refresh** softkey to remove this error.
No bursts found	This message is displayed if no valid burst was detected in the input data. To correct this problem check the following: The connections between the DUT and analyzer are correct. The input signal is of a sufficient level. The capture time is long enough to capture at least one complete burst. If running with a Free Run trigger then the capture time must be greater than the burst length (ideally at least twice the burst length) to ensure that a complete burst is recorded. Check that the demodulation settings are correct.
No bursts of desired type to analyze	This message is displayed if bursts are found, but none of desired type to analyze. Check that the setting for Burst Type is correct.
No signal found	This message is displayed when an automatic level detection measurement is executed and the measured signal level is lower the permitted minimum value.
Signal overload detected	This message is displayed when the OVLD enhancement label is displayed and indicates that the input mixer is overloaded. If this message is displayed then try increasing the setting for the Signal Level parameter (or settings Auto Level). If this does not clear the problem then an external attenuation may need to be applied.
The Zone marked for Analysis is not setup correctly (R&S FSL–K93 only)	This message is displayed when there are configuration errors in the frame setup. Check the zone/segment map and burst map for any highlighted errors.

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