R&S® FSV-K40
Firmware Option Phase Noise Measurements
Operating Manual

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Test & Measurement

Operating Manual

ROHDE&SCHWARZ

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

- R&S FSV-K40 (1310.8403.02)

This manual is applicable for the following analyzer models with firmware version 1.70 and higher:

- R&S®FSV 3 (1307.9002K03)
- R&S®FSV 7 (1307.9002K07)
- R&S®FSV 13 (1307.9002K13)
- R&S®FSV 30 (1307.9002K30)
- R&S®FSV 40 (1307.9002K39)
- R&S®FSV 40 (1307.9002K40)

The firmware of the instrument makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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

Contents

1 Preface

1.1 Documentation Overview

The user documentation for the R&S FSV is divided as follows:

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

Quick Start Guide

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

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

Operating Manuals

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

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

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

The following Operating Manuals are available for the R&S FSV:

- R&S FSV base unit; in addition:
  - R&S FSV-K9 Power Sensor Support
  - R&S FSV-K14 Spectrogram Measurement
- R&S FSV-K7 Analog Demodulation and R&S FSV-K7S FM Stereo Measurements
- R&S FSV-K10 GSM/EDGE Measurement
- R&S FSV-K30 Noise Figure Measurement
- R&S FSV-K40 Phase Noise Measurement
- R&S FSV-K70 Vector Signal Analysis Operating Manual
  R&S FSV-K70 Vector Signal Analysis Getting Started (First measurements)
- R&S FSV-K72 3GPP FDD BTS Analysis
- R&S FSV-K73 3GPP FDD UE Analysis
- R&S FSV-K76/77 3GPP TD-SCDMA BTS/UE Measurement
- R&S FSV-K82/83 CDMA2000 BTS/MS Analysis
- R&S FSV-K84/85 1xEV-DO BTS/MS Analysis
- R&S FSV-K91 WLAN IEEE 802.11a/b/g/j/n
- R&S FSV-K93 WiMAX IEEE 802.16 OFDM/OFDMA Analysis
- R&S FSV-K100/K104 EUTRA / LTE Downlink Measurement Application
- R&S FSV-K101/K105 EUTRA / LTE Uplink Measurement Application

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

Service Manual

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

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

Online Help

The online help contains context-specific help on operating the R&S FSV and all available options. It describes both manual and remote operation. The online help is installed on

the R&S FSV by default, and is also available as an executable .chm file on the CD delivered with the instrument.

Release Notes

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

1.2 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

1.2.2 Conventions for Procedure Descriptions

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

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

1.3 How to Use the Help System

Calling context-sensitive and general help

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

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

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

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

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

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

Contents of the help dialog box

The help dialog box contains four tabs:

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

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

Navigating in the table of contents

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

Navigating in the help topics

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

Searching for a topic

1. Change to the "Index" tab.

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

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

Changing the zoom

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

Closing the help window

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

2 Phase Noise Measurements Option R&S FSV-K40

Phase Noise Measurement Software R&S FSV-K40 extends the measurement capabilities of Rohde&Schwarz signal and spectrum analyzers by phase noise tests. The R&S FSV is ideal for this purpose because of its low inherent phase noise and noise figure. The high phase noise measurement speed is achieved through the high sweep rates of all analyzers. It is possible to trade off speed against accuracy at small resolution bandwidths (≤1 kHz) by using either FFT or digital filters. The software allows different settings within a phase noise diagram, e.g. FFT close to the carrier and analog/digital filters far off the carrier.

This part of the documentation consists of the following chapters:

2.1 Instrument Functions of Phase Noise Measurements (R&S FSV-K40)

To open the main Phase Noise measurements menu

- If the Phase Noise mode is not the active measurement mode, press the MODE key and activate the "Phase Noise" option.
- If the Phase Noise mode is already active, press the HOME key.
  The main phase noise figure measurements menu is displayed.

Menu and softkey description

In the following sections the specific softkeys available for phase noise measurements are described.

- chapter 2.1.2, "Softkeys of the Phase Noise Menu (R&S FSV-K40)", on page 26
- chapter 2.1.7, "Softkeys of the Sweep Menu – SWEEP key (R&S FSV-K40)", on page 31
- chapter 2.1.8, "Softkeys of the Trace Menu – TRACE key (R&S FSV-K40)", on page 31
- chapter 2.1.9, "Softkeys of the Auto Set menu - AUTO SET Key (R&S FSV-K40)", on page 35
- chapter 2.1.12, "Softkeys of the Lines Menu – LINES key (R&S FSV-K40)", on page 37
- chapter 2.1.10, "Softkeys of the Marker Menu – MKR key (R&S FSV-K40)", on page 36

- chapter 2.1.11, "Softkeys of the Marker To Menu – MKR-> key (R&S FSV-K40)", on page 37

The "Trigger", "Meas Config", "Input/Output", and "Marker Functions" menus are not available for Phase noise measurements.

Further information

- chapter 2.1.1.4, "Measurement Settings and Results Display", on page 24
- chapter 2.1.15, "Detector Overview", on page 40
- chapter 2.1.18, "Trace Mode Overview", on page 44
- chapter 2.1.16, "Selecting the Appropriate Filter Type", on page 42
- chapter 2.1.17, "List of Available RRC and Channel Filters", on page 42
- chapter 2.1.19, "ASCII File Export Format", on page 45

Tasks

- chapter 2.1.1.1, "Overview of General Settings", on page 13
- chapter 2.1.1.2, "Overview of Measurement Settings", on page 20
- chapter 2.1.1.3, "Running Measurements", on page 23
- chapter 2.1.13, "Working with Limit Lines", on page 38
- chapter 2.1.14, "Editing Limit Lines", on page 39

2.1.1 Measurements and Results

This section contains a detailed description of performing measurements and their results. It covers the following subjects:

2.1.1.1 Overview of General Settings

This section describes the "General Settings" view where all settings related to the general measurement can be modified, i.e. the signal characteristics, display settings, trace settings, residual calculation settings and spot noise settings.

When a particular parameter is selected within the "General Settings" view, the status bar changes to display information on the valid settings for the selected parameter.

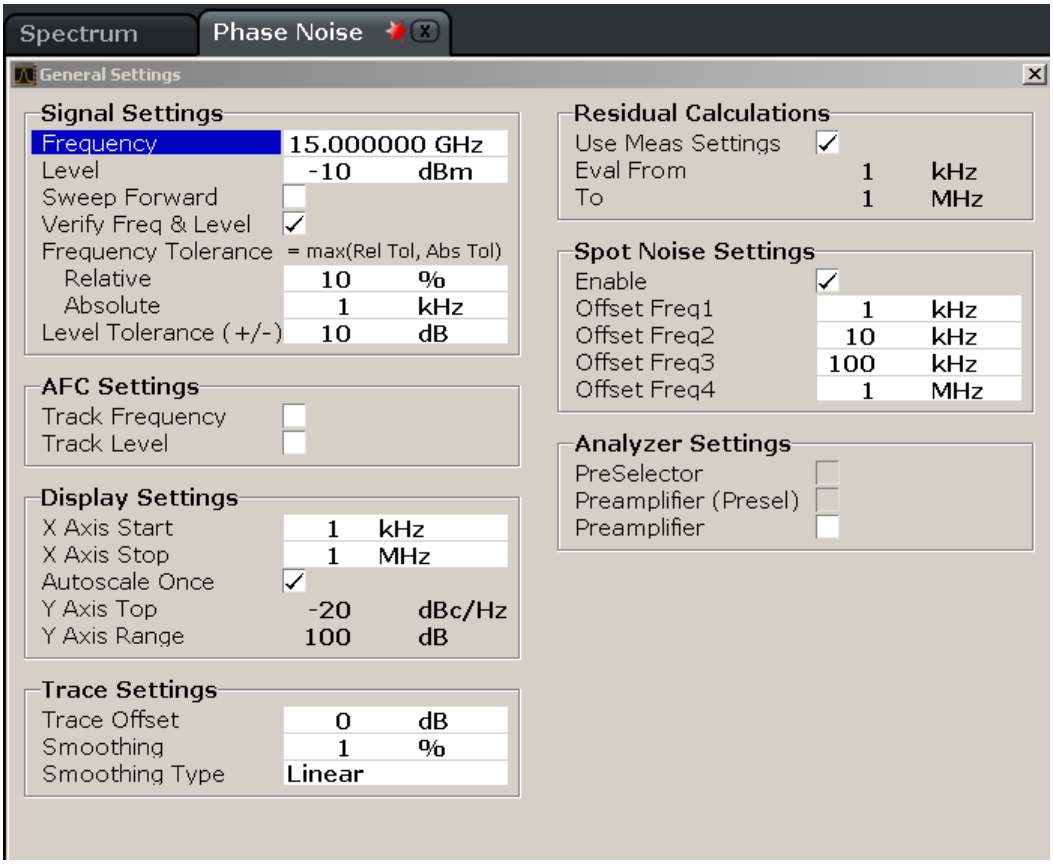


Fig. 2-1: "General Settings" view

The parameters within the "General Settings" view are logically grouped together into:

Signal Settings
The "Signal Settings" are the general settings concerning the level and frequency of the signal to be measured. These settings contain the following parameters:

- "Frequency" on page 15
- "Level" on page 15
- "Sweep Forward" on page 15
- "Verify Freq and Level" on page 15
- "Frequency Tolerance" on page 16
- "Level Tolerance" on page 16

Frequency ← Signal Settings
Specifies the center frequency of the signal to be measured.

Tip: you can switch directly to this field by pressing the FREQ key.

SCPI command:
`[SENSe:]FREQuency:CENTer` on page 79

Level ← Signal Settings
Specifies the expected level of the RF input signal.

Tip: you can switch directly to this field by pressing the AMPT key.

`[SENSe:]POWer:RLEVel` on page 82

Sweep Forward ← Signal Settings
Determines the sweep direction for the current measurement.

"ON" The measurement is performed from the start offset frequency to the stop offset frequency.

"OFF" The measurement is performed from the stop offset frequency to the start offset frequency.

SCPI command:
`[SENSe:]SWEep:FORWard` on page 83

Verify Freq and Level ← Signal Settings
Enables a search across a frequency tolerance range, for the carrier of greatest magnitude. Carrier frequency and level are measured. If the level is within a level tolerance range, the measured level overrides the specified Level. Otherwise the measurement is aborted.

This should be used when the carrier frequency is not known precisely.

When "Verify Freq" is on, Frequency Tolerance and Level Tolerance parameters become enabled.

SCPI command:
`[SENSe:]FREQuency:VERify[:STATe]` on page 80

Frequency Tolerance ← Signal Settings
Used to verify the input signal frequency; the value used is the higher value of the specified "Relative" or "Absolute" tolerance values.

"Relative" The "Relative Frequency Tolerance" parameter is the ratio of the subspan's start frequency. A frequency and level check is carried out before each subsweep.

"Absolute" The "Absolute Frequency Tolerance" is the range either side of the "Signal Frequency" within which the carrier is known to be. A frequency and level check is carried out before each subsweep.

SCPI command:
`[SENSe:]FREQuency:VERify:TOLerance:RELative` on page 80
`[SENSe:]FREQuency:VERify:TOLerance` on page 80

Level Tolerance ← Signal Settings
Offset relative to the "Level". It is used to verify the "Level" of the input signal.

"Level Tolerance" specifies the maximum and mimum deviation from the specified "Level" setting that the input signal may vary by and still pass the verification, i.e. the measured level between ("Level"+"Level_Tolerance") and ("Level"-"Level_Tolerance") is accepted.

SCPI command:
`[SENSe:]POWer:RLEVel:VERify:TOLerance` on page 82

AFC Settings Track Frequency
Enables or disables the signal frequency tracking mechanism during the measurement.

This parameter is only available when the "Verify Freq and Level" on page 15 parameter is enabled.

SCPI command:
`[SENSe:]FREQuency:TRACk` on page 79

Track Level ← AFC Settings Track Frequency
Enables or disables the signal level tracking mechanism during the measurement.

This parameter is only available when the "Verify Freq and Level" on page 15 parameter is enabled.

SCPI command:
`[SENSe:]POWer:TRACk` on page 83

Display Settings
The display settings configure the display of the measurement results. The settings contain the following parameters:

- "X Axis Start" on page 17
- "X Axis Stop" on page 17

- "Autoscale Once" on page 17
- "Y Axis Top" on page 17
- "Y Axis Range" on page 17

X Axis Start ← Display Settings
Specifies the minimum frequency for the X axis.

When "X Axis Start" changes, the "Start" parameter in the "Measurement Settings" view is updated accordingly.

SCPI command:
`[SENSe:]FREQuency:STARt` on page 79

X Axis Stop ← Display Settings
Specifies the maximum frequency for the X axis.

When "X Axis Stop" changes, the "Stop" parameter in the "Measurement Settings" view is updated accordingly.

SCPI command:
`[SENSe:]FREQuency:STOP` on page 79

Autoscale Once ← Display Settings
If activated, the y-axis scaling is calculated from the results.

The autoscaling is only carried out once in the first sweep. The subsequent sweeps do not autoscale the y-axis.

When "Autoscale Once" is on, "Y Axis Top" and "Range" parameters are unavailable. When it is off, the "Y Axis Top" and "Range" parameters are editable.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 71

Y Axis Top ← Display Settings
Specifies the maximum phase noise level in the y-axis for the trace results.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 71

Y Axis Range ← Display Settings
Specifies the distance from the top to the origin in the y-axis.

SCPI command:
`[SENSe:]POWer:RLEVel:VERify:TOLerance` on page 82

Trace Settings
The trace settings configure the trace and contain the following parameters:

- "Trace Offset" on page 18
- "Smoothing" on page 18
- "Smoothing Type" on page 18

If smoothing is activated using the "Smoothing" on page 33 softkey in the "Trace" menu, the trace on the screen is smoothed by the defined smoothing percentage (see "Smoothing" on page 18). Each trace (trace1, trace2 and trace3) can be smoothed and unsmoothed individually.

The smoothing algorithm used is as follows:

$$y'(s) = 10 * Log_{10}\left(\left(\sum_{x-s-\left(\frac{n-1}{2}\right)}^{x-s+\left(\frac{n-1}{2}\right)} 10^{\left(\frac{y(x)}{10}\right)}\right) \div n\right)$$

Where:

"s" = the trace sample number

"y(s)" = the phase noise at sample "s"

"x" = the sample offset from "s"

"n" = the width of the sliding window

When "x" exceeds the boundary samples, the boundary sample is used, i.e. if the trace has samples numbered 0 to 500, then with "n" = 5 and "s" = 0, the average is calculated as:

$$y'(0) = 10 * Log_{10}\left(\left(3 * 10^{\left(\frac{y(0)}{10}\right)} + 10^{\left(\frac{y(1)}{10}\right)} + 10^{\left(\frac{y(2)}{10}\right)}\right) \div 5\right)$$

If both trace averaging (see "Sweep Mode Settings" on page 21) and smoothing are activated, then trace smoothing is applied first, and averaging is performed on the smoothed trace.

When smoothing is applied to a trace, the original (unsmoothed) trace is still held in memory. This makes it possible to toggle between a smoothed and unsmoothed trace without the need to run a new measurement sweep.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture` on page 69

Trace Offset ← Trace Settings

Defines an arithmetic reference level offset which is added to the y axis labelling.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 71

Smoothing ← Trace Settings

Specifies the % of the display width to be used as a window when a trace is smoothed.

The larger the setting of the "Smoothing" parameter, the greater the smoothing effect.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture` on page 69

Smoothing Type ← Trace Settings

Defines whether linear or logarithmic smoothing is to be used.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:TYPE` on page 70

Residual Calculations Use Meas Settings
Specifies whether to use the whole measurement range or the user defined evaluation range for the residual calculations.

If the "Use Meas Settings" is activated, the "Eval From" on page 19 and "To" on page 19 fields become disabled and residual calculations are performed across the complete range of the measurement results.

If the "Use Meas Settings" is deactivated, the "Eval From" on page 19 and "To" on page 19 fields become enabled. Use them to specify the range over which residual calculations are performed.

SCPI command:
`CALCulate<n>:EVALuation[:STATe]` on page 52

Eval From
Specifies the start of the measurement range for which residual calculations are to be performed.

The minimum value that can be specified for the "Eval From" setting is the value of the "X Axis Start" on page 17 setting.

The maximum value that can be specified for the "Eval From" setting is the value of the "X Axis Stop" on page 17 setting.

When the "X Axis Start" on page 17 or "X Axis Stop" on page 17 settings are modified, the "Eval From" is automatically adjusted to ensure that it is not outside the measurement range.

The "Eval From" setting cannot be set higher than the "To" setting.

SCPI command:
`CALCulate<n>:EVALuation:STARt` on page 53

To
Specifies the end of the measurement range for which residual calculations are to be performed.

The minimum value that can be specified for the "To" setting is the value of the "X Axis Start" on page 17 setting.

The maximum value that can be specified for the "To" setting is the value of the "X Axis Stop" on page 17 setting.

When the "X Axis Start" on page 17or "X Axis Stop" on page 17 settings are modified, the "Eval From" on page 19 setting is automatically adjusted to ensure that it is not outside the measurement range.

The "To" setting cannot be set lower than the "Eval From" on page 19 setting.

SCPI command:
`CALCulate<n>:EVALuation:STOP` on page 53

Spot Noise Settings
In spot noise settings you can specify up to 4 discrete frequency points from which the phase noise result from a measurement sweep can be obtained and displayed.

Spot noise results are updated while a sweep is running.

Enable ← Spot Noise Settings
Activates and deactivates spot noise calculations.

SCPI command:
`CALCulate<n>:SNOise<m>:STATe` on page 65
`CALCulate<n>:SNOise<m>:AOFF` on page 65

Offset Freq 1,2,3,4 ← Spot Noise Settings
In the "Offset Freq" settings you can specify up to four frequency points at which spot noise calculations are performed.

If an offset frequency is specified which is outside the measurement frequency range, no results are displayed for that offset frequency.

SCPI command:
`CALCulate<n>:SNOise<m>:X` on page 65

PreSelector
Activates or deactivates the preselector (if installed).

SCPI command:
`INPut:PRESelection[:STATe]` on page 75

Preamplifier (Preselect)
Activates or deactivates the preamplifier on the preselector (if installed).

SCPI command:
`INPut:GAIN:STATe` on page 75

Preamplifier
Activates or deactivates the preamplifier.

SCPI command:
`INPut:GAIN:STATe` on page 75

2.1.1.2 Overview of Measurement Settings

This section describes the "Measurement Settings" view, in which the settings associated with measurement sweep are specified.

The "Measurement Settings" are logically grouped together into:

- "Sweep Mode Settings" on page 21
- "Span Settings" on page 22
- "Carrier Frequency Offset Table" on page 22
- "Preset Settings" on page 23

When a particular parameter is selected within the "Measurement Settings" view, the status bar changes to display information about the valid settings for the selected parameter.

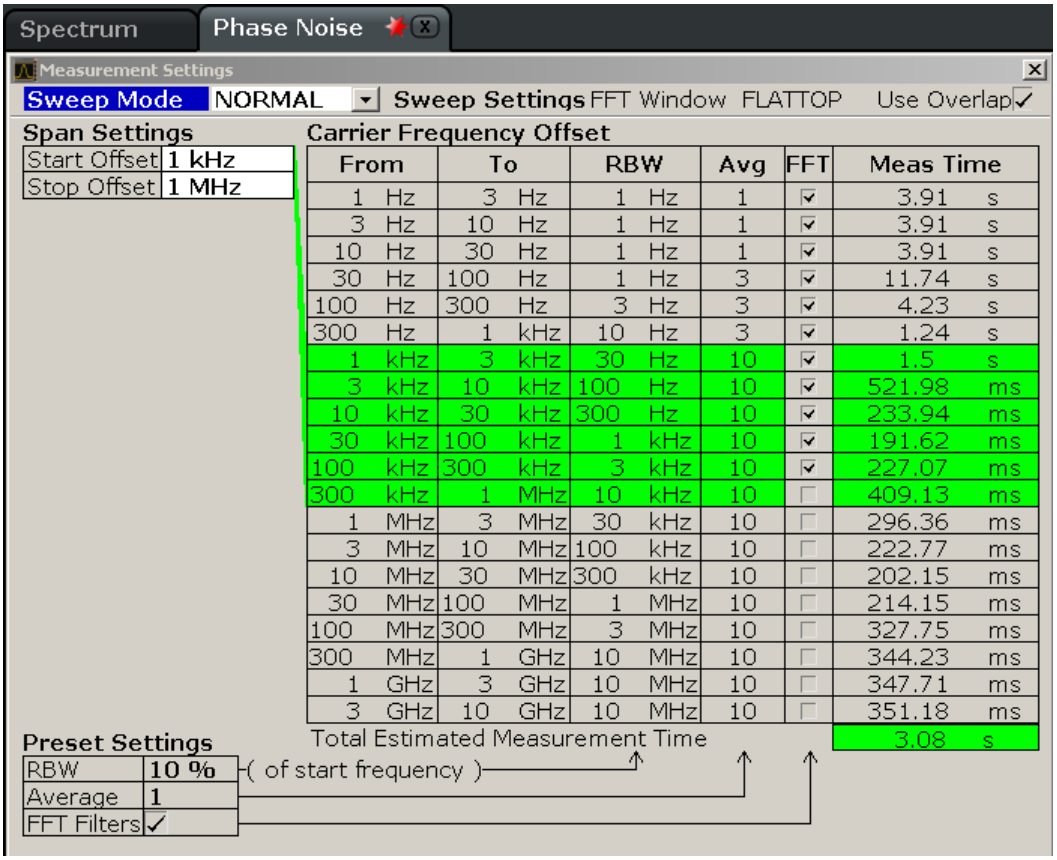


Fig. 2-2: Measurement Settings view

Sweep Mode Settings

When the "Sweep Mode" parameter is changed, the "Carrier Frequency Offset" table is updated from the instrument's default settings.

Tip: You can switch directly to this field by pressing the "Sweep Mode" softkey.

In fast, normal and averaged modes, the table is not editable, it is for information only.

"Fast" Not averaged. The measurement is very fast, as the average column is set to 1 for all sub-bands.

"Normal" Normal averaged. The measurement is slower than the "Fast" mode, but the sub-bands are averaged more.

"Averaged" Highly averaged. The measurement is very slow, with high average in each sub-band for more accurate results.

"Manual" The "RBW", "Average" and "FFT" columns in the "Carrier Ferquency Offset Table", as well as the "Preset Settings", can be set by the user (see "Carrier Frequency Offset Table" on page 22 and "Preset Settings" on page 23).

Sweep Settings ← Sweep Mode Settings

The following sweep settings are displayed for information only:

Sweep type	FFT, Sweep or Auto
Window function	Window function for FFT, e.g. "Window FLATTOP"
Use overlap	Overlapping FFTs

Span Settings
Defines the span settings of the measurement.

Start Offset ← Span Settings
Defines the start frequency of the measurement.

When this parameter changes, the "X Axis Start" on page 17 parameter in the "General Settings" view is updated accordingly.

The selected span for the noise measurement is highlighted in the "Carrier Frequency Offset Table" on page 22 table.

Tip: you can switch directly to this setting by pressing the SPAN key.

Stop Offset ← Span Settings
Defines the stop frequency of the measurement.

When this parameter changes, the "X Axis Stop" on page 17 parameter in the "General Settings" view is updated accordingly.

The selected span for the noise measurement is highlighted in the "Carrier Frequency Offset Table" on page 22 table.

Carrier Frequency Offset Table

Carrier Frequency Offset

From	To	RBW	Avg	FFT	Meas Time
1 Hz	3 Hz	1 Hz	1	☑	3.91 s
3 Hz	10 Hz	1 Hz	1	☑	3.91 s
10 Hz	30 Hz	1 Hz	1	☑	3.91 s
30 Hz	100 Hz	1 Hz	3	☑	11.74 s
100 Hz	300 Hz	3 Hz	3	☑	4.23 s
300 Hz	1 kHz	10 Hz	3	☑	1.24 s
1 kHz	3 kHz	30 Hz	10	☑	1.5 s
3 kHz	10 kHz	100 Hz	10	☑	521.98 ms
10 kHz	30 kHz	300 Hz	10	☑	233.94 ms
30 kHz	100 kHz	1 kHz	10	☑	191.62 ms
100 kHz	300 kHz	3 kHz	10	☑	227.07 ms
300 kHz	1 MHz	10 kHz	10	☐	409.13 ms
1 MHz	3 MHz	30 kHz	10	☐	296.36 ms
3 MHz	10 MHz	100 kHz	10	☐	222.77 ms
10 MHz	30 MHz	300 kHz	10	☐	202.15 ms
30 MHz	100 MHz	1 MHz	10	☐	214.15 ms
100 MHz	300 MHz	3 MHz	10	☐	327.75 ms
300 MHz	1 GHz	10 MHz	10	☐	344.23 ms
1 GHz	3 GHz	10 MHz	10	☐	347.71 ms
3 GHz	10 GHz	10 MHz	10	☐	351.18 ms
Total Estimated Measurement Time					3.08 s

Note: The selected spans for the noise measurement are highlighted in the "Carrier Frequency Offset" table.

The "RBW", "Avg" and "FFT" fields are editable in "Manual" sweep mode only. For all other sweep modes, this table is for information only.

The total measurement time for the selected sub-bands is displayed at the bottom of the table.

From ← Carrier Frequency Offset Table
The start frequency of each sub-band.

SCPI command:
`[SENSe:]FREQuency:STARt` on page 79

To ← Carrier Frequency Offset Table
The stop frequency of each sub-band.

SCPI command:
`[SENSe:]FREQuency:STOP` on page 79

RBW ← Carrier Frequency Offset Table
The resolution filter bandwidth used for each sub-band. Enter values in steps of 1/3/10.

Tip: you can switch directly to the first "RBW" field in the span by pressing the BW key.

Range ← Carrier Frequency Offset Table
0.1 % .. 30 % of the start frequency in that row.

Average ← Carrier Frequency Offset Table
The number of sweeps to average over for each sub-band.

Range ← Carrier Frequency Offset Table
1 .. 10000

FFT ← Carrier Frequency Offset Table
Selection to use the FFT Resolution Filter or the conventional filter for each decade.

FFT is only available for RBW values between 1 Hz and 30 kHz.

Meas Time ← Carrier Frequency Offset Table
The estimated measurement time for each sub-band. Note this time is for the measurement only and does not include processing time.

Preset Settings
The "Preset Settings" display the default values used for "RBW" , "Average" , "FFT" when the "Preset Settings" softkey is pressed (see "Preset Settings" on page 29). For sweep mode "MANUAL", you can edit these settings. In this case, the values in the "Carrier Frequency Offset" table are changed accordingly (see "Carrier Frequency Offset Table" on page 22).

2.1.1.3 Running Measurements

To start a measurement, press the RUN SINGLE or RUN CONT key.

- "RUN SINGLE" switches to single sweep mode and performs a single sweep, just as the Single Sweep softkey in the "Sweep" menu does.

- "RUN CONT" switches to continuous sweep mode and starts sweeping, just as the "Continuous Sweep" on page 31 softkey in the "Sweep" menu does.

If you press one of the RUN keys while a measurement is running, the measurement is aborted.

During a measurement, the text "Running…" is displayed in the status bar at the bottom of the screen. A progress bar is also displayed to show progress through the current measurement sweep. After successful completion of a single measurement, the status bar displays "Measurement Complete".

If the "Verify Freq and Level" on page 15 parameter is selected in the "General Settings" view, then R&S FSV-K40 checks if there is a signal within the specified frequency and level tolerance ranges relative to the specified signal frequency and level. If no signal is found, or a signal is found which is outside the tolerance range, then a message is displayed in the status bar ("No signals found within tolerance range") and the measurement is aborted.

While a measurement sweep is running, changing any of the settings in the "General Settings" or "Meas Settings" views causes the measurement to be aborted, apart from the following settings:

- "Verify On/Off" on page 28
- "Track Level On/Off" on page 28
- "Track Freq On/Off" on page 29
- "Preset Settings" on page 29
- "Autoscale Y Axis" on page 29
- "Ref Meas" on page 29

Once a measurement sweep has been performed, all active limit lines as well as the limit result are displayed.

2.1.1.4 Measurement Settings and Results Display

The diagram header shows the general measurement settings used to obtain the current measurement results.

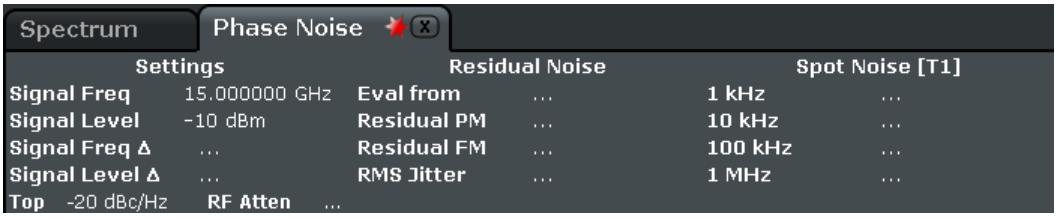


Fig. 2-3: Diagram header with measurement settings and results

The header includes the following information:

Settings	
Signal Frequency	The frequency of the measured input signal.
Signal Level	The level of the input signal
Signal Freq Δ	The measured frequency difference (during verification and tracking)
Signal Level Δ	The measured level difference (during verification and tracking)
Top	The Y-Axis top (the maximum phase noise level in the y-axis for the trace results)
RF Atten	The RF attenuation
Residual Noise	
Eval from ... to ...	The frequency range for which residual noise is calculated. The range of the residual noise calculations is displayed in the results trace by two lines, marker EL1 and EL2.
Residual PM	The residual PM result over the selected evaluation range.
Residual FM	The residual FM result over the selected evaluation range.
RMS Jitter	The RMS jitter result over the selected evaluation range
Spot Noise	
1 kHz/ 10 kHz/ 100 kHz/ 1MHz	Spot noise results at selected frequencies within the evaluation range

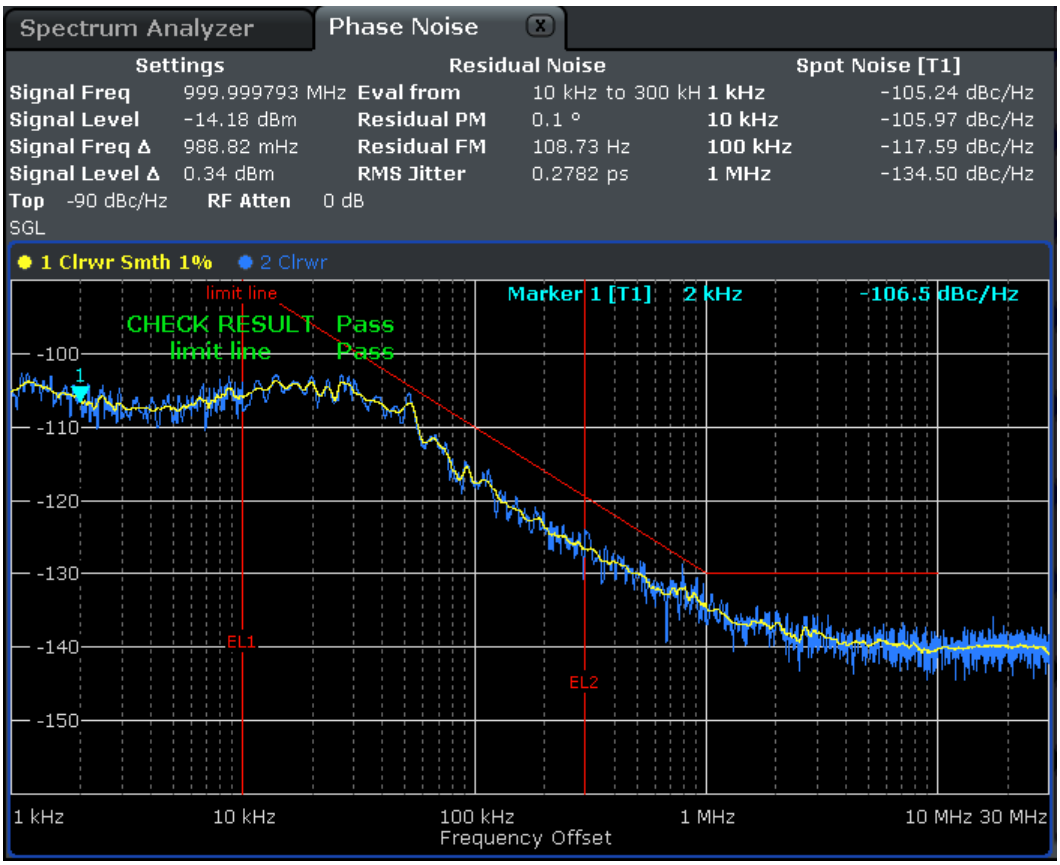


Fig. 2-4: Phase Noise Measurement Results

Note that the residual noise results are displayed at the end of a measurement sweep. If you change the range for the residual noise results in the "General Setting" view after a measurement sweep has been run, the residual noise results are automatically updated. The range of the residual noise calculations is displayed in the results trace by two lines, marker EL1 and EL2.

2.1.1.5 Saving and Recalling Settings and Results

The save/recall functions for phase noise measurements using R&S FSV-K40 are the same as for the base unit. For details see the Save/Rcl menu description for the base unit.

Specifically in the R&S FSV-K40 option, the following items can be saved or recalled:

- **Current Settings** - all user settings for phase noise measurements
- **K40 Results** - all current trace results
- **All Limit Lines** - all defined limit lines

2.1.2 Softkeys of the Phase Noise Menu (R&S FSV-K40)

The following table shows all softkeys available in the "Phase Noise" menu.

General Settings
Displays the "General Settings" view and the "General Settings" submenu. See Overview of General Settings for details.

Signal Settings ← General Settings
Switches to the first setting in the "Signal Settings" area of the "General Settings" view.

Display Settings ← General Settings
Switches to the first setting in the "Display Settings" area of the "General Settings" view. See Overview of General Settings for details.

Trace Settings ← General Settings
Switches to the first setting in the "Trace Settings" area of the "General Settings" view. See Overview of General Settings for details.

Residual Calc ← General Settings
Switches to the first setting in the "Residual Calculations" area of the "General Settings" view. See Overview of General Settings for details.

Spot Noise ← General Settings
Switches to the first setting in the "Spot Noise Settings" area of the "General Settings" view. See Overview of General Settings for details.

Smoothing % ← General Settings
Switches to the "Smoothing" setting in the "Trace Settings" area of the "General Settings" view. See Overview of General Settings for details.

Meas Settings
Displays the "Meas Settings" view and the "Meas Settings" submenu. See Overview of Measurement Settings for details.

Sweep Mode ← Meas Settings
Switches to the "Sweep Mode" setting in the "Measurement Settings" view. See Overview of Measurement Settings for details.

Span Start ← Meas Settings
Switches to the "Start Offset" setting in the "Span Settings" area of the "Measurement Settings" view. See Overview of Measurement Settings for details.

Span Stop ← Meas Settings
Switches to the "Stop Offset" setting in the "Span Settings" area of the "Measurement Settings" view. See Overview of Measurement Settings for details.

Subspan RBW ← Meas Settings
Switches to the first field in the "RBW" column for the subspan in the "Measurement Settings" view. This softkey is only available in sweep mode "MANUAL". See Overview of Measurement Settings for details.

RBW % ← Meas Settings
Switches to the "RBW" setting in the "Preset Settings" area of the "Measurement Settings" view. This softkey is only available in sweep mode "MANUAL". See Overview of Measurement Settings for details.

Average ← Meas Settings
Switches to the "Average" setting in the "Preset Settings" area of the "Measurement Settings" view. This softkey is only available in sweep mode "MANUAL". See Overview of Measurement Settings for details.

Use FFT On/Off ← Meas Settings
Switches to the "FFT Filters" setting in the "Preset Settings" area of the "Measurement Settings" view. This softkey is only available in sweep mode "MANUAL". See Overview of Measurement Settings for details.

Verify On/Off
toggles frequency and level verification on and off

SCPI command:
`[SENSe:]FREQuency:VERify[:STATe]`

Track Level On/Off
toggles level tracking on and off

SCPI command:
`[SENSe:]POWer:TRACk`

Track Freq On/Off
toggles frequency tracking on and off

SCPI command:
`[SENSe:]FREQuency:TRACk`

Preset Settings
Presets the option back to the default settings

Autoscale Y Axis
Scales the Y axis according to the trace results

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 71

Ref Meas
Performs a measurement and stores the trace as a reference trace in trace 3

SCPI command:
`CONFigure:POWer:EXPected:RF`

2.1.3 FREQ key

This key opens the "General Settings" dialog box and jumps directly to the "Frequency" field (see "Frequency" on page 15). Furthermore, a submenu with the following softkeys is displayed:

Frequency
Opens the "General Settings" dialog box and jumps directly to the "Frequency" field (see "Frequency" on page 15).

SCPI command:
`[SENSe:]FREQuency:CENTer` on page 79

X Axis Start
Opens the "General Settings" dialog box and jumps directly to the "X Axis Start" field (see "X Axis Start" on page 17).

SCPI command:
`[SENSe:]FREQuency:STARt` on page 79

X Axis Stop
Opens the "General Settings" dialog box and jumps directly to the "X Axis Stop" field (see "X Axis Stop" on page 17).

SCPI command:
`[SENSe:]FREQuency:STOP` on page 79

2.1.4 SPAN key

This key opens the "Measurement Settings" dialog box and jumps directly to the "Start Offset" field (see "Start Offset" on page 22"Span Settings" on page 22).

Furthermore, the "Frequency" submenu is displayed, see chapter 2.1.3, "FREQ key", on page 29.

2.1.5 AMPT key

This key opens the "General Settings" dialog box and jumps directly to the "Level" field (see "Level" on page 15).

Furthermore, a submenu with the following softkeys is displayed:

Level
Opens the "General Settings" dialog box and jumps directly to the "Level" field (see "Level" on page 15).

SCPI command:
`[SENSe:]POWer:RLEVel` on page 82

Autoscale Once
Activates or deactivates the "Autoscale Once" function (see "Autoscale Once" on page 17).

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 71

Y Axis Top
Opens the "General Settings" dialog box and jumps directly to the "Y Axis Top" field (see "Y Axis Top" on page 17).

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 71

Y Axis Range
Opens the "General Settings" dialog box and jumps directly to the "Y Axis Range" field (see "Y Axis Range" on page 17).

SCPI command:
`[SENSe:]POWer:RLEVel:VERify:TOLerance` on page 82

2.1.6 BW key

This key opens the "Measurement Settings" dialog box and jumps directly to the "Sweep Mode" field (see "Sweep Mode Settings" on page 21).

2.1.7 Softkeys of the Sweep Menu – SWEEP key (R&S FSV-K40)

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 the "Sweep Count" softkey, "Sweep Count" on page 31).

SCPI command:
`INIT:CONT ON`, see `INITiate<n>:CONTinuous` on page 74

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.

SCPI command:
`INIT:CONT OFF`, see `INITiate<n>:CONTinuous` on page 74

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.

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.

In continuous sweep mode, if sweep count = 0 (default), averaging is performed over 10 sweeps. For sweep count =1, no averaging, maxhold or minhold operations are performed.

SCPI command:
`[SENSe:]SWEep:COUNt` on page 83

2.1.8 Softkeys of the Trace Menu – TRACE key (R&S FSV-K40)

The TRACE key is used to configure the data acquisition for measurement and the analysis of the measurement data. In this section, only the commands specific to the phase noise option are described. The following softkeys of the "Trace" menu are available for phase noise measurements:

Trace 1 / Trace 2 / Trace 3
Selects the active trace (1, 2, 3) and opens the ""Trace"" submenu for the selected trace.

Clear Write ← Trace 1 / Trace 2 / Trace 3
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

All available detectors can be selected.

SCPI command:
`DISP:TRAC:MODE WRIT`, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 69

Max Hold ← Trace 1 / Trace 2 / Trace 3
The maximum value is determined over several sweeps and displayed. The R&S FSV 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.

SCPI command:
`DISP:TRAC:MODE MAXH`, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 69

Min Hold ← Trace 1 / Trace 2 / Trace 3
The minimum value is determined from several measurements and displayed. The R&S FSV 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.

SCPI command:
`DISP:TRAC:MODE MINH`, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 69

Average ← Trace 1 / Trace 2 / Trace 3
The average is formed over several sweeps. The Sweep Count determines the number of averaging procedures.

All available detectors can be selected. If the detector is automatically selected, the sample detector is used (see chapter 2.1.15, "Detector Overview", on page 40).

This mode is not available for statistics measurements.

SCPI command:
DISP:TRAC:MODE AVER, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 69

View ← Trace 1 / Trace 2 / Trace 3
The current contents of the trace memory are frozen and displayed.

Note: 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 displayed trace no longer matches the current instrument setting is indicated by the icon on the tab label.

If the level range or reference level is changed, the R&S FSV 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.

SCPI command:
DISP:TRAC:MODE VIEW, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 69

Blank ← Trace 1 / Trace 2 / Trace 3
Hides the selected trace.

SCPI command:
DISP:TRAC OFF, see DISPlay[:WINDow<n>]:TRACe<t>[:STATe] on page 68

Smoothing ← Trace 1 / Trace 2 / Trace 3
Activates or deactivates smoothing for the selected trace according to the "Trace Settings" on page 17. If activated, the trace on the screen is smoothed by the smoothing percentage (see "Smoothing" on page 18). Toggling this softkey has an immediate effect on the active trace on display. Each trace (trace1, trace2 and trace3) can be smoothed/unsmoothed individually.

For details on smoothing, see "Trace Settings" on page 17.

SCPI command:
DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe] on page 70

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.

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.

In continuous sweep mode, if sweep count = 0 (default), averaging is performed over 10 sweeps. For sweep count =1, no averaging, maxhold or minhold operations are performed.

SCPI command:
[SENSe:]SWEep:COUNt on page 83

ASCII Trace Export
Opens the "ASCII Trace Export Name" dialog box and saves the active trace in ASCII format to the specified file and directory.

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 chapter 2.1.19, "ASCII File Export Format", on page 45.

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 (see "Decim Sep" on page 34).

SCPI command:
`FORMat:DEXPort:DSEParator` on page 73
`MMEMory:STORe<n>:TRACe` on page 76

Decim Sep
Selects the decimal separator with floating-point numerals for the ASCII Trace export to support evaluation programs (e.g. MS-Excel) in different languages. The values '.' (decimal point) and ',' (comma) can be set.

SCPI command:
`FORMat:DEXPort:DSEParator` on page 73

Trace Math
Opens the "Trace Math" submenu to select a trace math function. The following functions are available:

- "T1-T3->T1" on page 34
- "T2-T3->T2" on page 34

T1-T3->T1 ← Trace Math
Activates/Deactivates the trace math function that substracts Trace3 from Trace1 and copies the results into Trace1.

To switch off the trace math, use the Trace Math Off softkey.

SCPI command:
`CALCulate<n>:MATH[:EXPression][:DEFine]` on page 66
`CALCulate<n>:MATH:STATe` on page 67

T2-T3->T2 ← Trace Math
Activates/Deactivates the trace math function that substracts Trace3 from Trace2 and copies the results into Trace2.

To switch off the trace math, use the Trace Math Off softkey.

SCPI command:
`CALCulate<n>:MATH[:EXPression][:DEFine]` on page 66
`CALCulate<n>:MATH:STATe` on page 67

Trace Math Off ← Trace Math
Deactivates any previously selected trace math functions.

SCPI command:
`CALC:MATH:STAT OFF`, see `CALCulate<n>:MATH:STATe` on page 67

2.1.9 Softkeys of the Auto Set menu - AUTO SET Key (R&S FSV-K40)

The following table shows all softkeys available in the "Auto Set" menu. These functions automatically select the optimal settings for the current measurement.

Auto All
Performs all automatic settings.

- "Auto Freq" on page 35
- "Auto Level" on page 35

This function overwrites the "Level" and "Frequency" settings in the "Signal Settings", see "Signal Settings" on page 15.

SCPI command:
`[SENSe:]ADJust:ALL` on page 77

Auto Freq
Defines the center frequency automatically by determining the highest frequency level in the frequency span. This function uses the signal counter; thus it is intended for use with sinusoidal signals.

This function overwrites the "Frequency" setting in the "Signal Settings", see "Frequency" on page 15.

This function is not available for input from the R&S Digital I/Q Interface (option R&S FSV-B17).

SCPI command:
`[SENSe:]ADJust:FREQuency` on page 78

Auto Level
Defines the optimal reference level for the current measurement automatically.

This function overwrites the "Level" setting in the "Signal Settings", see "Level" on page 15.

SCPI command:
`[SENSe:]ADJust:LEVel` on page 78

2.1.10 Softkeys of the Marker Menu – MKR key (R&S FSV-K40)

The MKR key opens a submenu for the marker settings. The following table shows all softkeys available in the "Marker" menu in "Phase Noise" mode.

Marker 1/2/3/4
Selects the corresponding marker and activates it.

Marker 1 is always a normal marker. After Marker 2 to 4 have been switched on, they are delta markers that are referenced to Marker 1. These markers can be converted into markers with absolute value displays using the "Marker Norm/Delta" softkey. When Marker 1 is the active marker, pressing the "Marker Norm/Delta" softkey switches on an additional delta marker. Pressing the "Marker 1" to "Marker 4" softkey again switches the corresponding marker off.

SCPI command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 62
`CALCulate<n>:MARKer<m>:X` on page 63
`CALCulate<n>:MARKer<m>:Y` on page 64
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 50
`CALCulate<n>:DELTamarker<m>:X` on page 51
`CALCulate<n>:DELTamarker<m>:Y` on page 52

Marker Norm/Delta
Changes the active marker to a normal (norm) or delta marker (with respect to marker 1).

SCPI command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 62
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 50

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 result 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 FSV for further measurements.

If the display has not yet been switched to the new frequency display range and you press the softkey, the procedure is aborted. If an instrument setting is changed during this operation, the procedure is also aborted.

SCPI command:
`CALCulate<n>:MARKer<m>:FUNCtion:ZOOM` on page 62

All Marker Off
Switches all markers off. It also switches off all functions and displays that are associated with the markers/delta markers.

SCPI command:
CALCulate<n>:MARKer<m>:AOFF on page 62

2.1.11 Softkeys of the Marker To Menu – MKR-> key (R&S FSV-K40)

The following table shows all softkeys available in the "Marker To" menu in "Phase Noise" mode (MKR-> key).

Select Marker
Opens a submenu to select one of the markers.

Marker to Trace
Opens an edit dialog box to enter the number of the trace on which the marker is to be placed.

SCPI command:
CALCulate<n>:MARKer<m>:TRACe on page 63

2.1.12 Softkeys of the Lines Menu – LINES key (R&S FSV-K40)

The LINES key is used to configure limit and display lines. The "Lines" menu and the "Select Limit Line" dialog box are displayed. For details on the "Select Limit Line" dialog box refer to chapter 2.1.13, "Working with Limit Lines", on page 38.

The following table shows all softkeys available in the "Lines" menu in Phase Noise mode (LINES key).

New
Displays the "Edit Limit Line" dialog box and the "Limit Line Editor" submenu. For details on creating a new limit line, see chapter 2.1.14, "Editing Limit Lines", on page 39.

Name ← New
Switches to the "Name" field of the "Limit Line Editor". For details see chapter 2.1.14, "Editing Limit Lines", on page 39.

SCPI command:
CALCulate<n>:LIMit<k>:NAME on page 58

Value ← New
Switches to the "Frequency" field of the "Limit Line Editor". For details see chapter 2.1.14, "Editing Limit Lines", on page 39.

Insert ← New
Inserts a row above the currently selected row in the Frequency/Limits table of the "Limit Line Editor". For details see chapter 2.1.14, "Editing Limit Lines", on page 39.

Delete ← New
Deletes the currently selected row in the Frequency/Limits table of the "Limit Line Editor". For details see chapter 2.1.14, "Editing Limit Lines", on page 39. This action requires no confirmation.

Save ← New
Saves the currently displayed limit line definition. If data is missing or if some data is invalid, an error message is displayed.

Edit
Displays the "Edit Limit Line" dialog box in edit mode with all data of the selected limit line. For further details refer to chapter 2.1.14, "Editing Limit Lines", on page 39.

Delete
Deletes the selected limit line.

SCPI command:
CALCulate<n>:LIMit<k>:DELete on page 56

2.1.13 Working with Limit Lines

1. Press the LINES key.
   The "Select Limit Line" dialog box is displayed. For each limit line, the following information is given:

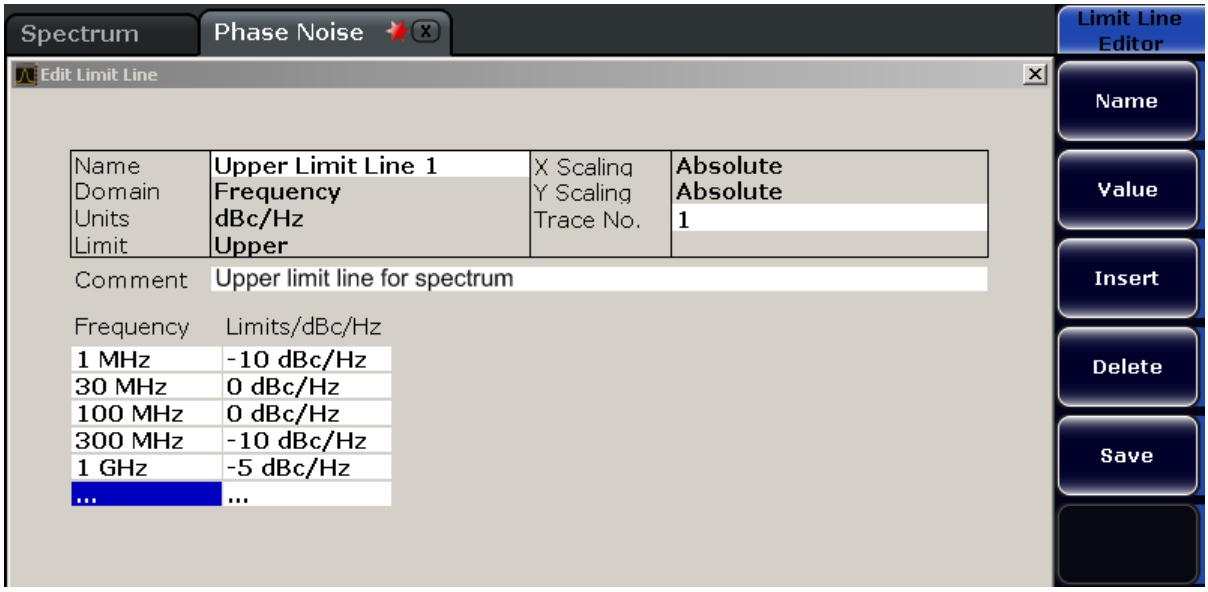
Name	Unique ID of the limit line as defined in the "Name" field (see chapter 2.1.14, "Editing Limit Lines", on page 39).
Domain	Frequency or time domain
Units	Unit of the y-axis
Limit	Type of limit (for phase noise: upper)
X Scaling	Absolute or relative scaling
Y Scaling	Absolute or relative scaling

Trace No.	Selected trace (defined in "Trace No." field, see chapter 2.1.14, "Editing Limit Lines", on page 39)
Compatible	Indicates compatibility of the limit line to the current measurement settings
Check	Activates/Deactivates the limit check using the limit line for the trace. If a limit check is performed, the trace values are checked whether they exceed the limit values and the result ("Pass"/"Fail") is indicated in the display.
Comment	Optional description as defined in the "Comment" field (see chapter 2.1.14, "Editing Limit Lines", on page 39).

2. To define a new limit line, press the "New" softkey and enter the limit line characteristics as described in chapter 2.1.14, "Editing Limit Lines", on page 39.
3. To modify a limit line, select the limit line you want to edit and press the "Edit" softkey as described in chapter 2.1.14, "Editing Limit Lines", on page 39.
4. To save a limit line, press the "Save" softkey.
   If data is missing or if some data is invalid, an error message is displayed.
5. To delete a limit line, select the limit line you want to edit and press the "Delete" softkey.

2.1.14 Editing Limit Lines

When you press the "New" softkey to define a new limit line (see "New" on page 37), or the "Edit" softkey to edit an existing limit line (see "Edit" on page 38), the "Edit Limit Line" dialog box and the "Limit Line Editor" submenu are displayed.



To create or edit a limit line:

1. Enter the following settings as required:

Name	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.
Trace No.	Trace number for which the limit line is defined.
Comment	Description for the limit line. Any combination of alphanumeric characters is allowed.
Frequency	Receive frequencies (in Hz)
Limit	Limits for the receive frequencies (in dBc/Hz).

The "Frequency/Limits" table lists the limit values for specific frequency values. The list can contain up to 100 frequency/limit value pairs. Note that the frequency values must be in ascending order.

2. To insert a new frequency/limit entry, press the ENTER key after entering a limit, or press the "Insert" softkey.
   To delete a frequency/limit entry, select the entry and press the "Delete" softkey.
3. When you have entered all required values, press the "Save" softkey.
   If data is missing or if some data is invalid, an error message is displayed. Correct the input, if necessary.
4. In the "Select Limit Line" view, define whether the limit line is to be used to perform a limit check for the trace by activating or deactivating the "Check" option for the limit line.

Remote commands:

`CALCulate<n>:LIMit<k>:COMMent` on page 54

Specifies a description for the limit line.

`CALCulate<n>:LIMit<k>:CONTrol[:DATA]` on page 55

Specifies the receive frequencies.

`CALCulate<n>:LIMit<k>:LOWer[:DATA]` on page 57

`CALCulate<n>:LIMit<k>:UPPer[:DATA]` on page 59

Specifies the limits for the receive frequencies.

2.1.15 Detector Overview

The measurement detector for the individual display modes can be selected directly by the user or set automatically by the R&S FSV. The detector activated for the specific trace is indicated in the corresponding trace display field by an abbreviation.

The detectors of the R&S FSV 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 691. The following detectors are available:

Table 2-1: Detector types

Detector	Indicator	Function
Auto Peak	Ap	Determines the maximum and the minimum value within a measurement point (not available for SEM)
Positive Peak	Pk	Determines the maximum value within a measurement point
Negative Peak (min peak)	Mi	Determines the minimum value within a measurement point
RMS	Rm	Determines the root mean square power within a measurement point
Average	Av	Determines the linear average power within a measurement point
Sample	Sa	Selects the last value within a measurement point
Quasi Peak	QP	Determines the quasipeak power within a measurement point for EMI measurements (not available for SEM)

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.

Number of measured values

During a frequency sweep, the R&S FSV increments the first local oscillator in steps that are smaller than approximately 1/10 of the bandwidth. This ensures that the oscillator step speed is conform 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 691 (= default number of trace points displayed on the screen). Choosing less then 691 measured values (e.g. 125 or 251) will lead to an interpolated measurement curve, choosing more than 691 points (e.g. 1001, 2001 …) will result in several measured values being overlaid at the same frequency position.

RMS detector and VBW

If the RMS detector is selected, the video bandwidth in the hardware is bypassed. Thus, duplicate trace averaging with small VBWs and RMS detector no longer occurs. However, the VBW is still considered when calculating the sweep time. This leads to a longer sweep time for small VBW values. Thus, you can reduce the VBW value to achieve more stable trace curves even when using an RMS detector. Normally, if the RMS detector is used the sweep time should be increased to get more stable trace curves.

2.1.16 Selecting the Appropriate Filter Type

All resolution bandwidths are realized with digital filters.

The video filters are responsible 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 advisable 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:

- Normal (3dB) (Gaussian) filters
  The Gaussian filters are set by default. The available bandwidths are specified in the data sheet.
- CISPR (6 dB) filters
- MIL Std (6 dB) filters
  Note that the 6 dB bandwidths are available only with option R&S FSV-K54.
- Channel filters
  For details see chapter 2.1.17, "List of Available RRC and Channel Filters", on page 42 .
  Channel filters do not support FFT mode.
- RRC filters
  For details see chapter 2.1.17, "List of Available RRC and Channel Filters", on page 42 .
  RRC filters do not support FFT mode.
- 5-Pole filters
  The available bandwidths are specified in the data sheet.
  5-Pole filters do not support FFT mode.

2.1.17 List of Available RRC and Channel Filters

For power measurement a number of especially steep-edged channel filters are available (see the following table). The indicated filter bandwidth is the 3 dB bandwidth. For RRC filters, the fixed roll-off factor (α) is also indicated.

Table 2-2: Filter types

Filter Bandwidth	Filter Type	Application
100 Hz	CFILter	
200 Hz	CFILter	A0
300 Hz	CFILter	
500 Hz	CFILter	
1 kHz	CFILter	
1.5 kHz	CFILter	
2 kHz	CFILter	

Filter Bandwidth	Filter Type	Application
2.4 kHz	CFILter	SSB
2.7 kHz	CFILter	
3 kHz	CFILter	
3.4 kHz	CFILter	
4 kHz	CFILter	DAB, Satellite
4.5 kHz	CFILter	
5 kHz	CFILter	
6 kHz	CFILter	
6 kHz, α=0.2	RRC	APCO
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

Filter Bandwidth	Filter Type	Application
1.228 MHz	CFILter	CDMAone
1.28 MHz, α=0.22	RRC	
1.5 MHz	CFILter	DAB
2 MHz	CFILter	
3 MHz	CFILter	
3.75 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	
20 MHz	CFILter	
28 MHz	CFILter	
40 MHz	CFILter	

2.1.18 Trace Mode Overview

The traces can be activated individually 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 FSV offers 6 different trace modes:

Clear Write
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

All available detectors can be selected.

SCPI command:
`DISP:TRAC:MODE WRIT`, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 69

Max Hold
The maximum value is determined over several sweeps and displayed. The R&S FSV 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.

SCPI command:
`DISP:TRAC:MODE MAXH`, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 69

Min Hold
The minimum value is determined from several measurements and displayed. The R&S FSV 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.

SCPI command:
`DISP:TRAC:MODE MINH`, see `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 69

Average
The average is formed over several sweeps. The Sweep Count determines the number of averaging procedures.

All available detectors can be selected. If the detector is automatically selected, the sample detector is used (see chapter 2.1.15, "Detector Overview", on page 40).

This mode is not available for statistics measurements.

SCPI command:
`DISP:TRAC:MODE AVER`, see `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 69

View
The current contents of the trace memory are frozen and displayed.

Note: 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 displayed trace no longer matches the current instrument setting is indicated by the icon on the tab label.

If the level range or reference level is changed, the R&S FSV 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.

SCPI command:
`DISP:TRAC:MODE VIEW`, see `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 69

Blank
Hides the selected trace.

SCPI command:
`DISP:TRAC OFF`, see `DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 68

2.1.19 ASCII File Export 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 and data section	Description
Type;FSV;	Instrument model
Version;1.50;	Firmware version
Date;01.Apr 2010;	Date of data set storage
Screen;A;	Instrument mode
Points per Symbol;4;	Points per symbol
x Axis Start;-13;sym;	Start value of the x axis
x Axis Stop;135;sym;	Stop value of the x axis
Ref value y axis;-10.00;dBm;	Y axis reference value
Ref value position;100;%;	Y axis reference position
Trace;1;	Trace number
Meas;Result;	Result type
Meas Signal;Magnitude;	Result display
Demodulator;Offset QPSK;	Demodulation type
ResultMode;Trace;	Result mode
x unit;sym;	Unit of the x axis
y unit;dBm;	Unit of the y axis
Trace Mode;Clear Write;	Trace mode
Values;592;	Number of results
<values>	List of results

2.2 Remote Control

This section specifies the remote control commands specific to the R&S FSV-K40 option. Only those commands provided for this option are specified.

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

2.2.1 Notation

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

Individual Description

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

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

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

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

Upper/Lower Case Notation

Upper/lower case letters are used to mark the long or short form of the key words of a command in the description. The instrument itself does not distinguish between upper and lower case letters.

Special Characters

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

Example:

```
SENSe:FREQuency:CW|:FIXed
```

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

```
SENSe:FREQuency:CW 1E3
```

```
SENSe:FREQuency:FIXed 1E3
```

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

Example: Selection of the parameters for the command

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

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

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

Description of Parameters

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

For details see the chapter "SCPI Command Structure" in the base unit description.

<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.

2.2.2 CALCulate subsystem

2.2.2.1 CALCulate:DELTamarker subsystem

CALCulate<n>:DELTamarker<m>:AOFF

This command switches off all active delta markers in the window specified by the suffix <n>.

Suffix:

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

<m> marker number

Example: CALC:DELT:AOFF
Switches off all delta markers.

Mode: A, ADEMOD, CDMA, EVDO, PHN, TDS, VSA, WCDMA

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

This command defines the marker specified by the suffix <m> as a delta marker for the window specified by the suffix <n>. If the corresponding marker was not already active, it is activated and positioned on the maximum of the measurement curve.

If no suffix is given for DELTamarker, delta marker 1 is selected automatically.

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

<m> marker number

Parameters:
<State> ON | OFF

*RST: OFF

Example: `CALC:DELT1 ON`
Switches marker 1 to delta marker mode.

Mode: All

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

This command assigns the selected delta marker to the indicated trace in the window specified by the suffix <n>. The selected trace must be active, i.e. its state must be different from "BLANK".

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

<m> marker number

Parameters:
<TraceNumber> **1 to 6**
Selects trace 1 through 6.

Example: `CALC:DELT3:TRAC 2`
Assigns delta marker 3 to trace 2.

Mode: A, ADEMOD, CDMA, EVDO, PHN, TDS, WCDMA, SPECM, RT, VSA

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

This command positions the selected delta marker to the indicated value in the window specified by the suffix <n>. The input is in absolute values.

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

<m> marker number

Parameters:
<Position> 0 to maximum frequency or sweep time

Example: `CALC:DELT:X?`
Outputs the absolute frequency/time of delta marker 1.

Mode: A, ADEMOD, CDMA, EVDO, PHN, TDS, WCDMA, VSA

CALCulate<n>:DELTamarker<m>:Y

This command queries the measured value of the selected delta marker in the specified window, or defines its position on the y-axis. The corresponding delta marker is 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.

The query result is output in dBc/Hz.

Suffix:

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

<m> marker number

Example:
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a sweep and waits for its end.
```
CALC:DELT2 ON
```
Switches on delta marker 2.
```
CALC:DELT2:Y?
```
Outputs measurement value of delta marker 2.

Mode: PHN

2.2.2.2 CALCulate:EVALuation Subsystem

CALCulate<n>:EVALuation[:STATe] <State>

This command specifies whether residual noise values are calculated over the entire trace or within a specified frequency range.

Suffix:

<n> 1...4
window

Parameters:

<State> ON (1) | OFF (0)

ON (1)
The residual noise values are calculated over the range specified by CALCulate<n>:EVALuation:STARt on page 53 and CALCulate<n>:EVALuation:STOP on page 53

OFF (0)
The results are calculated over the entire trace.

*RST: 0

Example: CALC:EVAL 0
Specifies that residual noise is calculated over the entire trace.

Mode: PHN

CALCulate<n>:EVALuation:STARt <Frequency>

This command specifies the start frequency for residual noise calculation when CALCulate<n>:EVALuation[:STATe] on page 52 is switched OFF.

Suffix:

<n> 1...4
window

Parameters:

<Frequency> Range: 1 Hz to 3 GHz
*RST: 1 kHz

Example: CALC:EVAL:STARt 1MHZ
Specifies that residual noise is calculated starting from 1 MHz

Mode: PHN

CALCulate<n>:EVALuation:STOP <Frequency>

This command specifies the stop frequency for residual noise calculation when CALCulate<n>:EVALuation[:STATe] on page 52 is switched ON. This command has no effect if CALCulate<n>:EVALuation[:STATe] on page 52is switched OFF.

Suffix:

<n> 1...4
window

Parameters:

<Frequency> Range: 3 Hz to 10 GHz
*RST: 1 MHz

Example: CALC:EVAL:STOP 1 MHZ
Specifies that residual noise is calculated up to 1 MHz.

Mode: PHN

2.2.2.3 CALCulate:LIM subsystem

The CALCulate:LIMit subsystem consists of commands for the limit lines and the corresponding limit checks. The limit lines can be defined as upper or lower limit lines. The number of X- and Y-values must be identical.

Up to 8 limit lines can be defined at the same time (LIMIT1 to LIMIT8) for each window. Each limit line can be assigned a name. An explanatory comment can also be assigned. For details see chapter 2.1.13, "Working with Limit Lines", on page 38.

A short programming example for limit lines is provided in chapter 2.2.2.4, "Programming Example for Limit Lines", on page 60.

CALCulate<n>:LIMit<k>:CLEar[:IMMediate]

This command deletes the result of the current limit check (stored in the STATus:QUEStionable:LIMit event register) for the selected limit line.

Suffix:

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

<k> 1...8
limit line

Example: CALC:LIM:CLE
Deletes the result of the limit check.

Mode: PHN

CALCulate<n>:LIMit<k>:COMMent <Comment>

This command defines a comment for the selected limit line in all windows (max. 40 characters).

Suffix:
<n> irrelevant

<k> limit line

Parameters:
<Comment>

Example: `CALC:LIM5:COMM 'Upper limit for spectrum'`
Defines the comment for limit line 5.

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

CALCulate<n>:LIMit<k>:CONTrol[:DATA] <XValue>, <XValue>

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.

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

<k> 1...8
limit line

Parameters:
<XValue>, <XValue> **<numeric_value>,<numeric_value>**
*RST: - (CALC:LIM is set to OFF)

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

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

CALCulate<n>:LIMit<k>:CONTrol:SHIFt <XValue>

This command moves a limit line by the indicated value in x direction. The line is shifted by modifying the individual x values.

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

<k> 1...8
limit line

Parameters:

<XValue> **<numeric_value>**

*RST: - (CALC:LIM is set to OFF)

Example: `CALC:LIM2:CONT:SHIF 50 kHz`
Shifts all reference values of limit line 2 by 50 kHz.

Mode: PHN

CALCulate<n>:LIMit<k>:COPY <Line>

This command copies one limit line onto another one

Suffix:

<n> irrelevant

<k> limit line

Parameters:

<Line> 1 to 8 | <name>

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.

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

CALCulate<n>:LIMit<k>:DELete

This command deletes the selected limit line.

Suffix:

<n> irrelevant

<k> limit line

Example: `CALC:LIM1:DEL`
Deletes limit line 1.

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

CALCulate<n>:LIMit<k>:FAIL

This command queries the result of the limit check of the indicated limit line. It should be noted that a complete sweep must have been performed for obtaining a correct result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided.

Suffix:

<n> irrelevant

<k> limit line

Return values:

<Result> **0**
PASS

1
FAIL

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

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

CALCulate<n>:LIMit<k>:LOWer[:DATA] <LimitLineValues>

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.

If the measured values are smaller than the LOWer limit line, the limit check signals errors.

Suffix:

<n> irrelevant

<k> 1...8
limit line

Parameters:

<LimitLineValues> numeric values, separated by commas
*RST: (LIMit:STATe is set to OFF)

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.

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

CALCulate<n>:LIMit<k>:LOWer:SHIFt <YValue>

This command moves a limit line by the indicated value in y direction. The line is shifted by modifying the individual y values.

Suffix:

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

<k> 1...8
limit line

Parameters:

<YValue> **<numeric_value>**

*RST: - (CALC:LIM is set to OFF)

Example: `CALC:LIM2:LOW:SHIF 20 dB`
Shifts all Y-values of limit line 2 by 20 dB.

Mode: PHN

CALCulate<n>:LIMit<k>:LOWer:STATe <State>

This command switches on or off the indicated limit line. The limit check is activated separately with `CALCulate<n>:LIMit<k>:STATe`.

The result of the limit check can be queried with `CALCulate<n>:LIMit<k>:FAIL`.

Suffix:

<n> irrelevant

<k> 1...8
limit line

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:LIM4:LOW:STAT ON`
Switches on limit line 4 (lower limit).

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

CALCulate<n>:LIMit<k>:NAME <Name>

This command assigns a name to a limit line. If it does not exist already, a limit line with this name is created.

Suffix:

<n> irrelevant

<k> 1...8 (NF: 1...6)
limit line

Parameters:

<Name> <name of limit line>

*RST: REM1 to REM8 for lines 1 to 8

Example: `CALC:LIM1:NAME 'FM1'`
Assigns the name FM1 to limit line 1.

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

CALCulate<n>:LIMit<k>:STATe <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<n>:LIMit<k>:FAIL.

Suffix:
<n> irrelevant

<k> limit line

Parameters:
<State> ON | OFF

*RST: OFF

Example: CALC:LIM:STAT ON
Switches on the limit check for limit line 1.

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

CALCulate<n>:LIMit<k>:TRACe <Number>

This command assigns a limit line to the selected trace.

Suffix:
<n> irrelevant

<k> 1...8
limit line

Parameters:
<Number> 1...6

Trace number

*RST: 1

Example: CALC:LIM1:TRAC 2
Assigns the limit line 1 to trace 2.

Mode: PHN

CALCulate<n>:LIMit<k>:UPPer[:DATA] <LimitLineValues>

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 limit check indicates errors if the measured values exceed the UPPer limit line.

Suffix:
<n> irrelevant

<k> 1...8
limit line

Parameters:
<LimitLineValues> numeric values, separated by commas

*RST: ("CALCulate<n>:LIMit<k>" is set to OFF)

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

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

CALCulate<n>:LIMit<k>:UPPer:SHIFt <YValue>

This command moves a limit line by the indicated value in y direction. The line is shifted by modifying the individual y values.

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

<k> 1...8
limit line

Parameters:
<YValue> **<numeric_value>**
*RST: - (CALC:LIM is set to OFF)

Example: CALC:LIM2:UPP:SHIF 20 dB
Shifts all Y-values of limit line 2 by 20 dB.

Mode: PHN

CALCulate<n>:LIMit<k>:UPPer:STATe <State>

This command switches on or off the indicated limit line. The limit check is activated separately with CALCulate<n>:LIMit<k>:STATe.

The result of the limit check can be queried with CALCulate<n>:LIMit<k>:FAIL.

Suffix:
<n> irrelevant

<k> 1...8
limit line

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

Example: CALC:LIM4:UPP:STAT ON
Switches on limit line 4 (upper limit).

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

2.2.2.4 Programming Example for Limit Lines

The following example describes a simple limit line scenario via remote control.

Programming task:

Definition and use of a new limit line 5 for a trace in the Noise Figure window with the following features:

- upper limit line
- 5 reference values:
  - 126 MHz/-40 dB
  - 127 MHz/-40 dB
  - 128 MHz/-20 dB
  - 129 MHz/-40 dB
  - 130 MHz/-40 dB

Definition of the line:

Defining the name:

```
CALC:LIM5:NAME 'TEST1'
```

Entering the comment:

```
CALC:LIM5:COMM 'Upper limit line'
```

Associated trace in screen A:

```
CALC:LIM5:TRAC 2
```

Defining the X-axis values:

```
CALC:LIM5:CONT 126MHZ, 127MHZ, 128MHZ,  129MHZ, 130MHZ
```

Defining the y values:

```
CALC:LIM5:UPP -40, -40, -30, -40, -40
```

Switching on and evaluating the line

Switching on the line

```
CALC:LIM5:UPP:STAT ON
```

Switching on the limit

```
CALC:LIM5:STAT ON
```

Starting a new measurement with synchronization:

```
INIT;*WAI
```

Querying the limit check result:

```
CALC:LIM5:FAIL?
```

2.2.2.5 CALculate:MARker subsystem

CALCulate<n>:MARKer<m>:AOFF

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

Suffix:

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

<m> depends on mode
irrelevant

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

Mode: all

CALCulate<n>:MARKer<m>:FUNCtion:ZOOM <Range>

This command defines the range to be zoomed around marker 1 in the window specified by the suffix <n>. 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.

Suffix:

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

<m> marker number

Parameters:

<Range> **<numeric_value>**

Example: `INIT:CONT OFF`
Switches to single sweep mode
`CALC:MARK:FUNC:ZOOM 1kHz;*WAI`
Activates zooming and waits for its end.

Mode: A-F, ADEMOD, PHN

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

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

Suffix:

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

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

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK3 ON`
Switches on marker 3 or switches to marker mode.

Mode: all

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

This command assigns the selected marker to the indicated trace in the specified window. The corresponding trace must be active, i.e. its status must not be "BLANK".

If necessary, the corresponding marker is switched on prior to the assignment.

Suffix:

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

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

Parameters:

<Trace> **1 to 6**
Trace number the marker is assigned to.

Example: `CALC:MARK3:TRAC 2`
Assigns marker 3 to trace 2.

Mode: all

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

This command positions the selected marker to the indicated x-value in the window specified by the suffix <n>.

Suffix:

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

<m> marker number

Parameters:

<Position> 0 to MAX (frequency | sweep time | level)

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

Mode: ALL

CALCulate<n>:MARKer<m>:Y <YValue>

This command queries the measured value of the selected marker in the window specified by the suffix <n>, or defines its y-value. 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 after the change of a parameter and before the query of the Y value. This is only possible in single sweep mode.

The y-value is defined in dBc/Hz.

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

<m> marker number

Parameters:
<YValue> numeric value

Return values:
<Result> The measured value of the selected marker is returned.

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.

Mode: PHN

2.2.2.6 CALCulate:SNOise Subsystem

The `CALCulate:SNOise` subsystem allows spot noise measurement points to be set, and results returned.

Note that for all spot noise commands the suffix for the `CALCulate` command must be 1.

CALCulate<n>:SNOise<m>:AOFF

Switches off all active spot noise markers in the specified measurement window.

Suffix:

<n> 1
window

<m> 1...4
spot noise marker

Example: `CALC1:SNO:AOFF`
Switches off all spot noise markers in the screen A window.

Mode: PHN

CALCulate<n>:SNOise<m>:STATe <State>

Switches on or off the currently selected spot noise marker in the selected measurement window. If no indication is made, marker 1 is selected automatically.

Suffix:

<n> 1
window

<m> 1...4
spot noise marker

Parameters:

<State> ON | OFF
*RST: 1

Example: `CALC1:SNO1:STATE ON`
Switches the screen A marker ON.

Mode: PHN

CALCulate<n>:SNOise<m>:X <Frequency>

Positions the selected slot noise marker to the indicated frequency

Suffix:

<n> 1
window

<m> 1...4
spot noise marker

Parameters:

<Frequency> <numeric value>

Example: `CALC1:SNO:X 2MHz`
Positions spot noise marker 1 in screen A to time 2 MHz.

Mode: PHN

CALCulate<n>:SNOise<m>:Y?

Returns the measured spot noise marker result in the selected measurement window. The units for this command are dBc/Hz.

Suffix:
<n> 1
window

<m> 1...4
spot noise marker

Return values:
<Result> <numeric value>

Example: `CALC1:SNO:Y?`
Outputs the measured value of spot noise marker 1 in screen A.

Usage: Query only

Mode: PHN

2.2.2.7 Other CALCulate commands

CALCulate<n>:MATH[:EXPression][:DEFine] <Expression>

This command defines the mathematical expression for relating traces to trace1.

Suffix:
<n> irrelevant

Parameters:
<Expression> (TRACe1-TRACe2) | (TRACe1-TRACe3) | (TRACe1-TRACe4) | (TRACe1-TRACe5) | (TRACe1-TRACe6)

(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.

Mode: A, SPECM, PHN

CALCulate<n>:MATH:STATe <State>

This command switches the mathematical relation of traces on or off.

Suffix:
<n> irrelevant

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

Example: `CALC:MATH:STAT ON`
Switches on the trace mathematics.

Mode: A, PHN, SPECM

2.2.3 CONFigure Subsystem

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 of the measurements are queried.

CONFigure:POWer:AUTO <State>

Switches on or off automatic power level detection. When switched on, power level detection is performed at the start of each measurement sweep.

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

Example: `CONF:POW:AUTO 1`
The FSV-K40 option detects the input power level automatically

Mode: PHN

CONFigure:POWer:EXPected:RF <InputLevel>

Specifies the input power level of the source signal as supplied to the Analyzer RF input.

Parameters:
<InputLevel> <numeric value>
*RST: 0

Example: `CONF:POW:EXP:RF 9`
The FSV-K40 option assumes an input signal strength of 9 dBm

Mode: PHN

CONFigure:REFMeas ONCE

Configures and initiates a reference measurement.

Example: `CONF:REFM ONCE`
A reference measurement is started.

Mode: PHN

2.2.4 DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

DISPlay:FORMat <Format>

This command switches the measurement result display between FULL SCREEN and SPLIT SCREEN.

Parameters:
<Format> SINGle | SPLit

SPLit
Show 2 or more screens on the display

SINGle
Show only 1 screen on the display

*RST: SPL

Example: `DISP:FORM SING`

Mode: all

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command switches on or off the display of the corresponding trace in the window specified by the suffix <n>. The other measurements are not aborted but continue running in the background.

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

<t> trace

Parameters:

<State> ON | OFF

*RST: ON for TRACe1, OFF for TRACe2 to 6

Example: `DISP:TRAC3 ON`

Mode: all

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

This command defines the type of display and the evaluation of the traces in the window specified by the suffix <n>. WRITE corresponds to the Clr/Write mode of manual operation. The trace is switched off (= BLANK in manual operation) with `DISPlay[:WINDow<n>]:TRACe<t>[:STATe]`.

The number of measurements for AVERage, MAXHold and MINHold is defined with the `[SENSe:]AVERage<n>:COUNt` or `[SENSe:]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.

Suffix:

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

<t> trace

Parameters:

<Mode> WRITe | VIEW | AVERage | MAXHold | MINHold | BLANk

*RST: WRITe for TRACe1, STATe OFF for TRACe2/3/4/5/6

For details on trace modes refer to chapter 2.1.18, "Trace Mode Overview", on page 44.

Example:

```
INIT: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 maximum peak for trace 3.
```
INIT;*WAI
```
Starts the measurement and waits for the end of the 16 sweeps.

Mode: all

DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture <Value>

Specifies the aperture of the window to be used when trace smoothing is performed.

A single aperture applies to all traces which require smoothing.

Suffix:

<n> irrelevant

<t> irrelevant

Parameters:

<Value> <numeric value>

*RST: 0

Example: `DISP:TRAC1:SMO:APER 1`
Sets the smoothing window for trace 1 to 1 %

Usage: SCPI confirmed

Mode: PHN

DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe] <State>

Specifies whether smoothing of a particular trace is carried out.

Suffix:

<n> irrelevant

<t> 1...3
trace

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DISP:TRAC1:SMO 1`
Specifies that smoothing of trace 1 is to be performed

Usage: SCPI confirmed

Mode: PHN

DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:TYPE <Type>

Specifies whether linear or logarithmic smoothing is to be used when trace smoothing is performed.

Suffix:

<n> irrelevant

<t> 1...3
trace

Parameters:

<Type> LINear | LOGarithmic

*RST: LIN

Example: `DISP:TRAC1:SMO:TYPE LIN`
Sets the smoothing type for trace 1

Usage: SCPI confirmed

Mode: PHN

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

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.

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

<t> only 1
trace

Parameters:
<Mode> ON | OFF | ONCE

ON
Automatic scaling is on.

OFF
Automatic scaling is off.

ONCE
Automatic scaling is performed once, then switched off again.

*RST: OFF

Example: `DISP:WIND2:TRAC:Y:SCAL:AUTO ONCE`
Activates automatic scaling of the Y-axis for the active trace

Mode: CDMA, EVDO, OFDM, OFDMA/WiBro, PHN

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

This command sets the reference level.

With the reference level offset <> 0, the indicated value range of the reference level is modified by the offset.

Suffix:
<n> irrelevant.

<t> irrelevant

Parameters:
<Value> *RST: -10dBm

Example: `DISP:TRAC:Y:RLEV -60dBm`

Mode: A, ADEMOD, BT, CDMA, EVDO, PHN, TDS, VSA, WCDMA

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Value>

This command sets the reference level offset.

Suffix:
<n> irrelevant.

<t> irrelevant

Parameters:
<Value> -200dB to 200dB
*RST: 0dB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Mode: ALL

2.2.5 FETCh Subsystem

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFigure and SENSe subsystems.

FETCh:PNOise:RFM?

Returns the measured Residual FM result for the specified trace.

Example: `FETC:PNO1:RFM?`
Returns the Residual FM result for Trace1

Usage: Query only

Mode: PHN

FETCh:PNOise:RPM?

Returns the measured Residual PM result for the specified trace.

Example: `FETC:PNO2:RPM?`
Returns the Residual PM result for Trace2

Usage: Query only

Mode: PHN

FETCh:PNOise:RMS?

Returns the measured Residual RMS result for the specified trace.

Example: `FETC:PNO3:RMS?`
Returns the Residual RMS result for Trace3

Usage: Query only

Mode: PHN

2.2.6 FORMat subsystem

FORMat[:DATA] <Format>

This command specifies the data format for the data transmitted from the instrument to the control PC. It is used for the transmission of trace data. The data format of trace data received by the instrument is automatically recognized, regardless of the format which is programmed.

Parameters:

<Format> ASCii | REAL

ASCii
ASCII data are transmitted in plain text, separated by commas.

REAL
REAL data are transmitted as 32-bit IEEE 754 floating-point numbers in the "definite length block format".

*RST: ASCII

Example:
```
FORM REAL,32
FORM ASC
```

Mode: all

FORMat:DEXPort:DSEParator <Separator>

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.

Parameters:

<Separator> POINt | COMMA

*RST: (factory setting is POINt; *RST does not affect setting)

Example:
```
FORM:DEXP:DSEP POIN
```
Sets the decimal point as separator.

Mode: all

2.2.7 INITiate subsystem

INITiate<n>:CONTinuous <State>

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

The sweep is started immediately.

Suffix:
<n> irrelevant

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

Example: `INIT:CONT OFF`
Switches the sequence to single sweep.
`INIT:CONT ON`
Switches the sequence to continuous sweep.

Mode: all

INITiate<n>[:IMMediate]

The command initiates a new measurement sequence.

With sweep count > 0 or average count > 0, this means a restart of the indicated number of measurements. With trace functions MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

In single sweep mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous sweep mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous sweep mode in remote control, as results like trace data or markers are only valid after a single sweep end synchronization.

Suffix:
<n> irrelevant

Example: `INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Setting the sweep counter to 20 sweeps.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 sweeps.

Mode: all

INITiate<n>:DISPlay <State>

This command configures the behaviour of the display during a single sweep.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF

ON
The display is switched on during the measurement

OFF
The display is switched off during the measurement

Mode: PHN

2.2.8 INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

INPut:GAIN:STATe <State>

This command switches the preamplifier on or off (only for option RF Preamplifier, R&S FSV-B22/B24).

With option R&S FSV-B22, the preamplifier only has an effect below 7 GHz.

With option R&S FSV-B24, the amplifier applies to the entire frequency range.

This command is not available when using R&S Digital I/Q Interface (R&S FSV-B17).

Parameters:
<State> ON | OFF

*RST: OFF

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

Mode: A, ADEMOD, BT, CDMA, EVDO, NF, PHN, WCDMA, GSM, VSA, TDS

INPut:PRESelection[:STATe] <State>

Switches the preselection on or off.

Parameters:
<State> ON | OFF

*RST: OFF

Example: `INP:PRES:STAT ON`
- preselection is switched on.

Mode: PHN

The command is only available with the preselector option B2.

2.2.9 INSTrument subsystem

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

INSTrument[:SELect] <Mode>

This command switches between the measurement modes by means of text parameters.

Parameters:

<Mode> **PNOise**
Phase Noise Mode (R&S FSV-K40 option)

INSTrument:NSELect <Mode>

This command switches between the measurement modes by means of numbers.

Parameters:

<Mode> **20**
Phase Noise Mode (R&S FSV-K40 option)

2.2.10 MMEMory subsystem

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command stores the selected trace in the specified window in a file with ASCII format. The file format is described in chapter 2.1.19, "ASCII File Export Format", on page 45

The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the `FORMat:DEXPort:DSEParator` command (see `FORMat:DEXPort:DSEParator` on page 73).

Suffix:

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

Parameters:

<Trace> 1 to 3
selected measurement trace

<FileName> DOS file name
The file name includes indication of the path and the drive name. Indication of the path complies with DOS conventions.

Example: `MMEM:STOR:TRAC 3,'TEST.ASC'`
Stores trace 3 in the file TEST.ASC.

Mode: all

2.2.11 SENSe Subsystem

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 returns the parameter's value in the same format as it is set.

e.g SENS:FREQ 10GHZ – sets the frequency to 10 GHz

SENS:FREQ? – response 10GHZ – returns the current frequency

[SENSe:]ADJust:ALL

Activates all automatic settings:

- Frequency
- Level

Example: `ADJ:ALL`

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

[SENSe:]ADJust:FREQuency

Defines the center frequency automatically by determining the highest level in the frequency span.

Example: `ADJ:FREQ`

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

[SENSe:]ADJust:LEVel

This command automatically sets the optimal reference level for the current measurement.

Example: `ADJ:LEV`

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

[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio <Ratio>

This command specifies the RBW value to be used for each sub span as a ratio of the start frequency of the sub span. A value of 10%, for example, specifies that the RBW will be set to 10% of the start frequency value. If the required RBW is not valid, the nearest RBW value is used.

Parameters:

<Ratio> percentage of the start frequency

*RST: 10 PCT

Example: `BAND:RAT 1 PCT`
Sets the RBW ratio to 1% of the start frequency

Mode: PHN

[SENSe:]BANDwidth|BWIDth[:RESolution]:TYPE <FilterType>

This command defines the filter type for the resolution bandwidth.

Parameters:

<FilterType> **NORMal**
Gaussian filter

FFT
FFT filter

*RST: NORMal

Example: `BAND:TYPE FFT`

Mode: PHN

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency of the analyzer or the measuring frequency for span = 0.

Parameters:

<Frequency> Range: 0 to fmax
*RST: fmax/2
Default unit: Hz
f_{max} is specified in the data sheet. min span is 10 Hz

Example: `FREQ:CENT 100 MHz`

Mode: all

[SENSe:]FREQuency:STARt <Frequency>

This command specifies the start frequency for a phase noise measurement.

Parameters:

<Frequency> *RST: 1 kHz

Example: `FREQ:STAR 20kHz`

Mode: PHN

[SENSe:]FREQuency:STOP <Frequency>

This command specifies the stop frequency for a phase noise measurement.

Parameters:

<Frequency> *RST: 1 MHz

Example: `FREQ:STOP 2 MHz`

Mode: PHN

[SENSe:]FREQuency:TRACk <State>

Switches the automatic frequency control on and off.

Parameters:

<State> ON | OFF
*RST: ON

Example: `SENS:FREQ:TRACk ON`
Sets the automatic frequency control to ON.

Usage: SCPI confirmed

Mode: PHN

[SENSe:]FREQuency:VERify[:STATe] <State>

Specifies whether frequency and level verification are to be performed before a phase noise measurement.

This command is synonymous with `[SENSe:]POWer:RLEVel:VERify[:STATe]` on page 82.

Parameters:

<State> ON | OFF

*RST: ON

Example: `SENS:FREQ:VER ON`
Specifies that frequency and level verification is to be performed

Usage: SCPI confirmed

Mode: PHN

[SENSe:]FREQuency:VERify:TOLerance <FreqTolerance>

Specifies the absolute frequency tolerance for the verification of the signal. If the signal frequency varies from the specified center frequency by a value greater than the tolerance then the verification fails.

The setting for this parameter only has an effect if the `[SENSe:]FREQuency:VERify[:STATe]` on page 80 or `[SENSe:]POWer:RLEVel:VERify[:STATe]` on page 82 command is set to ON.

The tolerance used during the measurement is the highest of the absolute and the relative tolerance values.

Parameters:

<FreqTolerance> <numeric value>

*RST: 1 PCT

Example: `SENS:FREQ:VER:TOL 1KHZ`
Sets the absolute frequency tolerance for the verification measurement to 1 kHz

Usage: SCPI confirmed

Mode: PHN

[SENSe:]FREQuency:VERify:TOLerance:RELative <FreqTolerance>

Specifies the relative frequency tolerance for the verification of the signal. If the signal frequency varies from the specified center frequency by a value greater than the tolerance then the verification fails.

The setting for this parameter only has an effect if the `[SENSe:]FREQuency:VERify[:STATe]` on page 80 or `[SENSe:]POWer:RLEVel:VERify[:STATe]` on page 82 command is set to ON.

The tolerance used during the measurement is the highest of the absolute and the relative tolerance values.

Parameters:

<FreqTolerance> <numeric value> from 0 to 100

*RST: 1 PCT

Example: `SENS:FREQ:VER:TOL:REL 10`
Sets the relative frequency tolerance for the verification measurement to 10 %

Usage: SCPI confirmed

Mode: PHN

[SENSe:]LIST:RANGe<range>:BANDwidth[:RESolution] <Value>

This command sets the RBW value for the specified range.

Suffix:

<range> 1...20
range

Parameters:

<Value> Refer to the data sheet.

*RST: depends on sub-band

Example: `LIST:RANG2:BAND:RES 5000`
Sets the RBW for range 2 to 5 kHz.

Mode: PHN

[SENSe:]LIST:RANGe<range>:FILTer:TYPE <Type>

This command sets the filter type for the specified range (sub-band).

Suffix:

<range> 1...20
range (sub-band)

Parameters:

<Type> **NORMal**
Gaussian filters

FFT
FFT filter

*RST: NORM
The available bandwidths of the filters are specified in the data sheet.

Example: `LIST:RANG1:FILT:TYPE FFT`
Sets the FFT filter type for range 1.

Mode: PHN

[SENSe:]LIST:RANGe<1..20>:SWEep:COUNt <Value>

Selects the sweep count for the specified sub-band:

Parameters:

<Value> <numeric value>

*RST: sub-band dependent

Example: `SENS:LIST:RANG2:SWE:COUN 1`
Sets the sweep count to 1

Usage: SCPI confirmed

Mode: PHN

[SENSe:]POWer:RLEVel <Power>

This command specifies the expected power.

Parameters:

<Power> **numeric value in dB**

Range: -100 to 30
*RST: 10 dB

Example: `SENS:POW:RLEV 0 DB`
Sets the expected power level to 0 dB.

Usage: SCPI confirmed

Mode: PHN

[SENSe:]POWer:RLEVel:VERify[:STATe] <State>

Specifies whether frequency and level verification are to be performed before a phase noise measurement.

This command is synonymous with `[SENSe:]FREQuency:VERify[:STATe]` on page 80.

Parameters:

<State> ON | OFF

*RST: ON

Example: `SENS:POW:RLEV:VER 1`
Specifies that frequency and level verification is to be performed

Usage: SCPI confirmed

Mode: PHN

[SENSe:]POWer:RLEVel:VERify:TOLerance <PowerTolerance>

Specifies the power tolerance for the verification of the signal. If the signal level varies from the specified level by a value greater than the tolerance then the verification fails.

The setting for this parameter only has an effect if the [SENSe:]FREQuency:VERify[:STATe] on page 80 or [SENSe:]POWer:RLEVel:VERify[:STATe] on page 82 command is set to ON.

Parameters:

<PowerTolerance> <numeric value>

*RST: 10 dB

Example: SENS:POW:RLEV:TOLerance 5DB
Sets the level tolerance for the verification measurement to 1 dB

Usage: SCPI confirmed

Mode: PHN

[SENSe:]POWer:TRACk <State>

Switches the automatic level control on and off.

Parameters:

<State> ON | OFF

*RST: ON

Example: SENS:POW:TRACk ON
Sets the automatic level control to ON.

Usage: SCPI confirmed

Mode: PHN

[SENSe:]SWEep:COUNt <NumberSweeps>

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.

Parameters:

<NumberSweeps> 0 to 32767

*RST: 0 (GSM: 200, PHN:1)

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.

Mode: A, ADEMOD, BT, CDMA, EVDO, PHN, TDS, WCDMA, GSM, NF

[SENSe:]SWEep:FORWard <State>

Specifies the sweep direction. When switched on the sweep direction is from the start frequency to the stop frequency. When switched off the sweep direction is reversed

Parameters:

<State> ON | OFF

*RST: OFF

Example: SENS:SWEep:FORWard 1
The sweep direction is set to sweep from start to stop frequency

Usage: SCPI confirmed

Mode: PHN

[SENSe:]SWEep:MODE <Mode>

This remote control command specifies the general sweep mode for the measurement. The sweep mode is used to set the RBW, Average and FFT settings for each sub-sweep to specific values. When the sweep mode is set to MANual then the sub-sweep settings may be speciifed

Parameters:

<Mode> FAST | NORMal | AVERaged | MANual

FAST
Not averaged. The measurement is very fast, as the average column is set to 1 for all sub-bands.

NORMal
Normal averaged. The measurement is slower than the "Fast" mode, but the sub-bands are averaged more.

AVERaged
Highly averaged. The measurement is very slow, with high average in each sub-band for more accurate results.

MANual
The "RBW", "Average" and "FFT" columns in the "Carrier Frequency Offset Table", as well as the "Preset Settings", can be set by the user (see [SENSe:]LIST:RANGe<range>:BANDwidth[:RESolution] on page 81, [SENSe:]SWEep:COUNt on page 83, and [SENSe:]LIST:RANGe<range>:FILTer:TYPE on page 81).

*RST: MANual

Example: SENS:SWEep:MODe FAST
'Sets the sweep mode such that each sub-sweep is executed as fast as possible.

Mode: PHN

[SENSe:]SWEep:POINts? <NumberPoints>

This command queries the number of points measured for trace 1.

Parameters:

<NumberPoints>

Example: SWE:POIN 251

Usage: Query only

Mode: PHN

2.2.12 STATus Subsystem

The STATus subsystem contains the commands for the status reporting registers specific to R&S FSV-K40 (see chapter 2.2.13, "Status Reporting System", on page 89). *RST does not influence the status registers.

STATus:QUEStionable:CONDition

This command queries the CONDition section of the "STATus:QUEStionable" register. This section contains the sum bit of the next lower register. This register part can only be read, but not written into or cleared. Readout does not delete the contents of the CONDition section.

Example: STAT:QUES:COND?

Mode: all

STATus:QUEStionable[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable register. The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it.

Example: STAT:QUES?

Usage: Query only

Mode: all

STATus:QUEStionable:PNOise:CONDition?

Queries the contents of the CONDition section of the `STATus:QUEStionable:PNOIse` register. Readout does not delete the contents of the CONDition section.

Example: `STAT:QUES:PNOI:COND?`

Usage: Query only
SCPI confirmed

Mode: PHN

STATus:QUEStionable:PNOise:ENABle <BitDefinition>

Sets the bits of the ENABle section of the `STATus:QUEStionable:PNOise[:EVENt]` on page 87. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Parameters:
<BitDefinition> Range: 0 to 65535
*RST: 65535

Example: `STAT:QUES:PNOI:ENAB 65535`
All events bits are represented in the PNOIse summary bit.

Mode: PHN

STATus:QUEStionable:PNOise:PTRansition <BitDefinition>

Determines what bits in the `STATus:QUEStionable:PNOIse Condition` register sets the corresponding bit in the `STATus:QUEStionable:PNOIse 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.

Parameters:
<BitDefinition> Range: 0 to 65535
*RST: 65535

Example: `STAT:QUES:PNOi:PTR 65535`
All condition bits are summarised in the Event register when a positive transition occurs.

Mode: PHN

STATus:QUEStionable:PNOise:NTRansition <BitDefinition>

Determines which bits in the `STATus:QUEStionable:PNOIse Condition` sets the corresponding bit in the `STATus:QUEStionable:PNOIse 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.

Parameters:

<BitDefinition> Range: 0 to 65535
*RST: 0

Example: `STAT:QUES:PNOi:NTR 65535`
All condition bits are summarised in the Event register when a positive transition occurs.

Mode: PHN

STATus:QUEStionable:PNOise[:EVENt]?

This command queries the contents of the EVENt section of the `STATus:QUEStionable:PNOise` register. Readout deletes the contents of the EVENt section. Which events can occur is described in chapter 2.2.13, "Status Reporting System", on page 89.

Usage: Query only

Mode: PHN

STATus:QUEStionable:LIMit[:EVENt]
STATus:QUEStionable:POWer[:EVENt]?

The EVENt part indicates whether an event has occurred since the last reading. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it.

Possible events are described in:

chapter 2.2.13.3, "STATus:QUEStionable:LIMit Register", on page 92

chapter 2.2.13.5, "STATus:QUEStionable:POWer Register", on page 93

Usage: Query only
SCPI confirmed

Mode: PHN

STATus:QUEStionable:LIMit:CONDition
STATus:QUEStionable:POWer:CONDition?

Contains the current status of the instrument. This register part can only be read, but not written into or cleared. Readout does not delete the contents of the CONDition section.

Usage: Query only
SCPI confirmed

Mode: PHN

STATus:QUEStionable:LIMit:ENABle
STATus:QUEStionable:POWer:ENABle? <Filter>

Determines whether the `EVENt` bit of the associated status register contributes to the sum bit of the `STATus:QUEStionable` register. Each bit of the EVENt part is "ANDed" with the associated ENABle bit. The results of all logical operations of this part are passed on to the event sum bit via an "OR" function.

Parameters:

<Filter> The sum of the decimal values of the event bits that are to be enabled for the summmary bit.

Range: 0 to 65535

Usage: Query only
SCPI confirmed

Mode: PHN

STATus:QUEStionable:LIMit:NTRansition
STATus:QUEStionable:POWer:NTRansition? <Mode>

This bit acts as a transition filter. When a bit of the `CONDition` part of the associated status register for the result type is changed from 1 to 0, the `NTR` bit decides whether the `EVENt` bit is set to 1.

Usage: Query only
SCPI confirmed

Mode: PHN

STATus:QUEStionable:LIMit:PTRansition
STATus:QUEStionable:POWer:PTRansition?

This bit acts as a transition filter. When a bit of the `CONDition` part of the associated status register for the result type is changed from 0 to 1, the `PTR` bit decides whether the `EVENt` bit is set to 1.

Parameters:

<Filter> The sum of the decimal values of the event bits that are to be enabled.

Range: 0 to 65535

Example: `STAT:QUES:LIM:PTR 65535`
All condition bits will be summarized in the Event register when a positive transition occurs.

Usage: Query only
SCPI confirmed

Mode: PHN

2.2.13 Status Reporting System

In addition to the registers provided by the base system, the following registers are used or modified in the Phase Noise Measurements option (R&S FSV-K40):

- `STATus:OPERation`
  Although this register is provided by the base system, the Noise Figure Measurements option makes use of bits not used within the base system.
- `STATus:QUEStionable`
  Although this register is provided by the base system, the Noise Figure Measurements option makes use of bits not used within the base system.
- `STATus:QUEStionable:LIMit`
- `STATus:QUEStionable:PNOise`
- This register is provided by the R&S FSV-K40 option.
- `STATus:QUEStionable:POWer`
  Although this register is provided by the base system, the Noise Figure Measurements option makes use of bits not used within the base system.

2.2.13.1 STATus:OPERation Register

This register contains information on which actions the instrument is executing or which actions the instrument has executed since the last reading. It can be read using the commands `STATus:OPERation:CONDition` or `STATus:OPERation:EVENt`.

Table 2-3: Meaning of the bits used in the STATus:OPERation register

Bit No.	Meaning
0	`CALibrating` This bit is set as long as the instrument is performing a calibration.
1 - 3	Not used

Bit No.	Meaning
4	MEASuring This bit is set when a measurement is in progress (R&S FSV-K40 specific)
5 - 7	Not used
8	`HardCOPy` in progress This bit is set while the instrument is printing a hardcopy.
9 - 14	Not used
15	This bit is always 0.

2.2.13.2 STATus:QUEStionable Register

This register contains information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be read using the commands `STATus:QUEStionable:CONDition` or `STATus:QUEStionable[:EVENt]`.

Table 2-4: Meaning of the bits used in the STATus:QUEStionable register

Bit No	Meaning
0 to 2	These bits are not used
3	POWer This bit is set if a questionable power occurs, see chapter 2.2.13.5, "STATus:QUEStionable:POWer Register", on page 93
4	TEMPerature This bit is set if a questionable temperature occurs.
5	FREQuency The bit is set if a frequency is questionable
6 to 7	These bits are not used
8	CALibration The bit is set if a measurement is performed uncalibrated (= label "UNCAL")
9	LIMit (device-specific) This bit is set if a limit value is violated (for the Spectrum Mask measurement only), see chapter 2.2.13.3, "STATus:QUEStionable:LIMit Register", on page 92
10	LMARgin (device-specific) These bits are not used within R&S FSV--K40
11	SYNC (device-dependent) These bits are not used within R&S FSV-K40
12	ACPLimit These bits are not used within R&S FSV-K40
13	PNoise This bit is set if a phase noise error occurs, see chapter 2.2.13.4, "STATus:QUEStionable:PNOise Register", on page 92

Bit No	Meaning
14	Not used
15	This bit is always 0

2.2.13.3 STATus:QUEStionable:LIMit Register

This register contains information about the observance of limit lines. It can be read using the commands `STATus:QUEStionable:LIMit:CONDition?` and `STATus:QUEStionable:LIMit[:EVENt]?`.

Note that no limit lines are displayed in screen B and as such all bits in the LIMit2 register will always be set to 0.

Table 2-5: Meaning of the bits used in the STATus:QUEStionable:LIMit register

Bit No	Meaning
0	LIMit FAIL This bit is set if limit line 1 is violated
1	LIMit FAIL This bit is set if limit line 2 is violated
2	LIMit FAIL This bit is set if limit line 3 is violated
3	LIMit FAIL This bit is set if limit line 4 is violated
4	LIMit FAIL This bit is set if limit line 5 is violated
5	LIMit FAIL This bit is set if limit line 6 is violated
6	LIMit FAIL This bit is set if limit line 7 is violated
7	LIMit FAIL This bit is set if limit line 8 is violated
8 to 14	These bits are not used
15	This bit is always 0

2.2.13.4 STATus:QUEStionable:PNOise Register

The bits in the `STATus:QUEStionable:PNOise` register indicate events that occur during phase noise measurements. To query the status use the commands `STATus:QUEStionable:PNOise:CONDition` on page 86 or `STATus:QUEStionable:PNOise[:EVENt]` on page 87.

Bit No	Meaning
0	No traces are active This bit is set when all the traces are switch off.
1	"SIGNal not found" This bit is set if no valid signal is detected
2	"VERify signal failed" This bit is set if verification failed to detect a signal within the supplied tolerances.
3 to 14	These bits are not used
15	This bit is always 0

2.2.13.5 STATus:QUEStionable:POWer Register

This register contains all information about possible overloads of the unit. It can be read using the commands `STATus:QUEStionable:POWer:CONDition?` and `STATus:QUEStionable:POWer[:EVENt]?`.

Table 2-6: Meaning of the bits used in the STATus:QUEStionable:POWer register

Bit No.	Meaning
0	OVERload (Screen A) This bit is set if the RF input is overloaded. "OVLD" is displayed.
1	UNDerload (Screen A) This bit is set if the RF input is underloaded. "UNLD" is displayed.
2	IF_OVerload (Screen A) This bit is set if the IF path is overloaded. "IFOVL" is displayed.
3 to 7	Not used
8	OVERload (Screen B) This bit is set if the RF input is overloaded. "OVLD" is displayed.
9	UNDerload (Screen B) This bit is set if the RF input is underloaded. "UNLD" is displayed.
10	IF_OVerload (Screen B) This bit is set if the IF path is overloaded. "IFOVL" is displayed.
11 - 14	Not used
15	This bit is always 0.

2.2.14 TRACe subsystem

TRACe<n>[:DATA]?

This command returns the current phase noise trace results as a comma separated list.

Suffix:

<n> 1...4
window; For applications that have only one measurement screen, the suffix is irrelevant.

Usage: Query only

Mode: PHN

2.2.15 Other Commands Referenced in this Document

[SENSe:]AVERage<n>:COUNt <NoMeasurements>

This command defines the number of measurements which contribute to the average value in the window specified by the AVERage<n> suffix.

Note that continuous averaging is 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.

This command has the same effect as the `[SENSe<source>:]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 in the window.

Suffix:

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

Parameters:

<NoMeasurements> 0 to 32767

*RST: 0

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.

Mode: all

List of Commands

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