



ROHDE & SCHWARZ

Test and Measurement
Division

Software Manual

WiMAX IEEE 802.16-2004 TX Tests

Application Firmware R&S FSQ-K92

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1 General Information

The Rohde & Schwarz FSQ-K92 application extends the functionality of the R&S FSQ spectrum analyzer to enable WiMAX TX-measurements according to IEEE standards 802.16-2004

This manual supports the user in working with R&S FSQ-K92. It aids the preparation, execution and evaluation of a measurement and gives many helpful hints and examples.

For the user wanting to make a quick start to using R&S FSQ-K92, the Quick Start Guide section below works step-by-step through an ordinary measurement. The remainder of this section describes all of the basic information about how the FSQ-K92 application works, without covering measurements in detail. A detailed description of all measurement modes, settings and results can be found in section 2. Section 4 covers remote control operation of R&S FSQ-K92.

This section covers the following subjects:

Introduction to R&S FSQ-K92 measurements

- Installation
- Starting the application
- Exiting the application
- Quick start guide – allows the user to get up-and-running in minimum time
- Navigation
- Save/recall – saving & recalling user settings & measurement results
- Printing

Introduction to R&S FSQ-K92 WiMAX Measurements

The use of an R&S FSQ spectrum analyzer with its high sensitivity enables the accurate and reproducible TX-measurement of a WiMAX Device Under Test (DUT) according to the standards specified for the device:

- Modulation formats:
 - IEEE 802.16-2004
 - BPSK (IEEE 802.16-2004 only)
 - QPSK
 - 16QAM
 - 64QAM
- Modulation measurements:
 - Constellation diagram
 - Constellation diagram per OFDM carrier
 - I/Q offset and I/Q imbalance
 - Carrier and symbol frequency errors
 - Modulation error (EVM) per OFDM carrier or symbol
 - Amplitude response and group-delay distortion (spectral flatness)
- Amplitude statistics (CCDF) and crest factor
- Transmit spectrum mask
- Adjacent Channel Power (Absolute and Relative)
- FFT, also over a selected part of the signal, e.g. preamble
- Payload bit information
- Capture time selectable up to 50 ms, multiple sweeps possible for large number of bursts

Installation

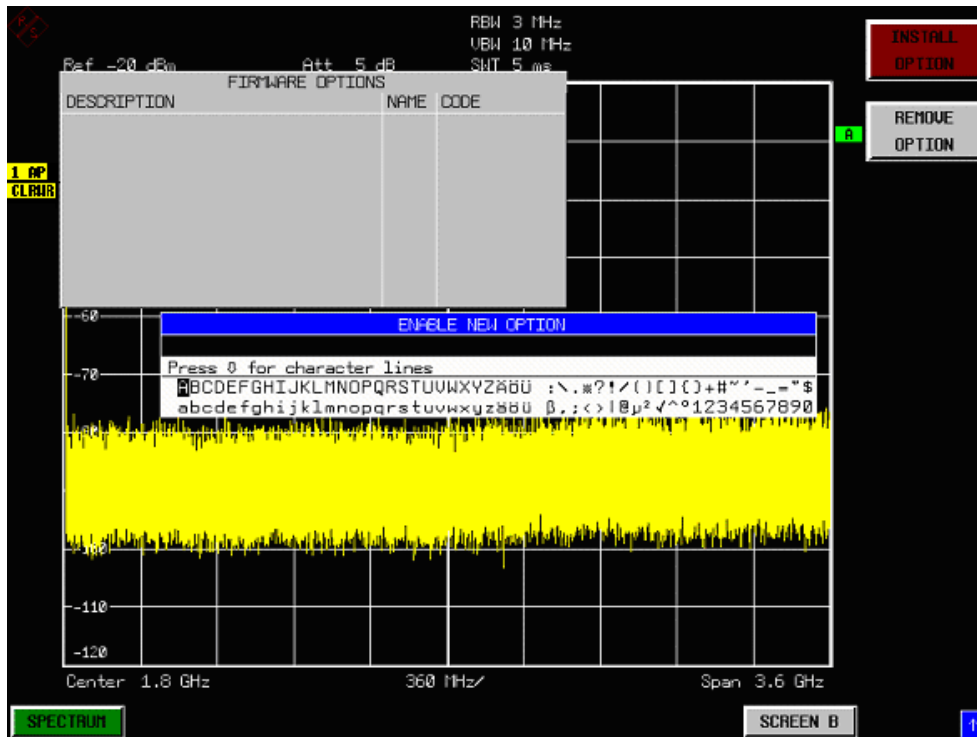
From the analyzer select firmware update.

- Press the **SETUP** hardkey followed by **NEXT**, **FIRMWARE UPDATE** and finally the **FIRMWARE UPDATE** softkey. Following the instructions displayed.

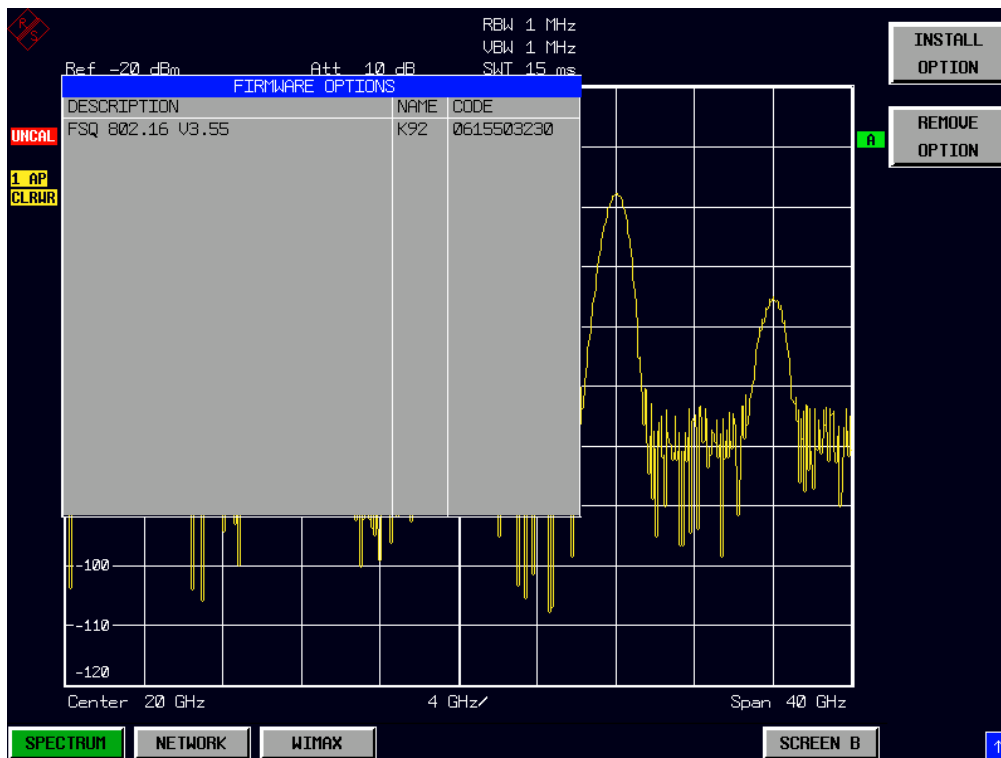
Once the installation has completed the analyzer will reboot.

Once the option has been installed it needs to be activated:

- Start up the analyzer
- Press the **SETUP** hardkey, followed by the **GENERAL SETUP** softkey and then the **OPTIONS** softkey. A list of the options currently activated is displayed.
- Press the **INSTALL OPTION** softkey. A Dialog is displayed allowing the option key to be entered.



- Enter the option key supplied with the R&S FSQ-K92 software.
- When a valid option key has been supplied a dialog will be displayed explaining that a reboot is required to complete this operation. Select OK in this dialog and the instrument will be rebooted
- When the analyzer starts after the reboot a new hotkey will be displayed at the bottom of the display labelled *WIMAX*. In addition an entry for the R&S FSQ-K92 option will be displayed in the *FIRMWARE OPTIONS* dialog.



Starting the application

Power up the R&S FSQ spectrum analyzer. When R&S FSQ-K92 is correctly installed there will be a hotkey labelled *WIMAX* at the bottom of the screen. Press the *WIMAX* hotkey to start R&S FSQ-K92.

Note that if the spectrum analyzer is powered down whilst FSQ-K92 is active, then when the spectrum analyzer is powered up again it will start up in the R&S FSQ-K92 application.

Exiting the application

To exit the R&S FSQ-K92 option, press the *SPECTRUM* hotkey at the bottom of the screen. This will cause the option to exit and the spectrum analyzer to be activated.

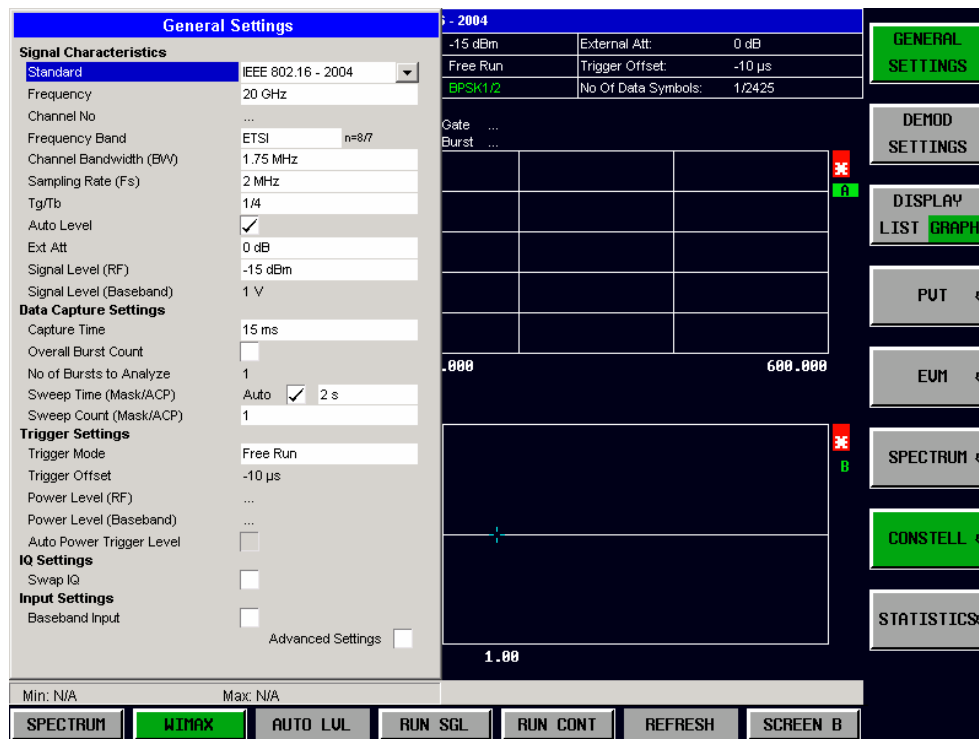
Quick Start Guide

This section helps the user to quickly become familiar with R&S FSQ-K92 by working step-by-step through an ordinary measurement. (Refer to section 2 for a detailed reference guide.)

For this example a DUT using IEEE 802.16-2004 will be used. The DUT will be connected to the analyzer using the RF input of the analyzer. The DUT will generate a signal modulated using 64QAM 2/3

Setting up the measurement

- Start the R&S FSQ-K92 application.
- Press the *GENERAL SETTINGS* softkey to open the General Settings view.



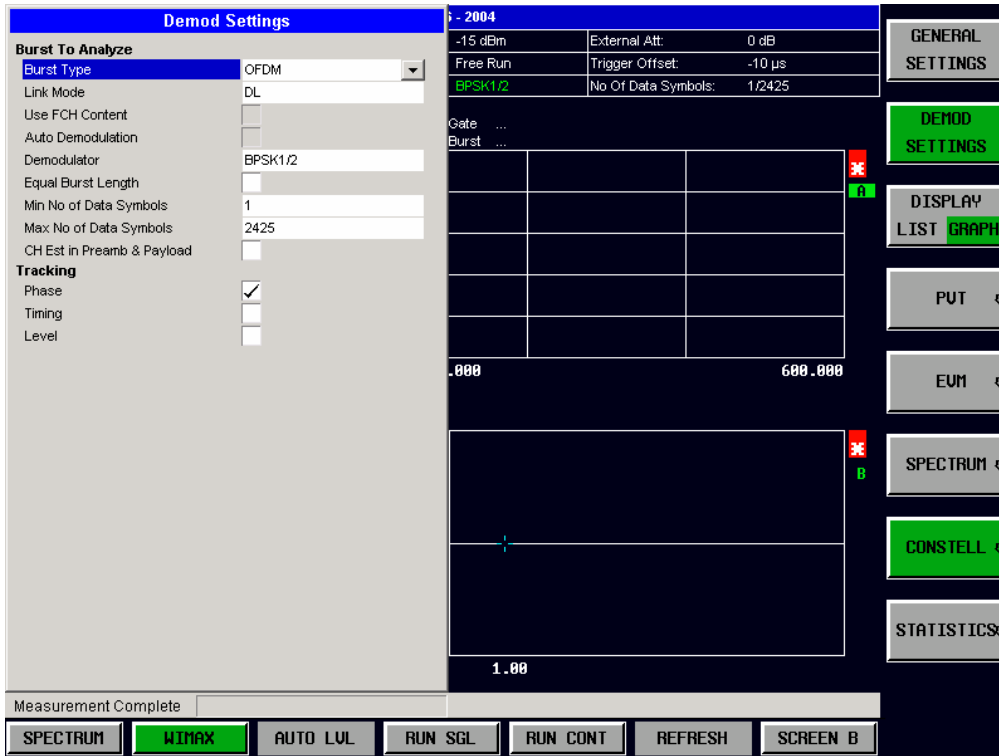
- Select the *Frequency* field and enter the desired frequency to measure. Note that when a valid frequency is entered the *Channel No* field updates.
- Select the *Frequency Band* in which the Signal to be analyzed is located. The target band is either one of the bands given as example in the 802.16-2004 standard¹ or an unspecified band.
- Select either the *Channel Bandwidth (BW)* or *Sampling Rate (Fs)* according to the characteristics of the signal to be analyzed. The second parameter is derived from the first according to the standard².
- Select the $G = T_g / T_b$ CP [Cyclic Prefix] to useful time ratio according to the characteristics of the signal to be analyzed.
- Switch Off the *Auto Level* Field. In this example the level detection measurement will be executed manually.

All other settings in this view are sufficient for this example.

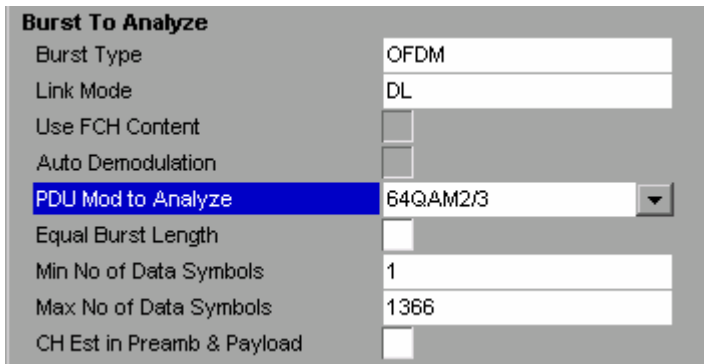
¹ B.3.2 Wireless MAN-OFDM/OFDMA PHY symbol and performance parameters.

² 8.3.2.2 Derived Parameter definitions

- Press the *DEMOD SETTINGS* softkey to open the Demod Settings view



- Select the *Link Mode* of the Bursts to be analyzed.
- Enter the modulation scheme used in the *PDU Mod to Analyze* field.



Close the Demod Settings by pressing the *WIMAX* hotkey.

Performing Level Detection

- Connect the DUT to the RF input of the spectrum analyzer. (see Fig. 1-1)

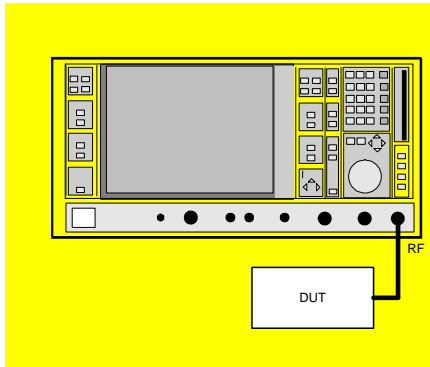


Fig. 1-1 Preparation for level detection

- Start the Level Detection measurement by pressing the *AUTO LVL* hotkey.
- During the level detection measurement the text "*Running ...*" is displayed in the Status Bar at the bottom of the screen.
- After successful level detection, the Status Bar will display "*Measurement Complete*", the signal level field for the selected input will be updated to show the detected signal level and the Magnitude Capture Buffer (Screen A) will be updated to show the zero span trace obtained during the measurement sequence.

Performing the main measurement

After level detection has been successfully completed the main measurement can be started. The set-up for the main measurement is the same as that for the level detection measurement.

- Start the measurement by pressing the *RUN SGL* hotkey.
- During the measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen.

Measurement results are updated once the measurement has completed. The results are displayed in graphical form. The display can be toggled to a tabular list of measurement points by pressing the *DISPLAY* softkey

Navigation

This section deals with navigation within the option. Navigation here is taken to mean all forms of interaction with the option except for remote control. The different methods of interacting with the option are:

- Hotkeys
- Softkeys
- Hardkeys
- Numeric Keypad
- Roll-key
- Cursor Keys
- External Keyboard
- Mouse

Hotkeys

Hotkeys are allocated to the seven keys at the bottom edge of the screen. On initial start-up of the K92 option, the hotkeys provided are shown in Fig. 1-2. These hotkeys are present at all times once the option has been started.

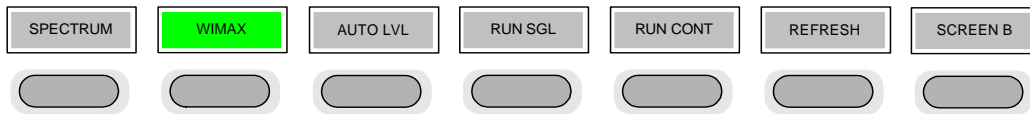
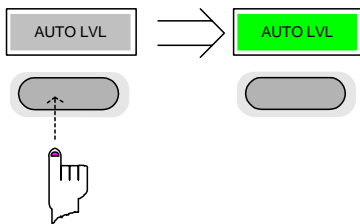


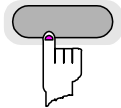
Fig. 1-2 Initial Hotkey menu

A keystroke activates the associated hotkey. An activated hotkey changes colour to green, as shown.



These hotkeys perform the following operations:

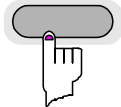
SPECTRUM



The *SPECTRUM* hotkey exits the R&S FSQ-K92 option & returns to the spectrum analyzer with all previous settings restored.

The *WIMAX* hotkey returns the user to the main measurement menu of R&S FSQ-K92, where measurement results can be seen. All settings views and dialogs are removed from the display, and the default softkey menu is displayed

AUTO LVL

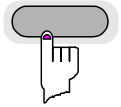


The *WIMAX* hotkey remains green whenever R&S FSQ-K92 is active
The *AUTO LVL* hotkey starts an automatic level detection measurement.

If another measurement is running then the running measurement will be aborted before the automatic level detection measurement is started. If a continuous measurement is running when the *AUTO LVL* hot-key is pressed then the continuous measurement shall resume after the automatic level detection has completed

Pressing the *AUTO LVL* hotkey whilst an automatic level detection measurement is running causes the measurement to be stopped (aborted).

RUN SGL



The *RUN SGL* hotkey starts the selected measurement in single sweep mode.

If another measurement is running, such as a continuous sweep measurement, the running measurement will be aborted before the single sweep measurement is started.

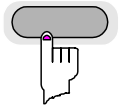
Pressing the *RUN SGL* hotkey whilst a single frequency range measurement is running causes the measurement to be stopped (aborted).

The *RUN CONT* hotkey starts the selected measurement in continuous sweep mode

If another measurement is running then the running measurement will be aborted before the continuous sweep measurement is started.

Pressing the *RUN CONT* hotkey whilst a continuous sweep measurement is running causes the measurement to be stopped (aborted).

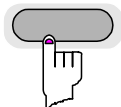
REFRESH



The *REFRESH* hotkey updates the current measurement results with respect to the current gate settings.

The *REFRESH* hotkey is only available for measurement results which are affected by the gate settings (Spectrum FFT, PVT and CCDF). The *REFRESH* hotkey only becomes available when the gate settings are modified after a measurement result has been obtained.

SCREEN [A|B]



The *SCREEN [A|B]* hotkey selects the specified screen as the active screen.

In full screen mode pressing the *SCREEN [A|B]* hotkey will display the specified screen.

After Pressing the *SCREEN [A|B]* hotkey the label displayed in the hotkey is changed e.g. after pressing the *SCREEN A* hotkey the label of the hotkey is changed to *SCREEN B*. The label indicates which screen will become the active screen after the hotkey is pressed.

Softkeys

Settings Softkeys

The softkeys are assigned to the nine keys on the right-hand side of the display. These enable quick access to all of the parameter settings and measurement screens of the K92 option. Each of the top two softkeys, when pressed, brings up a settings view for a group of parameters. These softkeys are always available (except when using Save/Recall and Print manager or controlling markers) and are as follows:

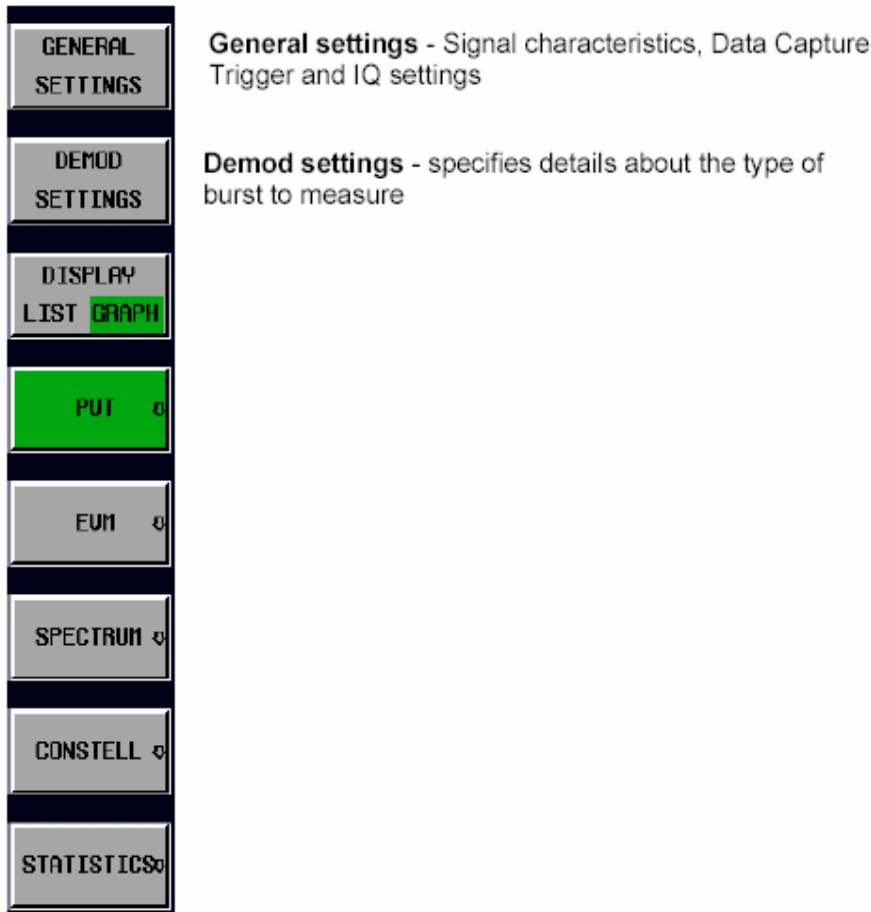


Fig. 1-3 Main softkeys

Each of these groups of settings is described in detail in the Measurements & Settings section of this manual.

Other Softkeys

All other softkeys have different functions depending on the instrument state. Therefore, the labels (text) on the softkeys will vary to reflect their current function. The state of the softkeys is indicated by different appearances and colours, as follows:

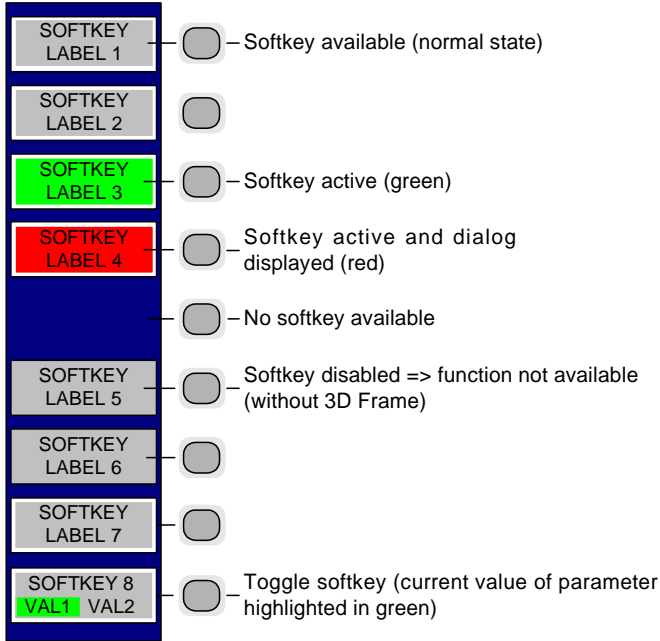


Fig. 1-4 Setup of the softkey area

A softkey in its normal state, where its function is available, is coloured grey with a 3D border.

A softkey that is disabled, because its function is not available, is coloured grey without a 3D border. Softkeys may become disabled because of the state of the instrument or because other settings disable the function associated with the softkey.

An active softkey (highlighted in green) is used when the softkey selects an item or view. For example, the *GATE SETTINGS* softkey will be highlighted green when the Gate Settings pop-up dialog is displayed.

A toggle softkey is used to change the value of a parameter that has only two states. Each press of the softkey toggles the value of the parameter. The current parameter value is highlighted in green in the lower half of the softkey label. For example, in the measurement results view, the *DISPLAY* softkey will have either *LIST* or *GRAPH* highlighted in green depending on whether the results are currently displayed as a list of measurement points or graphical trace(s).

When no function is assigned to a softkey then no softkey label will be shown.

Hardkeys

Hardkeys allow quick access to the desired parameter and various functions. The hardkeys supported by the K92 option are as follows (other hardkeys do nothing):

FREQ Hardkey	When the <i>FREQ</i> hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the <i>Frequency</i> parameter is selected.
AMPT Hardkey	When the AMPT hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the relevant <i>Signal Level</i> parameter for the selected signal input is selected.
MKR Hardkey	When the MKR hardkey is pressed the main Marker softkey menu is displayed (if it is not already being displayed).
MKR-> Hardkey	When the MKR-> hardkey is pressed the Marker extension softkey menu is displayed (if it is not already being displayed).
SWEEP Hardkey	When the SWEEP hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the <i>Capture Time</i> parameter is selected.
MEAS Hardkey	When the MEAS hardkey is pressed the Main softkey menu is displayed (if it is not already being displayed).
TRACE Hardkey	When the TRACE hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the <i>Burst Count</i> parameter is selected.
LINES Hardkey	When the LINES hardkey is pressed the Limit Lines softkey menu is displayed (if it is not already being displayed) and the first limit in the results summary is selected. Note this hard-key only functions when the results summary is displayed
DISP Hardkey	When the DISP hardkey is pressed the Display softkey menu is displayed (if it is not already being displayed).
FILE Hardkey	When the FILE hardkey is pressed, the Save & Recall softkey menu is displayed, allowing the save & recall of settings and/or measurement results of the K92 option.
PRESET Hardkey	When the PRESET hardkey is pressed the K92 option is exited and a preset will be performed. Note that all options (including R&S FSQ-K92) shall also be preset.
HCOPY Hardkey	When the HCOPY hardkey is pressed the print manager softkey menu is displayed, allowing selection of the items to be printed.

External Keyboard

The external keyboard is optional. The keys on the external keyboard that can be used to interact with the K92 option are as follows:

Number keys 0 to 9

Decimal point (“.”) Inserts a decimal point “.” at the cursor position.

Minus key (“-“) Changes the sign of the mantissa or exponent of a numeric parameter. A “-“ is inserted at the cursor position in the case of an alphanumeric parameter.

ESC key Aborts the entry before it has been terminated. The previous value is restored.
Closes the entry field after termination of input.
Closes pop-up dialogs.

ENTER key Terminates the input of dimension quantities. The new value is set.
Invokes the input of parameters or immediately sets the new value.
Selects the highlighted item in drop-down menus.

Left and Right Cursor Keys are used to: Navigate between individual parameters within the setting views and some of the pop-up dialogs.
Navigate between the individual items within drop-down menus.
Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.

Up and Down Cursor keys are used to: Navigate between individual parameters within the setting views and some of the pop-up dialogs.
Navigate between the individual items within drop-down menus.
Increment or decrement the value of a parameter during numeric entry.

CTRL keys Used to activate hotkeys. Each of the seven hotkeys is allocated a different function (F) key. To access these hotkeys press CTRL and the corresponding F key together (see Fig. 1-5):

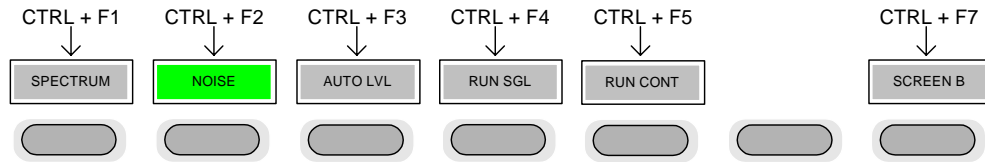


Fig. 1-5 Quick Access to Hotkeys

Function Keys Used to activate softkeys. Each of the nine softkeys is allocated a different function (F) key. To access these softkeys the corresponding F key, as shown below:

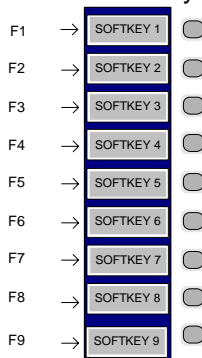


Fig. 1-6 Quick access to softkeys

Mouse

The mouse can be used to select individual parameters within the settings views or data entry dialogs and to activate hotkeys and softkeys. It can also be used to select values from a drop-down list.

Selecting & Editing Parameters

Parameters are set either by numeric or alphanumeric entry or by simple selection from a list of possible values (a drop-down list is used to select an “enumerated” value) or by using checkboxes to turn a parameter setting on and off.

In all cases, the parameter has to be selected by placing focus on it and then editing has to be enabled before its value can be changed.

The rollkey and cursor keys on the front panel are provided for navigation and selection of parameters.

The numeric keypad, rollkey and cursor keys on the front panel and an external keyboard (optional) are provided for the entry of parameter values.

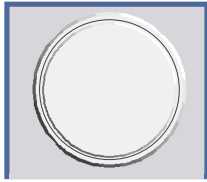
Numeric Keypad



The numeric keypad is provided for entry of numeric parameters. It contains the following keys:

- **Number keys 0 to 9**
Starts editing of the selected parameter. This enables a new value to be entered for a parameter directly without having to press *ENTER* first. The digit will be displayed as the first digit of the newly entered value. Inserts a digit at the cursor position when editing an alphanumeric parameter.
- **Decimal point**
Inserts a decimal point “.” at the cursor position.
- **Sign key (“-“)**
Changes the sign of the mantissa or exponent of a numeric parameter. A “-“ is inserted at the cursor position when editing an alphanumeric parameter.
- **Unit keys (GHz/-dBm, MHz/dBm, kHz/dB and Hz/dB)**
- **Provides the numeric value entered with the selected unit and sets the parameter to that value.**
The unit keys are all assigned the value “1” for dimensionless quantities or for level entries (e.g. in dB). The unit keys thus assume the function of an *ENTER* key.
- ***BACK* key**
Deletes the character to the left of the cursor with alphanumeric entry.
- ***ESC/CANCEL* key**
Aborts the entry of a new parameter value. The previous value is restored. Closes pop-up dialogs.
- ***ENTER* key**
Enables editing of the selected parameter (using numeric keys or rollkey). Finishes the editing of a parameter value. The new value is set. For an alphanumeric value, the new value is set to that displayed (using the current unit if applicable).
In a drop-down menu, the parameter is set to the currently selected value in the list.

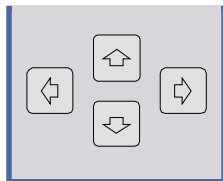
Rollkey





The rollkey has various functions:



- In a settings view, the rollkey can be used to navigate between individual parameters (the parameter selected being highlighted).
- In drop-down menus, the rollkey can be used to navigate between the individual values for the parameter.
- During numeric entry, the parameter is incremented (by turning clockwise) or decremented (by turning counter-clockwise) at a defined step size (depending on the parameter).
- In setting views and data entry dialogs pressing the rollkey invokes the input of parameters or immediately sets the new value, i.e. pressing the rollkey is like pressing the *ENTER* key.
- In drop-down menus, pressing the rollkey selects the relevant item.

Cursor Keys



The keys  and  are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.
- Navigate between the individual values within drop-down menus.
- Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.

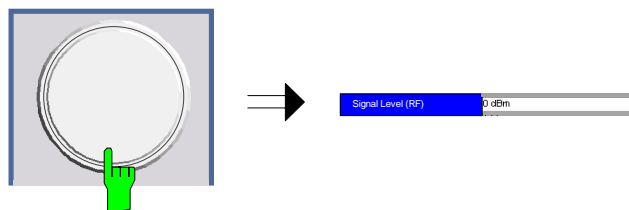
The keys  and  are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.
- Navigate between the individual items within drop-down menus.
- Increment or decrement the value of a parameter during numeric entry.

Selection of a parameter within a settings view

- Selection using rollkey**
- Press *GENERAL SETTINGS* softkey for example (General settings view is displayed).
 - Rotate the rollkey until reaching the required parameter.
Turning the rollkey clockwise selects parameters in the upward direction, turning it counter-clockwise selects parameters in the downward direction.





Example: Selecting *Signal Level* (General settings)



Note: When the *Signal Level* parameter is selected its label is highlighted blue.

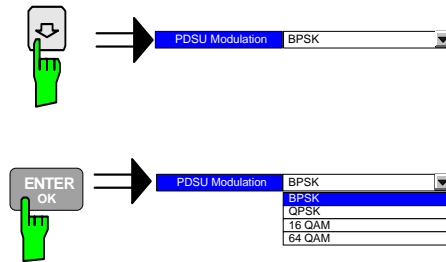
When the desired parameter is reached press the rollkey to edit the parameter.

Selection using cursor keys

Cursor  ,  ,  or  until obtaining the required parameter. Within a list of parameters, the *Down* and *Right* both move to the next item (down) in the list and the *Up* and *Left* keys both move to the previous item (up) in the list. Within a table of parameters, the cursor keys move the cursor in the direction indicated.

To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Example: Selecting PDSU Modulation

Note: When *ENTER* is pressed, a drop-down menu is displayed, which contains all the available settings to which the Demodulator parameter can be set.

Selection using mouse

- Use the mouse to move the cursor to the parameter and press the left mouse button to select the parameter.
- To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Selection using external keyboard

- Select parameter using the cursor keys (in the same way as using the cursor keys on the front panel).
- To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Entry of a numeric value

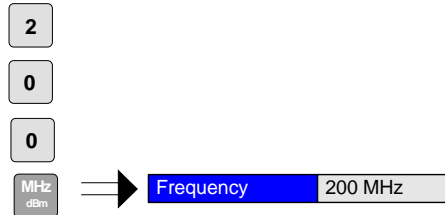
Once a parameter has been selected (see above), a new value for a numeric parameter can be entered in a number of ways. With the exception of entry via the number keys, to start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey before following the instructions below.

If an error occurs, for example, the entered value is out of range, then the new value will not be accepted for the parameter setting.

Entry using number keys (numeric keypad)

- Enter required value using the number keys.



Example: To enter 200 MHz



Note: *The parameter is not set to the new value until either one of the unit keys on the numeric keypad, the ENTER or the rollkey is pressed.*

If the new value is not valid, then a message box is displayed and the entered value will be replaced with a valid value. For example, when a value above the maximum allowed is entered, then the maximum value allowed will be shown in the entry box. The parameter will still be ready for editing so that another value can be entered if desired.

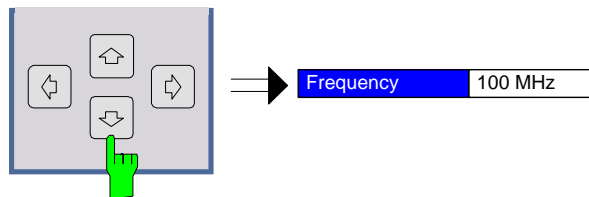
Entry using cursor keys

- Cursor  or  until obtaining the required value.

The application prevents the minimum and maximum values of the parameter from being exceeded and displays an “Out of range” message box if attempted.

N.B The cursor keys increment/decrement a parameter value in large steps.

Example: Cursor down to 100MHz



Note: *Each change of the parameter value takes place immediately. No other keys need to be pressed.*

Entry using rollkey

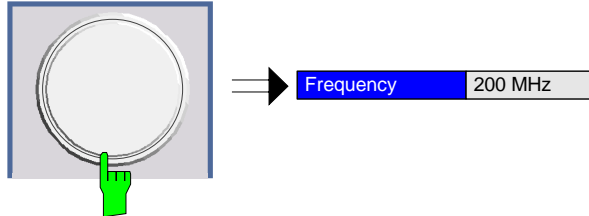
- Rotate the rollkey until reaching the required value.

Turning the rollkey clockwise increases the value, turning it counter-clockwise decreases the value.

The application prevents the minimum and maximum values of the parameter from being exceeded and displays an "Out of range" message box if attempted.

N.B The rollkey increment/decrement a parameter value in small steps

Example: Rotate to 200MHz



Note: Each change of the parameter value takes place immediately. No other keys need to be pressed.

Entry using external keyboard

- Enter value using number keys 0 – 9 in the same way as for using the number keys on the numeric keypad (see above).

Terminating the entry

- Press one of the unit keys on the numeric keypad.

The unit is entered in the parameter's edit box and the new parameter value is set immediately.



- Press the *ENTER* key (on numeric keypad or external keyboard) or press the rollkey.

The new parameter value is set immediately.

Note: *Pop-up dialogs, where used, do not close automatically. They can be closed by pressing the ESC key.*

In both cases, if the new value is not valid, then a message box is displayed and the entered value will be replaced with a valid value. For example, when a value above the maximum allowed is entered, then the maximum value allowed will be shown in the entry box. The parameter will still be ready for editing so that another value can be entered if desired.

Correcting the entry

- Position the cursor to the right of the digit which is to be deleted using the cursor keys  or .

- Press the BACK key. The digit to the left of the cursor is deleted.

- Enter new digits. Each digit is inserted to the left of the cursor, the other digits are shifted right.

Aborting the entry

- Press the *ESC* key during parameter editing.

The original parameter value is restored. The new entry is deleted.

- If a pop-up dialog is displayed, press the *ESC* key again.



The entry window is closed, the original value remains active.

Entry of an enumerated value

Once a parameter has been selected (see above), a new value for an enumerated parameter can be entered in a number of ways. To start editing the parameter, either press the *ENTER* key on the numeric keypad, press the rollkey or left click with the mouse on the drop down button before following the instructions below.

Note: *When the rollkey or ENTER is pressed, a drop-down menu is displayed, which contains all the available settings that may be selected for the parameter.*

Selection of setting using cursor keys

- Cursor  or  until obtaining the required setting.
- Press *ENTER* on external keyboard or numeric keypad, or press rollkey to select the desired setting of parameter.

Note: *Currently selected setting of the parameter is highlighted blue. Pressing ENTER sets the new setting of the parameter immediately.*

Selection of setting using rollkey

- Rotate the rollkey until reaching the required setting.
- Press rollkey to select setting.

Example: Select *Mode* parameter.

Note: *Currently selected setting of the parameter is highlighted blue. Pressing the rollkey sets the new setting of the parameter immediately.*

Selection of setting using mouse

- When the parameter is selected and ready for editing, select a new setting using the mouse by left-clicking on the new setting from the drop-down list. The new setting of the parameter is set immediately.

Selection of setting using external keyboard

- Select setting using cursor keys.
- Press *ENTER* to set the parameter to the new value.

Entry of a checkbox

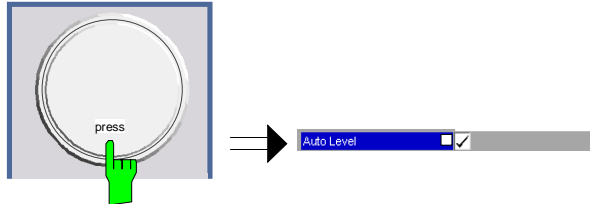
A checkbox is used for parameter settings that are either On or Off (Boolean settings). A checkmark (✓) appears in the box when the setting is On; the checkbox is empty when the setting is Off.

Once a parameter has been selected (see above), a new value for a Boolean parameter can be entered in a number of ways. Because Boolean parameters are very simple, it is not necessary to press the *ENTER* key on the numeric keypad or to press the rollkey in order to edit them.

Toggle between the two states of a checkbox using rollkey

- Press the rollkey to toggle between the two states.

Example: Turn *Auto Level* setting to Off



Note: The checkbox is empty when the settings is Off

Toggle between the two states of a checkbox using numeric keypad

- Press the *ENTER* key to toggle between the two states.

Example: Turn *Auto Level* setting to On



Toggle between the two states of a checkbox using a mouse

- Left-click on the checkbox to toggle between the two states.

Toggle between the two states of a checkbox using external keyboard

- Press *ENTER* to toggle between the two states.

Status Bar & Title Bar

Title Bar

The title bar is visible at the very top of the display when R&S FSQ-K92 is active and no settings views are displayed.



Fig. 1-7 Title Bar

The centre of the title bar shows the WiMAX standard applicable to the current measurement.

Status Bar

The main status bar is displayed at the bottom of the display, just above the hotkeys.

When a parameter in a settings view is selected, the status bar will display the minimum and maximum, settings for the selected parameter (see Fig. 1-8).

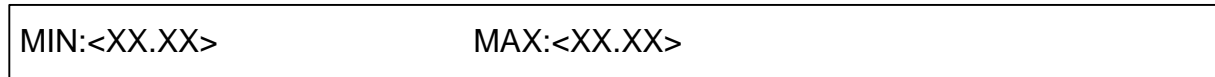


Fig. 1-8 Status Bar

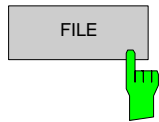
When a parameter whose value is enumerated or Boolean in type is selected in any dialog, the status bar will show "N/A" displayed for the minimum and maximum, since the minimum and maximum values are "Not Applicable."

At other times, the status bar shows the current measurement status along with detailed information about the progress through any running measurement.

The status bar is also used to display warning and error messages to the user. In order to highlight these messages, warning messages are displayed with a blue background and error messages with a red background. Refer to Section 6 for a list of warning and error messages.

Save/Recall

This section of the user manual describes the Save/Recall facility of the option.



The *FILE* hardkey brings up the Save/Recall softkey menu. Any settings views on display when the save/recall softkey menu is displayed shall be closed.

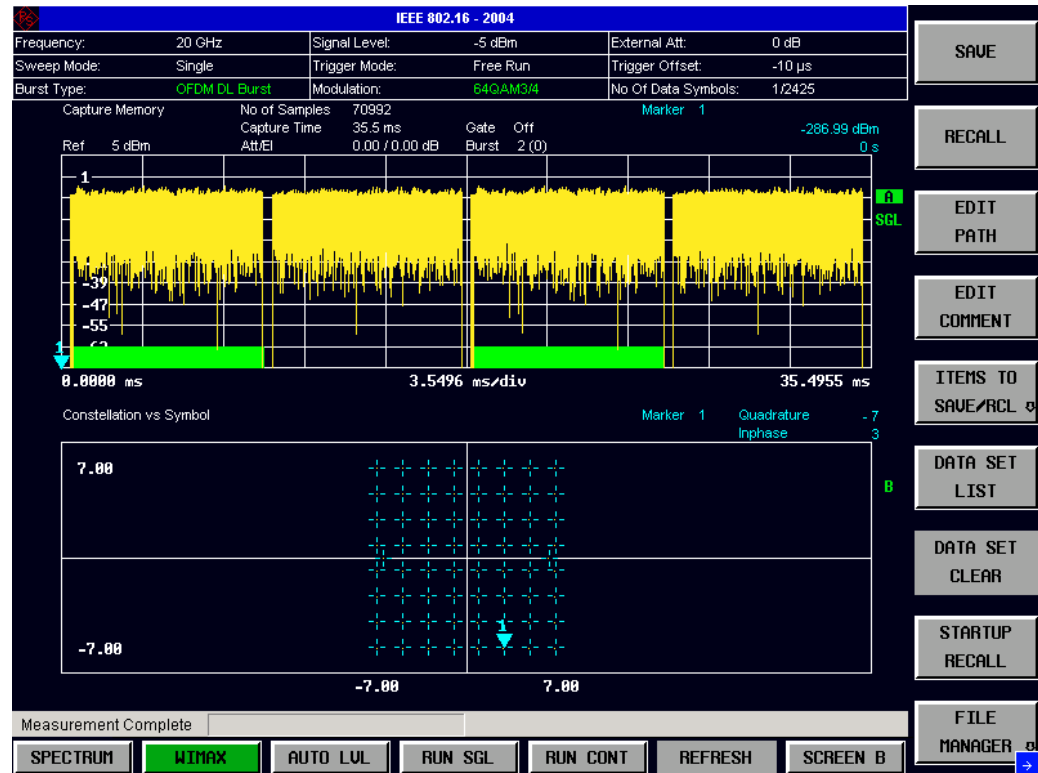


Fig. 1-9 Save/Recall softkey menu

The save/recall facility provided by R&S FSQ-K92 is exactly the same as that provided by the host analyzer. Refer to the user manual for the spectrum analyzer for details of the save/recall facility operation.

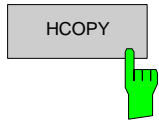
The save/recall facility in R&S FSQ-K92 provides the following items that can be saved and/or recalled:

- Current Settings All user settings provided by R&S FSQ-K92
- WIMAX Results All current trace and table results
- User Limits All limit lines and table limit values.
- IQ Data Allows the raw IQ trace results to be stored. When recalled the data is reprocessed to generate results

To close the save/recall softkey menu and return to the main R&S FSQ-K92 softkey menu, press the *WIMAX* hotkey.

Printing

This section of the user manual describes print facility of the option



The *HCOPY* hardkey brings up the print softkey menu. Any settings views on display when the print softkey menu is displayed shall be closed.

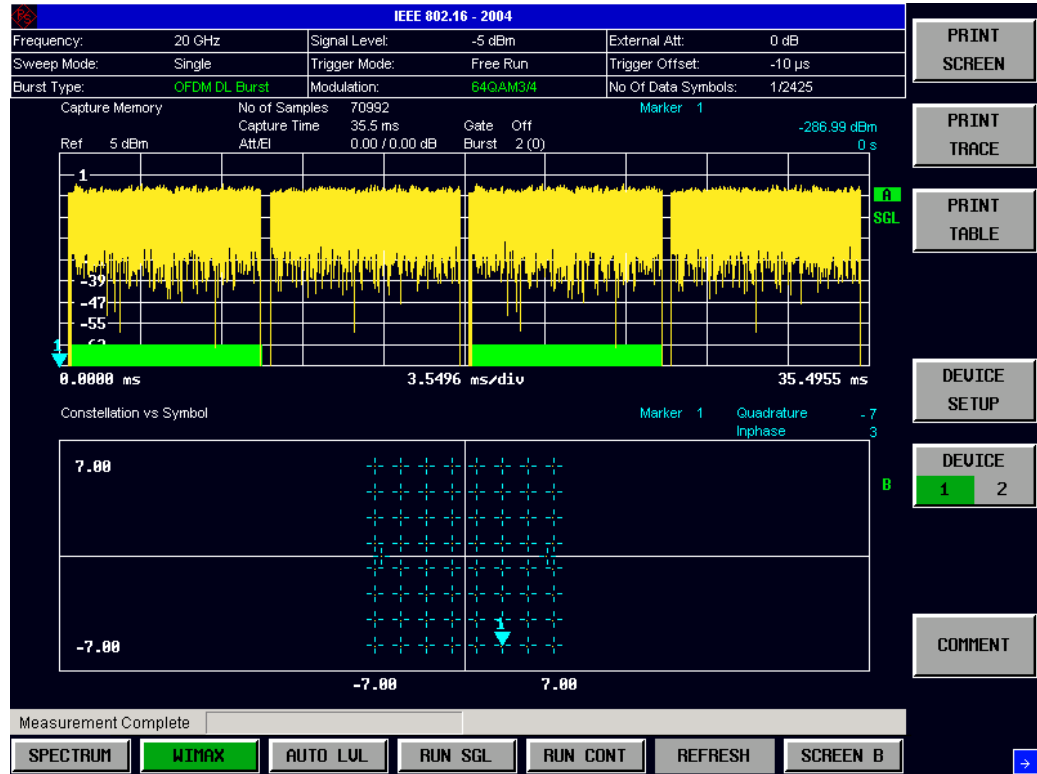


Fig. 1-10 Print softkey menu

The print facility provided by R&S FSQ-K92 is exactly the same as that provided by the host analyzer. Refer to the user manual for the spectrum analyzer for details of the print facility operation.

To close the print softkey menu and return to the main R&S FSQ-K92 softkey menu, press the *WIMAX* hotkey.

2 Measurements & Settings

This section contains a detailed description of all measurement modes, settings & results. It covers the following subjects:

- Measurement modes
- Running measurements
- Measurement results
- General settings
- Demodulation settings
- Gate settings
- Marker settings
- General hints about measurements

Measurements

R&S FSQ-K92 provides two main measurement types:

- IQ Measurements
- Frequency Sweep Measurements

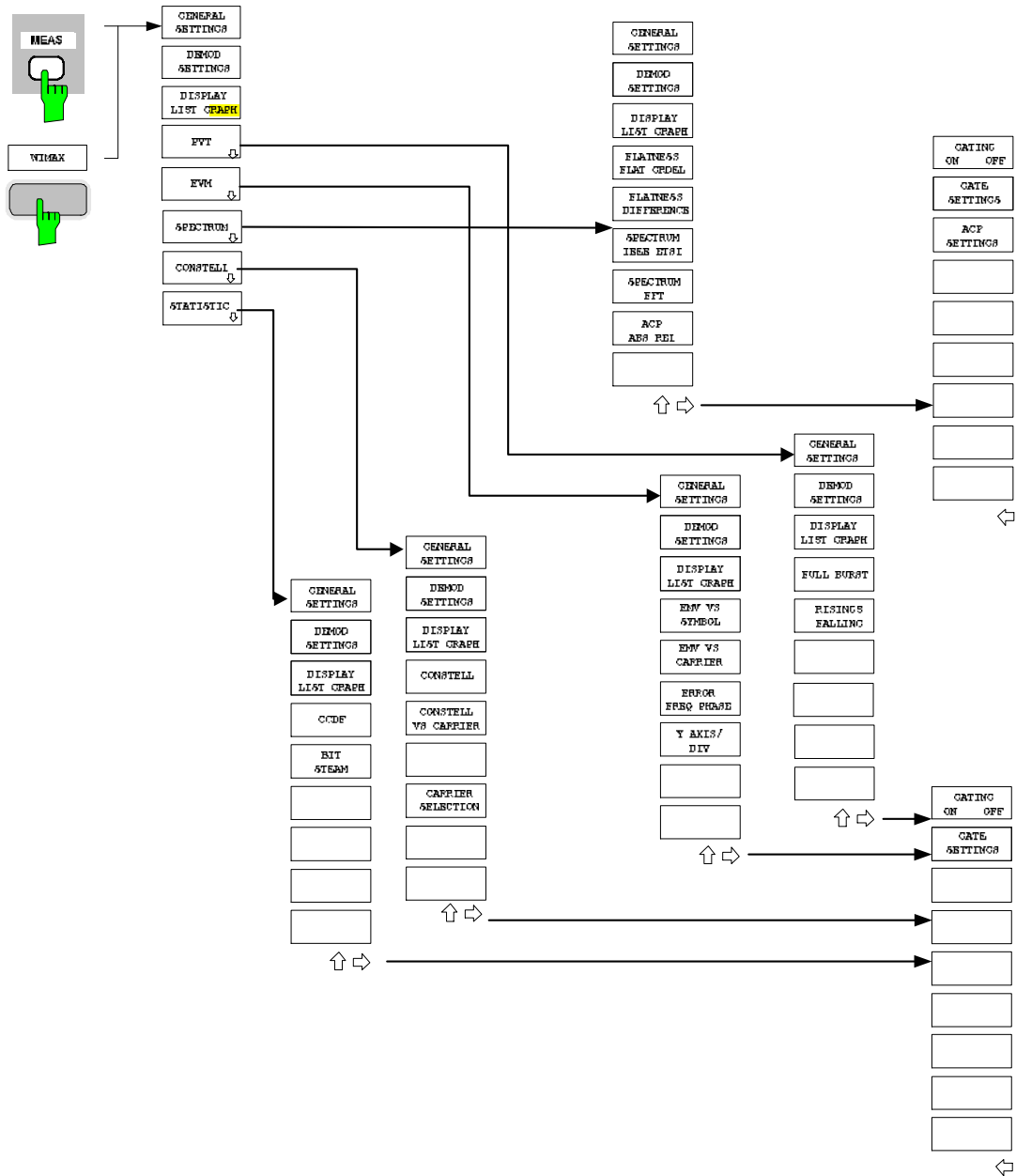


Fig. 2-1 IEEE 802.16-2004

IQ measurements

The following measurements results are obtained in IQ measurement mode:

- Power Vs Time (PVT)
- EVM Vs Symbol
- EVM Vs Carrier
- Phase Vs Preamble
- Frequency Vs Preamble
- Spectrum Flatness
- Spectrum Group Delay
- Spectrum Flatness Adjacent Carrier Power Difference
- Spectrum FFT
- Constellation Vs Symbol
- Constellation Vs Carrier
- Conditional Cumulative Distribution Function (CCDF)
- Bit Stream

For each of the above results the Magnitude Capture Buffer display is available.

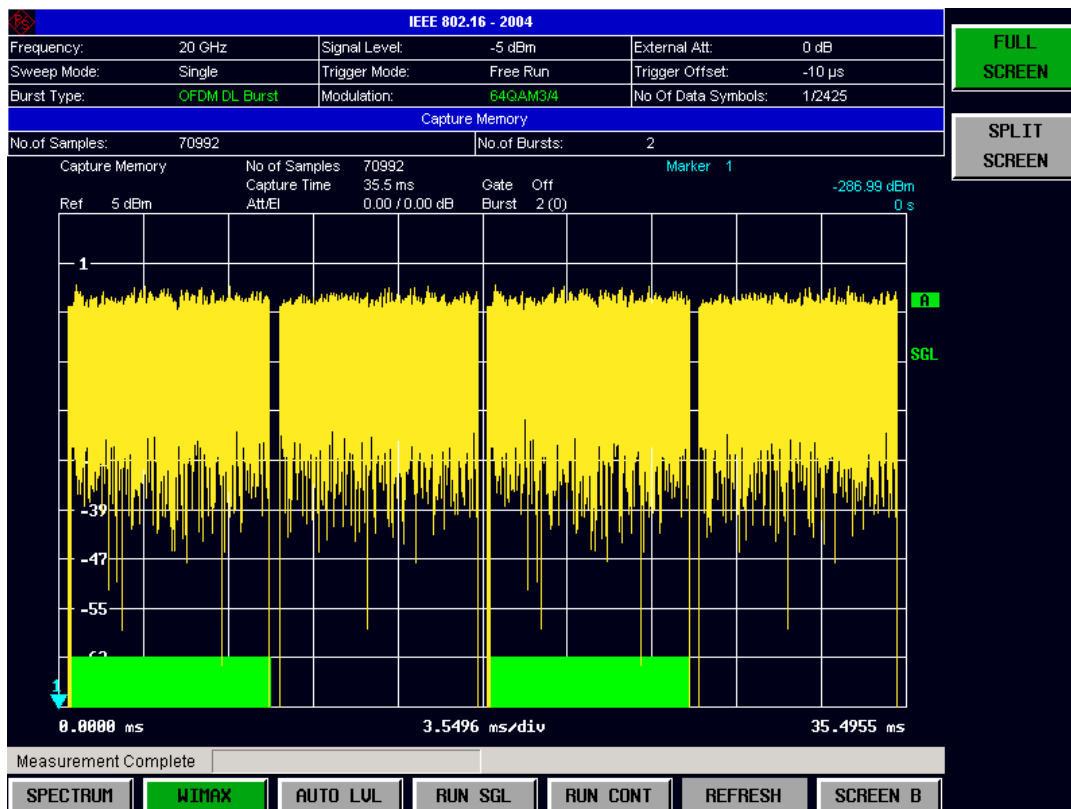


Fig. 2-2 Magnitude Capture Buffer Results

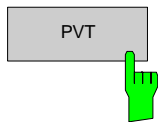
The Magnitude Capture buffer shows the complete range of captured data for the last sweep. All analyzed bursts are identified with a green bar at the bottom of the Magnitude Capture buffer. Only those bursts which matched the required criteria are marked with a green bar.

All IQ measurements process the same signal data and as such all IQ measurement results are available after a single IQ measurement execution.

IQ measurements can be run in split screen mode (allowing both the Magnitude Capture Buffer Display and the selected IQ measurement results to be displayed simultaneously) or in full screen mode (with either the Magnitude Capture Buffer Display or the selected IQ measurement results displayed).

IQ measurements may be performed for RF or Baseband input.

Power Vs Time(PVT)



The PVT measurement results are selected by pressing the *PVT* softkey in the main measurement softkey menu.

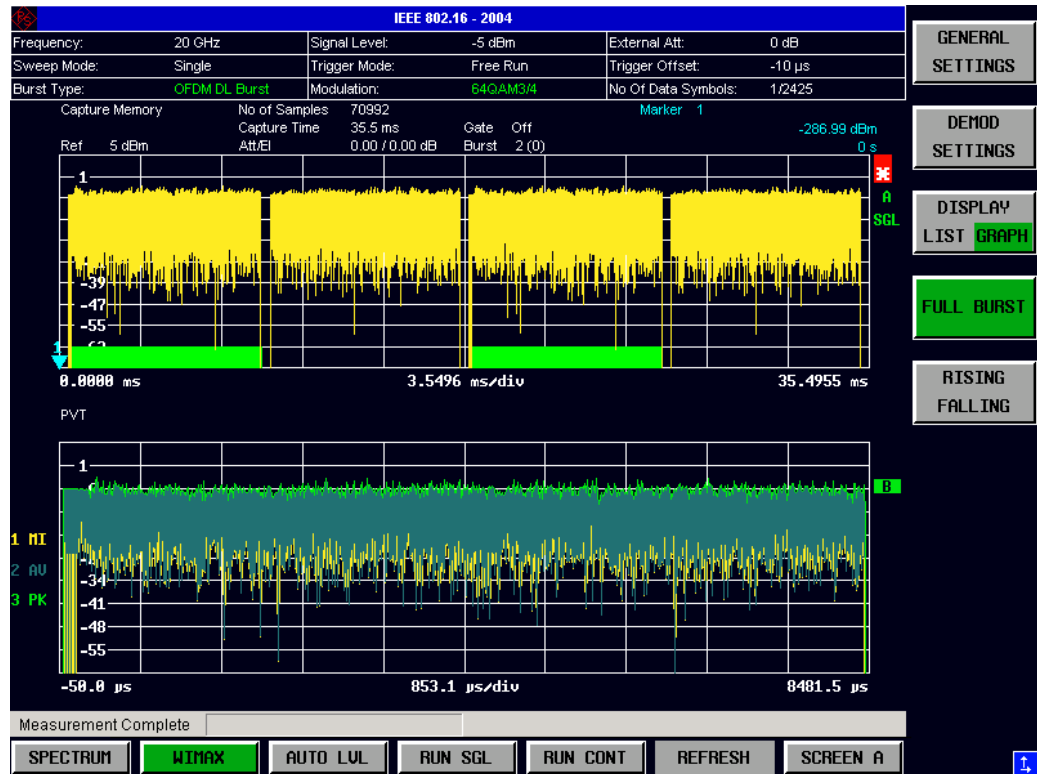
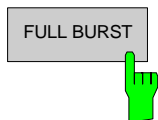
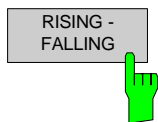


Fig. 2-3 PVT Results – Full Burst

The PVT results display shows the minimum, average and maximum levels measured over the full range of the measured input data, or over complete bursts displayed within the gating lines if gating is switched on. The results are displayed as a single burst. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the *REFRESH* hotkey



Pressing the *FULL BURST* softkey displays the results in a single graph with all burst data being displayed.



Pressing the *RISING FALLING* softkey displays the results in two separate graphs, the left hand side showing the rising edge and the right hand side showing the falling edge.

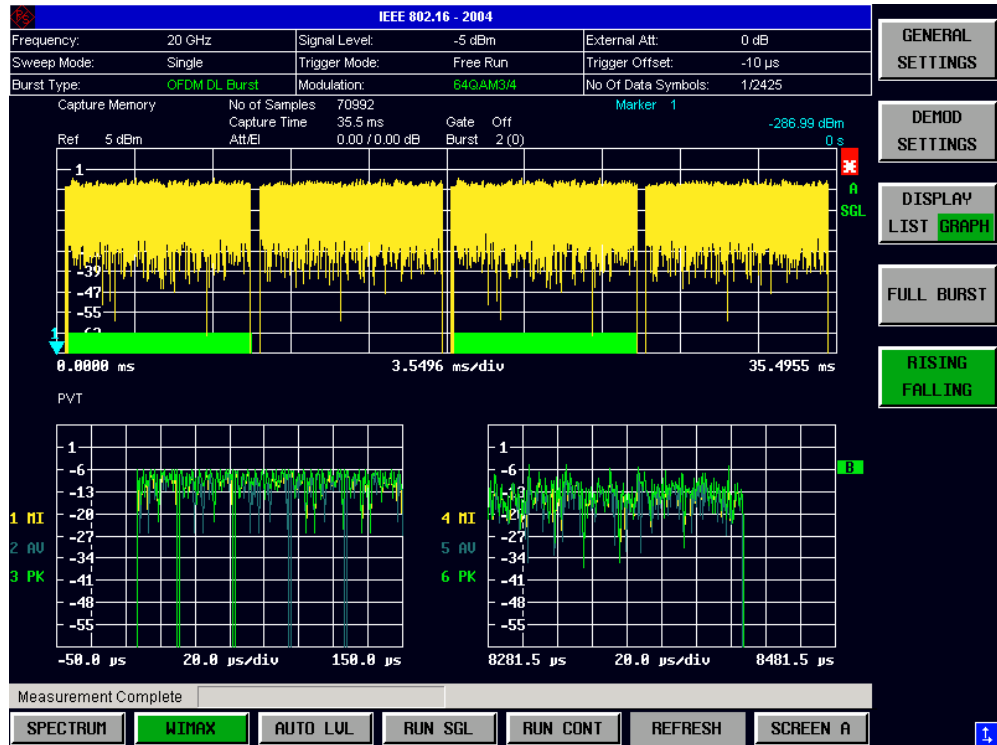
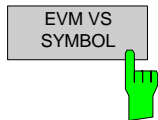


Fig. 2-4 PVT Results – Rising Falling Edge

EVM Vs Symbol



The EVM Vs Symbol measurement results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *EVM Vs SYMBOL* softkey

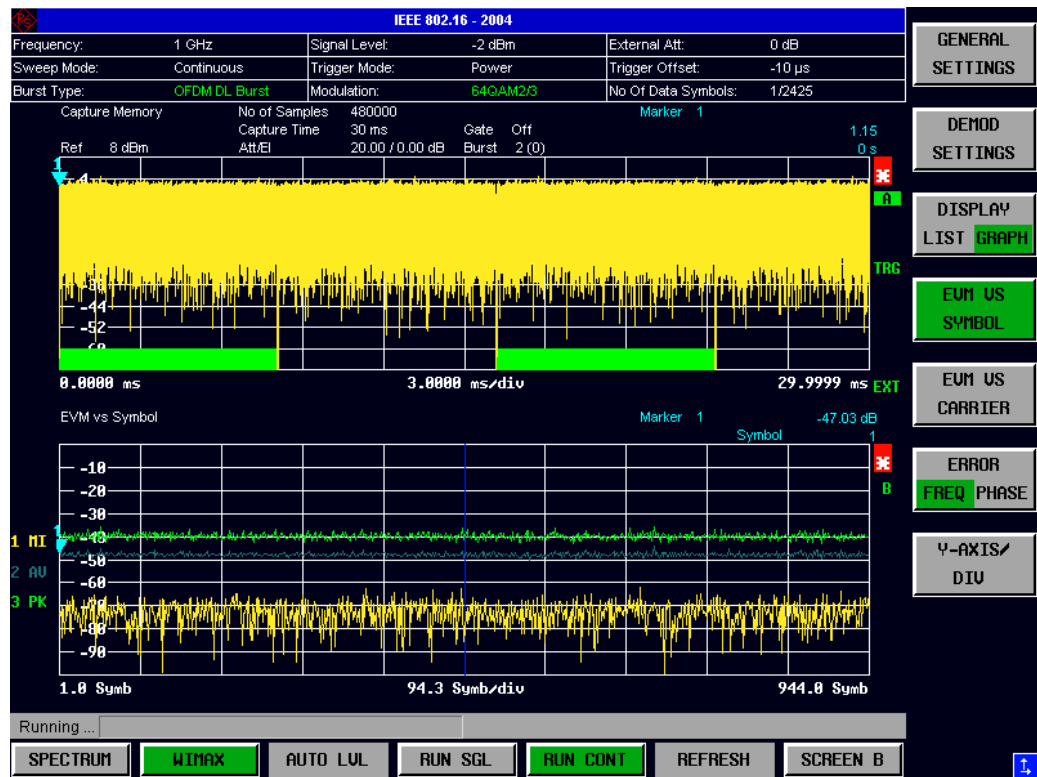
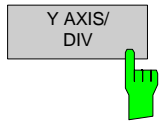


Fig. 2-5 EVM Vs Symbol

The EVM Vs Symbol results display shows the EVM measured over the full range of the measured input data. The results are displayed on a per-symbol basis, with blue vertical lines marking the boundaries of each burst. Note that burst boundary lines are only displayed if the number of analyzed bursts is less than 250. The minimum, average and maximum traces are displayed.

For the trace labelled with EVM a commonly used EVM definition is applied, which is the square root of the momentary error power normalized by the averaged reference power. For details of this measurements please refer to chapter 3.



Pressing **Y AXIS/ DIV** softkey displays a pop-up dialog which allows the settings of the Y-Axis to be controlled.

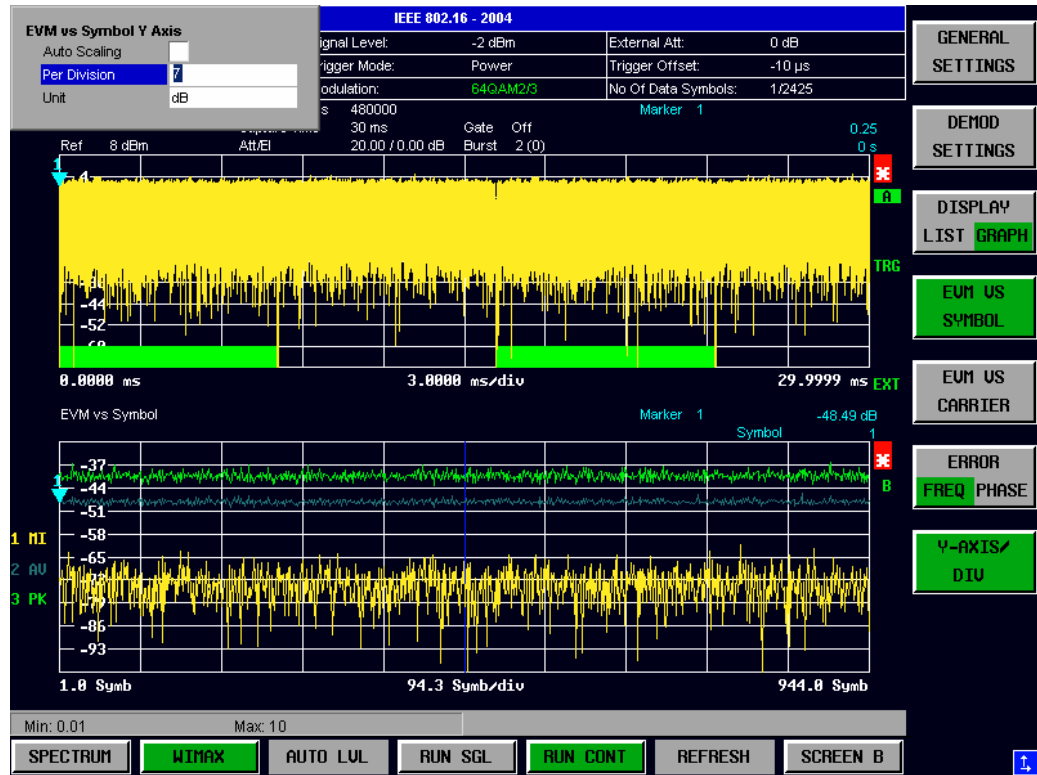


Fig. 2-6 EVM Vs Symbol - Y-Axis Scaling

EVM Vs Symbol Y Axis

Auto Scaling

EVM vs Symbol Y Axis	
Auto Scaling	<input checked="" type="checkbox"/>
Per Division	3
Unit	%

Auto Scaling specifies whether the Y-Axis scale should be calculated manually or automatically.

When the *Auto Scaling* parameter is switched OFF then the setting of the *Per Division* setting is used to calculate the Y-Axis scale.

Per Division

EVM vs Symbol Y Axis	
Auto Scaling	<input checked="" type="checkbox"/>
Per Division	3
Unit	%

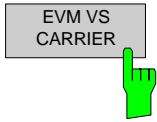
Per Division specifies the scaling is to be used when *Auto Scaling* is switched OFF.

Unit

EVM vs Symbol Y Axis	
Auto Scaling	<input checked="" type="checkbox"/>
Per Division	3
Unit	%

Unit allows Y-Axis unit to be specified.

EVM Vs Carrier



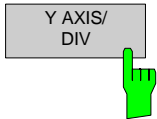
The EVM Vs Carrier measurement results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *EVM Vs CARRIER* softkey.



Fig. 2-7 EVM Vs Carrier Results

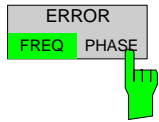
The EVM Vs Carrier results display shows the all EVM values recorded on a per-carrier basis over the full set of measured data. The minimum, average and maximum traces are displayed.

The scaling of the Y-Axis can be modified to allow the results to be scaled to an optimum level.



Pressing *Y AXIS/ DIV* softkey displays a pop-up dialog which allows the settings of the Y-Axis to be controlled. The settings provided are the same as for the EVM Vs Symbol measurement screen.

Error Vs Preamble



The Error Vs Preamble results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *ERROR FREQ/PHASE* softkey. Subsequent presses of the *ERROR FREQ/PHASE* softkey toggle the Error measurement between Frequency Error Vs Preamble and Phase Error Vs Preamble.

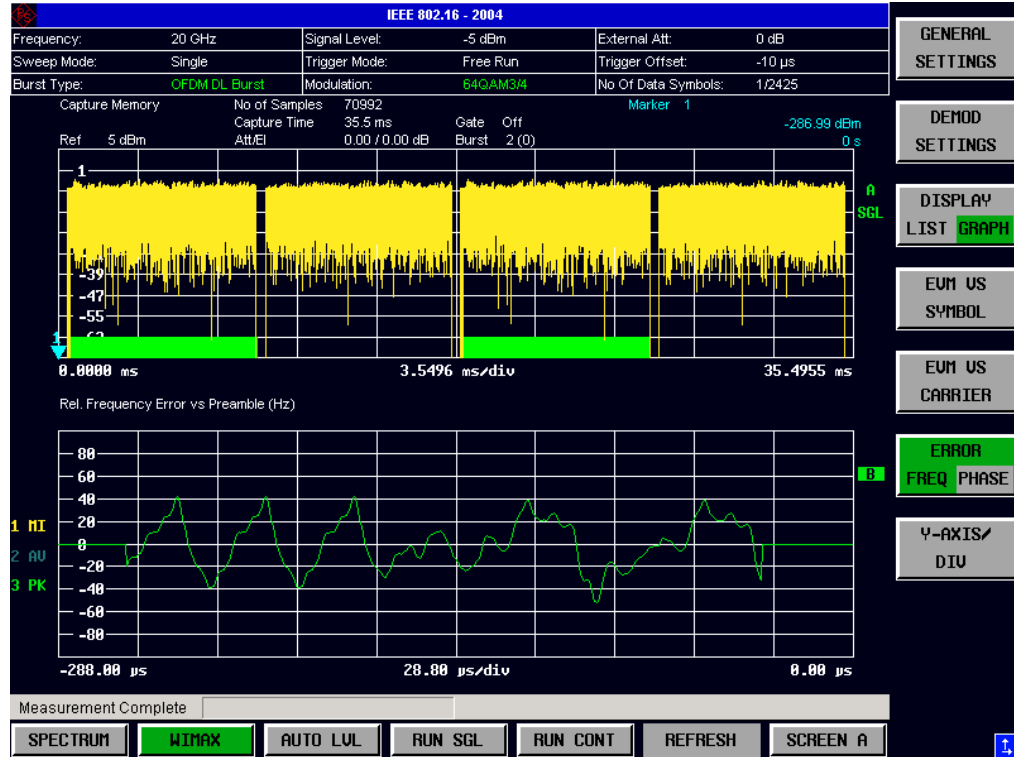
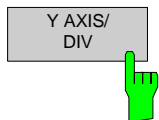


Fig. 2-8 Error Vs Preamble Results

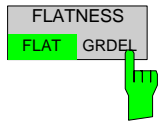
The Error Vs Preamble results display shows the error values recorded over the preamble part of the burst. A minimum, average and maximum trace are displayed. The results display either relative frequency error or phase error.

The scaling of the Y-Axis can be modified to allow the results to be scaled to an optimum level.



Pressing *Y AXIS/ DIV* softkey displays a pop-up dialog which allows the settings of the Y-Axis to be controlled. The settings provided are the same as for the *EVM Vs Symbol* measurement screen.

Spectrum Flatness



The Spectrum Flatness measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS FLAT/GRDEL* softkey. Subsequent presses of the *FLATNESS FLAT/GRDEL* softkey toggle the Flatness measurement between Spectrum Flatness and Spectrum Flatness Group Delay.

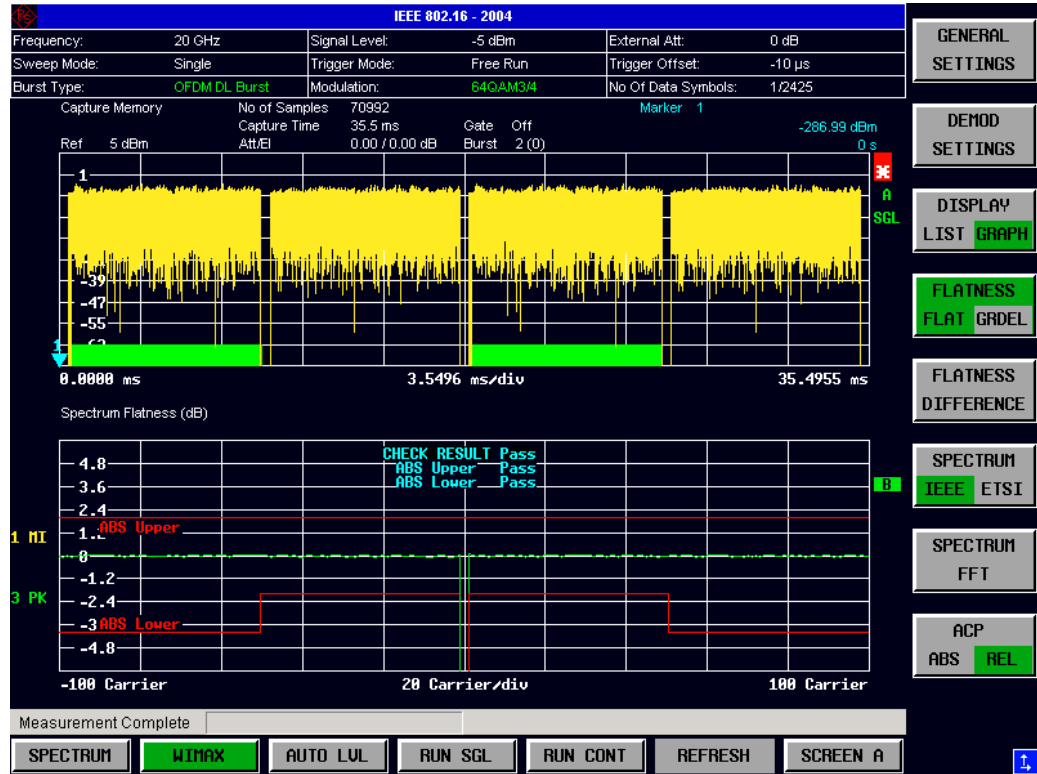



Fig. 2-9 Spectrum Flatness Results

The Spectrum Flatness results display shows either the Spectrum Flatness or the Group Delay values recorded on a per-carrier basis over the full set of measured data. A minimum, average and maximum trace are displayed for each of the result types. When Spectrum Flatness results are selected an upper and lower limit line representing the limits specified for the selected standard are displayed. An overall pass/fail status is displayed for the obtained (average) results against these limit lines.

Flatness Difference

FLATNESS DIFFERENCE



The Flatness Difference results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *FLATNESS DIFFERENCE* softkey.

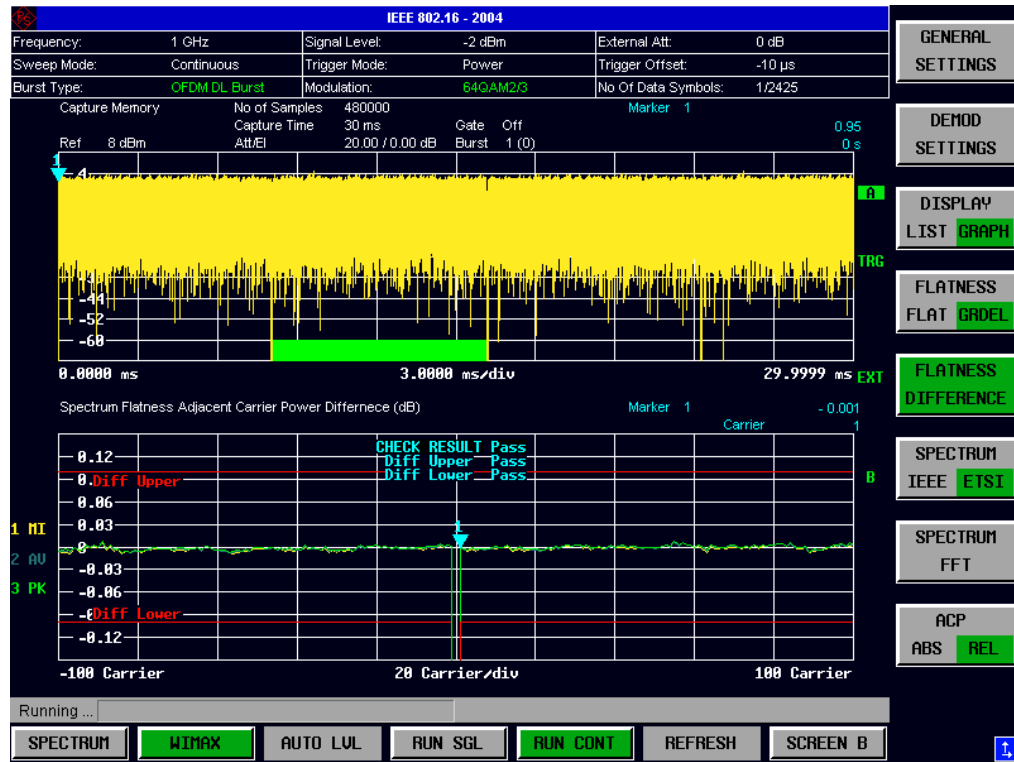
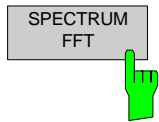


Fig. 2-10 Flatness Difference Results

The Flatness Difference results display shows the adjacent carrier power difference the preamble part of the burst. A minimum, average and maximum trace are displayed.

Spectrum FFT



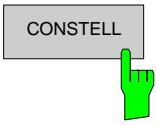
The Spectrum FFT measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *SPECTRUM FFT* softkey.



Fig. 2-11 Spectrum FFT Results

The Spectrum FFT results display shows the Power Vs Frequency results obtained from a FFT performed over the range of data in the Magnitude Capture buffer which lies within the gate lines. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the *REFRESH* hotkey

Constellation Vs Symbol



The Constellation diagram is selected by pressing the *CONSTELL* softkey in the main measurement softkey menu followed by the *CONSTELL* softkey,

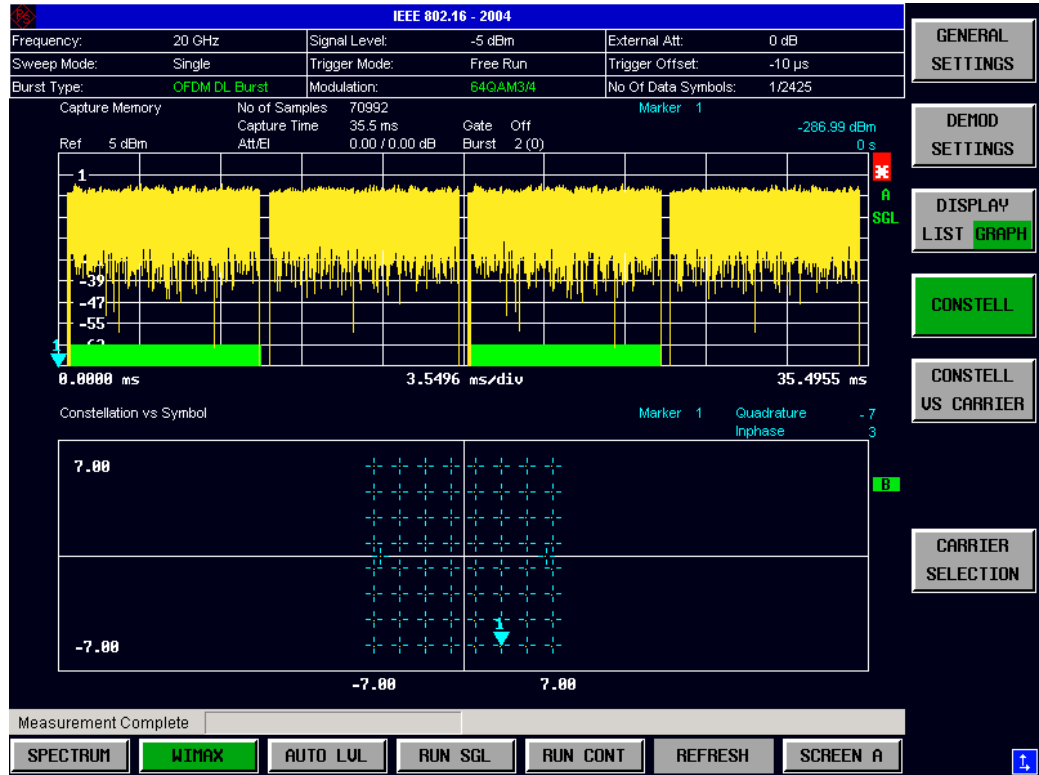
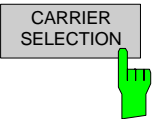


Fig. 2-12 Constellation Vs Symbol Results

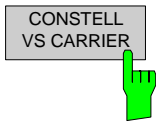
The Constellation display shows the Inphase and Quadrature phase results over the full range of the measured input data. The ideal points for the selected modulations scheme are displayed for reference purposes.

The amount of data displayed in the Constellation results display can be reduced by selecting the carrier or carriers for which data is to be displayed.



Pressing *CARRIER SELECTION* softkey displays a pop-up dialog which allows the carrier for data display to be selected. Either a specific carrier number or pilots only can be selected. Selecting All Carriers allows all the results to be displayed.

Constellation Vs Carrier



The Constellation Vs Carrier measurement results are selected by pressing the *CONSTELL* softkey in the main measurement softkey menu followed by the *CONSTELL VS CARRIER* softkey,

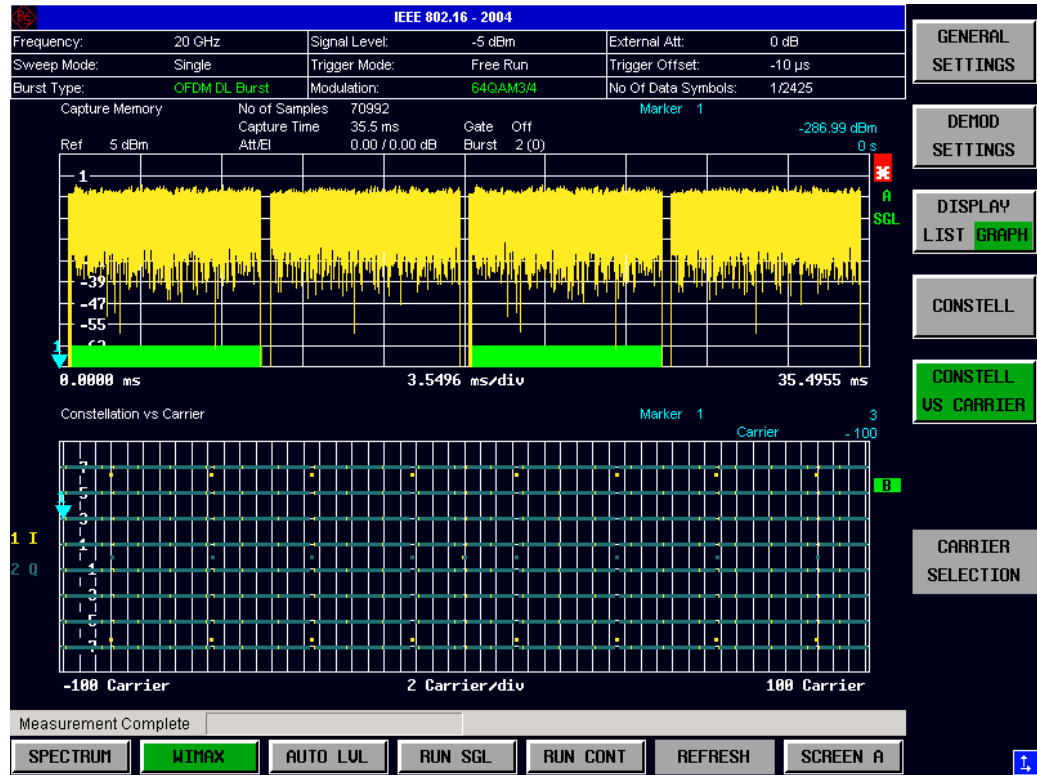
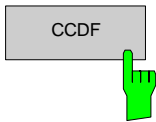


Fig. 2-13 Constellation Vs Carrier Results

The Constellation Vs Carrier results display shows the Inphase and Quadrature phase results over the full range of the measured input data plotted on a per-carrier basis. The magnitude of the Inphase and Quadrature part is shown on the Y-axis, both are displayed as separate traces (I-> trace 1, Q-> trace 2).

Conditional Cumulative Distribution Function (CCDF)



The CCDF measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *CCDF* softkey,

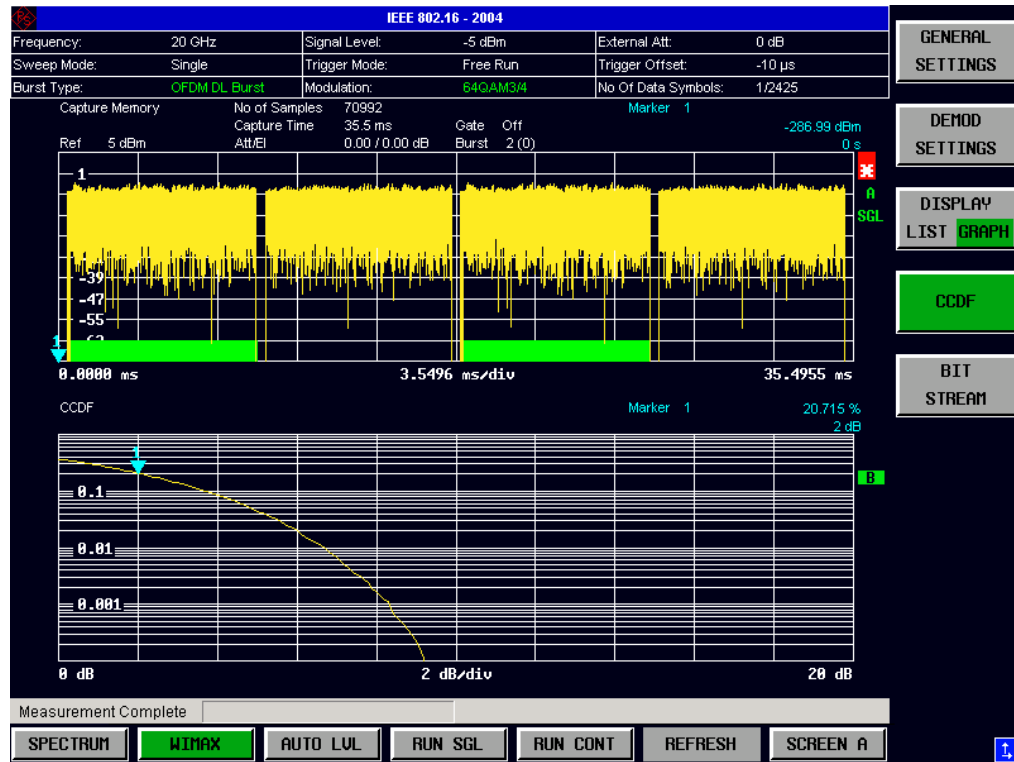
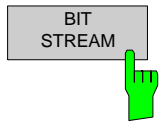


Fig. 2-14 CCDF Results

The CCDF results display shows the probability of an amplitude within the gating lines exceeding the mean power measured between the gating lines. The X-axis displays power relative to the measured mean power. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the *REFRESH* hotkey

Bit Stream



The Bit Stream measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *BIT STREAM* softkey.

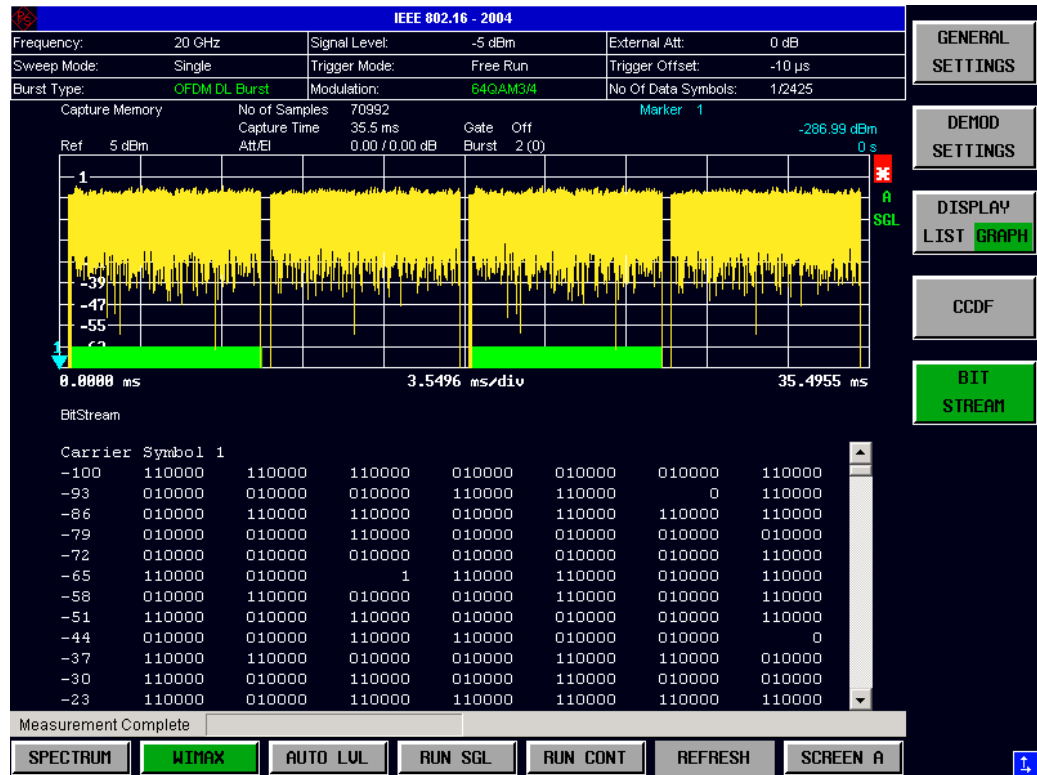


Fig. 2-15 Bit-Stream Results

The bit stream results display shows the demodulated data stream. These results are grouped by symbol and carrier. When no other dialogs are on display the results can be scrolled through using the cursor keys or scroll wheel.

Frequency sweep measurements

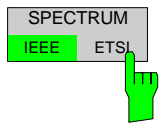
The following measurements results are obtained in frequency sweep mode:

- Spectrum Mask
- Spectrum ACP/ACPR

The frequency sweep measurements use different signal data to IQ measurements and as such it is not possible to run an IQ measurement and then view the results in the frequency sweep measurements and vice-versa. Also because each of the frequency sweep measurement use different settings to obtain signal data it is not possible to run a frequency sweep measurement and view the results in another frequency sweep measurement.

All frequency sweep measurements are run in full screen mode. Frequency sweep measurements are only available when RF input is selected.

Spectrum Mask



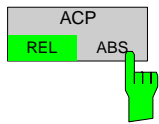
The Spectrum Mask measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *SPECTRUM IEEE/ETSI* softkey. Subsequent presses of the *SPECTRUM IEEE/ETSI* softkey toggle the Spectrum measurement between IEEE and ETSI standards.



Fig. 2-16 Spectrum Mask Results

The Spectrum Mask results display shows power against frequency. The span of the results is related to the specified sample rate. A limit line representing the spectrum mask specified for the selected standard is displayed and an overall pass/fail status is displayed for the obtained results against this limit line. If the *Sweep Count (Mask/ACP)* parameter in the General Settings view is set to any value other than 1 then the measurement is performed over the specified number of sweeps. When the measurement is performed over multiple sweeps a max hold trace is displayed as well as an average trace.

Spectrum ACP



The Spectrum ACP measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *ACP REL/ABS* softkey. Subsequent presses of the *ACP REL/ABS* softkey toggle the measurement between relative and absolute results display.

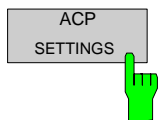


Fig. 2-17 Spectrum ACPR Results

The Spectrum ACPR (Adjacent Channel Power (Relative)) is similar to the Spectrum Mask measurement, and provides information about leakage into adjacent channels. The results show the relative power measured in the three nearest channels either side of the measured channel. This measurement is the same as the Adjacent Channel Power measurement provided by the Spectrum Analyzer. . If the *Sweep Count (Mask/ACP)* parameter in the General Settings view is set to any value other than 1 then the measurement is performed over the specified number of sweeps. When the measurement is performed over multiple sweeps a max hold trace is displayed as well as an average trace.

By default the ACP Settings are derived from the Channel Bandwidth setting of the General Settings Panel.

The Spectrum ACP measurement can be configured from the ACP settings view:



The *ACP SETTINGS* softkey brings up the ACP Settings view.



Fig. 2-18 ACP Settings view

No of Channels

No. of Channels	3
-----------------	---

No of Channels specifies then number of channels adjacent to the transmit channel to be measured.

If *No of Channels* is set to 0 then only the transmit channel is measured.

TX/ACP Channel BW

The TX/ACP Channel BW settings specify the bandwidth of specific channels.

TX Channel Bandwidth

TX/ACP Channel BW	
Channel	Bandwidth
TX	1.75 MHz
Adjacent	1.75 MHz
Alternate 1	1.75 MHz
Alternate 2	1.75 MHz

TX Channel Bandwidth specifies the bandwidth of the transmit channel to be measured by the ACP measurement.

Adjacent Channel Bandwidth

TX/ACP Channel BW	
Channel	Bandwidth
TX	1.75 MHz
Adjacent	1.75 MHz
Alternate 1	1.75 MHz
Alternate 2	1.75 MHz

Adjacent Channel Bandwidth specifies the bandwidth of the first channel before and after the transmit channel to be measured.

Alternate 1 Channel Bandwidth

TX/ACP Channel BW	
Channel	Bandwidth
TX	1.75 MHz
Adjacent	1.75 MHz
Alternate 1	1.75 MHz
Alternate 2	1.75 MHz

Adjacent Channel Bandwidth specifies the bandwidth of the second channel before and after the transmit channel to be measured.

Alternate 2 Channel Bandwidth

TX/ACP Channel BW	
Channel	Bandwidth
TX	1.75 MHz
Adjacent	1.75 MHz
Alternate 1	1.75 MHz
Alternate 2	1.75 MHz

Adjacent Channel Bandwidth specifies the bandwidth of the third channel before and after the transmit channel to be measured.

ACP Channel Spacing

The ACP Channel Spacing settings specify the spacing of specific channels.

Adjacent Channel Spacing

ACP Channel Spacing	
Channel	Spacing
Adjacent	1.75 MHz
Alternate 1	3.5 MHz
Alternate 2	5.25 MHz

Adjacent Channel Bandwidth specifies the spacing of the first channel before and after the transmit channel to be measured.

Alternate 1 Channel Spacing

ACP Channel Spacing	
Channel	Spacing
Adjacent	1.75 MHz
Alternate 1	3.5 MHz
Alternate 2	5.25 MHz

Adjacent Channel Bandwidth specifies the spacing of the second channel before and after the transmit channel to be measured.

Alternate 2 Channel Spacing

ACP Channel Spacing	
Channel	Spacing
Adjacent	1.75 MHz
Alternate 1	3.5 MHz
Alternate 2	5.25 MHz

Adjacent Channel Bandwidth specifies the spacing of the third channel before and after the transmit channel to be measured.

Automatic Level Detection

Automatic level detection allows the Signal Level and Reference Level settings to be calculated from the input signal.

Automatic level detection can be performed in one of two ways:

Pressing the *AUTO LVL* hot-key
Setting *Auto Level* in the General Settings view to ON

Running the Automatic Level Detection by pressing the *AUTO LVL* hot-key allows the level detection to be run at any time. Once the Automatic Level Detection has completed the trace is displayed in the Magnitude Capture Buffer display.

Running the Automatic Level Detection by Setting *Auto Level* in the General Settings view to ON means that an Automatic Level Detection measurement is executed before each main measurement sweep. When running the Automatic Level Detection this way no trace for the Automatic Level Detection measurement is displayed. This way of running the Automatic Level Detection will cause measurements to run more slowly and as such it is recommended that Automatic Level Detection is only run in this way when the speed of measurement is not important or when running continuous measurements are being run with a signal which varies in level from one sweep to the next.

Running measurements

To start a measurement, press the *RUN SGL* hotkey (single) or *RUN CONT* hotkey (continuous).

A single measurement will complete once the requested number of bursts have been obtained or a single sweep has been completed, depending on the measurement settings. When a measurement is completed in continuous mode then a new measurement will be started.

Note that if one measurement is started whilst another measurement is in progress, for example, a single measurement is started whilst a continuous measurement is in progress, then the first measurement will be aborted and the new measurement started immediately.

During a measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen. After successful completion of a single measurement, the Status Bar will display "*Measurement Complete*"

Measurement results

Measurement results

The tabular section below the title bar shows the overall measurement settings used to obtain the current measurement results.

IEEE 802.16 - 2004					
Frequency:	20 GHz	Signal Level:	-5 dBm	External Att:	0 dB
Sweep Mode:	Single	Trigger Mode:	Free Run	Trigger Offset:	-10 μ s
Burst Type:	OFDM DL Burst	Modulation:	64QAM3/4	No Of Data Symbols:	1/2425

Fig. 2-19 Overall measurement settings summary

The settings summary includes the following information:

- Frequency The frequency of the measured input signal. Note that no value is displayed in this field when Baseband input is selected.
- Sweep Mode Shows “Single” for a single measurement and “Continuous” for a continuous measurement.
- Burst Type The type of burst being analyzed.
- Signal Level The expected mean signal level for the input signal.
- Trigger Mode The trigger source used to start the measurement sweep
- Modulation Shows the settings of the *PDU Mod to Analyze* from the Demod Settings view.
- External Att The attenuation (positive values) or gain (negative values) applied to the signal externally (i.e. before the RF- or IQ- connector of the spectrum analyzer)
 - e.g.
 - External Att = 10dB means that before the RF-connector of the R&S FSQ a 10dB attenuator is used
 - External Att = -20dB means that before the RF-connector of the R&S FSQ a amplifier with 20dB gain is used
- Trigger Offset The trigger delay (positive value) or pre-trigger time (negative value) applied to the trigger.
- No Of Data Symbols Shows the minimum and maximum number of data symbols that a burst may have if it is to be considered in results analysis.

Results Summary

The results summary table is displayed for IQ measurements when the display mode is set to List. This table shows the overall measurement results and provides limit checking for result values in accordance with the selected standard.

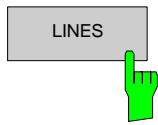


Fig. 2-20 Result Summary Table

Result values which are within the limit as specified by the standard are displayed in green. Result values which are outside of the limits specified by the standard are displayed in red with a '*' to the left. Results which have no limits specified by the standard are displayed in white. Limit values are displayed in white (not bold).

For more details regarding how the results are calculated see section 3

The limit values in the table of results can be modified.

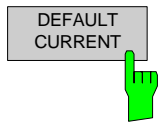


Pressing the *LINES* hardkey allows limits to be selected and modified

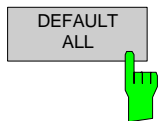
IEEE 802.16 - 2004						
Frequency:	20 GHz	Signal Level:	-33.1 dBm	External Att:	0 dB	
Sweep Mode:	Single	Trigger Mode:	Free Run	Trigger Offset:	-10 µs	
Burst Type:	OFDM DL Burst	Modulation:	64QAM3/4	No Of Data Symbols:	1/2425	
Result Summary						
No. of Bursts	8					
	Min	Mean	Limit	Max	Limit	Unit
EVM All Carriers	-50.92	-50.35	31.00	-49.39	-31.00	dB
EVM Data Carriers	-50.89	-50.34	-31.00	-49.42	-31.00	dB
EVM Pilot Carriers	-52.54	-50.50		-48.69		dB
IQ Offset	-47.09	-46.79		-46.42		dB
Gain Imbalance	0.00	0.00		0.00		dB
Quadrature Error	0.000	0.000		0.000		°
Center Frequency Error	-0.00	0.50 ± 160000		1.46 ± 160000		Hz
Symbol Clock Error	-0.13	1.59 ± 8		3.62 ± 8		ppm
Burst Power	-22.28	-22.28		-22.28		dBm
Crest Factor	5.70	5.70		5.72		dB
RSSI	-4.46	-4.46		-4.46		dBm
RSSI Standard Deviation		-43.52				dB
CINR	51.87	51.97		53.46		dB
CINR Standard Deviation		36.55				dB
Measurement Complete						
SPECTRUM WIMAX AUTO LVL RUN SGL RUN CONT REFRESH SCREEN B						

Fig. 2-21 Editing Limit Values

Limits are modified for the currently selected modulation scheme. Each modulation scheme may have its own set of user defined limits.



Pressing the *DEFAULT CURRENT* hardkey resets all limits for the current modulation scheme to those values specified in the selected standard



Pressing the *DEFAULT ALL* hardkey resets all limits for all modulation schemes to those values specified in the selected standard

The results displayed in this table are for the entire measurement. If a specific number of bursts have been requested which requires more than one sweep then the results summary update at the end of each sweep showing the results so far. The number of bursts measured and the number of bursts requested are displayed to show the progress through the measurement.

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

General Settings

This section of the user manual describes the General Settings view where all settings related to the overall measurement can be modified, that is the Signal Characteristics, Data Capture, Trigger IQ, Input and Advanced settings.

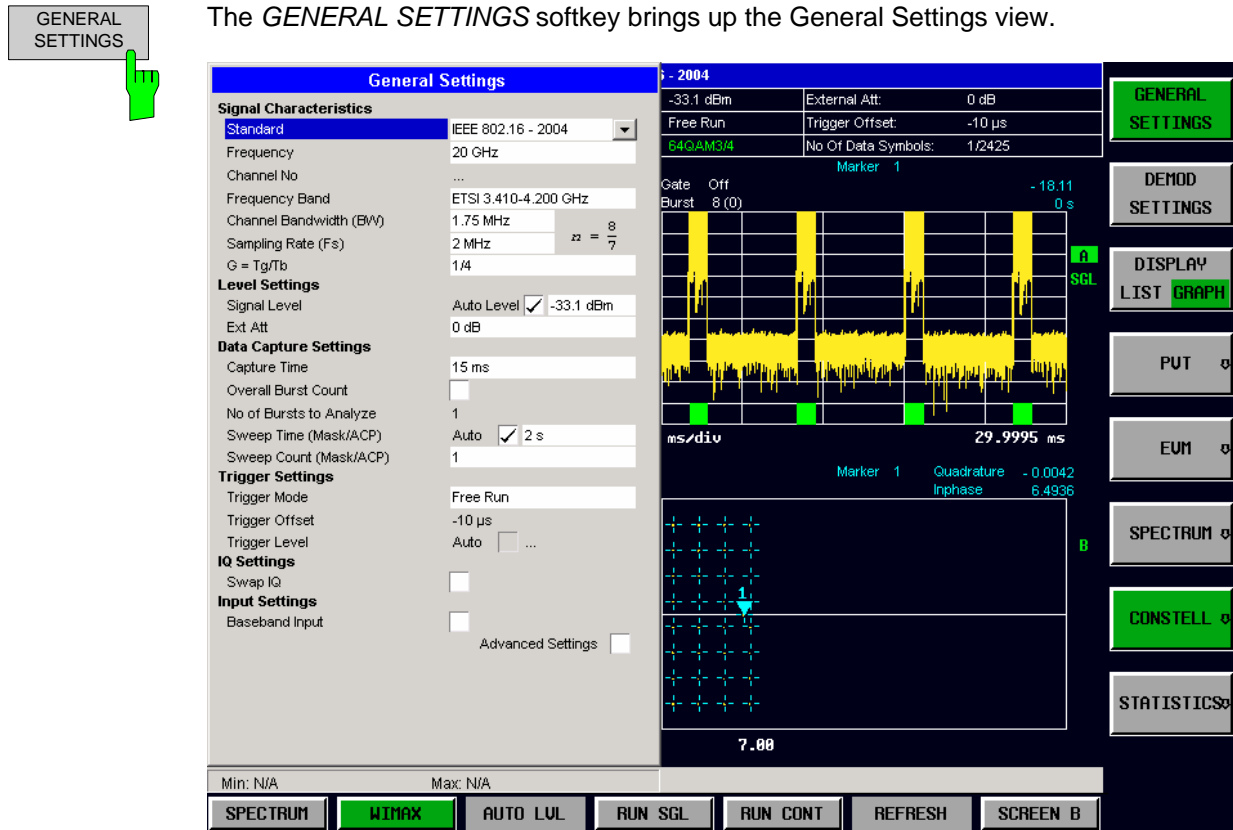


Fig. 2-22 General Settings view

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

- Signal Characteristics
- Level Settings
- Data Capture Settings
- Trigger Settings
- IQ Settings
- Input Settings
- Advanced Settings

Any parameters that are not available for editing will have a grey background. This usually occurs when one parameter setting makes another parameter invalid, for example if the *Trigger Mode* is Free Run then none of the parameters below this (*Trigger Offset*, *Power Level* and *Auto Power Trigger Level*) have any meaning, so these parameters are greyed out.

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

Signal Characteristics

The Signal Characteristics settings are the general settings concerning the physical attributes of the signal to be measured.

Standard

Signal Characteristics	
Standard	IEEE 802.16 - 2004
Frequency	20 GHz
Channel No	...
Frequency Band	ETSI 3.410-4.200 GHz
Channel Bandwidth (BW)	1.75 MHz
Sampling Rate (Fs)	2 MHz $n = \frac{8}{7}$
G = Tg/Tb	1/4

Standard is used to select the WiMAX standard to be measured against. This is necessary to ensure that the measurements are performed according to the specified standard with the correct limit values and limit lines.

This parameter provides a list of settings. The list provided depends on the standards which have been installed.

Frequency

Signal Characteristics	
Standard	IEEE 802.16 - 2004
Frequency	20 GHz
Channel No	...
Frequency Band	ETSI 3.410-4.200 GHz
Channel Bandwidth (BW)	1.75 MHz
Sampling Rate (Fs)	2 MHz $n = \frac{8}{7}$
G = Tg/Tb	1/4

Frequency specifies the Center Frequency of the signal to be measured.

When the *Frequency* is modified the *Channel No* parameter is updated accordingly.

The *Frequency* parameter is not editable when Baseband input is selected because *Frequency* only makes sense for a RF signal.

Channel No

Signal Characteristics	
Standard	IEEE 802.16 - 2004
Frequency	20 GHz
Channel No	-
Frequency Band	ETSI 3.410-4.200 GHz
Channel Bandwidth (BW)	1.75 MHz
Sampling Rate (Fs)	2 MHz $n = \frac{8}{7}$
G = Tg/Tb	1/4

Channel No specifies the channel to be measured.

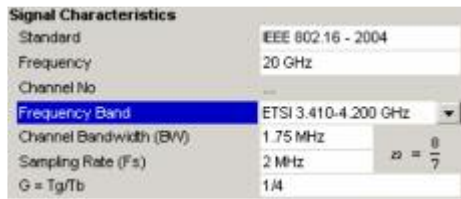
When the *Channel No* is modified the *Frequency* parameter is updated accordingly.

For the Licensed Bands {ETSI, MMDS, WCS} Channel Numbers are supported according to [IEEE Std 802.16-2004] "8.3.10.2 Transmitter channel bandwidth and RF carrier frequencies". For the target frequency bands see [IEEE Std 802.16-2004] "B.1 Targeted frequency bands". I.e. entering a Channel Number will derive the corresponding Center Frequency according to the section in the standard mentioned above.

For the License Exempt Bands {U-NII, CEPT} Channel Numbers are supported according to [IEEE Std 802.16-2004] "8.5.1 Channelization". I.e. entering a Channel Number will derive the corresponding Center Frequency according to the section in the standard mentioned above.

The *Channel No* parameter is not editable when Base band input is selected because *Channel No* only make sense for a RF signal

Frequency Band



Frequency Band specifies the relationship between the *Channel Bandwidth* and the *Sample Rate* parameters.

The ratio of sample rate to channel bandwidth is shown to the side of the *Frequency Band* settings in the following format:

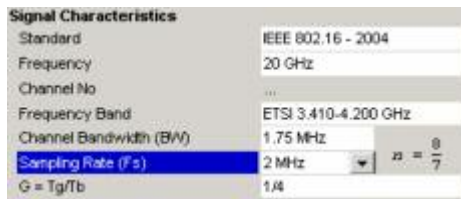
The Sampling Factor n is defined in the IEEE Std. 802.16-2004, section "8.3.2.2 Derived Parameter Definitions."

Channel Bandwidth



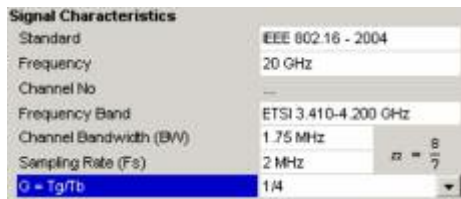
Channel Bandwidth specifies the bandwidth of the channel to be measured.

Sample Rate



Sample Rate specifies the sample rate used for IQ measurements.

G = Tg/Tb



$G = Tg/Tb$ specifies the guard time ratio

Level Settings

The level settings are the general settings concerning the level and attenuation of the signal to be measured

Auto Level



Auto Level selects whether the reference level for measurements is measured automatically (ON) or entered manually by the user (OFF).

When *Auto Level* is set to ON, R&S FSQ-K92 will measure the reference level automatically at the start of each measurement sweep. This ensures that the reference level is always set at the optimal level for obtaining accurate results but will result in slightly increased measurement times.

Signal Level (RF)

Level Settings	
Signal Level	Auto Level <input checked="" type="checkbox"/> -33.1 dBm
Ext Att	0 dB

Signal Level (RF) specifies the expected level of the RF input signal.

The *Signal Level (RF)* is updated after an automatic level detection measurement has been executed when RF input is selected.

The *Signal Level (RF)* parameter is not editable when Base band input is selected because *Signal Level (RF)* only make sense for an RF signal

Signal Level (Baseband)

Level Settings	
Signal Level	Auto Level <input checked="" type="checkbox"/> 1 V
Ext Att	0 dB

Signal Level (Baseband) specifies the expected level of the Baseband input signal.

The *Signal Level (Baseband)* is updated after an automatic level detection measurement has been executed when Baseband input is selected.

The *Signal Level (Baseband)* parameter is not editable when RF input is selected because *Signal Level (Baseband)* only make sense for a Baseband signal

Ext Att

Level Settings	
Signal Level	Auto Level <input checked="" type="checkbox"/> -33.1 dBm
Ext Att	0 dB

Ext Att specifies the external attenuation or gain applied to the RF signal. A positive value indicates attenuation, a negative value indicates gain.

All displayed power level values will be shifted by this value.

Data Capture Settings

The Data Capture settings specify how much data is to be captured and measured.

Capture Time

Data Capture Settings	
Capture Time	15 ms
Overall Burst Count	<input type="checkbox"/>
No of Bursts to Analyze	1
Sweep Time (Mask/ACP)	Auto <input checked="" type="checkbox"/> 2 s
Sweep Count (Mask/ACP)	1

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

Overall Burst Count

Data Capture Settings	
Capture Time	15 ms
Overall Burst Count	<input type="checkbox"/>
No of Bursts to Analyze	1
Sweep Time (Mask/ACP)	Auto <input checked="" type="checkbox"/> 2 s
Sweep Count (Mask/ACP)	1

Overall Burst Count specifies whether a specified number of bursts are to be captured and analyzed.

When *Overall Burst Count* is set to OFF then data analysis shall be performed on a single measurement sweep . When *Overall Burst Count* is set to ON then data analysis may be

performed over a number of consecutive sweeps until the required number of bursts has been captured and analyzed.

No of Burst to Analyze

Data Capture Settings	
Capture Time	15 ms
Overall Burst Count	<input type="checkbox"/>
No of Bursts to Analyze	1
Sweep Time (Mask/ACP)	Auto <input checked="" type="checkbox"/> 2 s
Sweep Count (Mask/ACP)	1

No of Burst to Analyze specifies the number of bursts to be measured.

If the number of bursts of the specified type are not contained in a single measurement sweep then measurement sweeps will continue to be performed until the requested number of bursts of the specified type have been captured.

The *No of Burst to Analyze* parameter is not editable when *Overall Burst Count* is set to OFF.

Sweep Time (Mask/ACPR)

Data Capture Settings	
Capture Time	15 ms
Overall Burst Count	<input type="checkbox"/>
No of Bursts to Analyze	1
Sweep Time (Mask/ACP)	Auto <input checked="" type="checkbox"/> 2 s
Sweep Count (Mask/ACP)	1

Sweep Time (ACPR/Mask) specifies whether the sweep time for the spectrum ACP & Mask measurements should be calculated automatically or specified manually.

If the sweep time auto check box is switched off the sweep time to be used can be specified.

Sweep Count (Mask/ACPR)

Data Capture Settings	
Capture Time	15 ms
Overall Burst Count	<input type="checkbox"/>
No of Bursts to Analyze	1
Sweep Time (Mask/ACP)	Auto <input checked="" type="checkbox"/> 2 s
Sweep Count (Mask/ACP)	1

Sweep Count (ACPR/Mask) specifies the number of sweeps which should be performed for Spectrum ACP/ACPR and Spectrum Mask measurements

Trigger Settings

The Trigger settings group contains all the settings related to the triggering of a measurement sweep.

Trigger Mode

Trigger Settings	
Trigger Mode	Free Run
Trigger Offset	-10 μ s
Trigger Level	Auto <input type="checkbox"/> ...

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

The possible values for the *Trigger Mode* are:

- Free Run** – the measurement sweep starts immediately.
- External** - triggering via a TTL signal at the input connector *EXT TRIGGER/GATE* on the rear panel.
- Power** - the measurement sweep starts when the signal power meets or exceeds the specified power trigger level.

Trigger Offset

Trigger Settings	
Trigger Mode	Power
Trigger Offset	-10 μ s
Trigger Level	Auto <input checked="" type="checkbox"/> 0 dBm

Trigger Offset specifies the time offset between the trigger signal and the start of the sweep. A negative value indicates a pre-trigger.

The *Trigger Offset* parameter is not editable when *Trigger Mode* is set to Free Run because this indicates that the measurement sweep should trigger immediately and as such a trigger delay or pre-trigger would not be appropriate.

Auto Power Trigger Level

Trigger Settings	
Trigger Mode	Power
Trigger Offset	-10 μ s
Trigger Level	Auto <input checked="" type="checkbox"/> 0 dBm

Auto Power Trigger Level selects whether the level for the power trigger is measured automatically (ON) or entered manually by the user (OFF).

When *Auto Power Trigger Level* is set to ON, R&S FSQ-K92 will measure and determine the power trigger level automatically at the start of each measurement sweep. This ensures that the power trigger level is always set at the optimal level for obtaining accurate results but will result in a slightly increased measurement times.

The *Auto Power Trigger Level* parameter is editable only when *Trigger Mode* is set to Power.

Trigger Level (RF)

Trigger Settings	
Trigger Mode	Power
Trigger Offset	-10 μ s
Trigger Level	Auto <input checked="" type="checkbox"/> 0 dBm

Trigger Level (RF) Specifies the trigger level when a power trigger is selected and RF input is selected

The *Trigger Level* parameter is editable only when *Trigger Mode* is set to Power.

The *Trigger Level (RF)* parameter is not editable when Baseband input is selected because *Trigger Level (RF)* only makes sense for an RF signal.

Trigger Level (Baseband)

Trigger Settings	
Trigger Mode	Power
Trigger Offset	-10 μ s
Trigger Level	Auto <input checked="" type="checkbox"/> 500 mV

Trigger Level (Baseband) Specifies the trigger level when a power trigger is selected and Baseband input is selected

The *Trigger Level* parameter is editable only when *Trigger Mode* is set to Power.

The *Trigger Level (Baseband)* parameter is not editable when RF input is selected because *Trigger Level (Baseband)* only makes sense for a Baseband signal.

IQ Settings

The IQ settings contains settings related the Inphase and Quadrature phase of the input signal.

Swap IQ

IQ Settings	
Swap IQ	<input type="checkbox"/>

Swap IQ allows selection between normal and inverted I/Q modulation. The settings for this parameter are:

OFF Normal I/Q modulation.

ON I and Q signals are interchanged.

Input Settings

The Input settings group contains settings related to the input source of the signal to be measured. Note that this group is only available when the B71 option is installed.

Baseband Input



Baseband Input allows the selection between RF and Baseband inputs. The settings for this parameter are:
 OFF RF Input.
 ON Baseband Input.

Advanced Settings

The Advanced Settings contains settings which control details of how the instrument operates and how measurements are performed.

The advanced settings are displayed on the right hand side of the general settings view, and are only displayed when the Advanced Settings checkbox is checked.

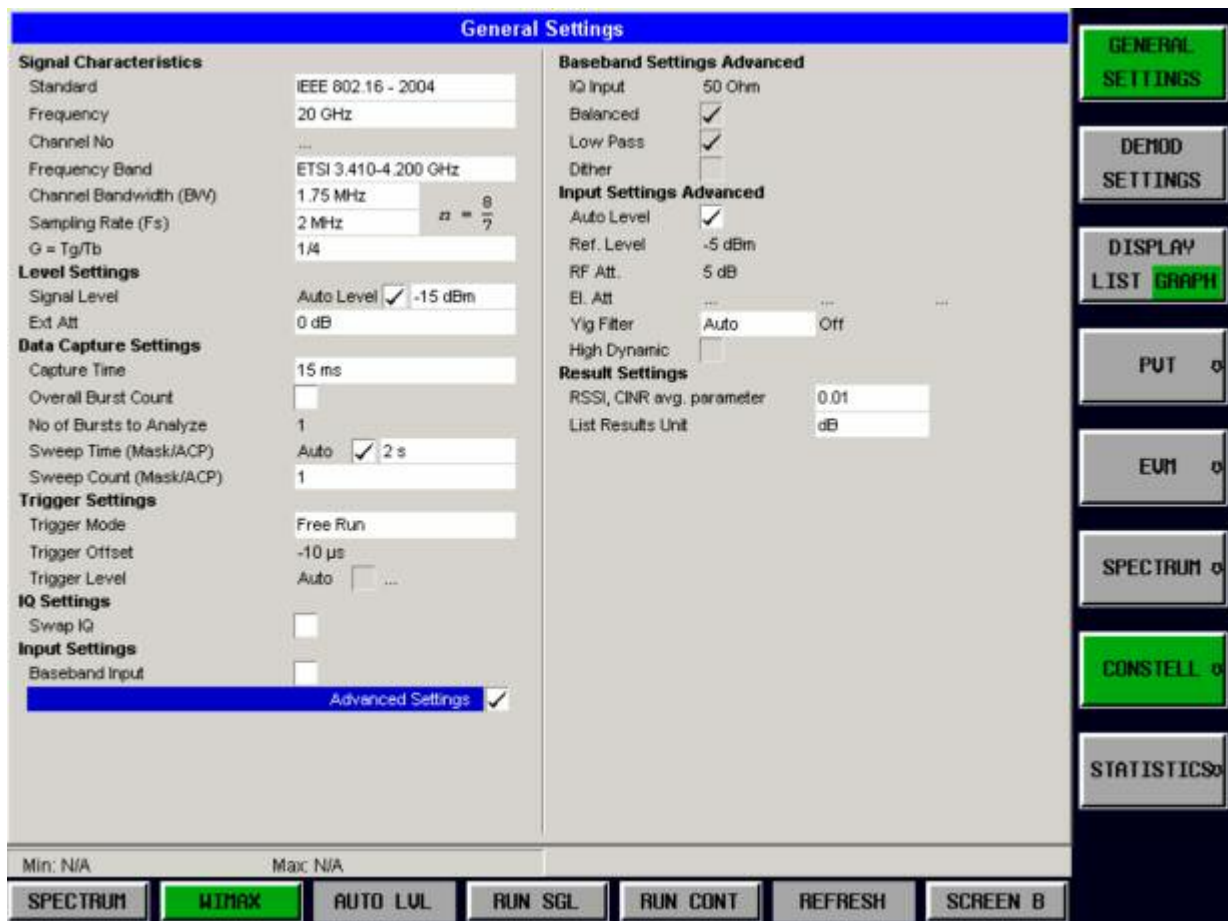
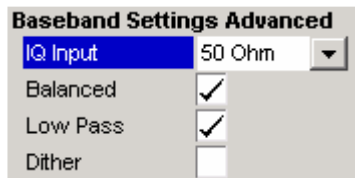


Fig. 2-23 Advanced Settings

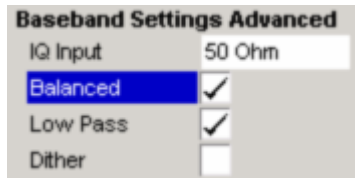
IQ Input



IQ Input allows the selection of the impedance of the Baseband inputs. The values that can be selected are 50 Ohms and 1K Ohm

The *IQ Input* parameter is editable only when Baseband input is selected.

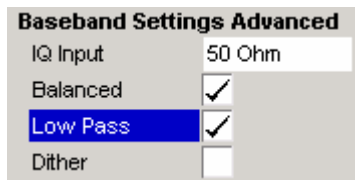
Balanced



Balanced switches the Baseband inputs between symmetrically (balanced) and asymmetrical (unbalanced).

The *Balanced* parameter is editable only when Baseband input is selected.

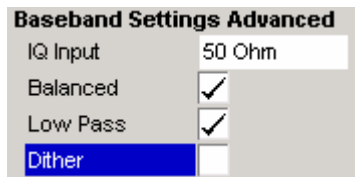
Low Pass



When switched on the *Low Pass* parameter specifies that a filter is applied from 36 MHz for the IQ inputs

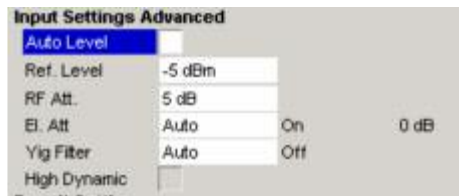
The *Low Pass* parameter is editable only when Baseband input is selected

Dither



When switched on the *Dither* parameter specifies that a 2 MHz wide noise signal at 42.67 MHz is injected into the signal path of the Baseband input. It appears in the spectrum at 38.92 MHz

Auto Level



Auto Level selects whether the reference level for measurements is measured automatically (ON) or entered manually by the user (OFF).

The *Auto Level* advanced settings is the same as the *Auto Level* in the Signal Characteristics. It is repeated in the Advanced Settings for convenience.

Ref Level



Ref Level specifies the reference level to use when running measurements

When the *Ref Level* is modified the *Signal Level* parameter is updated accordingly (depending on the currently selected standard and measurement type).

The *Ref Level* is editable only when *Auto Level* is switched off.

RF Att

Input Settings Advanced			
Auto Level	<input type="checkbox"/>		
Ref. Level	-5 dBm		
RF Att.	5 dB		
El. Att	Auto	On	0 dB
Yig Filter	Auto	Off	
High Dynamic	<input type="checkbox"/>		

Rf Att specifies the mechanical attenuation to be applied to the input RF signal

EI Att

Input Settings Advanced			
Auto Level	<input type="checkbox"/>		
Ref. Level	-5 dBm		
RF Att.	5 dB		
El. Att	Manual	On	0 dB
Yig Filter	Auto	Off	
High Dynamic	<input type="checkbox"/>		

The *EI Att* parameters specify the settings for the electronic attenuator

The *EI Att* parameters are:

Mode – Specifies whether the electronic attenuator should be controlled manually (Manual) or by the option (Auto)

State – Specifies whether the electronic attenuator should be switched ON or OFF

Settings – specifies the attenuation value the electronic attenuator should be switched to.

When the mode is set to Auto then the state and settings fields will be automatically calculated by the option and so these fields will not be editable.

When the state is switched off the setting field is non-editable.

When the frequency is set such that the electronics attenuator cannot be used then all the Electronic Attenuator fields are read-only.

YIG Filter

Input Settings Advanced			
Auto Level	<input type="checkbox"/>		
Ref. Level	-5 dBm		
RF Att.	5 dB		
El. Att	Manual	On	0 dB
Yig Filter	Manual	Off	
High Dynamic	<input type="checkbox"/>		

The *YIG Filter* parameter specifies how the YIG filter is used during measurements

The *YIG Filter* parameters are:

Mode – Specifies whether the YIG filter should be controlled manually (Manual) or by the option (Auto)

State – Specifies whether the YIG filter should be switched ON or OFF

When the mode is set to Auto then the state field will be automatically calculated by the option and so this field will not be editable.

High Dynamic

Input Settings Advanced			
Auto Level	<input type="checkbox"/>		
Ref. Level	-5 dBm		
RF Att.	5 dB		
El. Att.	Manual	On	0 dB
Yig Filter	Manual	Off	
High Dynamic	<input type="checkbox"/>		

The *High Dynamic* parameter is only available when the B72 option is installed, and the sample rate is set between 20.4 MHz and 40.8 MHz.

When the *High Dynamic* parameter is set to ON then measurements are performed using a wide filter in the normal signal path rather than using the B72 option.

The advantage of setting the *High Dynamic* parameter ON is a higher resolution (because the "normal" signal path uses a 14 bit ADC). The disadvantage is that all signals left or right the spectrum of interest are folded into the spectrum itself.

RSSI, CINR avg parameter

Result Settings	
RSSI, CINR avg. parameter	0.8
List Results Unit	dB

RSSI, CINR avg parameter specifies the mean and standard deviation for the RSSI and CINR results

See [IEEE Std 802.16-2004] "8.3.9.2 RSSI mean and standard deviation", "8.3.9.3 CINR mean and standard deviation"

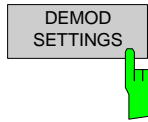
List Results Unit

Result Settings	
RSSI, CINR avg. parameter	0.8
List Results Unit	dB <input type="button" value="v"/>

List Results Unit specifies the units for the results in the results summary table.

Demod Settings

This section of the user manual describes the Demod (Short for Demodulation) Settings view where the settings associated with the signal modulation can be modified.



The *DEMOM SETTINGS* softkey brings up the Demod Settings view.

Fig. 2-24 Demod Settings view

The Demod settings are logically grouped together into:

- Burst to analyze settings
- Tracking settings

When a particular parameter is selected within the Demod Settings view the status bar changes to display information about the valid settings for the selected parameter. The parameters available in the Demod setting view are dependent on the currently selected standard.

Burst To Analyze Settings

The burst to analyze settings specify the characteristics of the bursts to be considered in the measurement results. Only those burst which meet the criteria specified in this group will be included in measurement analysis

Burst Type

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Modulation Detection Mode	None
Demodulator	BPSK1/2
Equal Burst Length	<input type="checkbox"/>
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

Burst Type specifies the type of burst which should be included in measurement analysis. Only one burst type can be selected for measurement results. The following burst types are supported:

OFDM
 OFDMA - Not currently supported

Link Mode

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Modulation Detection Mode	None
Demodulator	BPSK1/2
Equal Burst Length	<input type="checkbox"/>
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

Link Mode specifies the Link Mode of burst which should be included in measurement analysis. The following Link Mode types are supported:

UL - Up Link
 DL - Down Link

Use FCH Content

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Modulation Detection Mode	None
Demodulator	BPSK1/2
Equal Burst Length	<input type="checkbox"/>
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

Use FCH Content specifies whether the FCH field of the captured burst data should be decoded.

When *Use FCH Content* is set to ON then only those bursts whose modulation format matches the modulation format specified in the *PDU Mod to Analyze* parameter are included in the results analysis.

Currently this parameter is always switched off and cannot be modified.

Modulation Detection Mode

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Modulation Detection Mode	None
Demodulator	BPSK1/2
Equal Burst Length	<input type="checkbox"/>
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

Modulation detection mode specifies how the signal should be demodulated. The following values are supported:

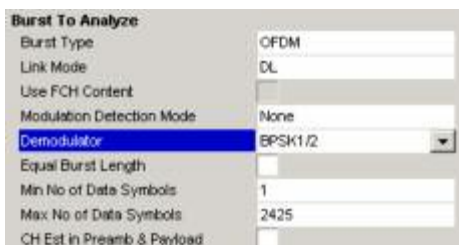
None - No modulation detection is performed. The signal will be analyzed according to the *Demodulator* setting. Therefore the *Demodulator* setting must match with the modulation format of the subframe. This setting excludes the analyze of multiple modulation formats in a subframe.
 First Symbol - The first data symbol specifies the modulation format. I.e. the signal

will be analysed according to the modulation format of the first data symbol. This setting supports multiple modulation formats in a subframe.

- User - Only bursts matching the setting in the *Demodulator* setting are analyzed. This setting supports multiple modulation formats in a subframe.

When *Modulation detection mode* is set to First Symbol then the *Demodulator* setting is disabled and will automatically update with the modulation scheme detected in the first symbol

Demodulator



In case *Modulation detection mode* $\in \{None, User\}$ *Demodulator* defines the modulation format according to which the signal will be analyzed. *Modulation detection mode* = *None*: The measurement application will apply this modulation format onto the subframe to be analyzed. Therefore, the modulation format defined by this parameter must match with the modulation format of the subframe to be analyzed.

Modulation detection mode = *User*: The areas of the subframe with the modulation format defined by this parameter will be analyzed.

Important Note:

At the moment the FSQ-K92 measurement application can't distinguish between different coding rates for the same modulation format. I.e. if the signal to be analyzed contains the profiles (modulation format A, coding rate B) and (modulation format C, coding rate D). The signal to be analysed must hold the following condition:

$$[A == C \Rightarrow B == D]$$

in order to produce correct measurement results,

Equal Burst Length

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Modulation Detection Mode	None
Demodulator	BPSK1/2
Equal Burst Length	<input type="checkbox"/>
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

Equal Burst Length allows burst with a range of data symbols/bytes or bursts with a specific number of data symbols/bytes to be selected for measurement analysis.

When *Equal Burst Length* is set to ON then the next parameter in the group becomes *No of Data Symbols* and only burst with exactly the number of symbols specified in *No of Data Symbols* are considered for measurement analysis.

When *Equal Burst Length* is set to OFF then the next parameter in the group becomes *Min No of Data Symbols* and bursts with a number of data symbols within the range specified by the *Min No of Data Symbols* and *Max No of Data Symbols* parameters take part in measurement analysis.

No of Data Symbols

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Auto Demodulation	<input type="checkbox"/>
Demodulator	64QAM3/4
Equal Burst Length	<input checked="" type="checkbox"/>
No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

No of Data Symbols specifies the number of data symbols a burst must have for it to be considered in measurement analysis.

No of Data Symbols is only available when *Equal Burst Length* is set to ON.

Min No of Data

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Modulation Detection Mode	None
Demodulator	BPSK1/2
Equal Burst Length	<input type="checkbox"/>
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

Min No of Data Symbols specifies the minimum number of data symbols a burst must have for it to be considered in measurement analysis.

Min No of Data Symbols is only available when *Equal Burst Length* is set to OFF.

Max No of Data Symbols

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Modulation Detection Mode	None
Demodulator	BPSK1/2
Equal Burst Length	<input type="checkbox"/>
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

Max No of Data Symbols specifies the maximum number of data symbols a burst must have for it to be considered in measurement analysis.

Max No of Data Symbols is only available when *Equal Burst Length* is set to OFF.

Chan Est in Preamb and Payload

Burst To Analyze	
Burst Type	OFDM
Link Mode	DL
Use FCH Content	<input type="checkbox"/>
Modulation Detection Mode	None
Demodulator	BPSK1/2
Equal Burst Length	<input type="checkbox"/>
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	<input type="checkbox"/>

Chan Est in Preamb and Payload specifies how accurately the EVM results should be calculated.

When *Chan Est in Preamb and Payload* is set to OFF then the EVM results are calculated in accordance with the selected standard. In this case channel estimation is done in the preamble only.

When *Chan Est in Preamb and Payload* is set to ON then the EVM results are calculated more accurately. In this case channel estimation is done in both preamble and payload.

Tracking Settings

The tracking settings allow various errors in measurement results to be compensated for.

Phase

Tracking	
Phase	<input checked="" type="checkbox"/>
Timing	<input checked="" type="checkbox"/>
Level	<input checked="" type="checkbox"/>

Phase is used to specify whether or not the measurement results should be compensated for phase error.

When *Phase* is set to ON then the measurement results will be compensated for phase error on a per-symbol basis.

Timing

Tracking	
Phase	<input checked="" type="checkbox"/>
Timing	<input checked="" type="checkbox"/>
Level	<input checked="" type="checkbox"/>

Timing is used to specify whether or not the measurement results should be compensated for timing error.

When *Timing* is set to ON then the measurement results will be compensated for timing error on a per-symbol basis.

Level

Tracking	
Phase	<input checked="" type="checkbox"/>
Timing	<input checked="" type="checkbox"/>
Level	<input checked="" type="checkbox"/>

Level is used to specify whether or not the measurement results should be compensated for level error.

When *Level* is set to ON then the measurement results will be compensated for level error on a per-symbol basis.

Gate Settings

This section of the user manual describes the Gate Settings. The gate settings allow the range of captured data used in results calculation to be specified.

When gating is switched on vertical lines are displayed in the Magnitude Capture trace. The two lines mark the area of data to be used in the calculation of results

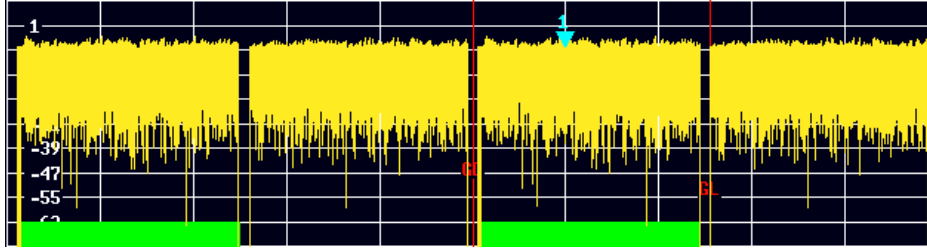


Fig. 2-25 Gate lines displayed in Magnitude Capture Buffer

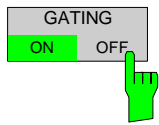
The gate settings can be used to specify the region of input data to analyze for the following measurements:

- PVT
- Spectrum FFT
- CCDF
- Spectrum Mask
- Spectrum ACP

The soft-keys to access the gate settings are located from each of the measurement soft-key menus. Press the NEXT hard-key to access the gate setting menu

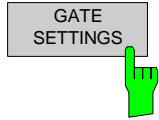


Fig. 2-26 Gate Settings menu view



The *GATING* softkey allows gating to be switched on or off.

When gating is switched off all the captured data is used in results calculation.



The *GATE SETTINGS* softkey displays the Gate Settings pop-up dialog.



Fig. 2-27 Gate Settings Pop-up Dialog

Gate Settings

The gate settings specify the characteristics of the gate to be applied to the measurement. Note that when the gate settings dialog is displayed when a frequency sweep measurement is active (Spectrum Mask and Spectrum ACP) the measurement view automatically swaps to the Magnitude Capture buffer display in order to allow the gate to be set the correct part of the sweep.

Delay

Gate Settings		
	Time	Samples
Delay	129 μ s	2579
Length	196 μ s	3920
Link Gate and Marker	<input type="checkbox"/>	

Delay specifies the start point of captured data to be used in results calculation, i.e. the delay from the start of the captured data.

Delay can be specified in the following ways:

- Time
- Samples

When the delay is specified in one unit, the other unit field is updated accordingly.

When a value is supplied for the gate delay (in any unit) the gate delay line in the Magnitude Capture Buffer (marker with GD) is displayed in the new position.

Length

Gate Settings		
	Time	Samples
Delay	129 μ s	2579
Length	196 μ s	3920
Link Gate and Marker	<input type="checkbox"/>	

Length specifies the amount of captured data to be used in results calculation.

Length can be specified in the following ways:

- Time
- Sample

When the length is specified in one unit, the other unit field is updated accordingly.

When a value is supplied for the gate length (in any unit) the gate length line in the Magnitude Capture Buffer (marker with GL) is displayed in the new position.

Link Gate and Marker

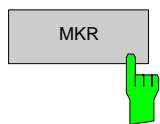
Gate Settings		
	Time	Samples
Delay	129 μ s	2579
Length	196 μ s	3920
Link Gate and Marker	<input type="checkbox"/>	

Link Gate and Marker allows the position of the marker and the gate lines to be linked.

When *Link Gate and Marker* is switched ON the marker is positioned half way between the gate start and the gate end. The marker position alters when the gate is modified, and the gate lines move with the marker when the marker position is altered.

Markers

This section of the user manual describes the Marker facility of the option.



The *MKR* hardkey brings up the marker softkey menu. Any settings views on display when the marker softkey menu is displayed shall be closed.

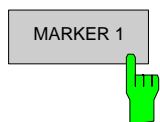


Fig. 2-28 Marker Menu

From the marker menu it is possible to adjust the marker position, use the marker to zoom in & out and switch the marker display off.

Adjusting Markers

The marker can be adjusted by pressing the marker softkey in the marker softkey menu



The *MARKER* softkey displays the Marker pop-up dialog. The contents of the marker pop-up depend on the type of graph to which the marker being adjusted belongs.

As soon as a field in the marker pop-up dialog is adjusted then the marker position in the trace will update, along with the results displayed for the marker.

Marker Zoom

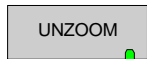
A zoom facility is available for markers belonging to the following result traces:

- Magnitude Capture
- PVT
- Constellation Vs Symbol
- Constellation Vs Carrier

A rectangular softkey with a grey background and the text "MARKER ZOOM" in black.

The *MARKER ZOOM* softkey displays the Marker Zoom pop-up dialog which contains the magnification factor for the zoom.

The maximum magnification depends on the type of results trace.

A rectangular softkey with a grey background and the text "UNZOOM" in black.

The *UNZOOM* softkey cancels the marker zoom.

Toggle Marker Display

Markers can be toggled by pressing the Marker soft-key as follows:

A rectangular softkey with a grey background and the text "MARKER 1" in black.

Pressing the *MARKER* softkey when the marker is not displayed (softkey has grey background) causes the Marker pop-up to be displayed and the marker to be switched on.

A rectangular softkey with a red background and the text "MARKER 1" in black.

Pressing the *MARKER* softkey when the Marker pop-up is displayed (softkey has red background) causes the marker to be switched off.

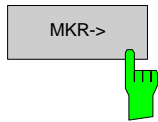
A rectangular softkey with a green background and the text "MARKER 1" in black.

Pressing the *MARKER* softkey when the Marker is displayed but the Marker pop-up is not displayed (softkey has green background) causes the Marker pop-up to be displayed.

All markers in the active screen can be switched off by pressing the *MARKER OFF* softkey

Assigning Markers to Traces

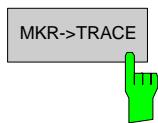
In result graphs which have more than one trace (e.g. PVT) the marker can be assigned to any of the displayed traces



Pressing the *MKR->* hardkey displays the Marker Extension softkey menu.



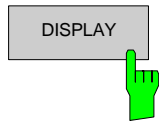
Fig. 2-29 Marker Extension Softkey Menu



Pressing the *MKR->TRACE* displays the Select Trace pop-up dialog. This allows the ID of the trace to which the marker is to be attached to be supplied.

Display Settings

The layout of the display can be controlled using the display menu



The *DISPLAY* hardkey brings up the display softkey menu. Any settings views on display when the display softkey menu is displayed shall be closed.

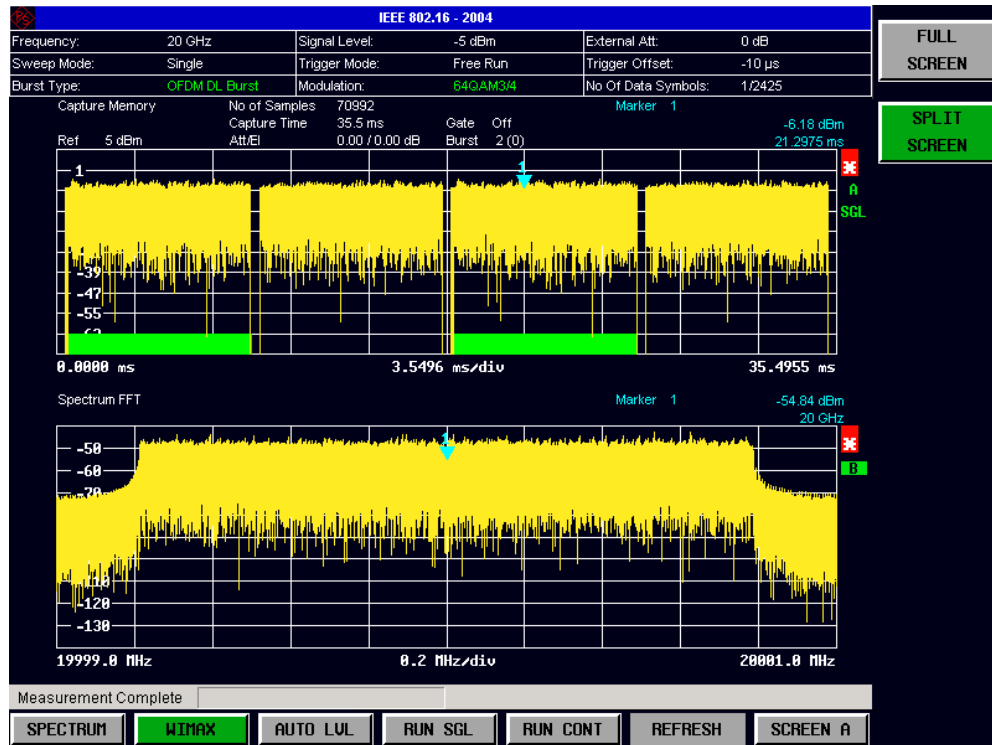


Fig. 2-30 Display Menu

The display menu allows the display to be changed between split and full screen display for IQ measurement results. Note that for frequency sweep measurement results (Spectrum Mask and Spectrum ACPR) the display is always full screen.

The active screen can be selected by pressing the *SCREEN A/SCREEN B* hotkey. A screen needs to be made active in order to control the markers it displays.

In full screen mode the *SCREEN A/SCREEN B* hotkey also toggles which screen is displayed.

3 Measurements in Detail

This section provides a more detailed explanation of the measurements provided by R&S FSQ-K92 and provides help for using R&S FSQ-K92 to measure the characteristics of specific types of DUT.

Signal Processing of the IEEE802.16-2004 OFDM measurement application

Abbreviations

$N_{FFT} = 256$	FFT length.
$a_{l,k}$	symbol from the alphabet at symbol-index l of subcarrier k
EVM_k	error vector magnitude of subcarrier k
EVM	error vector magnitude of current packet
g	signal gain
Δf	frequency deviation between Tx and Rx
l	symbol index $l = [1, nof_Symbols]$
$nof_symbols$	number of symbols of payload
H_k	channel transfer function of subcarrier k
k	channel index $k = [-128, 127]$
K_{mod}	modulation dependent normalization factor
ξ	relative clock error of reference oscillator
$r_{l,k}$	received symbol at symbol-index l of subcarrier k .
$Pilots = \{-88, -63, -38, -13, 13, 38, 63, 88\}$	

This description gives a rough view of the IEEE802.16-2004 OFDM measurement application signal processing. Details are disregarded in order to get a concept overview.

A diagram of the interesting blocks is shown in figure 1. First the RF signal is downconverted to the IF frequency $f_{IF} = 20.4$ MHz. The resulting IF signal $r_{IF}(t)$ is shown on the left-hand side of the figure. After bandpass filtering, the signal is sampled by an Analog to Digital Converter (ADC) at a sampling rate of $f_{s1} = 81.6$ MHz. This digital sequence is resampled to the new sampling frequency of $f_{s2} = 80$ MHz which is a multiple of the Nyquist rate (20 MHz). The subsequent digital downconverter shifts the IF signal to the complex base band. In the next step the base band signal is filtered by a FIR filter. To get an idea, the rough transfer function is plotted in the figure. This filter fulfils two tasks: first it suppresses the IF image frequency, secondly it attenuates the aliasing frequency bands caused by the subsequent downsampling. After filtering, the sequence is sampled down by the factor of 4. Thus the sampling rate of the downsampled sequence $r(i)$ is the Nyquist rate of $f_{s3} = 20$ MHz. Up to this point the digital part is implemented in an ASIC.

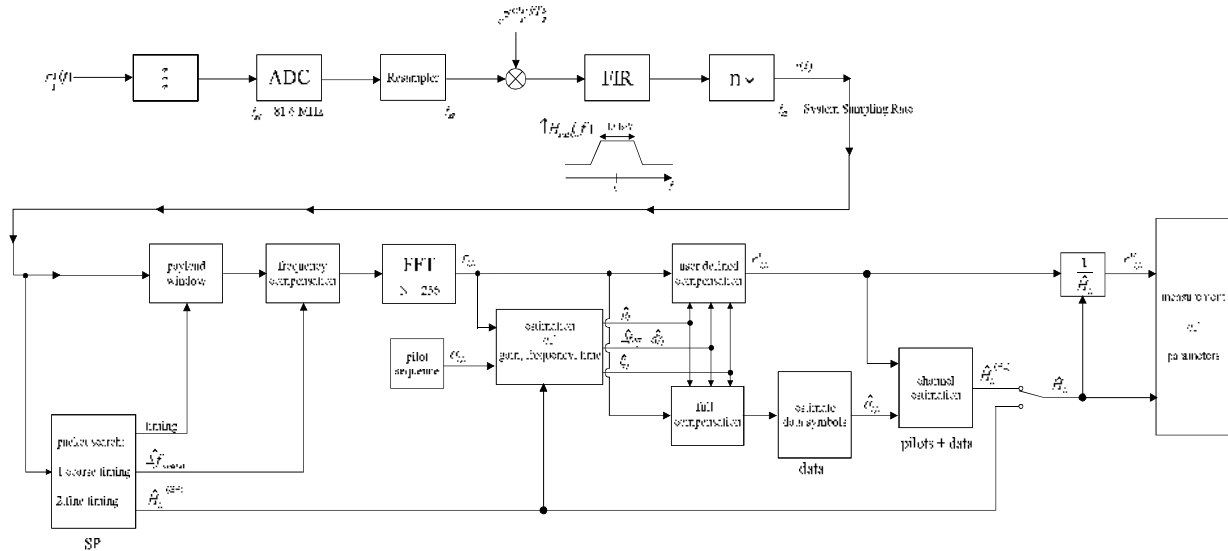


Fig. 3-1 Signal processing of the IEEE802.16 OFDM measurement application

In the lower part of the figure the subsequent digital signal processing is shown. In the first block the packet search is performed. This block detects the Short Preamble (SP) and recovers the timing. The coarse timing is detected first. This search is implemented in the time domain. The algorithm is based on cyclic repetition within the SP after $N = N_{FFT}/2 = 128$ samples. Note this cyclic repetition occurs also in the Long Preamble (LP). Numerous treatises exist on this subject, e.g. [1]-[3]. Furthermore a coarse estimate $\hat{\Delta f}_{coarse}^3$ of the Rx-Tx frequency offset Δf is derived from the metric in [6]. This can easily be understood because the phase of $r(i) \cdot r^*(i + N)$ is determined by the mod 2π frequency offset. As the frequency deviation Δf can exceed several bins (distance between neighbour sub-carriers) the SP is further used to solve this $n2\pi$ [offset over several bins] ambiguities.

After the coarse timing calculation the time estimate is improved by the fine timing calculation. This is achieved by first estimating the coarse frequency response $\hat{H}_k^{(SP)}$, with $k = [-100, 100]$ denoting the channel index of the occupied sub-carriers. First the FFT of the SP is calculated. After the FFT calculation the known symbol information of the SP sub-carriers is removed by dividing by the symbols. The result is a coarse estimate \hat{H}_k of the channel transfer function. In the next step the complex channel impulse response is computed by an IFFT. Next the energy of the windowed impulse response (the window size is equal to the guard period) is calculated for every trial time. Afterwards the trial time of the maximum energy is detected. This trial time is used to adjust the timing.

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

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

³ In this paper the hat generally describes an estimate. Example: \hat{X} is the estimate of X .

The transition to the frequency domain is achieved by an FFT of length 256. The FFT is performed symbol-wise for every of the $nof_symbols$ symbols of the payload. The calculated FFTs are described by $r_{l,k}$ with

- the symbol index $l = [1, nof_symbols]$ and
- the channel index $k = [-128, 127]$.

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

$$r_{l,k} = K_{mod} \cdot a_{l,k} \cdot g_l \cdot H_k \cdot e^{j(\text{phase}_l^{(common)} + \text{phase}_{l,k}^{(timing)})} + n_{l,k} \quad (1)$$

with

- the modulation-dependent normalization factor K_{mod} ,
- the alphabet symbol $a_{l,k}$ at symbol-index l of sub-carrier k ,
- the gain g_l at the symbol l in relation to the reference gain $g = 1$ at the Short Preamble (SP),
- the channel frequency response H_k at the Short Preamble (SP),
- the common phase drift $\text{phase}_l^{(common)}$ of all sub-carriers at symbol l (see below),
- the phase $\text{phase}_{l,k}^{(timing)}$ of sub-carrier k at symbol l caused by the timing drift (see below),
- the independent Gaussian distributed noise samples $n_{l,k}$.

The common phase drift in equation (1) is given by

$$\text{phase}_l^{(common)} = 2\pi \cdot N_s / N \cdot \Delta f_{rest} T \cdot l + d\gamma_l \quad (2)$$

with

- $N_s = N_g + N_b$ being the number of Nyquist samples of the symbol period,
- $N = N_b = 256$ being the number of Nyquist samples of the useful part of the symbol,
- Δf_{rest} being the (not yet compensated) frequency deviation,
- $d\gamma_l$ being the phase jitter at the symbol l .

In general, the coarse frequency estimate $\hat{\Delta f}_{coarse}$ (see figure 1) is not error-free. Therefore the remaining frequency error Δf_{rest} represents the not yet compensated frequency deviation in $r_{l,k}$. Consequently the overall frequency deviation of the device under test (DUT) is calculated by $\Delta f = \hat{\Delta f}_{coarse} + \Delta f_{rest}$. Remark: The only motivation for dividing the common phase drift in equation (2) into two parts is to be able to calculate the overall frequency deviation of the DUT.

The reason for the phase jitter $d\gamma_l$ in equation (2) may be different. The nonlinear part of the phase jitter may be caused by the phase noise of the DUT oscillator. Another reason for nonlinear phase jitter may be the increase of the DUT amplifier temperature at the beginning of the burst. Please note that besides the nonlinear part the phase jitter $d\gamma_l$ also contains a constant part. This constant part is caused by the not yet compensated frequency deviation Δf_{rest} . To understand this, please keep in mind that the measurement of the phase starts at the first symbol $l = 1$ of the payload. In contrast the channel frequency response H_k in equation (1) represents the channel at the Short Preamble of the preamble. Consequently the not yet compensated frequency deviation Δf_{rest} produces a phase drift between the Short Preamble and the first symbol of the payload. Therefore this phase drift appears as a constant value ("DC value") in $d\gamma_l$.

Referring to the IEEE802.16-2004 measurement standard *Chapter 8.3.10.1.2 "Transmitter constellation error and test method"* [6], the common phase drift $phase_l^{(common)}$ must be estimated and compensated from the pilots. Therefore this "symbol wise phase tracking" (Tracking Phase) is activated as the default setting of the R&S FSQ-K92.

Furthermore the timing drift in equation (1) is given by

$$phase_{l,k}^{(timing)} = 2\pi \cdot N_s / N \cdot \xi \cdot k \cdot l \quad (3)$$

with ξ being the relative clock deviation of the reference oscillator. Normally a symbol-wise timing jitter is negligible and thus not modelled in equation (3). There may be situations where the timing drift has to be taken into account. This is illustrated by an example: In accordance to [6] the allowed clock deviation of the DUT is up to $\xi_{max} = \pm 8$ ppm. Furthermore the maximal length of a frame $nof_symbols = 2420$ symbols⁴ is assumed. From equations (1) and (3), it results that the phase drift of the highest sub-carrier $k = 100$ in the last symbol $l = nof_symbols$ is two degrees. Even in the noise-free case, this would lead to symbol errors. The example shows that it is actually necessary to estimate and compensate the clock deviation, which is accomplished in the next block.

Referring to the IEEE802.16-2004 measurement standard [6], the timing drift $phase_{l,k}^{(timing)}$ is not part of the requirements. Therefore the "time tracking" (Tracking Time) is not activated as the default setting of the R&S FSQ-K92.

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

In addition the tracking of the gain g_l in equation (1) is supported for each symbol in relation to the reference gain $g = 1$ at the time instant of the Short Preamble (SP). At this time the coarse channel transfer function $\hat{H}_k^{(SP)}$ is calculated. This makes sense since the sequence $r'_{l,k}$ is compensated by the coarse channel transfer function $\hat{H}_k^{(SP)}$ before estimating the symbols. Consequently a potential change of the gain at the symbol l (caused, for example, by the increase of the DUT amplifier temperature) may lead to symbol errors especially for a large symbol alphabet M of the MQAM transmission. In this case the estimation and the subsequent compensation of the gain are useful.

Referring to the IEEE802.16-2004 measurement standard [6], the compensation of the gain g_l is not part of the requirements. Therefore the "gain tracking" (Tracking Gain) is not activated as the default setting of the R&S FSQ-K92.

How can the parameters above be calculated? In this application the optimum maximum likelihood algorithm is used. In the first estimation step the symbol-independent parameters Δf_{rest} and ξ are estimated. The symbol dependent parameters can be neglected in this step i.e. the parameters are set to $g_l = 1$ and $d\gamma_l = 0$. Referring to equation (1) the log likelihood function⁵

⁴ Assuming the maximal System Sampling Rate $F_s = 32$ MHz.

⁵ In this paper the tilde generally describes the trial parameters. Example: \tilde{X} is the trial parameter of X .

$$L_1(\tilde{\Delta f}_{rest}, \tilde{\xi}) \stackrel{\text{eq.(1)}}{=} \sum_{l=1}^{nof_symbols} \sum_{k \in Pilots} \left| r_{l,k} - a_{l,k} \cdot \hat{H}_k^{(SP)} \cdot e^{j(\tilde{p}hase_l^{(common)} + \tilde{p}hase_{l,k}^{(timing)})} \right|^2$$

with

$$\tilde{p}hase_l^{(common)} \stackrel{\text{eq.(2)}}{=} 2\pi \cdot N_s / N \cdot \tilde{\Delta f}_{rest} T \cdot l$$

$$\tilde{p}hase_l^{(timing)} \stackrel{\text{eq.(3)}}{=} 2\pi \cdot N_s / N \cdot \tilde{\xi} \cdot k \cdot l$$
(4)

must be calculated as a function of the trial parameters $\tilde{\Delta f}_{rest}$ and $\tilde{\xi}$. The trial parameters leading to the minimum of the log likelihood function are used as estimates $\hat{\Delta f}_{rest}$ and $\hat{\xi}$. In equation (4) the known pilot symbols $a_{l,k}$ are read from a table.

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

$$L_2(\tilde{g}_l, d\tilde{\gamma}_l) \stackrel{\text{eq.(1)}}{=} \sum_{k \in Pilots} \left| r_{l,k} - a_{l,k} \cdot \tilde{g}_l \cdot \hat{H}_k^{(SP)} \cdot e^{j(\tilde{p}hase_l^{(common)} + \tilde{p}hase_{l,k}^{(timing)})} \right|^2$$

with

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

$$\hat{p}hase_l^{(timing)} \stackrel{\text{eq.(3)}}{=} 2\pi \cdot N_s / N \cdot \hat{\xi} \cdot k \cdot l$$

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

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

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

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

In the lower compensation branch the full compensation is always performed. This separate compensation is necessary in order to avoid symbol errors. After the full compensation the secure estimation of the data symbols $\hat{a}_{l,k}$ is performed.

From equation (1) it is clear that first the channel transfer function H_k must be removed. This is achieved by dividing the known coarse channel estimate $\hat{H}_k^{(SP)}$ calculated from the SP. Usually an error free estimation of the data symbols can be assumed.

In the next block a better channel estimate $\hat{H}_k^{(PL)}$ of the data and pilot sub-carriers is calculated by using all *nof_symbols* symbols of the payload (PL). This can be accomplished at this point because the phase is compensated and the data symbols are known. The long observation interval of *nof_symbols* symbols (compared to the short interval of 1 symbol for the estimation of $\hat{H}_k^{(SP)}$) leads to a nearly error-free channel estimate.

In the following equalizer block $r'_{l,k}$ is compensated by the channel estimate. The resulting channel-compensated sequence is described by $r''_{l,k}$. The user may either choose the coarse channel estimate $\hat{H}_k^{(SP)}$ (from the Short Preamble) or the nearly error-free channel estimate $\hat{H}_k^{(PL)}$ (from the payload) for

equalization. In case of using the improved estimate $\hat{H}_k^{(PL)}$ a 2 dB reduction of the subsequent EVM measurement can be expected.

According to the IEEE802.16-2004 measurement standard [6], the coarse channel estimation $\hat{H}_k^{(SP)}$ (from the Short Preamble) has to be used for equalization. Therefore the default setting of the R&S FSQ-K92 is equalization from the coarse channel estimate derived from the Short Preamble.

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

$$EVM_k = \sqrt{\frac{1}{\text{nof_Symbols}} \cdot \sum_{l=1}^{\text{nof_Symbols}} \left| r''_{l,k} - K_{\text{mod}} \cdot a_{l,k} \right|^2} \quad (5)$$

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

$$EVM = \sqrt{\frac{1}{200} \cdot \sum_{\substack{k=-100 \\ (k \neq 0)}}^{100} EVM_k^2} \quad (6)$$

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

$$\overline{EVM} = \sqrt{\frac{1}{\text{nof_packets}} \sum_{\text{counter}=1}^{\text{nof_packets}} EVM^2(\text{counter})} \quad (7)$$

is calculated by averaging the packet EVM of all nof_packets detected packets. This parameter is equivalent to the so-called "RMS average of all errors $Error_{RMS}$ " of the IEEE802.16-2004 measurement commandment (see [6], *Chapter 8.3.10.1.2*).

RSSI Measurements

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

The RSSI statistics of the *Result Summary* is calculated as follows:

1. RSSI row:
Statistic {min, mean, max} of the $R[k]=RSSI[k]$.
The mean value is $\hat{\mu}_{RSSI \text{ dBm}}[k]$ according to [6] formula (89).
2. RSSI Standard Deviation row:
 $\hat{\sigma}_{RSSI \text{ dB}}$ according to [6] formula (91).

CINR Measurements

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

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

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

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

The CINR statistics of the *Result Summary* is calculated as follows:

1. CINR row:
Statistic {min, mean, max} of the CINR[k].
The mean value is $\hat{\mu}_{CINR, dB}[k]$ according to [6] formula (94).
2. CINR Standard Deviation row
 $\hat{\sigma}_{CINR, dB}$ according to [6] formula (96).

Literature

- [1] Speth, Classen, Meyr: „Frame synchronisation of OFDM systems in frequency selective fading channels“, VTC '97, pp. 1807-1811
- [2] Schmidl, Cox: „Robust Frequency and Timing Synchronization of OFDM“, IEEE Trans. on Comm., Dez. 1997, pp. 1613-621
- [3] Minn, Zeng, Bhargava: „On Timing Offset Estimation for OFDM“, IEEE Communication Letters, July 2000, pp. 242-244
- [4] Speth, Fechtel, Fock, Meyr: „Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM - Part I“, IEEE Trans. On Comm. VOL. 47, NO 11, Nov. 1999
- [5] Speth, Fechtel, Fock, Meyr: „Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM - Part II“, IEEE Trans. On Comm. VOL. 49, NO 4, April. 2001
- [6] IEEE802.16-2004, Part 16: Air Interface for Fixed Broadband Wireless Access Systems; 1 October 2004; Medium Access Control (MAC) and Physical Layer (PHY) specifications

4 Remote Control

Description of commands

This section specifies all the remote control commands specific to the R&S FSQ-K92 option. Only those commands provided for this option are specified. For details of remote control commands provided by the host analyzer please refer to the analyzer user manual.

Notation

In the following sections, all commands implemented in the instrument are first listed in tables 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.

Table of Commands

Command:	In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).
Parameter:	The parameter column indicates the requested parameters together with their specified range.
Unit:	The unit column indicates the basic unit of the physical parameters.
Comment:	In the comment column an indication is made on: <ul style="list-style-type: none"> – whether the command does not have a query form, – whether the command has only one query form – whether the command is implemented only with a certain option of the instrument

Indentations

The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level, the further the indentation to the right. Please note that the complete notation of the command always includes the higher levels as well.

Example: `SENSe:FREQuency:CENTer` is represented in the table as follows:

SENSe	first level
:FREQuency	second level
:CENTer	third level

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.

Upper/lower case notation

Upper/lower case letters are used to mark the long or short form of the key words of a command in the description (see Section 3.5.2). 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 1kHz:

```
SENSe:FREQuency:CW 1E3 = SENSe:FREQuency:FIXed 1E3
```

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

Example: Selection of the parameters for the command

```
DISPlay:FORMat FULL | SPLit
```

If parameter FULL is selected, full screen is displayed, in the case of SPLit, split screen is displayed.

- [] Key words in square brackets can be omitted when composing the header (cf. Section 3.5.2, Optional Keywords). 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 standardisation, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following (see also Section 3.5.5, "Parameters").

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

<numeric_value>

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

MINimum This keyword sets the parameter to the smallest possible value.

MAXimum This keyword sets the parameter to the largest 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.

SCPI Commands

ABORt Subsystem

The ABORt subsystem provide a mechanism by which running measurements can be aborted

COMMAND	PARAMETERS	UNIT	COMMENT
ABORt			

ABORt

This causes the current measurement, which is being performed, to be aborted.

Example: "ABOR" - The R&S FSQ-K92 option will abort the current active measurement.

Characteristics: *RST value: --
SCPI: Conforming

Mode: K92

CALCulate: Subsystem

CALCulate:LIMit Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
:CALCulate<1 2>			
:LIMit<1 to 8>			
:BURSt			
:ALL	:RESult? <numeric_value>...		
:EVM	--	--	query only
:ALL			
[:AVERAge]			
:RESult?	<numeric_value>	DB PCT	
:MAXimum	--	--	query only
:RESult?	<numeric_value>	DB PCT	
:DATA	--	--	query only
[:AVERAge]			
:RESult?	<numeric_value>	DB PCT	
:MAXimum	--	--	query only
:RESult?	<numeric_value>	DB PCT	
:FERRor	--	--	query only
[:AVERAge]			
:RESult?	<numeric_value>	PCT HZ	
:MAXimum	--	--	query only
:RESult?	<numeric_value>	PCT HZ	
:SSTiming	--	--	query only
[:AVERAge]			
:RESult?	<numeric_value>	PCT	
:MAXimum	--	--	query only
:RESult?	<numeric_value>	PCT	
:SYMBolerror	--	--	query only
[:AVERAge]			
:RESult?	<numeric_value>	PPM PCT	
:MAXimum	--	--	query only
:RESult?	<numeric_value>	PPM PCT	
:SPECTrum	--	--	query only
:Mask			
:CHECK			
:X?			query only
:Y?	--	HZ	query only
FAIL?	--	DBM	query only
	--		

CALCulate<1|2>:LIMit<1>:BURSt:ALL

This command sets or returns all the limit values. The results are input or output as a list of values separated by ',' in the following (ASCII) format:

```
<average EVM all bursts>, <max EVM all bursts>,
<average EVM data carriers >, <max EVM data carriers >
<average frequency error>, <max frequency error>,
<average symbol error>, <max symbol error>,
<average SS Timing>, <maximum SS Timing >
```

Note that the units for the EVM results are specified with the UNITS:EVM command

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

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESUlt

This command returns all the limit results (PASSED | FAILED). The results are output as a list of result strings separated by ',' in the following (ASCII) format:

<average EVM all bursts>, <max EVM all bursts>,
 <average EVM data carriers >, <max EVM data carriers >
 <average frequency error>, <max frequency error>,
 <average symbol error>, <max symbol error>,
 <average SS Timing>, <maximum SS Timing >

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

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERAge]

This command sets the average Error Vector Magnitude Limit in dB.

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

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERAge]:RESUlt

This command returns the average Error Vector Magnitude Limit result (PASSED | FAILED).

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

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum

This command sets the maximum Error Vector Magnitude Limit in dB.

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

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum:RESult

This command returns the maximum Error Vector Magnitude Limit result (PASSED | FAILED).

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]

This command sets the average frequency error limit in Hertz

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]:RESult

This command returns the average frequency error limit result (PASSED | FAILED)

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum

This command sets the maximum frequency error limit in Hertz

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESult

This command returns the maximum frequency error limit result (PASSED | FAILED)

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:SSTiming[:AVERAge]

This command sets the average Subscriber Station timing limit in percentage

Example: "CALC:LIM:BURS:SST 50" The average Subscriber Station limit is set to 50%

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:SSTiming[:AVERAge]:RESult

This command returns the average Subscriber Station limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:SST:RES?" Average Subscriber Station limit result is returned

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:SSTiming:MAXimum

This command sets the maximum Subscriber Station limit in percentage

Example: "CALC:LIM:BURS:SST:MAX?" Maximum Subscriber Station limit is returned

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:SSTiming:MAXimum:RESult

This command returns the maximum Subscriber Station limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:SST:MAX:RES?" Maximum Subscriber Station limit result is returned

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:SYMBOLerror[:AVERAge]

This command sets the average symbol error limit in Hertz

Example: "CALC:LIM:BURS:SYMB 10000" The average Subscriber Station limit is set to 10kHz

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage]:RESult

This command returns the average symbol error limit result (PASSED | FAILED)

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum

This command sets the maximum symbol error limit in Hertz

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum:RESult

This command returns the maximum symbol error limit result (PASSED | FAILED)

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECK:X

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

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECK:Y

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

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

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the R&S FSQ-K92 option.

CALCulate 1: Screen A

CALCulate 2: Screen B

Note: Currently there is only 1 marker is available per screen.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1 2> :MARKer<1> :MAXimum :MINimum :TRACe :X :Y :SYMBOL :CARRier : AOFF [:STATE]	 <numeric_value> <numeric_value> <numeric_value> <numeric_value> <numeric_value> <numeric_value> <Boolean>	 HZ S DB PCT DB	 no query no query query only

CALCulate<1|2>:MARKer<1>:MAXimum

This command sets the selected marker to the maximum peak value in the current trace. This command is only available for the following result displays:

Spectrum Flatness

Example: "CALC2:MARK:TRAC:MAX" Set marker 1 in screen B to maximum value in trace

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:MINimum

This command sets the selected marker to the minimum peak value in the current trace. This command is only available for the following result displays:

Spectrum Flatness

Example: "CALC2:MARK:TRAC:MIN" Set marker 1 in screen B to minimum value in trace

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:TRACe

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

This command is only available for the following result displays:

Constellation versus Carrier

EVM versus Symbol

EVM versus Carrier

Frequency error versus Preamble

Phase error versus Preamble

PVT Full Burst

PVT Rising / Falling

Spectrum Flatness

Spectrum Flatness Difference

Spectrum Mask - When Max Hold trace is displayed

Spectrum ACP/ACPR - When Max Hold trace is displayed

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

Characteristics: *RST value: 1
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:X

This command positions the selected marker to the indicated inphase (constellation Vs symbol), frequency (spectrum FFT, spectrum mask, spectrum APCR), time (magnitude capture buffer, auto level, PVT full burst, PVT rising / falling), power (CCDF), sub-carrier (constellation Vs carrier, EVM Vs carrier, spectrum flatness) or symbol (EVM Vs symbol) in the selected measurement window.

This command is query only for the following result displays:

Constellation Vs Symbol

Constellation Vs Carrier

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

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:Y

This command returns the Y position of the specified marker in the specified trace.

This command is query:

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

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:SYMBol

This command positions the selected marker to the indicated symbol (constellation Vs symbol and constellation Vs carrier).

This command is valid only for the following result displays:

Constellation Vs symbol

Constellation Vs carrier

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

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:CARRier

This command positions the selected marker to the indicated carrier (constellation Vs symbol and constellation Vs carrier).

This command is valid only for the following result displays:

Constellation Vs symbol

Constellation Vs carrier

Example: "CALC2:MARK:CARR -7" Positions marker 1 in screen B to carrier -7.
"CALC2:MARK:CARR?" Outputs the carrier value of marker 1 in screen B.

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:AOFF

This command switches off all active markers in the specified measurement window. The window will either be "screen a" or "screen b" and will be determined by the numeric value that follows the "CALCulate" keyword.

Example: "CALC1:MARK:AOFF" 'Switches off all markers in the screen A window.
"CALC2:MARK:AOFF" 'Switches off all markers in the screen B window.

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>[:STATe]

This command switches the specified marker in the specified screen on or off

Example: "CALC1:MARK1:STATE ON" Switches the screen A marker 1 ON.
"CALC2:MARK1:STATE OFF" Switches the screen B marker 1 OFF.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: K92

CALCulate:MARKer:FUNcTion Subsystem

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

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1 2> :MARKer<1> :FUNcTion :ZOOM :POWer :RESult [:CURRent] :MAXHold	<numeric_value>		
		DB	Query only
		DB	Query only

CALCulate<1|2>:MARKer<1>:FUNcTion:ZOOM

This command defines the ratio to be zoomed around the marker 1 in the selected measurement window. The default value is 1, where the full trace is shown.

This command is only available for the following result displays:

Constellation versus Carrier
 Constellation versus Symbol
 EVM versus Carrier
 Frequency error versus Preamble
 Phase error versus Preamble
 Spectrum Flatness
 Spectrum Flatness Difference
 Spectrum Group Delay
 PVT Full Burst
 PVT Rising / Falling
 Magnitude Capture Buffer

Example:

"CALC:MARK:FUNC:ZOOM 2"	Zooms 50% in screen A.
"CALC:MARK:FUNC:ZOOM 4"	Zooms 25% in screen A.
"CALC:MARK:FUNC:ZOOM 1"	Deactivates zooming in screen A.

Characteristics: *RST value: 1
 SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:FUNCtion:POWER:RESult[:CURRent]?

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

Results are output separated by commas in the following order:

1. Power of main channel
2. Power of lower adjacent channel
3. Power of upper adjacent channel
4. Power of lower alternate adjacent channel 1
5. Power of upper alternate adjacent channel 1
6. Power of lower alternate adjacent channel 2
7. Power of upper alternate adjacent channel 2

Adjacent channel power values are output in dB.

Example: "CALC2:MARK:FUNC:POW:RES?"

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

CALCulate<1|2>:MARKer<1>:FUNCtion:POWER:RESult:MAXHold?

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

Results are output separated by commas in the following order:

1. Power of main channel
2. Power of lower adjacent channel
3. Power of upper adjacent channel
4. Power of lower alternate adjacent channel 1
5. Power of upper alternate adjacent channel 1
6. Power of lower alternate adjacent channel 2
7. Power of upper alternate adjacent channel 2

Adjacent channel power values are output in dB.

Example: "CALC2:MARK:FUNC:POW:RES:MAXH?"

Characteristics: *RST value: -
SCPI: device-specific

Mode: K92

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.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:POWer			
:EXPeCted			
:RF	<numeric_value>	DBM	
:IQ	<numeric_value>	V	
:AUTO	<boolean> ONCE		
:CHANnel	<numeric_value>		
:STANdard	<numeric_value>		
:BURSt			
:PVT			
:SElect	EDGE FULL		
[:IMMediate]			
:EVM			
:ECARrier			
[:IMMediate]			
:ESYMBOL			
[:IMMediate]			
:SPEctrum			
:MASK			
:SElect	IEEE ETSI		
[:IMMediate]			
:FLATness			
:SElect	FLATness GRDelay DIFFerence		
[:IMMediate]			
:FFT			
[:IMMediate]			
:ACPR			
:SElect	ABS REL		
[:IMMediate]			
:CONSt			
:CCARrier			
[:IMMediate]			
:CSYMBOL			
[:IMMediate]			
:CARRier			
:SElect	-100 to 100 ALL PILots		
:STATistics			
:CCDF			
[:IMMediate]			
:BSTReam			
[:IMMediate]			
:PREamble			
:SElect	FREQ PHASe		
[:IMMediate]			
:WIMAX			
:FBANd	UNSPecified ETSI MMDS WCS		
:IGRatio	<numeric_value>		
:LMODe	DL UL		

CONFigure:POWer:EXPeCted:RF

This remote control command is used to specify the mean power level of the source signal as supplied to the Analyzer RF input. This value will be overwritten if Auto Level is turned on.

Example: "CONF:POW:EXP:RF 9" The R&S FS-K92 option assumes an input signal strength of 9 dBm

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:POWer:EXPeCted:IQ

This remote control command is used to specify the mean power level of the source signal as supplied to the Analyzer IQ inputs. This value will be overwritten if Auto Level is turned on.

Example: "CONF:POW:EXP:IQ 1" The R&S FSQ-K92 option assumes an input signal strength of 1 Volt

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:POWer:AUTO

This remote control command is used to switch on or off automatic power level detection. When switched on, power level detection is performed at the start of each measurement sweep. If this command is issued with the ONCE parameter then the auto level routine is performed immediately one time, regardless of the current state of this parameter (ON or OFF)

Example: "CONF:POW:AUTO 1" The R&S FSQ-K92 option will automatically detect the input power level

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:CHANnel

This remote control command is used to specify the input channel for which measurements are to be performed. This command will automatically cause the internal measurement frequency to be re-calculated.

Example: "CONF:CHAN 9" - The R&S FSQ-K92 option will perform measurements at the frequency represented by channel 9.

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: K92

CONFigure:STANdard

This remote control command specifies which Wireless LAN standard the option is configured to measure. The values are as follows:

0 = IEEE 802.16 - 2004

Example: "CONF:STAN 0" - The R&S FSQ-K92 option will perform measurements According to IEEE 802.16.- 2004

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:PVT:SElect

This remote control configures how R&S FSQ-K92 will interpret the power versus time measurement results.

The supplied string can be one of the following:

'EDGE' - configures the measurement to be rising and falling edge.

'FULL' - configures the measurement to be full burst.

Example: "CONF:BURS:PVT:SEL FULL" R&S FSQ-K92 option will interpret the measurement results as full burst

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:PVT[:IMMEDIATE]

This remote control command configures R&S FSQ-K92 measurement type to be Power Versus Time. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: "CONF:BURS:PVT" R&S FSQ-K92 option is configured to run a Power Versus Time measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:EVM:ECARrier[:IMMEDIATE]

This remote control command configures the R&S FSQ-K92 measurement type to be EVM Versus Carrier. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: "CONF:BURS:EVM:ECAR" R&S FSQ-K92 option is configured to run a EVM versus carrier measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:EVM:ESYMBOL[:IMMEDIATE]

This remote control command configures the FSQ-K92 measurement type to be EVM Versus Symbol. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: EVM: ESYM" R&S FSQ-K92 option is configured to run a EVM versus symbol measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:SPECTrum:MASK:SElect

This remote control configures how R&S FS-K92 will interpret the Spectrum MASK measurement results. This is either performed using the IEEE or ETSI standard.

Example: "CONF: BURS: SPECT: MASK: SEL ETSI" R&S FS-K92 option is will interpret the measurement results using the ETSI standard

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:SPECTrum:MASK[:IMMEDIATE]

This remote control command configures the R&S FSQ-K92 Flatness measurement type to be Spectrum mask. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: SPEC: MASK" R&S FSQ-K92 option is configured to run a Spectrum Mask measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:SPECTrum:FLATness:SElect

This remote control command configures the R&S FSQ-K92 Spectrum Flatness measurement type.

The supplied string can be one of the following:

FLATness - Spectrum Flatness results
GRDelay - Spectrum Flatness Group Delay results
DIFFerence- Spectrum Flatness Difference results specified.

Example: "CONF: BURS: SPEC: FLAT: SEL DIFF " R&S FSQ-K92 flatness measurement type is configure as Spectrum Flatness Difference

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be Spectrum flatness. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: SPEC: FLAT" R&S FSQ-K92 option is configured to run a Spectrum Flatness measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:SPECtrum:FFT[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be FFT (Fast Fourier Transform). After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: SPEC: FFT" R&S FSQ-K92 option is configured to run a FFT measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:SPECtrum:ACPR:SElect

This command sets the ACP measurement mode to either absolute or relative. The mode can be specified as follows:

ABS - Absolute measurement
REL - Relative measurement

Example: "CONF: BURS: SPEC: ACPR: SEL ABS" Sets the ACP measurement to absolute mode

Characteristics: *RST value: REL
SCPI: device specific

Mode: K92

CONFigure:BURSt:SPECtrum:ACPR[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be ACPR (adjacent channel power relative). After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: SPEC: ACPR" R&S FSQ-K92 option is configured to run a ACPR measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:CONSt:CCARrier[:IMMEDIATE]

This remote control command configures the R&S FSQ-K92 measurement type to be Constellation versus Carrier. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: CONS: CCAR" R&S FSQ-K92 option is configured to run a Constellation versus Carrier measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:CONSt:CSYMBOL[:IMMEDIATE]

This remote control command configures the R&S FSQ-K92 measurement type to be Constellation versus Symbol. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: CONS: CSYM" R&S FSQ-K92 option is configured to run a Constellation versus Symbol measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:CONSt:CARRier:SElect

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

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

Characteristics: *RST value: ALL
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:STATistics:CCDF[:IMMEDIATE]

This remote control command configures the R&S FSQ-K92 measurement type to be CCDF (conditional cumulative distribution functions.). After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: STAT: CCDF" R&S FSQ-K92 option is configured to run a CCDF measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:STATistics:BSTReam[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be bit stream. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: STAT: BSTR" R&S FSQ-K92 option is configured to run a bit stream measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:PREamble:SElect

This remote control command configures the R&S FSQ-K92 measurement type to be Phase or Frequency Vs Preamble. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: PRE: SEL_FREQ" R&S FSQ-K92 option will interpret the measurement results as Frequency Vs Preamble

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:BURSt:PREamble[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be Phase or Frequency Vs Preamble. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command

Example: "CONF: BURS: PRE" R&S FSQ-K92 option is configured to run a Pre-amble measurement.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:WIMAX:FBANd

This remote control command is used to specify the frequency band to be used

Example: "CONF: WIMAX: FBAN_ETSI" Sets the frequency band to ETSI.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:WIMAX:IGRatio

This remote control command is used to specify the inverse guard ratio for burst to be analyzed. The value supplied is the denominator for the guard ratio, and may be set to either 4, 8, 16 or 32.

Example: "CONF: WIMAX: IGR_32" Sets the guard ratio to 1/32.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

CONFigure:WIMAX:LMODe

This remote control command is used to specify the Link Mode to be used.

The supplied string can be one of the following:

DL	-	Down Link
UL	-	Up Link
ANY	-	Up Link or Down Link

Example: "CONF:WIMAX:LMODe ANY" Bursts using any Link Mode will be analyzed

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

DISPlay Subsystem

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

COMMAND	PARAMETERS	UNIT	COMMENT
:DISPlay			
:FORmat	SPLit SINGle		
[:WINDow<1 2>]			
:SElect			
:SSElect			
:TABLe	<boolean>		
:UNIT	DB PCT		
:TRACe<1...3>			
:Y			
:SCALE			
:AUTO	<boolean>		
:PDIVision	<numeric_value>		
:RLEVel	<numeric_value>	DB	
:OFFSet	<numeric_value>	DB	

DISPlay:FORMat

This command sets the visible screen display type to full or split screen.

Example: "DISP:FORM SINGLE" Sets the R&S FSQ-K92 display to full screen.

Characteristics: *RST value: SPL
SCPI: Device Specific

Mode: K92

DISPlay[:WINDow<1|2>]:SElect

This command selects whether screen A or screen B is active

Example: "DISP:WIND1:SEL" Sets the R&S FSQ-K92 screen A active.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

DISPlay[:WINDow<1|2>]:SSElect

This is an alias for DISPlay:WINDow[1|2]:SElect. SSElect means Screen SElect.

Example: "DISP:WIND1:SSEL" Sets the R&S FSQ-K92 screen A active.

Characteristics: *RST value: 1
SCPI: Device Specific

Mode: K92

DISPlay[:WINDow<1|2>]:TABLE

This command selects whether the results table is displayed

Example: "DISP:WIND1:TABL 0" Hides the results table

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: K92

DISPlay[:WINDow<1|2>]:TABLE:UNIT

This command specifies the units for table results.

Parameter: DB Table results returned in dB
PCT Table Imbalance results returned in %

Example: "UNIT:GIMB PCT" Gain Imbalance results to be returned in %.

Characteristics: *RST value: DB
SCPI: device specific

Mode: K92

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALE]:AUTO

This command switches on or off automatic scaling of the Y-axis for the specified trace display. Automatic scaling sets the Y-axis to automatically scale to best fit the measurement results. This command is only available for the following result displays:

EVM Vs Carrier

EVM Vs Symbol.

Frequency error Vs Preamble

Phase error Vs Preamble

The numeric suffix at WINDow<1|2> must be 2 as the relevant results are always displayed in screen B. The numeric suffix at TRACe<1 to 3> must be 1

Example: "DISP:WIND2:TRAC:Y:SCAL:AUTO ON" switches on automatic scaling of the Y-axis for the active trace

Characteristics: *RST value: ON

Mode: K92

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:PDIVision

This command sets the size of each Y scale division for the specified trace display. Note that this command has no affect if automatic scaling of the Y-axis is enabled. This command is only available for the following result displays:

EVM Vs Carrier

EVM Vs Symbol.

Frequency error Vs Preamble

Phase error Vs Preamble

The numeric suffix at WINDow<1|2> must be 2 as the relevant results are always displayed in screen B. The numeric suffix at TRACe<1 to 3> must be 1.

Example: "DISP:WIND2:TRAC:Y:SCAL:DPIV 2" Sets the Y scale division to size to 2.

Characteristics: *RST value: 3

Mode: K92

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel

This remote control command can be used to set the current internal instrument reference level used when performing measurements. The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example: "DISP:TRAC:Y:RLEV?" returns the current reference level in use

Characteristics: *RST value: -

Mode: K92

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet

This remote control command specifies the external attenuation/gain applied to measurements. The value corresponds to the reference level offset in spectrum analyzer mode. The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example: "DISP:TRAC:Y:RLEV:OFFS 10" external attenuation (level offset) of the analyzer is 10dB

"DISP:TRAC:Y:RLEV:OFFS -10" external attenuation of the analyzer is -10dB i.e. a gain of 10dB

Characteristics: *RST value: 0 dB

SCPI: conforming

Mode: K92

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.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			
:BURSt			
:ALL?		--	query only
:CINR?			query only
:CRESt			
:AVERAge?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:EVM			
:ALL			
:AVERAge?		PCT DB	query only
:MINimum?		PCT DB	query only
:MAXimum?		PCT DB	query only
:DATA			
:AVERAge?		PCT DB	query only
:MINimum?		PCT DB	query only
:MAXimum?		PCT DB	query only
:PILot			
:AVERAge?		PCT DB	query only
:MINimum?		PCT DB	query only
:MAXimum?		PCT DB	query only
:FERRor			
:AVERAge?		PPM HZ	query only
:MINimum?		PPM HZ	query only
:MAXimum?		PPM HZ	query only
:GIMBalance			
:AVERAge?		PCT DB	query only
:MINimum?		PCT DB	query only
:MAXimum?		PCT DB	query only
:IQOffset			
:AVERAge?		PCT DB	query only
:MINimum?		PCT DB	query only
:MAXimum?		PCT DB	query only
:QUADoffset			
:AVERAge?		DEG	query only
:MINimum?		DEG	query only
:MAXimum?		DEG	query only
:RMS			
:AVERAge?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
RSSi			query only
SSTiming			
:AVERAge?		PCT	query only
:MINimum?		PCT	query only
:MAXimum?		PCT	query only
:SYMBOLerror			
:AVERAge?		PPM	query only
:MINimum?		PPM	query only
:MAXimum?		PPM	query only

FETCh:BURSt:ALL?

This command returns all the results. The results are output as a list of result strings separated by ',' in the following (ASCII) format:

<min EVM all bursts>, <average EVM all bursts>, <max EVM all bursts>,
 <min EVM data carriers>, <average EVM data carriers >, <max EVM data carriers >
 <min EVM pilots>, <average EVM pilots >, <max EVM pilots >
 <min IQ offset>, <average IQ offset>, <maximum IQ offset>,
 <min gain imbalance>, <average gain imbalance>, <max gain imbalance>,
 <min quadrature offset>, <average quadrature offset>, <max quadrature offset>,
 <min frequency error>,<average frequency error>, <max frequency error>,
 <min symbol error>, <average symbol error>, <max symbol error>,
 <min burst power>,<average burst power>,<max burst power>,
 <min crest factor>,<average crest factor>,<max crest factor>,
 <min ss timing>,<average ss timing>,<max ss timing>,
 <min RSSI>,<average RSSI>,<max RSSI>,
 <min RSSI SD>,<average RSSI SD>,<max RSSI SD>,
 <min CINR>,<average CINR>,<max CINR>,
 <min CINR SD>,<average CINR SD>,<max CINR SD>

Note that the units for the EVM results are specified with the DISPlay:[WINDow1:]TABLE:UNIT command

Example: "FETC: BURS: ALL?" All calculated results are returned

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

FETCh:BURSt:CINR?

This command returns the minimum, average and maximum CINR values as well as the CINR standard deviation. The results are returned in the following format:

<minimum CINR>, <average CINR>, <maximum CINR>, <CINR Standard Deviation>

Example: "FETC: BURS: CINR?" The CINR results are returned

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

FETCh:BURSt:CRESt?

This command returns the average, minimum or maximum determined CREST factor (= ratio of peak power to average power) in dB.

Example: "FETC: BURS: CRES: MAX?" The maximum calculated crest factor from the most recent measurement is returned.

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

FETCh:BURSt:EVM:ALL

This command returns the Error Vector Magnitude measurement results summary (average, minimum or maximum value). This is a combined figure that represents the pilot, data and the free carrier.

Note that the units for the results are specified with the DISPLAY:[WINDOW1]:TABLE:UNIT command

Example: "FETC: BURS: EVM: ALL: MAX?" The maximum EVM recorded for all measurement carrier is returned.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

FETCh:BURSt:EVM:DATA

This command returns the Error Vector Magnitude measurement results summary for the data carrier (average, minimum or maximum value).

Note that the units for the results are specified with the DISPLAY:[WINDOW1]:TABLE:UNIT command

Example: "FETC: BURS: EVM: DATA: MAX?" The maximum EVM recorded for the data carrier is returned.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

FETCh:BURSt:EVM:PILot

This command returns the Error Vector Magnitude measurement results summary for the EVM pilot carrier (average, minimum or maximum value).

Note that the units for the results are specified with the DISPLAY[:WINDOW1]:TABLE:UNIT command

Example: "FETC: BURS: EVM: PIL: MAX?" The maximum EVM recorded for the EVM pilot carrier is returned.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

FETCh:BURSt:FERRor

This command returns the measured average, minimum or maximum frequency errors in Hertz

Example: "FETC: BURS: FERR: MAX?" The maximum frequency error from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

FETCh:BURSt:GIMBalance

This command returns the measured average, minimum or maximum IQ Imbalance errors.

Note that the units for the results are specified with the DISPlay[:WINDow1]:TABLE:UNIT command.

Example: "FETC: BURS: GIMB: MAX?" The maximum IQ Imbalance error from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

FETCh:BURSt:IQOffset

This command returns the measured average, minimum or maximum IQ Offset errors.

Note that the units for the results are specified with the DISPlay[:WINDow1]:TABLE:UNIT command.

Example: "FETC: BURS: IQOF: MAX?" The maximum IQ Offset error from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

FETCh:BURSt:QUADoffset

This command returns the accuracy in terms of the phase error of symbols within a burst.

Example: "FETC: BURS: QUAD: MAX?" The maximum angle error recorded for a symbol during the measurement.

Characteristics: *RST value: --
SCPI: Device Specific

Mode: K92

FETCh:BURSt:RMS

This command returns the average, minimum or maximum RMS burst power in dBm measured during the measurement.

This command is an alias for the FETCh:BURSt:POWer commands

Example: "FETC: BURS: RMS: MAX?" The maximum burst power from the most recent measurement is returned.

Characteristics: *RST value: --
SCPI: Device Specific

Mode: K92

FETCh:BURSt:RSSI

This command returns the minimum, average and maximum RSSI values as well as the RSSI standard deviation. The results are returned in the following format:

<minimum RSSI>, <average RSSI >, <maximum RSSI >, < RSSI Standard Deviation>

Example: "FETC:BURS:RSSI?" The CINR results are returned

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

FETCh:BURSt:SSTiming

This command returns the minimum, average and maximum subscriber station timing

Example: "FETC:BURS:SST:MAX?" The maximum subscriber station timing from the most recent measurement is returned.

Characteristics: *RST value: --
SCPI: Device Specific

Mode: K92

FETCh:BURSt:SYMBolerror

This command returns the percentage of symbols that were outside permissible de-modulation range within a burst.

Example: "FETC:BURS:SYMB:MAX?" The maximum number of symbols that were out of range per burst.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

FORMat Subsystem

The FORMat subsystem provide specifies the data format of the data transmitted from and to the instrument

COMMAND	PARAMETERS	UNIT	COMMENT
FORMat [:DATA]	ASCIi REAL UINT[,<numeric_value>]	-	

FORMat[:DATA] ASCIi | REAL| UINT [, 8 | 32]

This command specifies the data format for the data transmitted to from the instrument to the control PC. It controls whether the bitstream data is sent as ASCII or UINT8 binary format.

Example: "FORM UINT, 8" The R&S FSQ-K92 option will send bitstream data requested by the TRACE:DATA? command as unsigned integers in binary format.

Characteristics: *RST value: ASCIi
SCPI: Conforming

Mode: K92

INITiate Subsystem

The INITiate subsystem configures the instrument prior to a measurement being carried out. It is basically used to tell the instrument which measurement is to be performed and takes any necessary step to set up the instrument for the measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
INITiate [:IMMEDIATE] :CONTinuous	<Boolean>		no query no query

INITiate[:IMMEDIATE]

This remote control command requests the R&S FSQ-K92 option to start a new measurement sequence. If a measurement sequence is already in progress, then the command will be ignored.

Example: "INIT" - The R&S FSQ-K92 option will attempt to start a new measurement.

Characteristics: *RST value: -
SCPI: Conforming

Mode: K92

INITiate:CONTinuous

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

Example: "INIT:CONT OFF" The R&S FSQ-K92 option will attempt a non continuous measurement when initiated.

Characteristics: *RST value: 0
SCPI: Conforming

Mode: K92

INPut Subsystem

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

COMMAND	PARAMETERS	UNIT	COMMENT
:INPut			
:ATTenuation	<numeric_value>	DB	
:EATT	<numeric_value>	DB	
:AUTO	<Boolean>		
:STATe	<Boolean>		
:FILTer			
:YIG			
[:STATe]	<Boolean>		
:AUTO	<Boolean>		
:SElect	AIQ RF		
:IQ			
:BALanced			
[:STATe]	<Boolean>		B71 Option Only
:IMPedance	50 1000		B71 Option Only

INPut:ATTenuation

This command specifies the current input mechanical attenuator. The step width is 10 dB without the option electronic attenuator, the range 0 dB to 70 dB.

The input attenuation can be set in 5 dB steps between 0 dB and 75 dB with the option electronic attenuator

Example: "INP:ATT?" 'Returns the current mechanical attenuator setting in use

Characteristics: *RST value: -

Mode: K92

INPut:EATT

This command specifies the attenuation of the current input electronic input attenuator. The attenuation setting can only be varied in 5 dB steps from 0 to 30 dB. Other entries are rounded to the next lower integer value. The electronic attenuator is switched off in the default state.

Example: "INP:EATT?" 'Returns the current electronic attenuator setting in use

Characteristics: *RST value: -

Mode: K92

The command is only available with the electronic attenuator option B25.

INPut:EATT:AUTO

This command automatically couples the electronic input attenuation to the reference level and the attenuation of the mechanical attenuator (state ON) or switches the input attenuation to manual entry (state OFF).

Example: "INP:EATT:AUTO ON" Couples the attenuation of the electronic attenuator to the reference level.

Characteristics: *RST value: ON

SCPI: device-specific

Mode: K92

The command is only available with the electronic attenuator option B25.

INPut:EATT:STATe

This command switches the electronic input attenuation into the signal path (state ON) or removes it from the signal path (state OFF).

Example: "INP:EATT:STAT ON" Switches the electronic attenuator into the signal path.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: K92

The command is only available with the electronic attenuator option B25.

INPut:FILTer:YIG[:STATe]

This command switches the YIG filter for image frequency suppression into the signal path (condition ON) and/or removes it from the signal path (condition OFF).

Example: "INP:FILT:YIG OFF" Switches the YIG filter off

Characteristics: *RST value: ON
SCPI: device-specific

Mode: K92

INPut:SElect

This remote control command specifies whether the Baseband Inputs or RF input is the currently selected signal input. Note that Baseband input requires option B71. When option B71 is not installed then only RF selection is allowed.

Example: "INPut:SEL AIQ" Select Baseband Input

Characteristics: *RST value: RF
SCPI: conforming

Mode: K92

INPut:IQ:BALanced[:STATe]

This remote control command specifies whether the IQ inputs are symmetrical (balanced) or asymmetrical (unbalanced). Note that this command requires option B71.

Example: "INPut:IQ:BAL 1" Specifies symmetrical (balanced) IQ inputs.

Characteristics: *RST value: ON
SCPI: Device Specific

Mode: K92

INPut:IQ:IMPedance

This remote control command specifies the input impedance for the IQ inputs. Note that this command requires option B71.

Example: "INPut:IQ:IMP 50" Specifies 50 Ohm input impedance for IQ inputs.

Characteristics: *RST value: 50
SCPI: Device Specific

Mode: K92

INSTrument Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
INSTrument :SElect :NSElect	WIMax <numeric_value>		

INSTrument:SElect

This remote control command selects active operation of the R&S FSQ-K92 option by specifying its name.

Example: "INST:SEL WIM" The R&S FSQ-K92 option will be selected as the active option.

Characteristics: *RST value: SANalyzer
 SCPI: Device Specific

Mode: FSQ Base System

INSTrument:NSElect

This remote control command selects active operation of the FSQ-K92 option by specifying its associated option number.

Example: "INST:NSEL 23" The R&S FSQ-K92 option will be selected as the active option.

Characteristics: *RST value: 1
 SCPI: Device Specific

Mode: FSQ Base System

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 will return 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

COMMAND	PARAMETERS	UNIT	COMMENT
[[:SENSe]			
:BAWidth			
:CHANnel	<numeric_value>		
:FREQuency			
:CENTer	<numeric_value>	Hz	
:IQ			
:DITHer			
[:STATe]	<Boolean>		
:LPASs			
[:STATe]	<Boolean>		
:SWEEp			
:TIME	<numeric_value>	S	
:COUNt	<numeric_value>		
:EGATE	<Boolean>		
:HOLDoff			
[:TIMe]	<numeric_value>	S	
:SAMPle	<numeric_value>		
:LENgth			
[:TIMe]	<numeric_value>	S	
:SAMPle	<numeric_value>		
:LINK	<Boolean>		
:DEMod			
:CESTimation	<Boolean>		
:FORMat			
:SIGSymbol	<Boolean>		
[:BCONtent]			
:AUTo	<Boolean>		Not currently supported
:BANalyze	<String>		
:BTYPe	<String>		
:SYMBols			
:EQUal	<Boolean>		
:MIN	<numeric_value>		
:MAX	<numeric_value>		
:CRATe	<numeric_value>		Not currently supported

COMMAND	PARAMETERS	UNIT	COMMENT
:BURSt			
:COUNt	<numeric_value>		
:STATe	<Boolean>		
:POWer			
:ACHannel			
:SPACing			
[:ACHannel]		Hz	
:ALTErnate<1 2>		Hz	
:ACPairs	0 1 2 3		
:BANDwidth			
[:CHANnel]		Hz	
:ACHannel		Hz	
:ALTErnate<1 2>		Hz	
:BWIth			
[:CHANnel]		Hz	
:ACHannel		Hz	
:ALTErnate<1 2>		Hz	
:MODE	ABS REL		
:SWAPiq	<Boolean>		
:TRACking			
:LEVel	<Boolean>		
:PHASe	<Boolean>		
:TIME	<Boolean>		

[SENSe:]BANDwidth:CHANnel

The remote control command is used to specify the channel bandwidth of the signal to be measured.

Example: "SENS:BAND:CHAN 7MHZ" The R&S FSQ-K92 option uses a channel bandwidth value of 7 MHz

Characteristics: *RST value: 1.75 MHz
SCPI: conforming

Mode: K92

[SENSe:]FREQUency:CENTer

The remote control command is used to specify the frequency that the Analyzer will use to make measurements against the input signal.

Example: "SENS:FREQ:CENT 5GHZ" The R&S FSQ-K92 option uses the specified frequency value to set the analyzer detection frequency.

Characteristics: *RST value: $f_{max} / 2$
SCPI: conforming

Mode: K92

[SENSe:]IQ:DITHer[:STATe]

This instruction links a 2 MHz broad intoxication signal with 42.67 MHz into the signal path of the Baseband inputs. Note that this command requires option B71

Example: "SENS:IQ:DITH 1" Switches on the 2 MHz broad intoxication signal

Characteristics: *RST value: 0
SCPI: device specific

Mode: K92

[SENSe:]IQ:LPASs[:STATe]

This instruction switches a 36 MHz filter into the I and Q branch of the Baseband inputs. Note that this command requires option B71

Example: "SENS:IQ:LPASs 1" Switches on the low pass filter for the IQ inputs.

Characteristics: *RST value: 1
SCPI: device specific

Mode: K92

[SENSe:]SWEep:TIME

The remote control command is used to specify the sweep acquisition period (capture time) for which the input signal is to be measured.

Example: "SENS:SWEep:TIME 20ms" The R&S FSQ-K92 option uses the specified sweep acquisition period.

Characteristics: *RST value: 1ms
SCPI: conforming

Mode: K92

[SENSe:]SWEep:COUNT

The remote control command is used to specify the number of sweeps for Spectrum Mask and Spectrum ACPR measurements.

Example: "SENS:SWEep:COUNT 64" Sets the number of sweeps to 64.

Characteristics: *RST value: 1
SCPI: conforming

Mode: K92

[SENSe:]SWEep:EGATe

This command switches on/off the gating.

Example: "SENS:SWE:EGAT ON" Switches on gating.

Characteristics: *RST value: OFF
SCPI: device specific

Mode: K92

[SENSe:]SWEep:EGATe:HOLDoff[:TIME]

This command defines the gate delay in the capture buffer in time units. The range of this value is dependent on the last run measurement.

Example: "SENS:SWE:EGAT:HOLD 125µs" The R&S FSQ-K92 option will enforce a delay of 125µs in the capture buffer

Characteristics: *RST value: 100µs
SCPI: device specific

Mode: K92

[SENSe:]SWEep:EGATe:HOLDoff:SAMPle

This command defines the gate delay in the capture buffer as a number of samples. The range of this value is dependent on the last run measurement.

Example: "SENS:SWE:EGAT:HOLD:SAMP 2500" The R&S FSQ-K92 option will enforce a delay of 2500 samples in the capture buffer.

Characteristics: *RST value: 200
SCPI: device specific

Mode: K92

[SENSe:]SWEep:EGATe:LENGth[:TIME]

This command defines the gate time in the capture buffer in time units. The range of this value is dependent on the last run measurement.

Example: "SENS:SWE:EGAT:LENG 20ms" The R&S FSQ-K92 option will enforce a length of 20 milliseconds between sweeps.

Characteristics: *RST value: 400 μ s
SCPI: device specific

Mode: K92

[SENSe:]SWEep:EGATe:LENGth:SAMPle

This command defines the gate time in the capture buffer as a number of samples. The range of this value is dependent on the last run measurement.

Example: "SENS:SWE:EGAT:LENG:SAMP 200000" The R&S FSQ-K92 option will enforce a gate length of 200000 samples in the Capture buffer.

Characteristics: *RST value: 800
SCPI: device specific

Mode: K92

[SENSe:]SWEep:EGATe:LINK

This command links together the movement of the gating lines and the capture buffer marker

Example: "SENS:SWE:EGAT:LINK ON" Links the gating lines with the marker.

Characteristics: *RST value: 0
SCPI: device specific

Mode: K92

[SENSe:]DEMod:CESTimation

This command defines whether channel estimation will be done in preamble and payload (if set to 1) or only in preamble (if set to 0). The effect of this is most noticeable for the EVM measurement results, where the results will be improved when this feature is enabled.

However, this functionality is not supported by the IEEE 802.16 standard and must be disabled if the results are to be strictly measured against the standard.

Example: "SENS:DEMod:CEST 1" Specifies that the IQ measurement results will use channel estimation in preamble & payload.

Characteristics: *RST value: 0
SCPI: device specific

Mode: K92

[SENSe:]DEMod:FORMat:SIGSymbol

When this command is set to ON then the signal symbol field of the burst is analyzed to determine the details of the burst. When this field is set to ON only burst which match the supplied burst type and modulation are considered in results analysis.

Example: "SENSe:DEM:FORM:SIG ON" Specifies that the signal symbol field should be decoded.

Characteristics: *RST value:
SCPI: device specific

Mode: K92

[SENSe:]DEMod:FORMat[:BContent]:AUTo

When this command is set to ON then the signal symbol field of the burst is analyzed to determine the modulation scheme of the first burst. When this field is set to ON only bursts which match the modulation scheme are considered in results analysis.

Example: "SENSe:DEM:FORM:AUT ON" Specifies that the signal symbol field should be decoded.

Characteristics: *RST value:
SCPI: device specific

Mode: K92

[SENSe:]DEMod:FORMat:BANalyze

The remote control command sets the analysis modulation format that will be assumed when the measurement is performed. If the [SENSe:]DEMod:FORMat:SIGSymbol parameter has been set to ON then this command can be used to measure only certain burst types within a measurement sequence. The supplied string can be one of the following:

Current Definitions

'BPSK1/2'

'QPSK1/2'

'QPSK3/4'

'16QAM1/2'

'16QAM3/4'

'64QAM2/3'

Future Definitions

'BPSK'

'QPSK'

'QAM16'

'QAM64'

'

Note: *The future definitions shall be used in conjunction with the [SENSe:]DEMod:FORMat:CRATe command where modulation schemes support multiple coding rates.*

Example: "SENS:DEMod:FORM:BAN `QAM16`" The R&S FSQ-K92 option will only analyze bursts that are of the QAM16 modulation format

Characteristics: *RST value: 'QAM64'
SCPI: device specific

Mode: K92

[SENSe:]DEMod:FORMat:BANalyze:BTYPe

This remote control command specifies the type of burst to be analyzed. Only bursts of the specified type take part in measurement analysis.

The supplied string can be one of the following:

'OFDM'

'OFDMA'

Example: "SENS:DEMod:FORM:BAN:BTYPe `OFDM`" The R&S FSQ-K92 option will only analyze OFDM bursts

Characteristics: *RST value: 'OFDM'
SCPI: device specific

Mode: K92

[SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUAL

When this command is set to ON then only bursts of equal length will take part in the measurement analysis. When this command is set to OFF the value specified by the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MIN command specifies the number of symbols that a burst must have in order to take part in analysis

Example: "SENS:DEM:FORM:BAN:SYM:EQU 1" Only bursts of equal length will take part in analysis.

Characteristics: *RST value: 0
SCPI: device specific

Mode: K92

[SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MIN

This command specifies the number of data symbols required for bursts to qualify for measurement analysis. Only bursts with the specified number of symbols will be used in the measurement analysis. The number of data symbols is defined as the uncoded bits including service and tail bits.

When the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUAL command has been set to ON then this command specifies the exact number of symbols required for a burst to take part in measurement analysis. When the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUAL command is set to OFF this command specifies the minimum number of symbols required for a burst to take part in measurement analysis.

Example: "SENS:DEM:FORM:BAN:SYM:MIN 16" The R&S FSQ-K92 option will only analyze bursts which contain a symbol count of 16.

Characteristics: *RST value: 1
SCPI: device specific

Mode: K92

[SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MAX

This command specifies the maximum number of data symbols required for bursts to qualify for measurement analysis. Only bursts with the specified number of symbols will be used in the measurement analysis. The number of data symbols is defined as the uncoded bits including service and tail bits.

This value will not have any immediate effect if the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUAL command has been set to ON as in this case no range of symbols is allowed and only bursts with exactly the number of symbols specified by the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MIN command shall take place in measurement analysis.

Example: "SENS:DEM:FORM:BAN:SYM:MAX 1300" The R&S FSQ-K92 option will only analyze bursts which contain a maximum symbol count of 1300.

Characteristics: *RST value: 64
SCPI: device specific

Mode: K92

[SENSe:]DEMod:FORMat:CRATE

This command specifies the coding rate for the burst to be analyzed. Note this command is for future extension and is not currently implemented.

Mode: K92

[SENSE:]BURSt:COUNT

This command defines the number of bursts that will be analyzed by the measurement. This parameter is ignored if the setting for the [SENSE:]BURSt:COUNT:STATe parameter is off.

Example: "BURS:COUNT 16" - Sets the number of bursts to 16.

Characteristics: *RST value: 1
SCPI: device specific

Mode: K92

[SENSE:]BURSt:COUNT:STATe

When this command is set to on, the burst count parameter will be used by the measurement, otherwise the burst count parameter will be ignored.

Example: "BURS:COUNT:STAT 1" Sets the burst count state to ON

Characteristics: *RST value: OFF
SCPI: device specific

Mode: K92

[SENSE:]POWER:ACHannel:SPACing:ACHannel

This command defines the channel spacing of the adjacent channel to the TX channel.

Example: "POW:ACH:SPAC:ACH 33KHZ" Sets the spacing between the carrier signal and the adjacent channel to 33 kHz

Characteristics: *RST value: 1.75MHz
SCPI: device specific

Mode: K92

[SENSE:]POWER:ACHannel:SPACing:ALTErnate<1|2>

This command defines the spacing between the first (ALTErnate1) or the second alternate adjacent channel (ALTErnate2) and the TX channel.

Example: "POW:ACH:SPAC:ALT1 100KHZ" Sets the spacing between the TX channel and the alternate adjacent channel 1 to 100 kHz

Characteristics: *RST value: 3.5MHz for alternate adjacent channel 1
5.25MHz for alternate adjacent channel 2
SCPI: device specific

Mode: K92

[SENSe:]POWer:ACHannel:ACPairs

This command sets the number of adjacent channels (upper and lower channel in pairs). The figure 0 stands for pure channel power measurement.

Example: "POW:ACH:ACP 3" Sets the number of adjacent channels to 3, i.e. the adjacent channel and alternate adjacent channels 1 and 2 are switched on

Characteristics: *RST value: 3
SCPI: device specific

Mode: K92

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]

This command sets the channel bandwidth of the radio communication system.

Example: "POW:ACH:BWID 30KHZ" Sets the bandwidth of the TX channel to 30kHz

Characteristics: *RST value: 1.75 MHz
SCPI: device specific

Mode: K92

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel

This command defines the channel bandwidth of the adjacent channel of the radio transmission system.

Example: "POW:ACH:BWID:ACH 30KHZ" Sets the bandwidth of all adjacent channel to 30kHz

Characteristics: *RST value: 1.75 MHz
SCPI: device specific

Mode: K92

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALternate<1|2>

This command defines the channel bandwidth of the first/second alternate adjacent channel of the radio transmission system.

Example: "POW:ACH:BWID:ALT1 30KHZ" Sets the bandwidth of all first alternate adjacent channel to 30kHz

Characteristics: *RST value: 1.75 MHz
SCPI: device specific

Mode: K92

[SENSe:]POWer:ACHannel:MODE

This command sets the ACP measurement mode to either absolute or relative. The mode can be specified as follows:

ABS - Absolute measurement
REL - Relative measurement

Example: "POW:ACH:MODE ABS" Sets the ACP measurement to absolute mode

Characteristics: *RST value: REL
SCPI: device specific

Mode: K92

[SENSe:]SWAPiq

This command defines whether or not the recorded IQ pairs should be swapped (I<->Q) before being processed.

Example: "SWAP 1" Specifies that IQ values should be swapped.

Characteristics: *RST value: 0
SCPI: device specific

Mode: K92

[SENSe:]TRACking:LEVel

This command defines whether or not the measurement results should be compensated for level

Example: "TRAC:LEV 1" - Specifies that the measurement results should be compensated for level.

Characteristics: *RST value: 0
SCPI: device specific

Mode: K92

[SENSe:]TRACking:PHASe

This command defines whether or not the measurement results should be compensated for phase

Example: "TRAC:PHAS 1" Specifies that the measurement results should be compensated for phase.

Characteristics: *RST value: 1
SCPI: device specific

Mode: K92

[SENSe:]TRACking:TIME

This command defines whether or not the measurement results should be compensated for time

Example: "TRAC:TIME 1" Specifies that the measurement results should be compensated for time.

Characteristics: *RST value: 0
SCPI: device specific

Mode: K92

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (See Section Status reporting registers). *RST does not influence the status registers.

COMMAND	PARAMETERS	UNIT	COMMENT
STATus:			
:QUESTionable			
:LIMit<1 2>			
[:EVENT]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:POWer			
[:EVENT]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:SYNC			
[:EVENT]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	

STATus:QUESionable:LIMit<1|2>[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUESTionable:LIMit Register for screen A and B. Readout deletes the contents of the EVENT section.

Example: "STAT:QUES:LIM?"

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUESTionable:LIMit register for screen A and B. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:LIM:COND?"

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:LIMit<1|2>:ENABle

This command sets the bits of the ENABle section of the STATus:QUESionable:LIMit register for screen A and B. The ENABle register selectively enables the individual events of the associated EVENT section for the summary bit.

Example: "STAT:QUES:LIM:ENAB 65535" All events bits will be represented in the LIMit summary bit.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:LIMit<1|2>:PTRansition

This command determines what bits in the STATus:QUESionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUESionable:LIMit 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.

Example: "STAT:QUES:LIMit:PTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:LIMit<1|2>:NTRansition

This command determines what bits in the STATus:QUESionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUESionable:LIMit 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.

Example: "STAT:QUES:LIM:NTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:POWer[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUESionable:POWer Register. Readout deletes the contents of the EVENT section.

Example: "STAT:QUES:POW?"

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:POWer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:POWer register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:POW:COND?"

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:POWer:ENABLE

This command sets the bits of the ENABle section of the STATus:QUEStionable:POWer register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:POW:ENAB 65535" - All events bits will be represented in the POWer summary bit.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:POWer:PTRansition

This command determines what bits in the STATus:QUEStionable:POWer Condition register will set the corresponding bit in the STATus:QUEStionable:POWer 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.

Example: "STAT:QUES:POWer:PTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUESionable:POWer:NTRansition

This command determines what bits in the STATus:QUEStionable:POWer Condition will set the corresponding bit in the STATus:QUEStionable:POWer 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.

Example: "STAT:QUES:POW:NTR 65535" - All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUEStionable:SYNC:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:SYNC register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:SYNC:COND?"

Characteristics: *RST value: -
SCPI: Conforming

Mode: K92

STATus:QUEStionable:SYNC:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:SYNC register. The ENABle register selectively enables the individual events of the associated EVENT section for the summary bit.

Example: "STAT:QUES:SYNC:ENAB 65535" - All events bits will be represented in the SYNC summary bit.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUEStionable:SYNC:PTRansition

This command determines what bits in the STATus:QUEStionable:SYNC Condition register will set the corresponding bit in the STATus:QUEStionable:SYNC Event register when that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: "STAT:QUES:SYNC:PTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

STATus:QUEStionable:SYNC:NTRansition

This command determines what bits in the STATus:QUEStionable:SYNC Condition will set the corresponding bit in the STATus:QUEStionable:SYNC Event register when that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: "STAT:QUES:SYNC:NTR 65535" - All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: K92

TRACe Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

COMMAND	PARAMETERS	UNIT	COMMENT
TRACe [:DATA]	TRACE1 TRACE2 TRACE3 TRACE4 TRACE5 TRACE6		Query only
:IQ :DATA: :MEMory? :SRATe :FILTer :FLATness	<numeric_value>, <numeric_value> <numeric_value> NORMal WIDE	Hz	Query only

TRACE[:DATA]

This command returns all the measured data that relates to the currently selected measurement type. All results are returned in ASCII format. The returned data is particular to the currently selected measurement type and is specified below. DISPLAY:FORMat is not supported with this command.

IQ Measurements

There are a number of measurements that can be performed in IQ mode. No data will be returned for any of the following measurements, should it be requested, until such time as a measurement belonging to the IQ group has been previously run.

Running a frequency sweep measurement, for example Spectrum Mask, will not generate results for this measurement group.

Constellation Vs Symbol

This measurement represents I and Q data. The data will be returned as a repeating array of interleaved I and Q data in groups of selected carriers, until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

If "All Carriers" is selected, it will return 52 per of I and Q data per symbol.

If "Pilots Only" is selected, it will return 4 per of I and Q per symbol in the following order: Carrier – 21, Carrier –7, Carrier 7, Carrier 21.

If a single carrier is selected, it will return 1 per of I and Q data per symbol.

Constellation Vs Carrier

This measurement represents I and Q data. Data will be returned as a repeating array of interleaved I and Q data in groups of 199 channels including the channel 0, until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

Power Vs Time – Full Burst and Rising /falling data

Both measurement results are once again simply slightly different views of the same results data.

All fully complete bursts within the capture time are analyzed into three master bursts. The three master bursts relate to the minimum, maximum and average values across all complete bursts. This data is returned in dBm values to the user on a per sample basis. Each sample will in some way relate to an analysis of each corresponding sample within each processed burst.

The type of PVT data returned will be determined by the TRACE number passed as an argument to the SCPI command, in addition to the graphic type that is selected.

If the graphic type selected is full burst, then the return data is as follows.

TRACE1 – full burst, minimum burst data values.

TRACE2 – full burst, mean burst data values.

TRACE3 – full burst, maximum burst data values.

If the graphic type selected is EDGE, then the return data is as follows.

TRACE1 – rising edge, minimum burst data values.

TRACE2 – rising edge, mean burst data values.

TRACE3 – rising edge, maximum burst data values.

TRACE4 – falling edge, minimum burst data values.

TRACE5 – falling edge, mean burst data values.

TRACE6 – falling edge, maximum burst data values.

Spectrum Flatness

There are four separate traces that are available with this measurement. Trace data for a particular trace will only be returnable by querying the appropriate trace

Spectrum flatness provides two basic graph types. These are an absolute power value graph (ABS) and a relative group delay graph, which are both plotted on a per carrier basis. All 52 carriers are drawn, in addition to the unused 0 carrier. Both the absolute power and group delay graph groups will allow all the data points to be returned as one trace and an average of all the channels as the other trace.

E.g. the return data will either be one single group of 199 carriers if the average trace is selected or a repeating group of 199 carriers if all the data is requested.

TRACE1 – ABS (all analyzed trains)

TRACE2 – Group Delay (all analyzed trains)

TRACE3 – ABS (average trace)

TRACE4 – Group Delay (average trace)

Absolute power results are returned in dB and group delay results are returned in ns.

Spectrum FFT

All FFT points will be returned if the data for this measurement is requested. This will be an exhaustive call, due to the fact that there are nearly always more FFT points than IQ samples. The number of FFT points is the number presented by a power of 2 that is higher than the total number of samples.

E.g. if there were 20000 samples, then 32768 FFT points would be returned.

Data will be returned in floating point format in dBm. TRACE1 is used for this measurement results.

Statistics Bitstream data

Data will be returned in repeating groups of 199 data channels where each symbol value will be represented by an integer value within one byte. Channel 0 is unused and will therefore not have any data associated with it, with no return data being provided. The number of repeating groups that are returned will be equal to the number of measured symbols. Currently, 64QAM has the highest data rate and it contains symbol values up to 63, making the proposal of one byte sufficient in size to represent all symbol data values, regardless of the modulation type in use. Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.

Statistics CCDF - Complementary cumulative distribution function

Up to a maximum of 201 data points will be returned in addition to a data count value. The first value in the return data will represent the quantity of probability values that follow. Each of the potential 201 data points will be returned as probability value and will represent the total number of samples that are equal to or exceed the corresponding power level. Probability data will be returned up to the power level that contains at least one sample. It is highly unlikely that the full 201 data values will ever be returned. Each probability value will be returned as a floating point number, with a value less than 1.

Statistics Signal Field data

Data will be returned as an array of hexadecimal values, with each hexadecimal value representing the 24 bit long signal field for a single burst.

EVM Vs Carrier

Two trace types are provided with this measurement. There is an average EVM value for each of the 200 channels or a repeating group of EVM values for each channel. The number of repeating groups will correspond to the number of fully analyzed trains.

Each EVM value will be returned as a floating point number, expressed in units of dBm.

TRACE1 – Average EVM values per channel

TRACE2 – All EVM values per channel for each full train of the capture period

EVM Vs Symbol

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum EVM value, as measured over the complete capture period.

The number of repeating groups that are returned will be equal to the number of measured symbols.

Each EVM value will be returned as a floating point number, expressed in units of dBm.

TRACE1 – Minimum EVM values

TRACE2 – Mean EVM values

TRACE3 – Maximum EVM values

Error Vs Preamble

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum frequency or phase value as measured over the preamble part of the burst.

Frequency Sweep Measurements

No data will be returned for this type of measurement, should it be requested, until such time as a measurement has been previously run.

Running an IQ measurement will not generate results for this type of measurement.

Spectrum Mask

Result data will be returned as 625 trace points in floating point format. These trace points are obtained directly from the base system via the measurement API and the quantity is therefore a fixed value. Only an array of Y data will be returned. TRACE1 is used for this measurement results.

Spectrum ACPR

Result data will be returned as 625 trace points in floating point format. These trace points are obtained directly from the base system via the measurement API and the quantity is therefore a fixed value. Only an array of Y data will be returned. TRACE1 is used for this measurement results.

Example: "TRAC? TRACE2" The measurement data for the selected graph is returned.

Characteristics: *RST value: -
SCPI: conforming

Mode: K92

TRACE:IQ:DATA:MEMory?

Returns all the IQ data associated with the measurement acquisition time.

The result values are scaled linear in unit *Volt* and correspond to the voltage at the RF input of the instrument. The command returns a comma separated list of the measured voltage values in floating point format (Comma Separated Values = CSV). The number of values returned is 2 * number of samples, the first half being the I-values, the second half the Q-values.

Parameter: <offset samples> Offset of the values to be read related to the start of the acquired data.
 Value range: 0 to <# of samples> - 1
 <# of samples> Number of measurement values to be read.
 Value range: 1 to <# of samples> - <offset samples>

Example: "TRAC:IQ:DATA:MEM? 0,2000" - Requests first 2000 samples.

Characteristics: *RST value: -
 SCPI: device specific.

Mode: K92

TRACE:IQ:SRATe

This command allows the sample rate for IQ measurements to be specified

Example: "TRACE:IQ:SRAT 20000" - Specifies a sample rate of 20 MHz.

Characteristics: *RST value: -
 SCPI: Device Specific

Mode: K92

TRACE:IQ:FILTer:FLATness

This command determines whether the wideband detector filters are to be used in preference to the wideband detector board, (B72 option), for a specified sample rate. The use of the wideband filters is restricted to the 20.4MHz to 40.8MHz range. These filters are only switchable if the B72 option is available in the test instrument. An FSQ which does not have the B72 option will automatically use the wideband filters where the sample rate is in the 20.4MHz to 40.8MHz range. This command only applies to the FSQ instrument.

Example: "TRACE:IQ:FILT:FLAT WIDE" - Specifies the use of wideband detector filters.

Characteristics: *RST value: NORMal-
 SCPI: Device Specific

Mode: K92

Trigger Subsystem

The trigger subsystem is used to synchronize device action(s) with events.

COMMAND	PARAMETERS	UNIT	COMMENT
:TRIGger [:SEQUence] :MODE :LEVel :Power :AUTO :HOLDoff	IMMediate EXTernal POWer <numeric_value> <Boolean> <numeric_value>	 DBM V S	

TRIGger[:SEQUence]:MODE

This command configures how triggering is to be performed.

Parameter:

IMMediate	automatically triggers the next measurement at the end of the previous measurement. This corresponds to the FREE RUN setting.
EXTernal	the next measurement is triggered by the signal at the external trigger input e.g. a Gated trigger
POWer	triggering of the measurement via signals which are the measurement channel.

Example: "TRIG:MODE IMM" AUTO triggering will occur for the next measurement at the specified video percentage value.

Characteristics: *RST value: IMMediate
SCPI: device specific

Mode: K92

TRIGger[:SEQUence]:LEVel:POWer

This command accepts the level of the input signal for which triggering will occur. The value is specified in dBm for RF input and Volts for base band inputs.

Example: "TRIG:LEV:POW 10 DBM" Set to 10 dBm for RF measurement.
"TRIG:LEV:POW 1 V" Set to 1 Volt for base band measurement.

Characteristics: *RST value: 0 DBM
SCPI: Device Specific

Mode: K92

TRIGger[:SEQuence]:LEVel:POWer:AUTO

This command specifies whether or not an automatic power trigger level calculation is performed before each main measurement. The setting of this command is ignored if the setting for TRIGger[:SEQuence]:MODE is not POWER.

Example: “TRIG:LEV:POW:AUTO 1” Specifies that an automatic power trigger level calculation should be performed before the start of each main measurement.

Characteristics: *RST value: 0
 SCPI: Device Specific

Mode: K92

TRIGger[:SEQuence]:HOLDoff

This command defines the length of the trigger delay. A negative delay time (pretrigger) can be set.

Example: “TRIG:HOLD 500us” The R&S FSQ-K92 option use a holdoff period of 500µs after the trigger condition has been met.

Characteristics: *RST value: -10µs
 SCPI: Conforming

Mode: K92

Unit Subsystem

The unit subsystem specifies the units for specific result types.

COMMAND	PARAMETERS	UNIT	COMMENT
:UNIT			
:EVM	DB PCT		
:PREamble	HZ PCT		
:TABLe	DB PCT		

UNIT:EVM

This command specifies the units for EVM trace results.

Parameter: DB EVM trace results returned in dB
PCT EVM trace results returned in %

Example: "UNIT:EVM PCT" EVM results to be returned in %.

Characteristics: *RST value: DB
SCPI: device specific

Mode: K92

UNIT:PREamble

This command specifies the units for Preamble error results.

Parameter:

HZ Preamble error results returned in Hz
PCT Preamble error results returned in %

Example: "UNIT:PRE PCT" - Preamble error results to be returned in %.

Characteristics: *RST value: DB
SCPI: device specific

Mode: K92

UNIT:TABLe

This command specifies the units for EVM results in the table of results.

Parameter: DB EVM results returned in dB
PCT EVM results returned in %

Example: "UNIT:TABL PCT" EVM results to be returned in %.

Characteristics: *RST value: DB
SCPI: device specific

Mode: K92

Status reporting registers

The status reporting system (see Fig. 4-1) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out a calibration and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATUS:OPERation and STATUS:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STATus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfils the same function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in

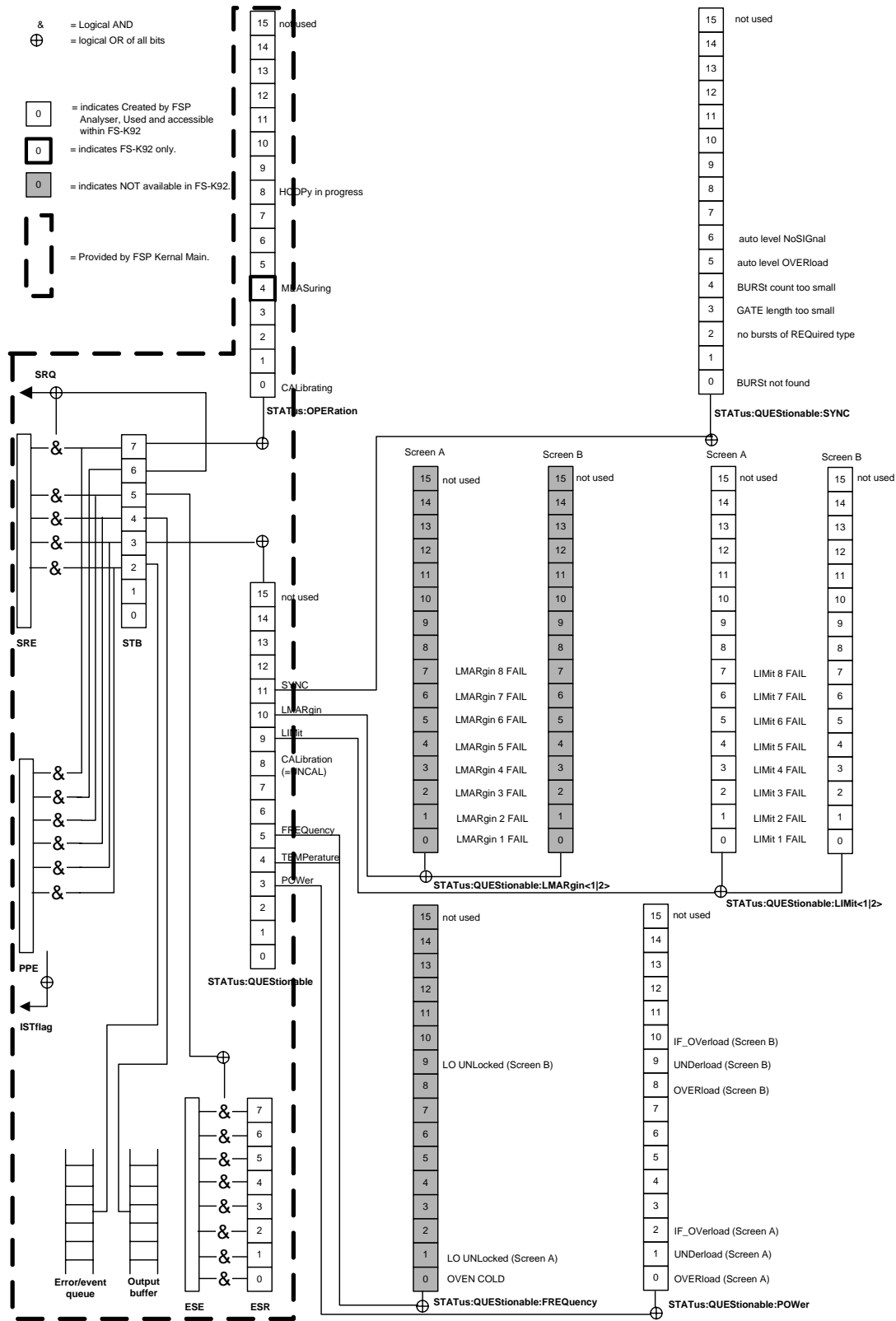


Fig. 4-1 Overview of the status registers

Description of the Status Registers

All the status registers shown in Fig. 4-1 are the same as those provided by the base system, with the exception of the following:

STATUS:OPERation – Although this register is provided by R&S FSP Kernel main, R&S FSQ-K92 makes use of bits 4 & 7 in this register which are not used within R&S FSP Kernel main

STATUS:QUESTionable:ACPLimit – This register is provided by the analyzer and is not available from the R&S FSQ-K92 command tree

STATUS:QUESTionable:LIMit2 – This register is provided by the analyzer and is not available from the R&S FSQ-K92 command tree

STATUS:QUESTionable:LMARgin<1|2> – These registers are provided by the analyzer and are not available from the R&S FSQ-K92 command tree

The deviations from the status register structure of the base system are detailed below.

STATUS:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVEnt part, information on which actions the instrument has executed since the last reading. It can be read using commands "STATUS:OPERation:CONDition?" or "STATUS:OPERation[:EVEnt]?".

Bit No	Meaning
0	CALibrating This bit is set as long as the instrument is performing a calibration.
1 to 3	These bits are not used
4	MEASuring A '1' in this bit position indicates that a measurement is in progress. R&S FSQ-K92 only
5 to 7	These bits are not used
8	HardCOPy in progress This bit is set while the instrument is printing a hardcopy.
9 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable Register

This register comprises information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be queried by commands `STATus:QUEStionable:CONDition?` and `STATus:QUEStionable[:EVENT]?`.

Bit No	Meaning
0 to 2	These bits are not used
3	POWer This bit is set if a questionable power occurs (cf. also section "STATus:QUEStionable:POWer Register").
4	TEMPerature This bit is set if a questionable temperature occurs.
5	FREQuency The bit is set if a frequency is questionable (cf. section "STATus:QUEStionable:FREQuency Register").
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 (see also section STATus:QUEStionable:LIMit Register). Note: Limit register is associated with limit lines for the Spectrum Mask measurement only.
10	LMARgin (device-specific) This bit is set if a margin is violated (see also section STATus:QUEStionable:LMARgin Register)
11	SYNC (device-dependent) This bit is set if, in measurements or pre-measurements in WIMAX mode, synchronization fails, no signal is detected or no burst is found. This bit is also set if input settings conflict with the measurement setup (see also "STATus:QUEStionable:SYNC Register").
13 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable:LIMit Register

This register comprises information about the observance of limit lines in the corresponding measurement window (LIMit 1 corresponds to Screen A, LIMit 2 to Screen B). It can be queried with command `STATus:QUEStionable:LIMit<1|2>:CONDition?` and `STATus:QUEStionable:LIMit<1|2>[:EVENT]?`.

Note that no limit lines are displayed in screen A and as such all bits in the LIMit1 register will always be set to 0.

Bit No	Meaning
0 to 1	These bits are not used
2	LIMit FAIL This bit is set if the ETSI Spectrum Mask limit line is violated
3	LIMit FAIL This bit is set if the IEEE Spectrum Mask limit line is violated.
4	LIMit FAIL This bit is set if the Spectrum Flatness (Upper) limit line is violated
5	LIMit FAIL This bit is set if the Spectrum Flatness (Lower) limit line is violated
6	LIMit FAIL This bit is set if the Spectrum Flatness Difference (Upper) limit line is violated
7	LIMit FAIL This bit is set if the Spectrum Flatness Difference (Lower) limit line is violated
8-14	These bits are not used
15	This bit is always 0

STATUS:QUESTIONABLE:SYNC Register

This contains information about sync and bursts not found, and about pre-measurement results exceeding or falling short of expected values.

The bits can be queried with commands "STATUS:QUESTIONABLE:SYNC:CONDITION?" and "STATUS:QUESTIONABLE:SYNC[:EVENT]?".

Bit No	Meaning
0	BURSt not found This bit is set if an IQ measurement is performed and no bursts are detected
1	This bit is not used
2	no bursts of REQuired type This bit is set if an IQ measurement is performed and no bursts of the specified type are detected
3	GATE length too small This bit is set if gating is used in a measurement and the gate length is not set sufficiently large enough
4	BURSt count too small This bit is set if a PVT measurement is performed with gating active and there is not at least 1 burst within the gate lines
5	auto level OVERload This bit is set if a signal overload is detected when an auto-level measurement is performed
6	auto level NoSIGnal This bit is set if no signal is detected by the auto-level measurement
7 to 14	These bits are not used
15	This bit is always 0

Error Reporting

Error reporting for the K92 option is carried out using the Service Request (SRQ) interrupt in the GPIB interface. When an error occurs a Service Request interrupt will be generated. The master can then query the slave instrument for the error that triggered the interrupt. Errors are queried through the "SYSTem:ERRor" command.

Table of softkeys with assignment of IEC/IEEE bus commands

Key LINES or Hotkey WIMAX

GENERAL SETTINGS

```
:CONFigure:STANdard
:[SENSe:]FREQuency:CENTer
:CONFigure:CHANnel
:CONFigure:WIMax:FBANd
:SENSe:BANDwidth:CHANnel
:TRACe:IQ:SRATe
:CONFigure:WIMax:IGRatio
:CONFigure:POWer:AUTO
:DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet
:CONFigure:POWer:EXPEcted:RF
:CONFigure:POWer:EXPEcted:IQ
:[SENSe:]SWEEp:TIME
:[SENSe:]BURSt:COUNT:STATe
:[SENSe:]BURSt:COUNT
:[SENSe:]SWEEp:COUNT
:TRIGger[:SEQuence]:MODE
:TRIGger[:SEQuence]:HOLDoff
:TRIGger[:SEQuence]:LEVel:POWer
:TRIGger[:SEQuence]:LEVel:POWer:AUTO
:[SENSe:]SWAPiq
:INPut:SElect
:INPut:IQ:IMPedance
:INPut:IQ:BALanced[:STATe]
:[SENSe:]IQ:LPASs[:STATe]
:[SENSe:]IQ:DITHer[:STATe]
:CONFigure:POWer:AUTO
:DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel
:INPut1:ATTenuation
:INPut1:EATT:STATe
:INPut1:EATT:AUTO
:INPut1:EATT
:INPut1:FILTer:YIG:AUTO
:INPut1:FILTer:YIG:STATe
:UNIT:TABLE
```

DEMOM SETTINGS

```
: [SENSe:]DEMOM:FORMat:BANalyze:BTYPe
:CONFigure:WIMax:LMODe
:[SENSe:]DEMOM:FORMat:AUTO
:[SENSe:]DEMOM:FORMat:BANalyze
:[SENSe:]DEMOM:BANalyze:SYMBOLs:EQUal
:[SENSe:]DEMOM:BANalyze:SYMBOLs:MIN
:[SENSe:]DEMOM:BANalyze:SYMBOLs:MAX
:[SENSe:]DEMOM:CEStimation
:[SENSe:]TRACking:PHASe
:[SENSe:]TRACking:TIME
:[SENSe:]TRACking:LEVel
```

DISPLAY LIST GRAPH

```
:DISPlay[:WINDow<1|2>]:TABLE
Result query:
:FETCh:BURSt:ALL?
:FETCh:BURSt:PREAmble?
:FETCh:BURSt:PAYLoad?
:FETCh:BURSt:RMS?
:FETCh:BURSt:PEAK?
:FETCh:BURSt:CRESt?
:FETCh:BURSt:FERRor?
:FETCh:BURSt:SYMBOLerror?
:FETCh:BURSt:IQOffset
:FETCh:BURSt:GIMBalance
:FETCh:BURSt:QUADoffset
:FETCh:BURSt:EVM:ALL
:FETCh:BURSt:EVM:DATA
:FETCh:BURSt:EVM:PIlot
```

PVT	:CONFigure:BUrSt:PVT[:IMMediate]
GENERAL SETTINGS	:CONFigure:STANdard :[SENSe:]FREQuency:CENTer :CONFigure:CHANnel :CONFigure:WIMax:FBANd :SENSe:BANDwidth:CHANnel :TRACe:IQ:SRATe :CONFigure:WIMax:IGRatio :CONFigure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALE]:RLEVel:OFFSet :CONFigure:POWer:EXPeCted:RF :CONFigure:POWer:EXPeCted:IQ :[SENSe:]SWEep:TIME :[SENSe:]BUrSt:COUNT:STATe :[SENSe:]BUrSt:COUNT :[SENSe:]SWEep:COUNT :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SElect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASs[:STATe] :[SENSe:]IQ:DITHer[:STATe] :CONFigure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALE]:RLEVel :INPut1:ATTenuation :INPut1:EATT:STATe :INPut1:EATT:AUTO :INPut1:EATT :INPut1:FILTer:YIG:AUTO :INPut1:FILTer:YIG:STATe :UNIT:TABLE
DEMOD SETTINGS	:[SENSe:]DEMod:FORMat:BANalyze:BTYPe :CONFigure:WIMax:LMODe :[SENSe:]DEMod:FORMat:AUTO :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMBOLs:EQUAl :[SENSe:]DEMod:BANalyze:SYMBOLs:MIN :[SENSe:]DEMod:BANalyze:SYMBOLs:MAX :[SENSe:]DEMod:CEStimation :[SENSe:]TRACking:PHASe :[SENSe:]TRACking:TIME :[SENSe:]TRACking:LEVel
DISPLAY LIST GRAPH	:DISPlay[:WINDow<1 2>]:TABLE
FULL BURST	:CONFigure:BUrSt:PVT:SElect FULL
RISING FALLING	:CONFigure:BUrSt:PVT:SElect EDGE
GATING ON OFF	:[SENSe:]SWEep:EGATe
GATE SETTINGS	:[SENSe:]SWEep:EGATe:HOLDoff[:TIME] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIME] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK

EVM	---
GENERAL SETTINGS	:CONFIgure:STANdard :[SENSe:]FREQuency:CENTer :CONFIgure:CHANnel :CONFIgure:WIMax:FBANd :SENSe:BANDwidth:CHANnel :TRACe:IQ:SRATe :CONFIgure:WIMax:IGRatio :CONFIgure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet :CONFIgure:POWer:EXPEcted:RF :CONFIgure:POWer:EXPEcted:IQ :[SENSe:]SWEep:TIME :[SENSe:]BURSt:COUNT:STATe :[SENSe:]BURSt:COUNT :[SENSe:]SWEep:COUNT :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SElect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASS[:STATe] :[SENSe:]IQ:DITHer[:STATe] :CONFIgure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALe]:RLEVel :INPut1:ATTenuation :INPut1:EATT:STATe :INPut1:EATT:AUTO :INPut1:EATT :INPut1:FILTer:YIG:AUTO :INPut1:FILTer:YIG:STATe :UNIT:TABLE :[SENSe:]DEMod:FORMat:BANalyze:BTYPe :CONFIgure:WIMax:LMODE :[SENSe:]DEMod:FORMat:AUTO :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMBOLs:EQUal :[SENSe:]DEMod:BANalyze:SYMBOLs:MIN :[SENSe:]DEMod:BANalyze:SYMBOLs:MAX :[SENSe:]DEMod:CESTimation :[SENSe:]TRACking:PHASe :[SENSe:]TRACking:TIME :[SENSe:]TRACking:LEVel
DEMODO SETTINGS	:DISPlay[:WINDow<1 2>]:TABLE
DISPLAY LIST GRAPH	
EVM VS SYMBOL	:CONFIgure:BURSt:EVM:ESYMBOL[:IMMediate]
EVM VS CARRIER	:CONFIgure:BURSt:EVM:ECARRIER[:IMMediate]
ERROR FREQ PHASE	:CONFIgure:BURSt:PREamble:SElect FREQ PHASe :CONFIgure:BURSt:PREamble [:IMMediate]
Y AXIS / DIV	:DISPlay[:WINDow<1 2>]:TACel:Y[:SCALe]:AUTO :DISPlay[:WINDow<1 2>]:TRACel:Y[:SCALe]:PDIVision
GATING ON OFF	:[SENSe:]SWEep:EGATe
GATE SETTINGS	:[SENSe:]SWEep:EGATe:HOLDoff[:TIME] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIME] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK

SPECTRUM	---
GENERAL SETTINGS	<pre> :CONFIgure:STANdard :[SENSe:]FREQuency:CENTer :CONFIgure:CHANnel :CONFIgure:WIMax:FBANd :SENSe:BANDwidth:CHANnel :TRACe:IQ:SRATe :CONFIgure:WIMax:IGRatio :CONFIgure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet :CONFIgure:POWer:EXPEcted:RF :CONFIgure:POWer:EXPEcted:IQ :[SENSe:]SWEep:TIME :[SENSe:]BURSt:COUNT:STATE :[SENSe:]BURSt:COUNT :[SENSe:]SWEep:COUNT :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SElect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATE] :[SENSe:]IQ:LPASs[:STATE] :[SENSe:]IQ:DITHer[:STATE] :CONFIgure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALe]:RLEVel :INPut1:ATTenuation :INPut1:EATT:STATE :INPut1:EATT:AUTO :INPut1:EATT :INPut1:FILTer:YIG:AUTO :INPut1:FILTer:YIG:STATE :UNIT:TABLE :[SENSe:]DEMod:FORMat:BANalyze:BTYPe :CONFIgure:WIMax:LMODE :[SENSe:]DEMod:FORMat:AUTO :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMBOLs:EQUal :[SENSe:]DEMod:BANalyze:SYMBOLs:MIN :[SENSe:]DEMod:BANalyze:SYMBOLs:MAX :[SENSe:]DEMod:CEStimation :[SENSe:]TRACking:PHASe :[SENSe:]TRACking:TIME :[SENSe:]TRACking:LEVel </pre>
DEMOM SETTINGS	<pre> :DISPlay[:WINDow<1 2>]:TABLE </pre>
DISPLAY LIST GRAPH	<pre> :DISPlay[:WINDow<1 2>]:TABLE </pre>
FLATNESS FLAT GRDEL	<pre> :CONFIgure:BURSt:SPECTrum:FLATness:SElect FLATness GRDelay :CONFIgure:BURSt:SPECTrum:FLATness[:IMMediate] </pre>
SFLATNESS DIFFERENCE	<pre> :CONFIgure:BURSt:SPECTrum:FLATness:SElect DIFFerence :CONFIgure:BURSt:SPECTrum:FLATness[:IMMediate] </pre>
SPECTRUM IEEE ESTI	<pre> :CONFIgure:BURSt:SPECTrum:MASK:SElect IEEE ETSI :CONFIgure:BURSt:SPECTrum:MASK[:IMMediate] </pre>
SPECTRUM FTT	<pre> :CONFIgure:BURSt:SPECTrum:FFT[:IMMediate] </pre>
ACP ABS RELABS	<pre> :[SENSe:]POWer:ACHannel:MODE REL ABS :CONFIgure:BURSt:SPECTrum:ACPR[:IMMediate] . </pre>
GATING ON OFF	<pre> :[SENSe:]SWEep:EGATe </pre>

GATE SETTINGS	<pre>:[SENSe:]SWEep:EGATe:HOLDoff[:TIME] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPlE :[SENSe:]SWEep:EGATe:LENGth[:TIME] :[SENSe:]SWEep:EGATe:LENGth:SAMPlE :[SENSe:]SWEep:EGATe:LINK</pre>
CONSTELL	---
GENERAL SETTINGS	<pre>:CONFIgure:STANdard :[SENSe:]FREQuency:CENTer :CONFIgure:CHANnel :CONFIgure:WIMax:FBANd :SENSe:BANDwidth:CHANnel :TRACe:IQ:SRATe :CONFIgure:WIMax:IGRatio :CONFIgure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet :CONFIgure:POWer:EXPEcted:RF :CONFIgure:POWer:EXPEcted:IQ :[SENSe:]SWEep:TIME :[SENSe:]BURSt:COUNT:STATe :[SENSe:]BURSt:COUNT :[SENSe:]SWEep:COUNT :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SElect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASS[:STATe] :[SENSe:]IQ:DITHer[:STATe] :CONFIgure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALe]:RLEVel :INPut1:ATTenuation :INPut1:EATT:STATe :INPut1:EATT:AUTO :INPut1:EATT :INPut1:FILTer:YIG:AUTO :INPut1:FILTer:YIG:STATe :UNIT:TABLE</pre>
DEMODO SETTINGS	<pre>:[SENSe:]DEMOd:FORMat:BANalyze:BTYPe :CONFIgure:WIMax:LMOde :[SENSe:]DEMOd:FORMat:AUTO :[SENSe:]DEMOd:FORMat:BANalyze :[SENSe:]DEMOd:BANalyze:SYMBOLs:EQUal :[SENSe:]DEMOd:BANalyze:SYMBOLs:MIN :[SENSe:]DEMOd:BANalyze:SYMBOLs:MAX :[SENSe:]DEMOd:CEStimation :[SENSe:]TRACking:PHASe :[SENSe:]TRACking:TIME :[SENSe:]TRACking:LEVel</pre>
DISPLAY LIST GRAPH	<pre>:DISPlay[:WINDow<1 2>]:TABLE</pre>
CONSTELL	<pre>:CONFIgure:BURSt:CONStellation:CSYMBOL[:IMMediate]</pre>
CONSTELL VS CARRIER	<pre>:CONFIgure:BURSt:CONStellation:CCARRIER[:IMMediate]</pre>
CARRIER SELECTION	<pre>:CONFIgure:BURSt:CONStellation:CARRIER:SElect</pre>
GATING ON OFF	<pre>:[SENSe:]SWEep:EGATe</pre>

GATE SETTINGS	<pre>:[SENSe:]SWEep:EGATe:HOLDoff[:TIME] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIME] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK</pre>
STATISTICS	<pre>---</pre>
GENERAL SETTINGS	<pre>:CONFIgure:STANdard :[SENSe:]FREQuency:CENTer :CONFIgure:CHANnel :CONFIgure:WIMax:FBANd :SENSe:BANDwidth:CHANnel :TRACe:IQ:SRATe :CONFIgure:WIMax:IGRatio :CONFIgure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet :CONFIgure:POWer:EXPEcted:RF :CONFIgure:POWer:EXPEcted:IQ :[SENSe:]SWEep:TIME :[SENSe:]BURSt:COUNT:STATe :[SENSe:]BURSt:COUNT :[SENSe:]SWEep:COUNT :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiQ :INPut:SElect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASs[:STATe] :[SENSe:]IQ:DITHer[:STATe] :CONFIgure:POWer:AUTO :DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALe]:RLEVel :INPut1:ATTenuation :INPut1:EATT:STATe :INPut1:EATT:AUTO :INPut1:EATT :INPut1:FILTer:YIG:AUTO :INPut1:FILTer:YIG:STATe :UNIT:TABLE :[SENSe:]DEMod:FORMat:BANalyze:BTYPe :CONFIgure:WIMax:LMODe :[SENSe:]DEMod:FORMat:AUTO :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMBOLs:EQUal :[SENSe:]DEMod:BANalyze:SYMBOLs:MIN :[SENSe:]DEMod:BANalyze:SYMBOLs:MAX :[SENSe:]DEMod:CEStimation :[SENSe:]TRACking:PHASe :[SENSe:]TRACking:TIME :[SENSe:]TRACking:LEVel</pre>
DEMOM SETTINGS	<pre>:DISPlay[:WINDow<1 2>]:TABLE</pre>
DISPLAY LIST GRAPH	<pre>:CONFIgure:BURSt:STATistics:CCDF[:IMMEDIATE]</pre>
CCDF	<pre>:CONFIgure:BURSt:STATistics:BSTReam[:IMMEDIATE]</pre>
BIT STREAM	<pre>:CONFIgure:BURSt:STATistics:BSTReam[:IMMEDIATE]</pre>
GATING ON OFF	<pre>: [SENSe:]SWEep:EGATe</pre>
GATE SETTINGS	<pre>: [SENSe:]SWEep:EGATe:HOLDoff[:TIME] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIME] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK</pre>

Key DISP

FULL SCREEN

:DISPlay:FORMat SINGle

SPLIT SCREEN

: DISPlay:FORMat SPLit

Key LINES

```

:CALCulate<1|2>:LIMit<1>:BURSt:ALL
:CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERAge]
:CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERAge]:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum
:CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset[:AVERAge]
:CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset[:AVERAge]:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset:MAXimum
:CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset:MAXimum:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERAge]
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERAge]:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERAge]
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERAge]:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILOt[:AVERAge]
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILOt[:AVERAge]:RESuLT
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILOt:MAXimum
:CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILOt:MAXimum:RESuLT

```

Key MKR

MARKR 1	:CALCulate<1 2>:MARKer<1>:STATE :CALCulate<1 2>:MARKer<1>:X :CALCulate<1 2>:MARKer<1>:Y :CALCulate<1 2>:MARKer<1>:SYMBOL :CALCulate<1 2>:MARKer<1>:CARRIER :CALCulate<1 2>:MARKer<1>:FUNCTION:ZOOM 1
UNZOOM	
MARKER ZOOM	:CALCulate<1 2>:MARKer<1>:FUNCTION:ZOOM <numeric value>
MARKER OFF	:CALCulate<1 2>:MARKer<1>:AOFF

Key MKR->

SELECT MARKER	---
MKR->TRACE	:CALCulate<1 2>:MARKer<1>:TRACE

Hotkeys

SPECTRUM	:INSTrument:SElect SANalyzer :INSTrument:NSElect 1
WIMAX	---
AUTO LVL	---
RUN SGL	:INITiate:CONTinuous OFF; INITiate[:IMMediate]
RUN CONT	:INITiate:CONTinuous ON; INITiate[:IMMediate]
REFRESH	---
SCREEN A/B	:DISPlay[:WINDow<1 2>]:SElect :DISPlay[:WINDow<1 2>]:SSElect

5 Remote Control - Programming Examples

The following section provides some examples of commonly performed operations when using R&S FSQ-K92. For more general remote control examples please refer to the programming examples chapter in the instrument user manual.

Synchronization Entry of Option

The following example shows how to synchronize entering the FS-K92 option.

```
analyzer% = 20      ,Instrument address
CALL IBWRT(analyzer%, " INST:SEL WIMAX;*OPC?" ) ,waits for 1 from *OPC?
```

Selecting Measurements

Measurements are selected using the command CONFIGure:BURSt:<Meas Type> where <Meas Type> is as follows

<Meas Type>	Measurement Type
PVT	Power Vs Time (PVT)
PVT:SElect:EDGE	PVT rising and falling edge
PVT:SElect:FULL	PVT full burst
EVM:ECARrier	EVM Vs Carrier
EVM:ESYMBOL	EVM Vs Symbol
SPECTrum:MASK	Spectrum Mask
SPECTrum:MASK:SElect:IEEE	Spectrum Mask IEEE
SPECTrum:MASK:SElect:ETSI	Spectrum Mask ETSI
SPECTrum:FLATness	Spectrum Flatness
SPECTrum:FLATness:SElect FLATNESS	Spectrum Flatness
SPECTrum:FLATness:SElect GRDELAY	Spectrum Flatness – Group Delay
SPECTrum:FLATness:SElect DIFFERENCE	Spectrum Flatness – Difference
SPECTrum:FFT	Spectrum FFT
SPECTrum:ACPR	Spectrum ACPR
SPECTrum:ACPR:SElect ABS	Spectrum ACPR (Absolute)
SPECTrum:ACPR:SElect REL	Spectrum ACPR (Relative)
CONST:CCARrier	Constellation Vs Carrier
CONST:CSYMBOL	Constellation Vs Symbol
STATistics:CCDF	CCDF
STATistics:BSTReam	Bit Steam
PREamble	Preamble Error
PREamble:SElect FREQ	Frequency Error Vs Preamble
PREamble:SElect PHASE	Phase Error Vs Preamble

The following example shows how to select a Spectrum Mark ETSI measurement:

```
REM select Spectrum Mask Select ETSI
CALL IBWRT(analyzer%, "SPECTrum:MASK:SElect:ETSI")
```

Running Synchronized Measurements

The following examples show how measurements can be synchronized. Synchronization is necessary to ensure that the measurement has completed before the measurement results and markers are requested.

```
PUBLIC SUB SweepSync()
```

```
REM The command INITiate[:IMMEDIATE] starts a single sweep if the
REM command INIT:CONT OFF was previously sent. It should be ensured that
REM the next command is only then executed when the entire sweep is
REM complete.
CALL IBWRT(analyzer%, "INIT:CONT OFF")
```

```
REM ----- First possibility: Use of *WAI -----
CALL IBWRT(analyzer%, "INIT:IMM; *WAI")
```

```
REM ----- Second possibility: Use of *OPC? -----
OpcOk$ = SPACE$(2) 'Space for *OPC? - Provide response
CALL IBWRT(analyzer%, "INIT:IMM; *OPC?")
```

```
REM ----- here the controller can service other instrument-----
CALL IBRD(analyzer%, OpcOk$) 'Wait for "1" from *OPC?
```

```
REM ----- Third possibility: Use of *OPC -----
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM IBCONF!
CALL IBWRT(analyzer%, "*SRE 32") 'Permit service request for ESR
CALL IBWRT(analyzer%, "*ESE 1") 'Set event-enable bit for
                                'operation-complete bit
```

```
CALL IBWRT(analyzer%, "INIT:IMM; *OPC") 'Start sweep and
                                        'synchronize with OPC
```

```
CALL WaitSRQ(boardID%,result%) 'Wait for service request
```

```
REM ----- Fourth possibility: Use of INIT:IMM -----
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM IBCONF!
CALL IBWRT(analyzer%, "*SRE 128") 'Permit service request for ESR
CALL IBWRT(analyzer%, "*ESE 0") 'Set event-enable bit for
                                'operation-complete bit
```

```
CALL IBWRT(analyzer%, "STATus:OPERation:ENABle 16") 'Enable bit 4 of status
                                                    'operation register'
```

```
CALL IBWRT(analyzer%, "STAT:OPERation:NTRansition 16") 'Set Negative
                                                        'transition to 1
```

```
CALL IBWRT(analyzer%, "STATus:OPERation:PTRansition 0") 'Set Positive
                                                         'transition to 0
```

```
CALL IBWRT(analyzer%, "INIT:IMM") 'Start sweep and synchronize with OPC
```

```
CALL WaitSRQ(boardID%,result%) 'Wait for service request
```

```
REM Continue main program here.
```

```
END SUB
```

```
REM *****
```

6 List of Warnings & Error Messages

The list of possible warning & error messages are shown below:

Status Bar Message	Description
Gate length too small - must be greater than 1	This message is only displayed for the FFT measurement. This message indicates that there are no samples contained within the gating lines. Increase the Gate length and then press the <i>REFRESH</i> hotkey to remove this error.
No valid analyzed bursts within gating lines	This message is only displayed for the PVT measurement. This message indicates that there are no complete & valid bursts contained within the gating lines. Increase the Gate length and then press the <i>REFRESH</i> hotkey to remove this error.
No bursts found	<p>This message is displayed if no valid burst was detected in the input data. To correct this problem check the following:</p> <p>The connections between the DUT and analyzer are correct</p> <p>The input signal is of a sufficient level</p> <p>The capture time is long enough to capture at least one complete burst. If running with a Free Run trigger then the capture time must be greater than the burst length (ideally at least twice the burst length) to ensure that a complete burst is recorded.</p> <p>Check that the demod settings are correct</p>
No bursts of desired type to analyze	This message is displayed if bursts are found, but none of desired type to analyze. Check that the setting for Burst Type is correct.
No signal found	This message is displayed when an automatic level detection measurement is executed and the measured signal level is lower the permitted minimum value.
Signal overload detected	This message is displayed when the OVLD enhancement label is displayed and indicates that the input mixer is overloaded. If this message is displayed then try increasing the setting for the Signal Level parameter (or settings Auto Level). If this does not clear the problem then an external attenuation may need to be applied.

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