

R&S®FS-K130PC

Distortion Analysis Software

User Manual



1173.1162.12 – 03

This manual covers the following products:

- R&S®FS-K130PC (1310.0090.02)

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Trade names are trademarks of the owners.

The following abbreviations are used throughout this manual: R&S®FS-K130PC is abbreviated as R&S FS-K130PC.

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1 Documentation Overview

The documentation of the R&S FS-K130PC consists of the following parts:

User Manual

The user manual provides a detailed description of the R&S FS-K130PC functions.

It covers the following topics:

- installing and launching the R&S FS-K130PC
- setting up the R&S FS-K130PC in general
- setting up the R&S FS-K130PC for measurements
- performing measurements with the R&S FS-K130PC

Online Help

The online help provides quick access directly through the software interface to all information necessary to work with the R&S FS-K130PC.

It covers the same topics as the user manual.

Note that you need Microsoft Internet Explorer 4.0 or higher to properly view chm files. If certain security patches for operating system Windows XP® are installed, viewing the chm file from a network resource is not possible. Open the online help in a hard disk directory for correct indication of the help pages.

Internet

The [R&S FS-K130PC website](#) provides the latest versions of the software and the documentation and information for the R&S FS-K130PC.

If you have any questions about the software or suggestions, send an email to FS-K130@rohde-schwarz.com

Release Notes

The release notes provide information about new and modified functions and eliminated problems.

2 Welcome to R&S FS-K130PC

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2.1 System Requirements

You need the following minimum system configuration to use R&S FS-K130PC:

Operating System: Microsoft Windows XP Professional (+ SP2), Microsoft Windows Vista or Microsoft Windows 7 (32 and 64 bit versions).

Free Hard Disk Space: 1 GB

Free RAM: ≥1 GB

Graphics Resolution: ≥XGA (1024x768 pixel)

USB: one free USB port to connect the smartcard reader

alternatively: a built-in smartcard reader to connect the the card in ISO/IEC 7810-ID-1 format

Measuring instrument connection:

- Hardware: IEC/IEEE bus or LAN connection
- Software: VISA driver, National Instruments VISA version ≥4.2, Agilent IO Libraries Suite 15.1 or higher

The software supports the following Rohde & Schwarz spectrum and signal analyzers and signal generators:

- R&S®FSG
- R&S®FSQ
- R&S®FSU
- R&S®FSUP
- R&S®FSV
- R&S®FSVR
- R&S®FSW
- R&S®SMBV
- R&S®SMU
- R&S®SMW

2.2 Installing the Software

Working with the R&S FS-K130PC requires the installation of the software itself and the installation of several software components.

The best way to install the software and the required components is to use the browser tool that is delivered with the software.

If you install the software from a CD-ROM, systems that support the "AutoRun" functionality of the MS Windows operating system, automatically start the browser. If the system does not support the "AutoRun" feature or if you install the software from the download package available on the internet, you have to start the browser manually.



.NET Framework

.NET Framework 2.0 or higher is required to run both the browser tool and the software.

If opening the browser tool results in an error message, install the .NET Framework. The .NET Framework installer is available on the R&S FS-K130PC CD-ROM. It is also part of the download package available on the R&S FS-K130PC product homepage.

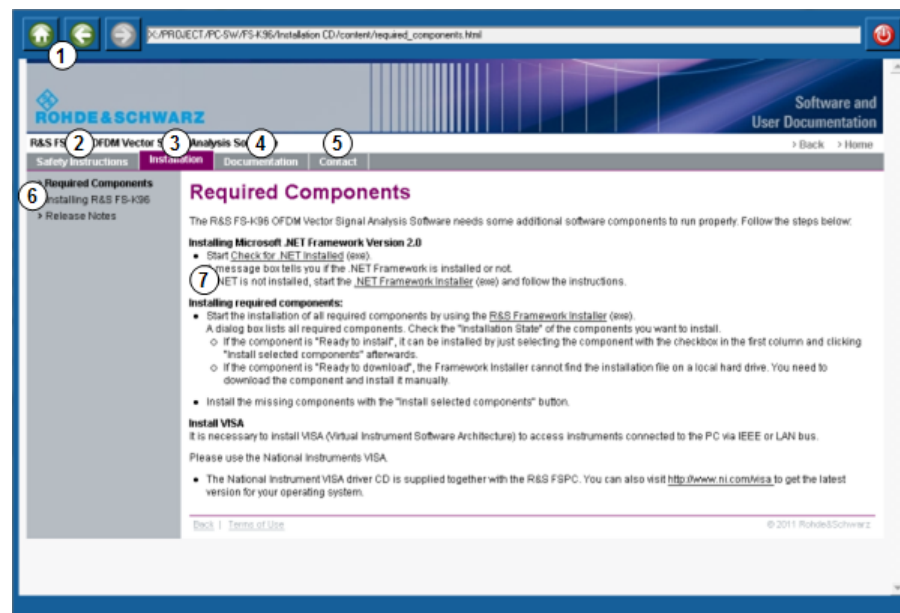
- ▶ Start the `dotnetfx.exe` and follow the instructions of the installer.

- ▶ Start the "AutoRun.exe".

The R&S FS-K130PC opens the browser tool.

The browser tool provides several tabs. Each one contains different information about the software (see number 2 to 5 in the picture below).

- ▶ Navigate to the "Installation" tab.



1 = Navigation and address bar

2 = Safety Instructions tab

3 = Software Installation tab

- 4 = Documentation tab
- 5 = Contact tab
- 6 = Tab menu
- 7 = Main window

The "Installation" tab has three categories in the tab menu:

- Required Components
Contains a guide to install the software components that are necessary to run the software.
- Software Installation
Contains a guide to install the R&S FS-K130PC itself.
- Release Notes
Contains the release notes that were issued with each software release.

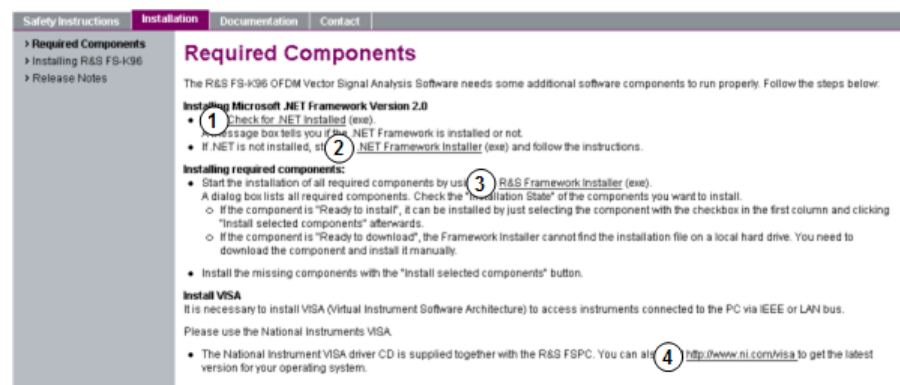
2.2.1 Installing Required Components

You have to install several software components required to successfully run the software. All components are delivered with the R&S FS-K130PC.

Required components

- Microsoft .NET Framework 2.0
- Microsoft Visual C++ Runtime Library (a specific version delivered with the R&S FS-K130PC)
- MATLAB Component Runtime R2012a (32-bit)
- Intel IPP Library Version 4.1
- VISA

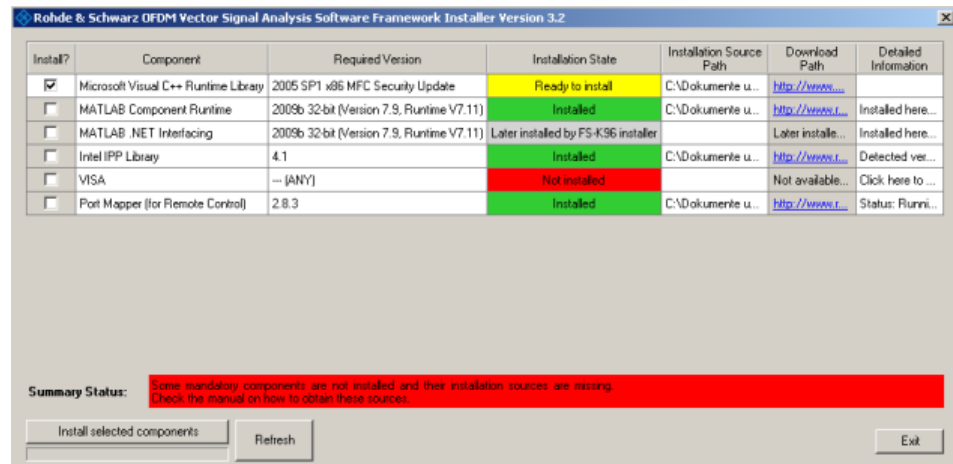
► Navigate to the "Required Components" category in the "Installation" tab.



- 1 = Check for .NET Framework installation
- 2 = Install .NET Framework
- 3 = Install other required components (MATLAB etc.)
- 4 = Install VISA

Installing software components

1. Click on the "R&S Framework Installer" link in the main window of the browser tool. The browser tool opens a dialog box that contains an overview of the required components. It also shows if you have to install them or not.



2. In the "Installation State" column, check if the corresponding software is already installed.

- **Ready to install**

The software is installed after you have selected it in the "Install?" column.

- **Ready to download**

The R&S Framework installer was not able to find the installation file for the corresponding software.

You have to get the program somewhere (for example download it off the internet) and install it manually.

Note that all components except the "Port Mapper" are mandatory.



Note that some installation routines may not confirm the installation by a message like 'Installation Finished'. Therefore it might be necessary to restart the framework installer and check again, if all components are installed.

Installing VISA

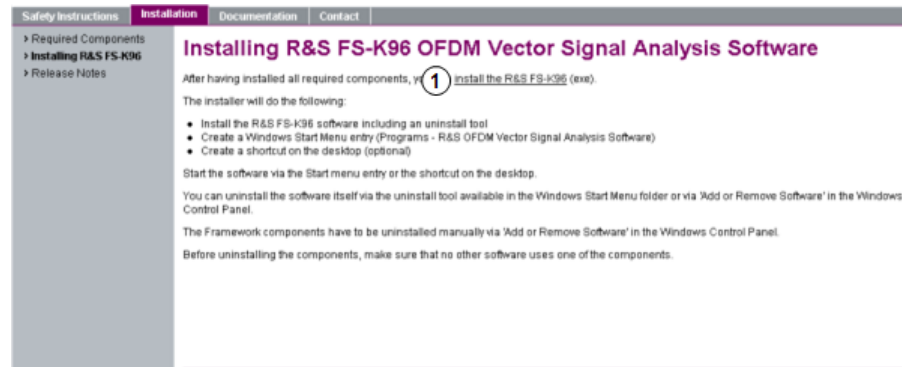
It is also necessary to install VISA (Virtual Instrument Software Architecture) to access instruments connected to the PC via IEEE or LAN bus.

It is recommended to use the National Instruments VISA driver. The National Instrument VISA driver CD is supplied together with the R&S FSPC. You can also visit <http://www.ni.com/visa> to get the latest version for your operating system if you are licensed to.

2.2.2 Installing R&S FS-K130PC

After installing all required components, you can install the R&S FS-K130PC.

- ▶ Navigate to the "Software Installation" category in the "Installation" tab.



1 = Install the analysis software

- ▶ Click on the "install the R&S FS-K130" link in the main window of the browser tool.

The installer performs the following actions:

- Install the R&S FS-K130PC software including an uninstall tool
 - Create a Windows Start Menu entry (Programs ⇌ R&S Distortion Analysis Software)
 - Create a shortcut on the desktop (optional)
 - If necessary (the software will specifically ask you to), set the required environment variables.
- ▶ Start the software via the Windows "Start Menu" entry or the shortcut on the desktop.

2.2.3 Deinstalling R&S FS-K130PC

You can uninstall the software itself via the uninstall tool available in the Windows "Start Menu" folder or via "Add or Remove Software" in the Windows "Control Panel".

The Framework components have to be uninstalled manually via "Add or Remove Software" in the Windows "Control Panel".

Before uninstalling the components, make sure that no other software uses one of the components.

The following components and programs have been installed:

- Microsoft .NET Framework 2.0
- Microsoft Visual C++ 2005 Redistributable
- Matlab Component Runtime 7.11
- Intel Integrated Performance Primitives RTI4.1
- Rohde & Schwarz Distortion Analysis Software (R&S FS-K130PC)

2.3 Using the Smart Card Reader

The software is licensed by a smart card licensing system. This licensing system requires a smart card to be connected to the PC when you are using the software. The smart card and dongle are available as separate products.

You can connect the smart card in two ways.

- Connect the smart card in SIM format.
If you want to connect the smart card in SIM format, use the USB smart card reader that is included in the delivery of the software.
- Connect the smart card in its full format.
If you want to connect the smart card in full format, an interface compatible to the card format is required.
The following devices are able to read the smart card in full format.
 - smart card reader integrated in a keyboard
 - smart card reader integrated in a notebook
 - smart card reader integrated in a desktop PC (e.g. OMNIKEY)
 - smart card reader connected to the computer via serial bus or USB (e.g. OMNIKEY)
 - USB reader connected to a LAN-to-USB converter to distribute the license via the network (e.g. DIGI AnywhereUSB/2)



Licensing support

If you have any difficulties with the licensing system, support is only assured when you are using the USB smart card reader that is delivered with the smart card.

Using the USB smart card reader

1. Included in the delivery of the software is the smart card in full format and a smart card reader.



2. Break out the smart card in SIM format.



3. Insert the smart card into the smart card reader.



- a) Turn the smart card reader in a way that the OMNIKEY label faces upward.
 - b) Insert the smart card with the chip face down and the angled corner facing away from the reader.
4. Push the smart card into the reader as far as possible.

The smart card reader is ready for use on any USB interface.



When you connect the reader to the computer, MS Windows automatically installs the necessary drivers. If not, you can install the drivers manually from the software CD. The required files are stored in the directory `\Install\USB SmartCard Reader Driver Files`. The driver files are named according to the processor architecture for which they are designed. (OMNIKEY3x21_x86 or OMNIKEY3x21_x64).

Information on drivers and driver updates are also included in the `ReadMe.txt` file in the same directory as the drivers.

Locking the computer

If you have difficulties unlocking the computer while the smart card is connected because MS Windows tries to get log-in information from the card after you have locked the computer.

You can solve this issue by editing the system registry.

Automatic change

- ▶ Run `DisableCAD.reg` to change the registry entry automatically. The file is in the same directory as the driver files.

Manual change

1. Open the Windows "Start Menu" and select the "Run" item.
2. Enter `regedit` into the dialog box to open the system registry.

3. Look for
`HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\policies\system.`
4. Set the value of `DisableCad` to 0.



Administration rights

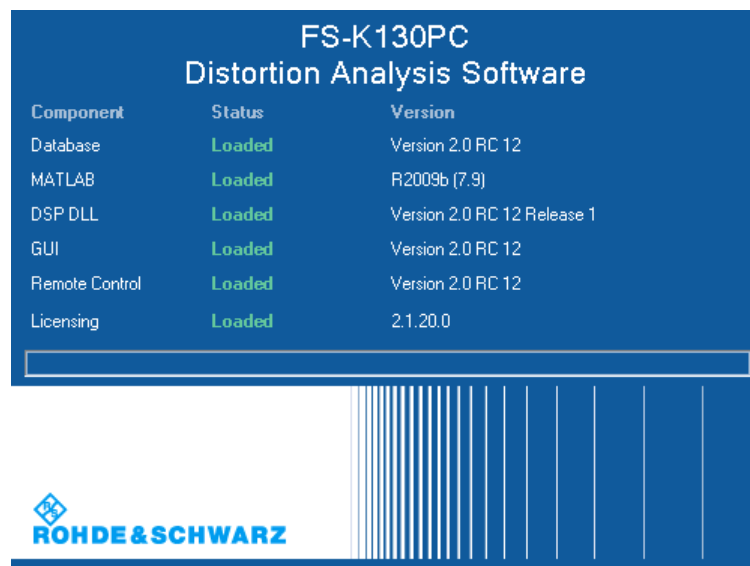
Security policies of your network environment might prevent you from editing the system registry or installing drivers. Contact your IT administration in that case.

2.4 Starting the Software

- ▶ Start the software with the desktop icon or in the Windows Start menu. In the Start menu, you can find the software under "Programs" ⇒ "R&S Distortion Analysis Software".

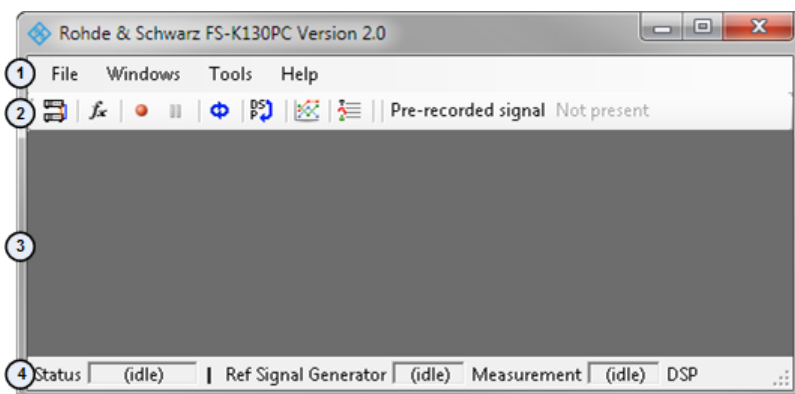


The R&S FS-K130PC checks if all required components are installed on your computer.



After that, the actual GUI opens.

The GUI of R&S FS-K130PC in its default state looks like this:

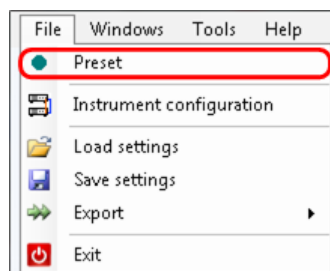


- 1 = Menu Bar: contains general functions of the software
- 2 = Toolbar: contains general measurement functions
- 3 = Workspace: contains elements for user interaction
- 4 = Status Bar: contains the status of miscellaneous processes that the software performs

Presetting the software

All settings have been assigned predefined values.

- ▶ Select the "Preset" menu item from the "File" menu.



The software restores the predefined values for all settings.

SCPI command:

```
SYST: PRES
```



If you change a setting to a value other than the predefined one, the font of this setting turns bold.

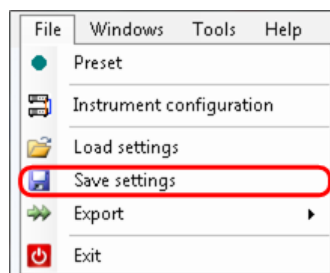
Preset state:

Changed state:

Loading and saving customized settings

If you have customized the values of any parameter, save that set of settings in a file for quick access at a later time.

- ▶ Select the "Save Settings" menu item from the "File" menu.



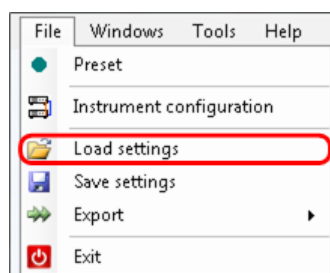
The R&S FS-K130PC opens a dialog box to save the current measurement configuration in a file with the *.FS_K130_Config file extension .



The FS_K130_Config file format

The FS_K130_Config file format is, in effect, an xml file format. Therefore you can open and edit the file with any editor capable of viewing xml files. However, if you want to change settings externally, make sure to keep the structure consistent.

- ▶ Select the "Load Settings" menu item from the "File" menu.

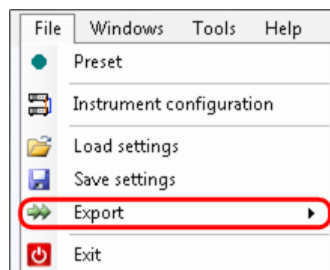


The R&S FS-K130PC opens a dialog box to select a file containing a previously saved measurement configuration.

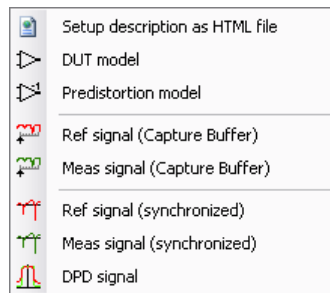
Exporting data

In addition to the measurement configuration, the software allows you export various other data, for example measurement results.

- ▶ Select the "Export" menu item from the "File" menu.

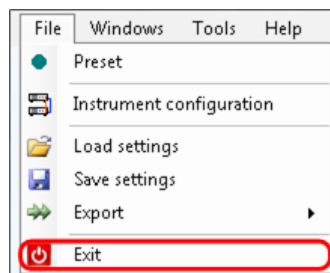


The R&S FS-K130PC opens a submenu to select the type of data you want to export.



Exiting the software

- ▶ Select the "Exit" menu item from the "File" menu.



2.5 Adding Windows to the Working Area

In the initial state, the workspace is completely empty. You have to add windows manually as required. The R&S FS-K130PC provides several types of windows. This chapter gives a quick overview of the window types.

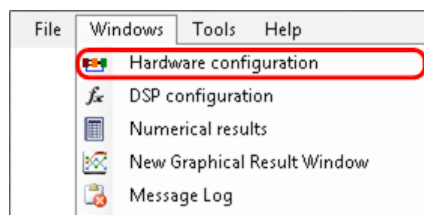
2.5.1 The Hardware Configuration

The "Hardware Configuration" window visualizes the signal flow over all (hardware) components in the test setup. Each component of the test setup is represented as a colored box. The lines in between visualize which components are connected.

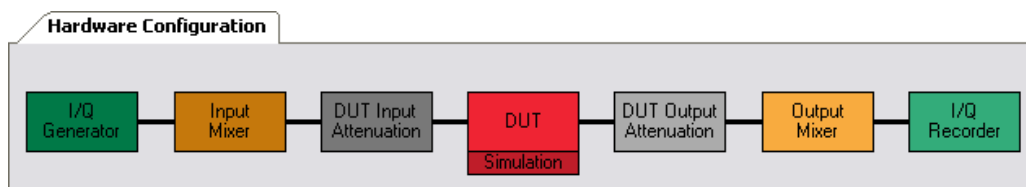
Depending on the test setup, the "Hardware Configuration" element may show different components and a different setup. Refer to the description of each hardware component for more information on its properties.

If you add the "Hardware Configuration" window, you can add it once.

- ▶ Select the "Hardware Configuration" menu item from the "Windows" menu.



The R&S FS-K130PC adds the "Hardware Configuration" window to the workspace.



The following components may be part of the "Hardware Configuration":

- [I/Q Generator](#)
- [Input Mixer](#)
- [DUT Input Attenuation](#)
- [DUT](#)
- [Simulation](#)
- [DUT Output Attenuation](#)
- [Output Mixer](#)
- [I/Q Recorder](#)



Quick software configuration

Clicking anywhere in the block diagram opens a dialog box that contains ten important settings for quick configuration of a measurement.

2.5.2 Hardware Properties

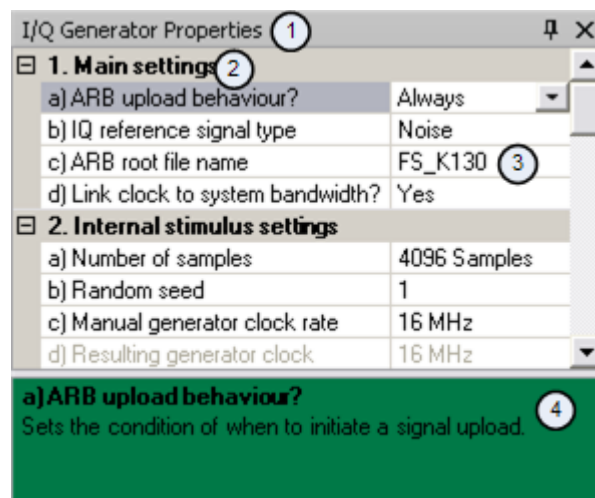
Each hardware component has its own characteristics. "Properties" windows contain all necessary characteristics of the corresponding hardware component.

If you add a "Properties" window, you can add one at a time.

- ▶ Click on the hardware component you want to set up.

The R&S FS-K130PC adds the corresponding "Properties" window to the workspace.

All "Properties" windows look similar.



1 = Title Bar: shows the name of the hardware component.

2 = Parameter Group: group of similar parameters.

3 = Parameter: individual parameters that you can configure.

4 = Parameter Description: short description of the selected parameter.

Parameter groups

Parameter groups are a set of parameters that serve a similar purpose or belong together in a way. To get a better view of a "Properties" window, you can expand or collapse a group of parameters.



- ▶ Click on the  or the  symbol.

Parameters

A parameter changes a certain characteristic of the hardware component.

The left column contains the name of the parameter. The right column contains the value belonging to that parameter.

A normal font in the right column means that the default value has been set. The font turns **bold** if you use values other than the default ones.

- ▶ Click in the right column of the parameter you want to change. The R&S FS-K130PC activates input for that parameter. There are three types of input for a parameter.
 - Select an item from a dropdown list ( shows after selecting the parameter)
 - Select a file from a standard Windows dialog box or open an extended dialog box that contains complex software properties ( shows after selecting the parameter)
 - Enter a value or name as you require including or excluding the unit (field stays empty, no icon shows). If you include a unit, you can use shortcuts, e.g. 'k' for 'kHz'.

Parameter description

The parameter description contains a short description of the selected parameter. You can find a detailed description of each parameter in [chapter 4, "Configuring and Performing Measurements"](#), on page 56. Pressing the F1 key while the parameter is active opens a more detailed help.

For more information on the help system see [chapter 2.7, "Using the Help System"](#), on page 24.

2.5.3 Measurement Results

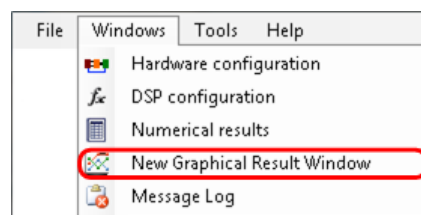
Measurement results are available in graphical and numerical form.

2.5.3.1 Graphical Results

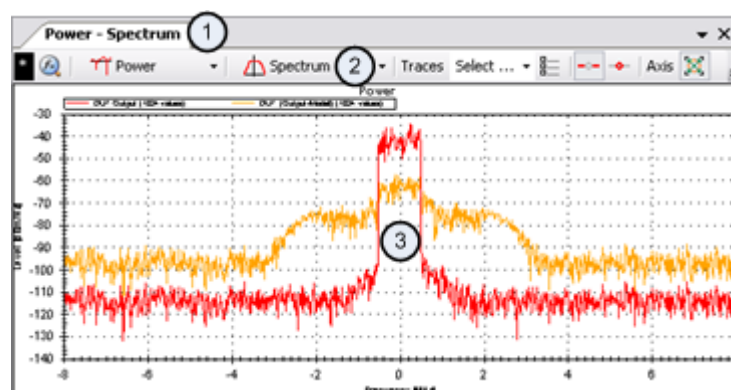
Graphical results or result displays visualize the results as traces in a diagram. Traces may be lines or points.

You can add as many graphical result windows as you like.

- ▶ Press the  icon or select the "New Graphical Result Window" menu item from the "Windows" menu.




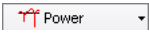
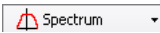
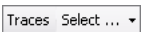










The R&S FS-K130PC adds a new result window to the workspace.



- 1 = Title Bar: shows the currently selected combination of result display and evaluation method.
- 2 = Toolbar: configures the result display.
- 3 = Result Display: shows the measurement results in graphic form, including a legend for the traces.

There are several result displays available to choose from in order for you to view the results from different perspectives.

You can configure result displays via its toolbar. The toolbar contains the following elements:

- The flag (red or black) indicates whether the displayed measurement results are valid or not.
-  to open the "DSP Properties" dialog box.
For more information see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.
-  to select the aspect of the result display.
For more information see [chapter 3, "Measurements and Result Displays"](#), on page 30.
-  to select the evaluation method.
For more information see [chapter 5.1, "Selecting the Evaluation Method"](#), on page 115.
-  to select the traces you want to see.
For more information see [chapter 3, "Measurements and Result Displays"](#), on page 30.
-  to deselect all traces.
-  to show a line between the measurement points.
-  to add dots to every measurement point.
-  to automatically scale the diagram to the results after each measurement.
-  to zoom or unzoom the result display in order to fit in the screen.
-  to update the trace.
-  to freeze the result display in focus. All other result displays update the results as defined. To stop the measurement in general use the  button in the toolbar of the main window.
-  to save the trace either in bitmap format or in vector format.
-  to export the trace data to the clipboard.
For more information see [chapter 5, "Analyzing Measurement Results"](#), on page 115.

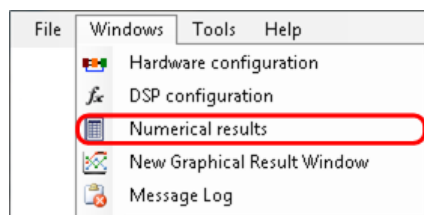
A right-click opens the context menu that contains additional functionality like the zoom. For more information see [chapter 5, "Analyzing Measurement Results"](#), on page 115.

2.5.3.2 Numerical Results

Numerical results show the results in a table.

If you add the "Numerical Results" window, you can add it once.

- ▶ Select the "Numerical Results" menu item from the "Windows" menu.



The R&S FS-K130PC adds numerical results table to the workspace.

Group	Item	Result
Main results (3)		
	DUT Input - RMS	0.0 dBm (5)
	DUT Input - Peak (4)	10.1 dBm (6)
	DUT Input - Crest	10.1 dBm (7)
	DUT Output - RMS	0.0 dBm (8)
	DUT Output - Peak	10.1 dBm

1 = Title Bar

2 = Save HTML report button

3 = Result group: group of similar results

4 = Result: individual measurement result

5 = Yellow result: approximate result

6 = White result: check not possible, but result is valid

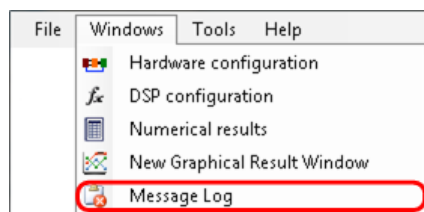
7 = Green result: valid result

8 = Red result: invalid result

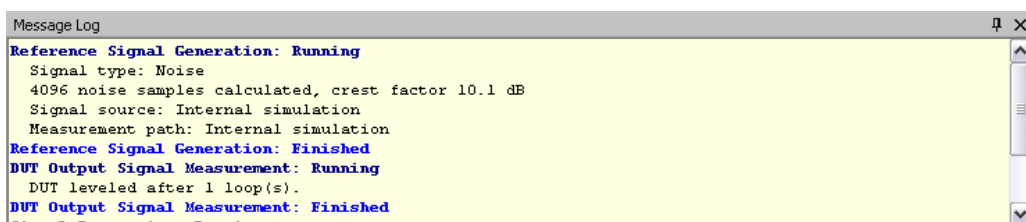
2.5.4 Message Log

The message log provides information about the measurement process or errors during the measurement. By default, the "Message Log" element is always active after starting R&S FS-K130PC.

- Select the "Message Log" menu item from the "Windows" menu.



You can copy the contents of the message log, for example, to file a problem report.

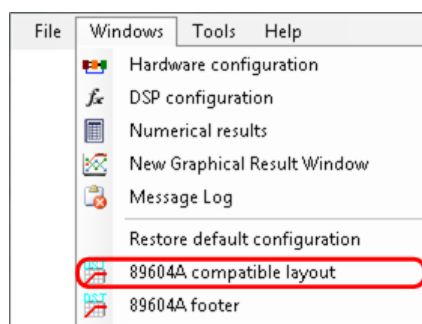


2.5.5 89604A Layout

If required, the software supports an Agilent 89604A mode.

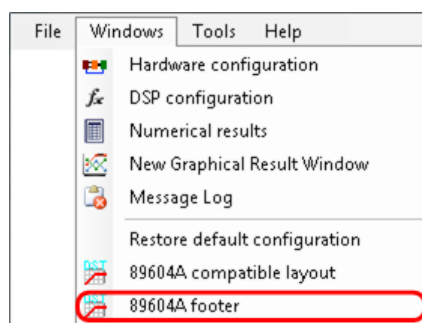
If you turn it on, the user interface of the R&S FS-K130PC looks like the Agilent 89604A user interface.

1. Select the 89604A "Compatible Layout" menu item from the "Windows" menu.



The R&S FS-K130PC rearranges the user interface to resemble the 89604A software. In "Compatible" mode, the user interface consists of four graphical result displays.

2. Select the "89604A Footer" menu item from the "Windows" menu.



The R&S FS-K130PC adds and emulates the 89604A footer. The footer contains numerical results and information about the measurement.

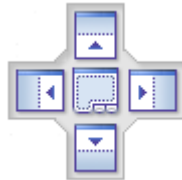
2.6 Customizing the User Interface

In addition to adding and removing elements to and from the workspace, you can also customize the layout of the user interface by docking elements to a particular position of the working area, by adding a tab to an existing element or by altogether removing an element from the user interface.

2.6.1 Docking Elements

1. Select an element in the title bar with the mouse and move it around until a docking spot appears.

Docking spots look like this:



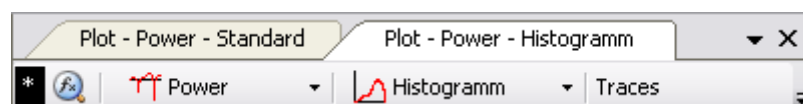
2. Move the mouse cursor over one of the possible docking spots. The border of the docking spot turns blue. The screen area in which the element will be positioned also turns blue.



3. Release the element. The element docks itself to the corresponding area of the GUI.


2.6.2 Adding an Element as a Tab

1. Select an element with the mouse and move it over the center docking spot in an area where another element already is.
2. Release the element. The released element is added as a tab to the element.



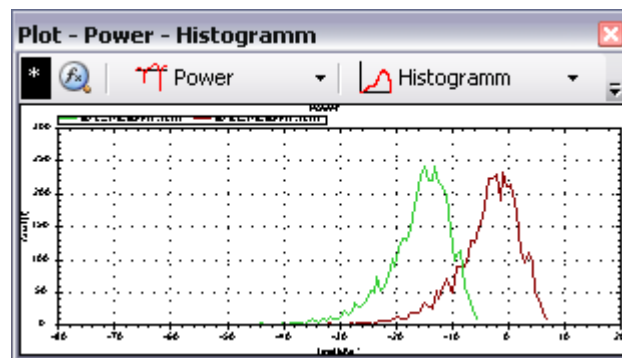
The active tab always is in a lighter color than the others.

Note that tabs may be at the top of the window or at the bottom of the window, depending on where the window is in the user interface.

3. Select the tab you need by either clicking on the tab itself or by clicking on the  symbol and selecting the tab you need from the list.

2.6.3 Removing an Element from the GUI

- ▶ Select an element with the mouse, move it around and release it. If you haven't docked the element or added it as a tab, it is floating around as an individual window. You can also move the element completely out of the GUI and work with it in an independent window (e.g. another monitor).



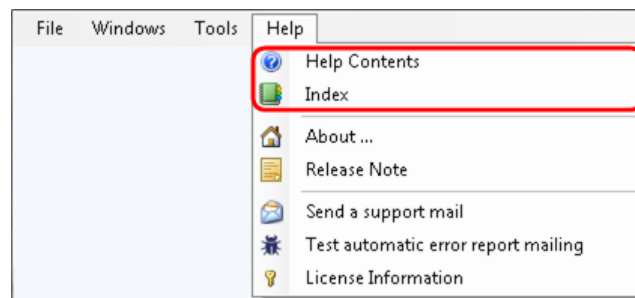
2.7 Using the Help System

The help system provides information about the functions of the software. It is available in several formats.

- **Manual**

The manual is the most substantial part of the documentation. In addition to a detailed description of all elements of the software, it also contains information on how to set up and perform various measurements and background information on the software. The manual is available in pdf format. You'll find it on the CD that comes with the software and can download it off the internet. Note that the version available on the internet may contain more current information than that on the CD.
- **Online Help**

Press the F1 key or select the "Help Contents" or "Index" menu item from the "Help" menu in the menu bar.



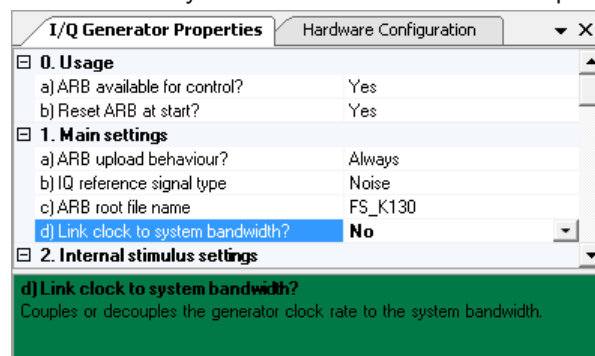
The "Help Contents" menu item opens the contents of the online help while the "Index" menu item opens the index of the online help.

If you press the F1 key while an element of the user interface is selected (e.g. a particular parameter in a dialog box), the software goes directly to the description of that parameter.

The online help contains the same information as the manual.

- **Parameter Description**

The dialog boxes contain a field at the bottom that shows a short description of the property or parameter you have currently selected. This field is always active and colored the way of the selected hardware component.



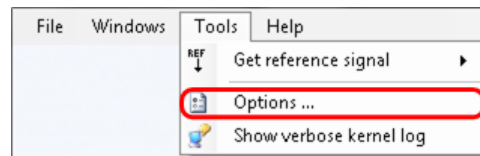
2.8 Using Support Functions

Support functions provide information on the software and system performance and provide support in case of complications while using the software.

2.8.1 Debugging Tools

In case of problems using the software, use the debugging tools provided by the software.

- ▶ Select the "Options" menu item from the "Tools" menu.



The R&S FS-K130PC opens the "Debug Properties" dialog box.

1. Debug properties	
a) Debug mode active?	No
b) Debug file root	C:\
c) Store DSP input?	No
d) Store DSP output?	No
e) VISA call logging depth?	Off

Debug Mode Active

Turns the debugging mode on and off.

Debug File Root

Shows the folder (including path) that contains the file that contains the debugging results (LOG output).

The folder also contains the software executable.

Store Kernel Input

If active, the R&S FS-K130PC saves the DSP input files in case unexpected signal processing events happen.

Problem solution for R&S customer support may be easier if you include these files in the error report to reproduce the entire DSP flow with all data going into the DSP. The DSP input file is stored in the "Debug File Root" folder.

Store Kernel Output

If active, the R&S FS-K130PC saves the DSP output files in case unexpected signal processing events happen.

Problem solution for R&S customer support may be easier if you include these files in the error report to reproduce the entire DSP flow with all data going out of the DSP. The DSP output file is stored in the "Debug File Root" folder.

VISA Call Logging Depth

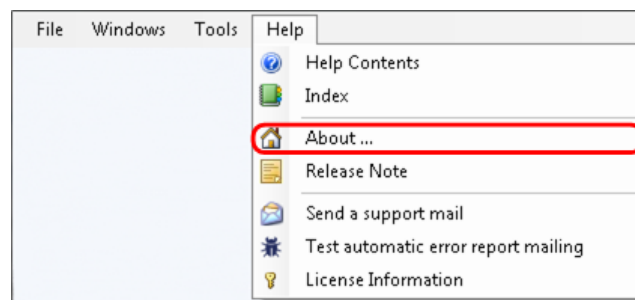
Defines the extent of logging of SCPI communication between PC and instrument.

Activate and use this feature to solve problems relating to remote control.

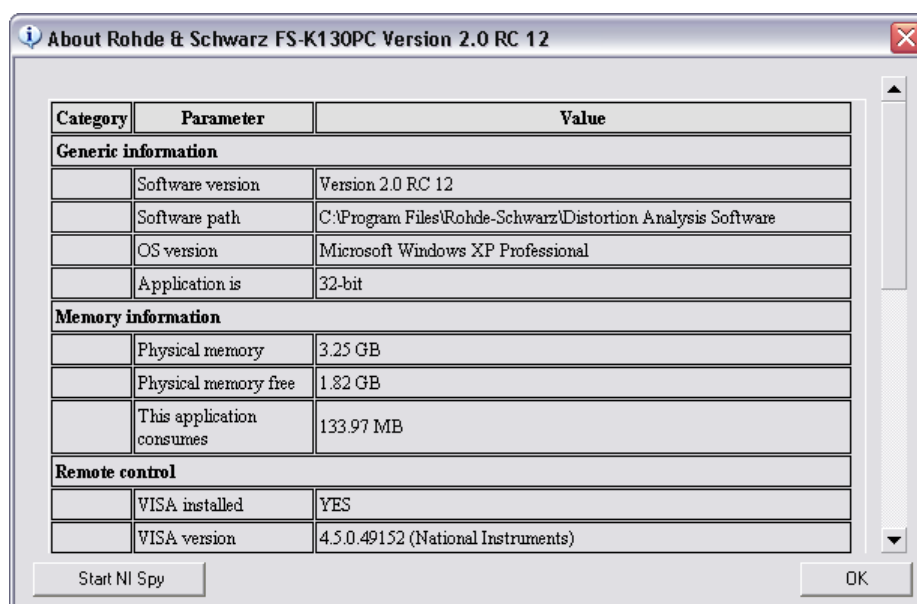
2.8.2 About the System

The performance of the R&S FS-K130PC depends on the system configuration you are using. If the system does not meet the requirements, the R&S FS-K130PC may not work correctly.

- ▶ Select the "About" menu item from the "Help" menu.



The "About" message box contains an overview of the state of the system components the R&S FS-K130PC requires (like memory usage or software versions). Use this information as a source to detect problems.



Start NI Spy

The "Start NISpy" button opens the NISpy software by National Instruments. NISpy is a debug tool that you can use if you encounter bugs or problems with the remote control.

NISpy will compile an error report for your problem after pressing the "Record" button. Save the report and send the file to Rohde & Schwarz customer support.

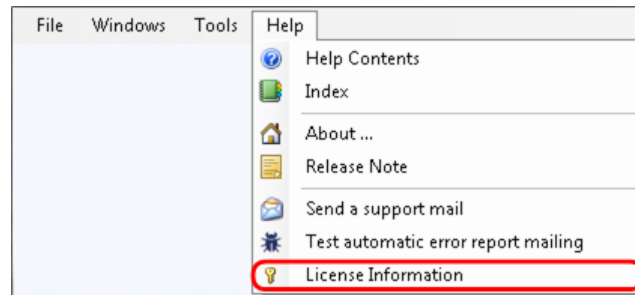
For more information on its functionality refer to the NISpy manual available at <http://www.ni.com> or the online help of the NISpy software.

Note that you have to install NISpy before you can use this function. NISpy is one component of the National Instruments VISA software package.

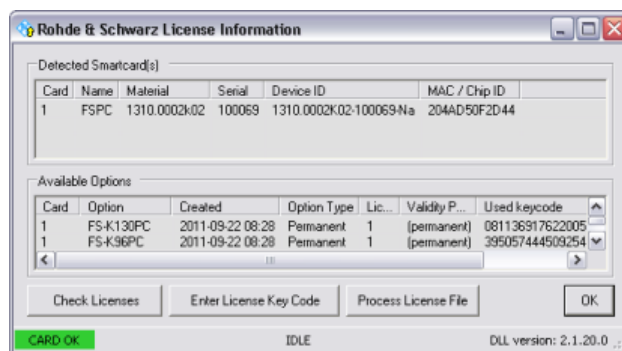
2.8.3 License Information

The R&S FS-K130PC only works in combination with a valid license.

- ▶ Select the "License Information" menu item from the "Help" menu.



The "License Information" dialog box contains several functions to manage R&S software licenses.



Check licenses

Scans the system for R&S licenses and updates the "Available Options" pane in the dialog box.

Enter license key code

Opens an input field to add a new license to the system.

Process license file

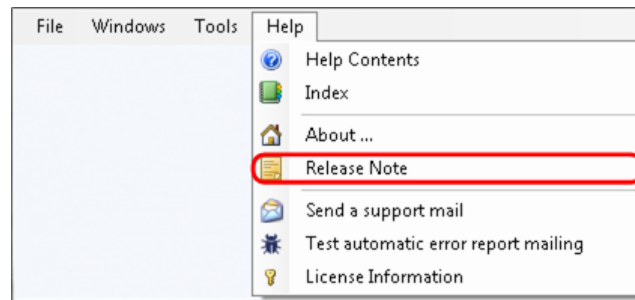
Adds a new license to the system via xml file.

2.8.4 Release Notes

Release notes contain functionality that has been added since the last version of the R&S FS-K130PC.

Release notes are also available on the CD and on the internet.

- ▶ Select the "Release Note" menu item from the "Help" menu.



The R&S FS-K130PC opens the release notes. The file contains all release notes that have been released since the first version of the software, including beta releases.

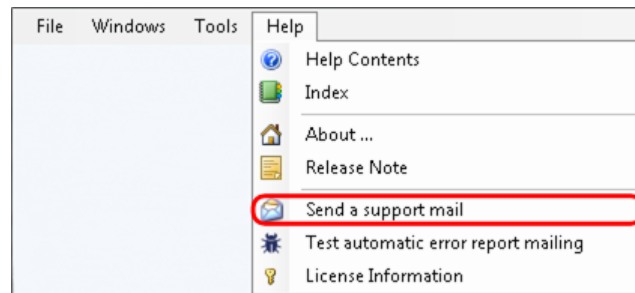
Exporting release notes

The "Save as RTF" button exports the release notes to a rtf file.

2.8.5 Direct Support

If you encounter problems that you cannot solve yourself, you can request support from Rohde & Schwarz.

- ▶ Select the "Send a Support Mail" menu item from the "Help" menu.



The R&S FS-K130PC creates an empty email with a corresponding subject and the support email address that you can use to send an error report.

3 Measurements and Result Displays

- [Recording a Reference Signal](#)..... 30
- [Graphical Measurement Results](#)..... 33
- [Selecting Traces](#)..... 45
- [Numerical Measurement Results](#)..... 46

3.1 Recording a Reference Signal

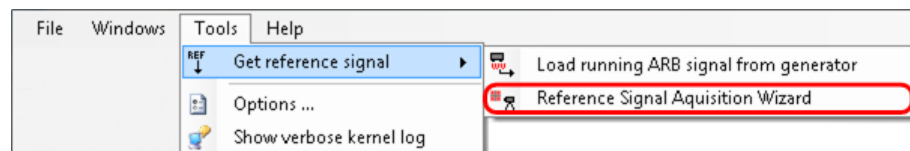
3.1.1 Using the Reference Signal Acquisition Wizard

The "Reference Signal Acquisition Wizard" provides functionality to capture a signal directly from a signal generator and then use it as the reference signal.

Alternatively, you can use an artificial reference signal that you load into the R&S FS-K130PC. For more information on how to handle files see [chapter 4.5, "Specifying the File Type"](#), on page 107.

When you are using the acquisition wizard, basically all you need to know about the signal is its center frequency. The wizard then records the signal, looks for the period and runs averaging on the I/Q data.

- ▶ Select the "Reference Signal Acquisition Wizard" menu item from the "Tools" menu.



The "Reference Signal Acquisition Wizard" dialog box opens.

3.1.1.1 Signal Acquisition

Defines the characteristics of the signal to capture and process.

1. Signal acquisition	
a) RF frequency	1 GHz
b) Sampling frequency	10 MHz
c) Sampling time	1 ms
d) Samples	10000 Sample
e) Use wideband measurement	Not available
f) Signal is pulsed?	No

RF Frequency

Defines the center frequency of the signal you want to use as the reference signal.

Remote command:
not supported

Sampling Frequency

Defines the number of samples the wizard acquires during the sampling period (sample rate).

Remote command:
not supported

Sampling Time

Defines the length of the sample that the wizard records to get the reference signal from.

Remote command:
not supported

Samples

Shows the number of samples that the wizard records and calculates the reference signal from.

The number of samples results from the sampling frequency and the sampling time.

Remote command:
not supported

Use Wideband Measurement Path

Turns the wideband path for a higher measurement bandwidth on and off.

Note that a higher measurement bandwidth might add unwanted effects (e.g. increased noise) to the measurement.

Wideband measurement paths are available with hardware options for the R&S FSQ, R&S FSV and R&S FSW. For more information refer to the datasheet of the analyzers.

Remote command:
CONF:IQSINK:WBAN ON | OFF

Signal Is Pulsed

Selects if the signal the reference signal is based on is a pulsed signal or not.

Remote command:
not supported

3.1.1.2 Signal Processing

Defines the characteristics of the signal processing.

2. Signal processing	
a) Minimum samples per period	1000
b) Maximum periods	100
c) Pulse detection limit	5 dB

Minimum Samples Per Period

Defines the number of samples that a reference signal period must include.

A reference signal period is one complete cycle of the signal used as reference signal which will repeat at its end. If you are using a normal ARB file, the reference signal period is the number of samples divided by the clock rate.

Remote command:
not supported

Maximum Periods

Defines the number of periods that a reference signal may include at most.

Remote command:
not supported

Pulse Detection Limit

Defines the level threshold for pulse detection.

If you have turned the detection of pulses in the reference signal on, the "Pulse Detection Limit" defines the minimum distance between the On and Off regions of supposed pulses. A signal is detected as a pulse if the distance between an On and an Off region is greater than the "Pulse Detection Limit".

Remote command:
CONF:DSP:MOD:PDET <numeric value>

3.1.1.3 Display Options

Capture Buffer On Failure Only

Turns the display of the complete capture buffer on and off.

When you turn this feature on, the complete capture buffer contents are displayed only if no periodicity could be found within the signal.

When you turn this feature off, the complete capture buffer is always displayed, regardless if a valid periodic signal is detected or not.

Note that displaying the complete capture buffer in case of a high number of averages may consume a lot of resources (memory and processing power).

Remote command:
not supported

3.1.1.4 Special Options

Store Raw Captured Signal

Turns the storage of the raw data of the reference signal that has been captured on and off.

When you turn this feature on, the software stores the selected reference signal in a file as a 32-bit floating vector. The data sequence is IQIQIQ.... The file name is "RefWizard_iqiq.iqw". The location of the file depends on the [Debug File Root](#) (by default, this is the directory the software was installed in).

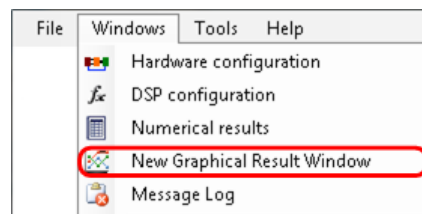
Remote command:
not supported

3.2 Graphical Measurement Results

The R&S FS-K130PC provides several result displays. Each result display shows a certain aspect of the signal characteristics.

Each result display features a customized set of traces. A trace shows the results for a particular signal. For more information see [chapter 3.3, "Selecting Traces"](#), on page 45.

1. Press the  icon or select the "New Graphical Result Window" menu item from the "Windows" menu.



The R&S FS-K130PC adds a new result window to the workspace.

2. Select the result display from the  dropdown menu in the toolbar of the diagram.

This chapter contains a description of all available result displays, including the trace types that are available for each result display.

• Capture Buffer	33
• Power	34
• Gain	36
• Constellation Diagram	38
• AM/AM	40
• AM/PM	41
• I and Q	43
• EVM	43
• Channel	44

3.2.1 Capture Buffer

The capture buffer contains the raw data that has been recorded during the first stage of signal processing (usually the synchronization algorithm). The raw data contains the

reference signal as well as the measurement signal. It is the source data for the synchronization and all further evaluations.

Both the reference signal and the measurement signal are shifted in time by the measured trigger delay of the synchronization algorithm. As both signals are matched in the time domain in that case, you can compare them visually.

You can use the capture buffer result display to identify the causes for possible unexpected or invalid results.

The available trace types are as follows:

Reference Signal.....	34
Measured Signal.....	34
Measured Signal with DPD.....	34

Reference Signal

Shows the characteristics of the reference signal over time. The reference signal represents the ideal signal for your purposes (as selected and present at the DUT input).

For more information on generating a reference signal see [chapter 3.1, "Recording a Reference Signal"](#), on page 30 and [chapter 4.3.1, "Configuring the I/Q Generation"](#), on page 59.

Measured Signal

Shows the characteristics of the measured signal over time.

The measured signal represents the characteristics of the DUT you are testing.

Measured Signal with DPD

Shows the characteristics of the measured signal over time, including digital predistortion (DPD).

The measured signal represents the characteristics of the DUT you are testing.

3.2.2 Power

The "Power" result display shows the power of the signal over time after the synchronization process has been finished. You can examine the signal from various angles within signal definition, measurement and processing flow.

The time period the software analyzes depends on the number of samples you have set.

The available trace types are as follows:

Reference Signal.....	35
Measured Signal.....	35
Modeled Signal.....	35
EVM (Reference Signal vs Measured Signal).....	35
EVM (Measured Signal vs Modeled Signal).....	35
Predistorted Signal.....	36
Measured Signal After DPD (Expected).....	36
Measured Signal After DPD (Measured).....	36

Reference Signal

Shows the power characteristics of the reference signal. The reference signal represents the ideal signal for your purposes (as selected and present at the DUT input).

For more information on generating a reference signal see [chapter 3.1, "Recording a Reference Signal"](#), on page 30 and [chapter 4.3.1, "Configuring the I/Q Generation"](#), on page 59.

Measured Signal

Shows the power characteristics of the (synchronized) measured signal at the DUT output.

The software uses this signal for the model estimation process.

To match both signals visually, you can eliminate the nominal gain of the measurement signal. For more information see ["Gain Normalization"](#) on page 117.

For more information on the measurement configuration see [chapter 4.3.8, "Configuring the I/Q Recorder"](#), on page 89.

Modeled Signal

Shows the power characteristics of the signal when the calculated model has been applied to the reference signal.

If the model matches the behavior of the DUT, the characteristics of the signal are the same as those of the measured signal (minus the noise).

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

EVM (Reference Signal vs Measured Signal)

Shows the error vector magnitude (EVM) between the reference signal and the measured signal.

To get useful results, the calculated linear gain is compensated to match both signals.

Depending on the DUT, noise and nonlinear effects may have been added to the measurement signal. These effects are visualized by this trace.

You can reduce the effects of noise by increasing the [Periods to Capture](#). This runs an averaging based on the complex data and thus reduces noise significantly.

In addition, if you are using the "Spectrum" evaluation, the trace shows the in-band distortion.

EVM (Measured Signal vs Modeled Signal)

Shows the error vector magnitude (EVM) between the modeled signal and the measured signal.

The EVM between the measured and modeled signal indicates the quality of the DUT modeling. If the model matches the DUT behavior, the modeling error is zero (or is merely influenced by noise).

This result display shows changes in the model and its parameters and thus allows you to optimize the modeling.

Predistorted Signal

Shows the signal that is applied to the DUT input, including digital predistortion (DPD) and after the DUT has been modeled and the DPD function has been calculated.

The predistorted signal is the signal that - applied to the DUT input or used as the input argument of the model function - creates an output signal at the DUT or model function showing the linear gain version of the input signal. In mathematical terms this means that if $x=f(y)$ is the model function, the predistortion function $a=p(b)$ is formed in such a way that $x=f(p(y))$ results in $x=G*y$ (with G being the linear gain factor).

If you are using the "Spectrum" evaluation, the DPD shows an increased ACP power as it must compensate the ACP power of the nonlinear behavior of the DUT.

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

Measured Signal After DPD (Expected)

Shows the expected power characteristics of the output signal, including digital predistortion (DPD).

If both the model and the DPD are calculated correctly, the expected signal is a linear amplified version of the reference signal.

Note: Because the DUT may get into high compression, the total RMS level may be lower than the measured measured signal without DPD.

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

Measured Signal After DPD (Measured)

Shows the measured power characteristics of the output signal, including digital predistortion (DPD).

If this signal is different to the expected signal, this is usually an indicator that the DUT does not behave according to the model or that the DPD is not possible with the selected model function. To get a better signal including digital predistortion, try, for example, to increase the model order or select the Volterra model instead of a polynomial model.

For more information on the measurement configuration see [chapter 4.3.8, "Configuring the I/Q Recorder"](#), on page 89.

3.2.3 Gain

The "Gain" result display shows the amplification and error effects of the DUT as a function of the DUT input or output power.

The gain is the ratio of the input and output power of the DUT.

Nonlinear effects typically result in a trace that drops near high power levels or does not follow the ideal horizontal gain line also in low-level regions.

The available trace types are as follows:

Gain vs Reference Signal.....	37
Gain vs Measured Signal.....	37
Gain vs Reference - Model.....	37
Gain vs Measured Signal after DPD (Expected).....	37
Gain vs Measured Signal after DPD (Measured).....	38
EVM vs Reference Signal.....	38
Gain vs Measured Signal (shifted to the reference peak).....	38

Gain vs Reference Signal

Shows the signal gain as a function of the reference signal power.

In case of nonlinear amplifiers or DUTs, the gain decreases if the input power becomes too high to follow the linear part of the DUT characteristics. For very low levels, the trace widens vertically due to noise influence.

Because of memory effects, the trace usually widens in the low-level and high-level ranges. Memory effects typically show as slopes on the curve, especially near high output powers.

Gain vs Measured Signal

Shows the signal gain as a function of the measured signal power.

In case of nonlinear amplifiers or DUTs, the gain decreases if the input power becomes too high to follow the linear part of the DUT characteristics. For very low levels, the trace widens vertically due to noise influence.

Because of memory effects, the trace usually widens in the low-level and high-level ranges. Memory effects typically show as slopes on the curve, especially near high output powers.

Gain vs Reference - Model

Shows the signal gain as a function of the signal used for the model estimation process.

If the DUT was modeled correctly, the trace should resemble the "Gain vs Ref" trace minus noise.

Because of memory effects, the trace usually widens in the low-level and high-level ranges. Memory effects typically show as slopes on the curve, especially near high output powers.

Gain vs Measured Signal after DPD (Expected)

Shows the expected signal gain as a function of the output signal including digital pre-distortion (DPD).

Because of memory effects, the trace usually widens in the low-level and high-level ranges. Memory effects typically show as slopes on the curve, especially near high output powers.

Note: Because the DUT may get into high compression, the total RMS level may be lower than the measured signal without DPD.

Available if you mix a DPD into the signal.

Gain vs Measured Signal after DPD (Measured)

Shows the measured signal gain as a function of the output signal including digital pre-distortion (DPD).

Because of memory effects, the trace usually widens in the low-level and high-level ranges. Memory effects typically show as slopes on the curve, especially near high output powers.

If this signal is different to the expected signal, this is usually an indicator that the DUT does not behave according to the model or that the DPD is not possible with the selected model function. To get a better signal including digital pre-distortion, try, for example, to increase the model order or select the Volterra model instead of a polynomial model.

Available if you mix a DPD into the signal.

EVM vs Reference Signal

Shows the error vector magnitude (EVM) as a function of the reference signal power.

In case of nonlinear DUTs, the EVM increases if the is getting higher to follow the linear part of the DUT characteristics. Linear DUTs have wider and higher EVM only in case of low powers because of the increasing influence of noise.

Gain vs Measured Signal (shifted to the reference peak)

Shows the gain as a function of the signal power that was actually measured.

Because of memory effects, the trace usually widens in the low-level and high-level ranges. Memory effects typically show as slopes on the curve, especially near high output powers.

3.2.4 Constellation Diagram

The constellation diagram shows the complex values in an I/Q diagram and plots the constellation for modulated signals (e.g. 16QAM).

The available trace types are as follows:

Reference Signal.....	38
Measured Signal.....	39
Modeled Signal.....	39
EVM (Reference vs Measured Signal).....	39
Predistorted Signal.....	39
After DPD (Expected).....	39
After DPD (Measured).....	40

Reference Signal

Shows the constellation diagram for the reference signal. The reference signal represents the ideal signal for your purposes (as selected and present at the DUT input).

For more information on generating a reference signal see [chapter 3.1, "Recording a Reference Signal"](#), on page 30 and [chapter 4.3.1, "Configuring the I/Q Generation"](#), on page 59.

Measured Signal

Shows the constellation diagram for the (synchronized) measured signal.

To match both signals visually, the nominal gain of the measurement signal can be eliminated. For more information see ["Gain Normalization"](#) on page 117.

For more information on the measurement configuration see [chapter 4.3.8, "Configuring the I/Q Recorder"](#), on page 89.

Modeled Signal

Shows the constellation diagram for the signal when the calculated model has been applied to the reference signal.

If the model matches the behavior of the DUT, the characteristics of the signal are the same as those of the measured signal (minus the noise).

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

EVM (Reference vs Measured Signal)

Shows the error vector magnitude (EVM) between the reference signal and the measured signal.

This constellation diagram allows you to, for example, see if noise is uniform or has a special shape.

Predistorted Signal

Shows the signal that is applied to the DUT input, including digital predistortion (DPD) and after the DUT has been modeled and the DPD function has been calculated.

The predistorted signal is the signal that - applied to the DUT input or used as the input argument of the model function - creates an output signal at the DUT or model function showing the linear gain version of the input signal. In mathematical terms this means that if $x=f(y)$ is the model function, the predistortion function $a=p(b)$ is formed in such a way that $x=f(p(y))$ results in $x=G*y$ (with G being the linear gain factor).

If you are using the "Spectrum" evaluation, the DPD shows an increased ACP power as it must compensate the ACP power of the nonlinear behavior of the DUT.

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

After DPD (Expected)

Shows the expected constellation diagram of the output signal, including digital predistortion (DPD).

If both the model and the DPD are calculated correctly, the expected signal is a linear amplified version of the reference signal.

Note: Because the DUT may get into high compression, the total RMS level may be lower than the measured measured signal without DPD.

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

After DPD (Measured)

Shows the measured constellation diagram of the output signal, including digital pre-distortion (DPD).

If this signal is different to the expected signal, this is usually an indicator that the DUT does not behave according to the model or that the DPD is not possible with the selected model function. To get a better signal including digital predistortion, try, for example, to increase the model order or select the Volterra model instead of a polynomial model.

For more information on the measurement configuration see [chapter 4.3.8, "Configuring the I/Q Recorder"](#), on page 89.

3.2.5 AM/AM

The AM/AM result display is the display used to observe nonlinear effects with and without memory. It shows the amplitude at the DUT output (or the signal processing block if one is used for DPD) versus the amplitude at the DUT input.

Nonlinear effects typically result in a trace that flattens near high power levels or does not follow the ideal straight line in low-level regions.

Memory effects typically show as slopes within the curve, especially near high output powers.

The available trace types are as follows:

Measured Signal.....	40
Modeled Signal.....	40
DPD.....	40
After DPD (Expected).....	41
After DPD (Measured).....	41
Ideal Signal.....	41

Measured Signal

Shows the AM/AM characteristics of the measured signal at the DUT output.

The software uses this signal for the model estimation process.

For more information on the measurement configuration see [chapter 4.3.8, "Configuring the I/Q Recorder"](#), on page 89.

Modeled Signal

Shows the AM/AM characteristics of the signal when the calculated model has been applied to the reference signal.

If the model matches the behavior of the DUT, the characteristics of the signal are the same as those of the measured signal (minus the noise).

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

DPD

Shows the signal that is applied to the DUT input, including digital predistortion (DPD) and after the DUT has been modeled and the DPD function has been calculated.

The predistorted signal is the signal that - applied to the DUT input or used as the input argument of the model function - creates an output signal at the DUT or model function showing the linear gain version of the input signal. In mathematical terms this means that if $x=f(y)$ is the model function, the predistortion function $a=p(b)$ is formed in such a way that $x=f(p(y))$ results in $x=G*y$ (with G being the linear gain factor).

If you are using the "Spectrum" evaluation, the DPD shows an increased ACP power as it must compensate the ACP power of the nonlinear behavior of the DUT.

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

After DPD (Expected)

Shows the expected AM/AM characteristics of the output signal, including digital predistortion (DPD).

If both the model and the DPD are calculated correctly, the expected signal is a linear amplified version of the reference signal. In that case, the signal would be represented by the following function.

$$y = \text{Gain} * x$$

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

After DPD (Measured)

Shows the measured AM/AM characteristics of the output signal, including digital predistortion (DPD).

For more information on the measurement configuration see [chapter 4.3.8, "Configuring the I/Q Recorder"](#), on page 89.

Ideal Signal

Shows the ideal AM/AM characteristics of the signal at the DUT output.

3.2.6 AM/PM

The AM/PM result display is the display used to observe nonlinear effects with and without memory. It shows the difference in phase between the DUT output and the DUT input versus the input of the DUT.

Nonlinear effects typically result in a trace that not equal to zero near high power levels.

Memory effects typically show as slopes within the curve, especially near high output powers.

The available trace types are as follows:

Measured Signal	42
Modeled Signal	42
Predistorted Signal	42
After DPD (Expected)	42
After DPD (Measured)	42

Measured Signal

Shows the AM/PM characteristics of the measured signal at the DUT output.

The software uses this signal for the model estimation process.

For more information on the measurement configuration see [chapter 4.3.8, "Configuring the I/Q Recorder"](#), on page 89.

Modeled Signal

Shows the AM/PM characteristics of the signal when the calculated model has been applied to the reference signal.

If the model matches the behavior of the DUT, the characteristics of the signal are the same as those of the measured signal (minus the noise).

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

Predistorted Signal

Shows the signal that is applied to the DUT input, including digital predistortion (DPD) and after the DUT has been modeled and the DPD function has been calculated.

The predistorted signal is the signal that - applied to the DUT input or used as the input argument of the model function - creates an output signal at the DUT or model function showing the linear gain version of the input signal. In mathematical terms this means that if $x=f(y)$ is the model function, the predistortion function $a=p(b)$ is formed in such a way that $x=f(p(y))$ results in $x=G*y$ (with G being the linear gain factor).

If you are using the "Spectrum" evaluation, the DPD shows an increased ACP power as it must compensate the ACP power of the nonlinear behavior of the DUT.

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

After DPD (Expected)

Shows the AM/PM characteristics of the signal applied to the DUT input, including digital predistortion (DPD).

This predistorted signal is the inverted modeled signal and is thus a mirrored version of the modeled signal. The mirror axis is represented by the following function.

$$y = 0$$

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

After DPD (Measured)

Shows the measured AM/PM characteristics of the output signal including digital predistortion (DPD).

For more information on the measurement configuration see [chapter 4.3.8, "Configuring the I/Q Recorder"](#), on page 89.

3.2.7 I and Q

The I and Q signals are separate representations of the complex measurement (input) and reference (output) signal. They can be used, e.g. to judge the difference influence of nonlinear effect in both I and Q chain of the DUT.

Reference I and Q	43
Measured I and Q	43
Model I and Q	43

Reference I and Q

Shows the I or Q parts of the reference signal used for the model estimation process.

Measured I and Q

Shows the I or Q parts of the (synchronized) measured signal used for the model estimation process.

To match both signals visually, the nominal gain of the measurement signal can be eliminated. For more information see "[Gain Normalization](#)" on page 117.

Model I and Q

Shows the I or Q parts of the signal used for the model estimation process.

3.2.8 EVM

The "EVM" result display shows the error vector magnitude of the signal over time. You can examine the signal from various angles within signal definition, measurement and processing flow.

The time period the software analyzes depends on the number of samples you have set.

The available trace types are as follows:

Reference Signal vs Measured Signal	43
Measured Signal vs Modeled Signal	44
Reference Signal vs Signal after DPD (Expected)	44
Reference Signal vs Signal after DPD (Measured)	44

Reference Signal vs Measured Signal

Shows the error vector magnitude (EVM) between the reference signal and the measured signal.

To get useful results, the calculated linear gain is compensated to match both signals.

Depending on the DUT, noise and nonlinear effects may have been added to the measurement signal. These effects are visualized by this trace.

You can reduce the effects of noise by increasing the [Periods to Capture](#). This runs an averaging based on the complex data and thus reduces noise significantly.

For more information on generating a reference signal see [chapter 3.1, "Recording a Reference Signal"](#), on page 30 and [chapter 4.3.1, "Configuring the I/Q Generation"](#), on page 59.

Measured Signal vs Modeled Signal

Shows the error vector magnitude (EVM) between the modeled signal and the measured signal.

The EVM between the measured and modeled signal indicates the quality of the DUT modeling. If the model matches the DUT behavior, the modeling error is zero (or is merely influenced by noise).

This result display shows changes in the model and its parameters and thus allows you to optimize the modeling.

For more information on supported models see [chapter 4.4, "Defining the DSP Properties"](#), on page 94.

Reference Signal vs Signal after DPD (Expected)

Shows the expected error vector magnitude (EVM) between the reference signal and the output signal, including digital predistortion.

Note: Because the DUT may get into high compression, the total RMS level may be lower than the measured signal without DPD.

Reference Signal vs Signal after DPD (Measured)

Shows the measured error vector magnitude (EVM) between the reference signal and the output signal, including digital predistortion.

If this signal is different to the expected signal, this is usually an indicator that the DUT does not behave according to the model or that the DPD is not possible with the selected model function. To get a better signal including digital predistortion, try, for example, to increase the model order or select the Volterra model instead of a polynomial model.

3.2.9 Channel

The "Channel" result display shows the impulse response of the DUT.

You can use this display, for example, to analyze the filter frequency response when frequency filtering is dominant effect in the signal chain of the DUT.

Note that non-linear devices might show a weird impulse response.

For useful results, it is recommended to display the result as a spectrum.

The available trace types are as follows:

Amplitude	44
Phase	44

Amplitude

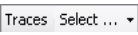

Shows the amplitude characteristics of the DUT's impulse response.

Phase

Shows the phase characteristics of the DUT's impulse response.

3.3 Selecting Traces

For every result display the R&S FS-K130PC provides a customized set of traces. In the result diagram, each trace is displayed in a different color. Above the diagram, the R&S FS-K130PC shows a legend with the name and color of every active trace currently in the diagram. The labels of the axis are the same as that of the current evaluation method. The scaling may be different for each trace and is adjusted accordingly. This chapter gives a short overview of the characteristics of all available traces.

1. From the  dropdown menu, select the trace you'd like to see. Each currently active trace has a check mark in front of it (). The same procedure also deselects individual traces.
2. Next to the trace selection dropdown menu is a deselect all traces function. Pressing the  button clears the diagram from all traces.

For a more comprehensive reference of available traces see the description of the result displays ([chapter 3.2, "Graphical Measurement Results"](#), on page 33).



Shortcuts

Instead of using the mouse to activate and deactivate a trace, you can also use shortcuts. The shortcuts are Ctrl-'number' with 'number' being the number of the trace as it appears in the dropdown menu. So, for example, to display the DUT Model trace (the 5th in the dropdown menu) in the Power result display, the shortcut would be Ctrl-5.

The figure below shows the signal flow and the stage the corresponding traces result from. The colors in the diagram correspond to the colors of the traces in the R&S FS-K130PC.

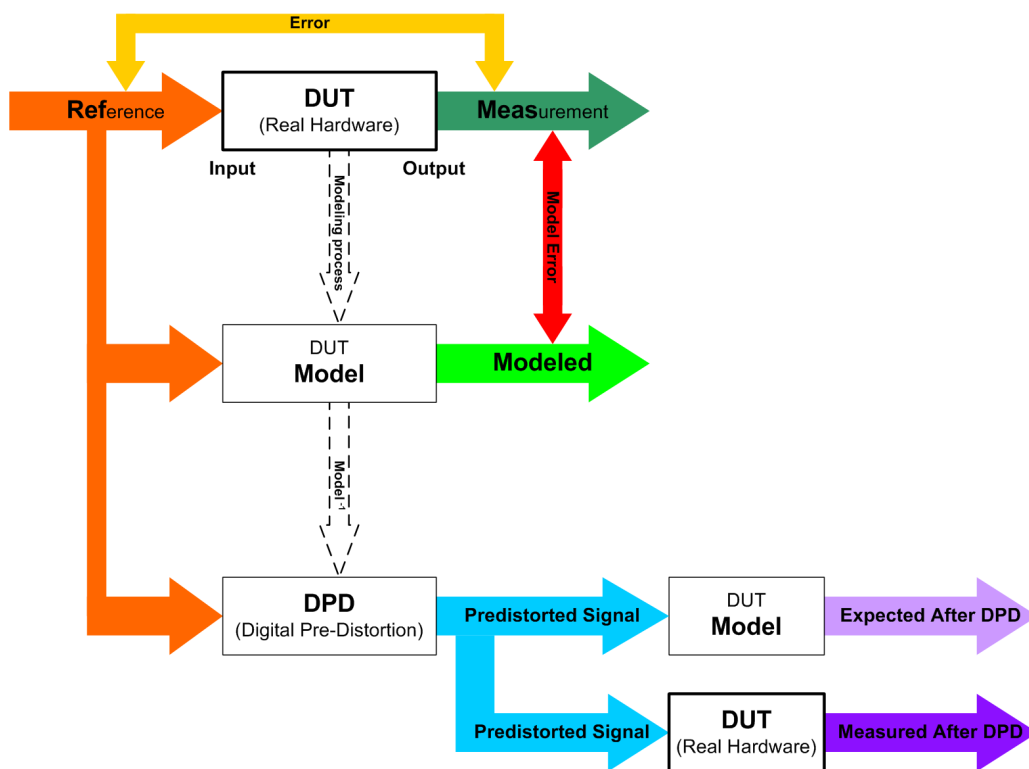
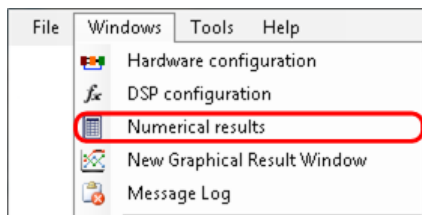


Fig. 3-1: Signal flow. The colors correspond to the traces you can view with the R&S FS-K130PC.

3.4 Numerical Measurement Results

The numerical results table contains the measurement results in numerical form. The table always shows the same results, no matter what hardware configuration, aspect of the result and evaluation method you are using.

- ▶ Select the "Numerical Results" menu item from the "Windows" menu.



The software opens the "Numerical Results" table.

Some results are colored to indicate if that result is feasible. Feasibility for each result depends on a predefined value range for that result.

- **Green**
Results are within the tolerance levels.
- **Yellow**

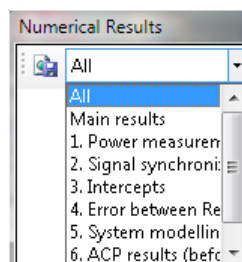
Results are not within the tolerance levels, but deviate only slightly.

- **Red**
Results are not within the tolerance levels, and deviate considerably.
- **White**
No tolerance levels have been defined for the results.

The numerical results are split into several result groups. Note that the first group is a compilation of several results that would otherwise appear only at the end of the table.

Selecting a result group

Use the dropdown menu on the top to jump directly to a certain group of results.



- [Power](#).....47
- [Signal Synchronization](#).....49
- [Intercepts](#)..... 51
- [Modulation Quality](#)..... 53
- [System Modeling](#).....53
- [CCDF](#)..... 54

3.4.1 Power

Power results show various aspects of the power of the signal at the DUT input and output.

I. Power measurement		
	DUT Input - RMS	0.0 dBm
	DUT Input - Peak	10.1 dBm
	DUT Input - Crest	10.1 dB
	DUT Output - RMS	0.0 dBm
	DUT Output - Peak	10.1 dBm
	DUT Output - Crest	10.1 dB
	DUT Output - Leveling error	0.0 dB

DUT Input (RMS)

RMS power at the DUT input.

R&S FS-K130PC sets the input RMS power during the auto-level process. It is the numerical (not measured) final output RMS power of the signal generator. The value is corrected by the DUT input attenuation that you have set in the signal flow.

Note: If you have set a duty cycle, the RMS power is corrected by the duty cycle to add to the RMS power during the ON time of the signal.

For more information see

- ["Duty Cycle"](#) on page 67

Remote command:

Query only: `FETCH:NUM:POW:INP:RMS?`

DUT Input (Peak)

Peak power at the DUT input.

R&S FS-K130PC calculates the input peak power from the input RMS power and the crest factor of the signal. It is a numerical calculation, not the measured power.

Remote command:

Query only: `FETCH:NUM:POW:INP:PEAK?`

DUT Input (Crest)

Crest factor of the signal at the DUT input.

R&S FS-K130PC calculates this value from the relation of the input RMS power and the input peak power.

Typically, the result is in the range from 4 to 8 dB for digitally modulated signals and from 8 to 12 dB for OFDM signals. These results may vary.

The Crest factor at the DUT input is always 3 dB in case of dual tone signals and 0 dB for CW signals.

Remote command:

Query only: `FETCH:NUM:POW:INP:CRES?`

DUT Output (RMS)

RMS power at the DUT output.

It is the power that the R&S FS-K130PC measures the output RMS power during the auto-level process. It is the configured final output RMS power of the DUT after a successful auto-level procedure.

Note: If you have set a duty cycle, the RMS power is corrected by the duty cycle to add to the RMS power during the ON time of the signal.

For more information see

- ["Duty Cycle"](#) on page 67

Remote command:

Query only: `FETCH:NUM:POW:OUT:RMS?`

DUT Output (Peak)

Peak power at the DUT output.

It is the power the R&S FS-K130PC measures at the DUT output.

Remote command:

Query only: `FETCH:NUM:POW:OUT:PEAK?`

DUT Output (Crest)

Crest factor of the signal at the DUT output.

R&S FS-K130PC calculates this value from the relation of the output RMS power and the output peak power.

Because of nonlinear effects of the DUT, the crest factor at the DUT output is reduced compared to the crest factor at the DUT input if the DUT enters the compression area.

Remote command:

Query only: `FETCH:NUM:POW:OUT:CRES?`

DUT Output (Leveling Error)

Level error between configured and measured RMS power at the DUT output.

During the auto-level process, R&S FS-K130PC adjusts the output RMS power to meet the RMS output power you have specified. After a correct auto-level procedure this result should be 0. However, a residual error can occur if, for example, the measurement bandwidth is not correct or if there are heavy nonlinear effects inside the DUT (e.g. negative gain around the target RMS value). You can eliminate that issue by adjusting the "Leveling Cycles" or the "Maximum Level Error".

For more information see

- ["Maximum Level Error"](#) on page 80
- ["Leveling Cycles"](#) on page 80

Remote command:

Query only: `FETCH:NUM:POW:OUT:ERR?`

3.4.2 Signal Synchronization

Signal synchronization results contain results that indicate the quality of the signal synchronization.

All errors are compensated by the synchronization algorithm.

2. Signal synchronization		
	Averages executed	1
	Confidence	100.00 %
	Frequency offset	100.01 Hz
	Phase offset	19.85 °
	Trigger offset	253.00 Samples
	IQ offset	-91.6 dB
	Gain imbalance	-92.7 dB
	Quadrature error	0.00 °
	IQ imbalance	-98.5 dB

Averages Executed

Number of I/Q reference signal data blocks used for averaging purposes.

Usually, the result should be the same as the average count you have set. Depending on the alignment of the reference signal relative to the measurement signal, however, the number of averages can be one lower or one higher compared to the set value.

For more information see

- "Periods to Capture" on page 90

Remote command:

Query only: `FETCH:NUM:SYNC:AVG?`

Confidence

Quality of the synchronization of reference signal and measured signal.

Typically, the confidence should be above 97%. Heavy nonlinear effects can cause lower values.

If the confidence is below 50%, it is likely that the reference and measurement signal are completely different. Probable causes are that the generator output is not connected to the DUT input, that I and Q are swapped or a damaged DUT.

Remote command:

Query only: `FETCH:NUM:SYNC:CONF?`

Frequency Offset

Frequency difference of reference signal and measurement signal.

If the reference oscillators of signal generator and analyzer are not coupled, the two internal 10 MHz OCXOs generate slightly different reference frequencies.

If the reference frequencies are coupled, the frequency offset should be about 0 Hz.

If the offset is very high, it is likely that

- the reference frequency sources are not coupled correctly, e.g. if the analyzer is configured for external reference frequency, but the cable is not connected.
- the OCXO offsets are too high, especially if you are using custom signal generators instead of measurement signal generator like the R&S SMU.

Within the simulation mode, the frequency offset can be set as a simulation parameter.

Remote command:

Query only: `FETCH:NUM:SYNC:FREQ?`

Phase Offset

Phase offset between reference signal and measurement signal.

If you are using the RF path for measurements, the phase between reference and measurement signal is random because the RF phases between signal generator and analyzer are not locked, even if the reference frequencies are locked. This is a typical behavior of two RF measurement instruments.

Remote command:

Query only: `FETCH:NUM:SYNC:PHAS?`

Trigger Offset

Offset between the trigger event and the start of the reference signal waveform.

Remote command:

Query only: `FETCH:NUM:SYNC:TIME?`

I/Q Offset

Shift of the ideal I/Q constellation in the I/Q plane.

The I/Q offset value can be seen as a complex linear shift of the ideal I/Q constellation points in the I/Q plane.

Remote command:

Query only: `FETCH:NUM:SYNC:IQOF?`

Gain Imbalance

Gain difference between the real (I) and imaginary (Q) part of the signal.

This effect is typically generated by two separate amplifiers in the I and Q path of the analog baseband signal generation which have different gains.

Remote command:

Query only: `FETCH:NUM:SYNC:GAIN?`

Quadrature Error

Phase deviation of the 90° phase difference between I and Q.

Within a typical transmitter, the I and Q signal parts are mixed with an angle of 90° by the IQ output mixer. Due to hardware imperfections, the signal delay of I and Q may be different and thus lead to an angle non-equal to 90°.

Remote command:

Query only: `FETCH:NUM:SYNC:QUAD?`

I/Q Imbalance

Combination of Quadrature error and Gain imbalance.

The I/Q imbalance parameter is another representation of the combination of Quadrature error and gain imbalance.

Remote command:

Query only: `FETCH:NUM:SYNC:IQIM?`

3.4.3 Intercepts

Intercepts results contain results that show the characteristics of the signal at various intercept points.

3. Intercepts	
Gain	0.0 dB
Compression	0.0 dB
1dB compression point (Input level)	17.8 dBm
IIP3	51.7 dBm
IIP5	31.7 dBm
OIP3	45.7 dBm
OIP5	25.6 dBm

Gain

Ratio between the output and input RMS power of the DUT.

Remote command:

Query only: `FETCH:NUM:INTE:GAIN?`

Compression

Ratio between the crest factor at the input and the output.

Compression typically cuts the peaks of the signal. This leads to a droop in crest factor and thus positive compression values.

Remote command:

Query only: `FETCH:NUM:INTE:COMP?`

Maximum Linear Gain

Maximum possible (linear) gain of the amplifier with the control power that you have defined.

When you compare the maximum possible gain with the gain that has been actually measured, you can determine how far the amplifier is still away from the optimum or if it has already past the compression point.

Remote command:

Query only: `FETCH:NUM:INTE:LGAIN?`

1 dB Compression Point (Input Level)

Input power level at which the output power drops 1 dB below the (theoretical) linear output power.

To calculate the 1 dB compression point, the software evaluates the linear (small-signal) gain value from the measurement data and fits it to the low-power region. From that it derives the intersection of the measured (non-linear) gain curve and a theoretical linear gain curve whose gain is 1 dB lower.

Remote command:

Query only: `FETCH:NUM:INTE:DB1C?`

IIP3 / IIP5 / OIP3 / OIP5

3rd and 5th order intercept points, the value is either the power at the input (IIP) or at the output (OIP).

To calculate the IPs, the software uses a polynomial model based on the measured data (IPs are only defined for memory-free conditions). After the model has been calculated, the R&S FS-K130PC applies a dual-tone signal to the model, increases the power of the signal and calculates its harmonic components (3rd and 5th order).

The intercept point Nth order is the point at which the power of the fundamental is the same as the power of the Nth harmonic signal component.

Note: Intercept point calculation. If the DUT has no significant compression effect in the measured input power region, the calculation of the IPs may fail.

Remote command:

IIP3 (query only): `FETCH:NUM:INTE:IIP3?`

IIP5 (query only): `FETCH:NUM:INTE:IIP5?`

OIP3 (query only): `FETCH:NUM:INTE:OIP3?`

OIP5 (query only): `FETCH:NUM:INTE:OIP5?`

3.4.4 Modulation Quality

The modulation quality results contain results that show the error between the reference signal and the signal that has been measured.

4. Modulation quality		
	EVM RMS	-60.1 dB
		0.10 %
	EVM Peak	-51.0 dB
		0.28 %

EVM RMS

RMS value of the error vector magnitude between synchronized reference and measurement signal.

The result summary shows the EVM in dB and %.

An additional EVM RMS is shown in case you have applied the DPD to the signal (→ [Use Model For DPD](#)). Note that the software captures additional I/Q data to calculate the EVM after DPD.

Remote command:

EVM (query only): `FETCH:NUM:MOD:EVM:RMS?`

EVM after DPD (query only): `FETCH:NUM:DPD:EVM:RMS?`

EVM Peak

Peak value of the error vector magnitude between synchronized reference and measurement signal.

The result summary shows the EVM in dB and %.

An additional EVM Peak is shown in case you have applied the DPD to the signal (→ [Use Model For DPD](#)). Note that the software captures additional I/Q data to calculate the EVM after DPD.

Remote command:

EVM (query only): `FETCH:NUM:MOD:EVM:PEAK?`

EVM after DPD (query only): `FETCH:NUM:DPD:EVM:PEAK?`

3.4.5 System Modeling

System modeling results contain results that indicate the quality of the measured signal compared to the modeled signal.

5. System modelling		
	Mean modelling error	-60.0 dB
		0.10 %

Mean Modeling Error

Mean error between the measured signal and the reference signal with the calculated model applied.

The mean modeling error thus shows if the model is precise enough to describe the real DUT behavior.

Note that there are still some factors like the noise floor that have an effect on the mean modeling error. These factors limit the quality of the results to a certain minimum value.

Remote command:

Query only: `FETCH:NUM:MOD:MERR:MEAN?`

3.4.6 CCDF

The CCDF results contain results that show details of the CCDF evaluation.

Details 1: CCDF detailed	
DUT Input - level above RMS	37.30 %
DUT Input - 10 % above	3.5 dB
DUT Input - 1 % above	6.6 dB
DUT Input - 0.1 % above	9.8 dB
DUT Input - 0.01 % above	10.1 dB
DUT Input - 0.001 % above	10.1 dB
DUT Output - level above RMS	37.30 %
DUT Output - 10 % above	3.5 dB
DUT Output - 1 % above	6.6 dB
DUT Output - 0.1 % above	9.8 dB
DUT Output - 0.01 % above	10.1 dB
DUT Output - 0.001 % above	10.1 dB

DUT Input (Level Above RMS)

Percentage of all signal amplitudes that are higher than the reference signal RMS level.

Remote command:

Query only: `FETCH:NUM:CCDF:INP:RMS?`

DUT Input (10% above, 1% above, 0.1% above, 0.01% above, 0.001% above)

X % of all signal amplitudes are N dB above the RMS level of the reference signal.

Remote command:

10 % (query only): `FETCH:NUM:CCDF:INP:P10?`

1 % (query only): `FETCH:NUM:CCDF:INP:P1?`

0.1 % (query only): `FETCH:NUM:CCDF:INP:P0_1?`

0.01 % (query only): `FETCH:NUM:CCDF:INP:P0_01?`

0.001 % (query only): `FETCH:NUM:CCDF:INP:P0_001?`

DUT Output (Level Above RMS)

Percentage of all signal amplitudes that are higher than the measured signal RMS level.

Remote command:

Query only: `FETCH:NUM:CCDF:OUT:RMS?`

DUT Output (10% above, 1% above, 0.1% above, 0.01% above, 0.001% above)

X % of all signal amplitudes are N dB above the RMS level of the measured signal.

Remote command:

10 % (query only): `FETCH:NUM:CCDF:OUT:P10?`

1 % (query only): `FETCH:NUM:CCDF:OUT:P1?`

0.1 % (query only): `FETCH:NUM:CCDF:OUT:P0_1?`

0.01 % (query only): `FETCH:NUM:CCDF:OUT:P0_01?`

0.001 % (query only): `FETCH:NUM:CCDF:OUT:P0_001?`

4 Configuring and Performing Measurements

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4.1 Performing Measurements

Without making any changes to the properties after starting the software the first time, or after a preset, the R&S FS-K130PC measures a signal that is simulated internally.

In its default state, this noise-like signal has a 1 MHz bandwidth and a clock rate of 16 MHz. A noise level of 60 dBc, a timing offset of 50 samples and a frequency offset of 100 Hz is applied to the signal. R&S FS-K130PC records 4096 samples for the evaluation.

The signal is then applied to a simulated DUT that generates AM/AM and AM/PM distortion.

To perform the measurement, proceed as follows:

1. Open one or more result displays ( button).
In its default state, the result display shows the Power aspect in combination with the Standard evaluation method.
There is no limit to the number of result display you can open simultaneously.
2. Press the  button in the toolbar to start the measurement.
R&S FS-K130PC performs a single measurement. It shows the results in the form of a trace in the diagram of the result display.
3. Press the  button in the toolbar again to open a second result display window.
Depending on the screen layout, R&S FS-K130PC either opens the result display in a second window or adds a tab to the result display you have already open. If in a tab, drag the result display out of the tab and dock it somewhere else to view both result displays at the same time.
4. Configure the result display(s) as you wish.
After running the measurement, you can configure the result display. For more information see [chapter 5, "Analyzing Measurement Results"](#), on page 115.



You can also run a measurement without opening a result display window first (graphical or numerical).






SCPI command:

Initiate a measurement: `INIT:IMM`

Check if ready (query only): `INIT:BUSY?`


4.1.1 Controlling the Measurement

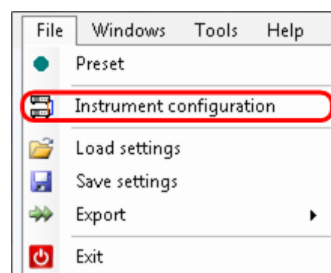
You can perform a measurement and control the course of the measurement.

-  starts the measurement. A measurement consists of capturing the data and displaying the results.
By default, the R&S FS-K130PC performs one measurement after you press the button; that means the R&S FS-K130PC fills its capture buffer once and shows the results to the data in the capture buffer.
-  pauses the measurement by interrupting the measurement without updating the result display. If you are measuring continuously, it interrupts the measurement loop. The result display shows the results to the last successfully finished measurement.
-  starts a continuous measurement. After each update of the result display, a new measurement begins.
-  reruns the measurement. Compared to a single measurement (), the software does not capture new data before updating the result display. Instead it uses the same data and calculates the results again (e.g. based on a change in the DSP settings).

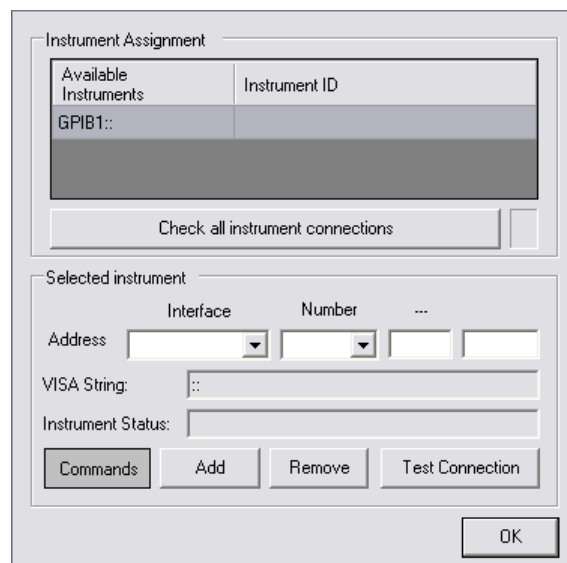
4.2 Configuring Instruments

If you have any hardware component in the test setup (like an analyzer or generator), define the characteristics of the remote connection in the "Instrument Configuration" dialog box.

- ▶ Click on the  button or select the "Instrument Connection" menu item from the "File" menu.



The "Instrument Connection Configuration" dialog box opens.



Instrument Assignment

The table shows all available instruments including their IDs, if you have queried them. You can always check if the instrument is connected by clicking on the "Check all Instrument Connections" button.

If there is more than one analyzer or generator in the list, the software automatically uses the first of the instruments it can find.

Selected Instrument

You can configure one of the instruments in the list by selecting it. The details of the instrument connections are then shown in the "Selected Instrument" area of the dialog box.

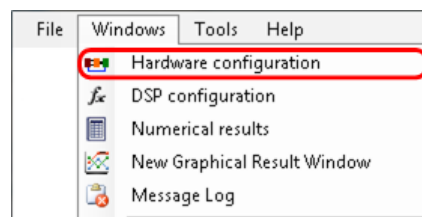
You now can:

- define the address of the instrument.
- see the resulting VISA String
- check the instrument status and test the selected instrument connection.

4.3 Configuring the Measurement

The Hardware Configuration window serves several purposes. For one, it visualizes the data flow in a block diagram. The block diagram consists of all hardware components you're using in the measurement. In addition, you define settings via the hardware configuration.

- ▶ Select the "Hardware Configuration" menu item from the "Windows" menu.



The "Instrument Connection Configuration" dialog box opens.

This chapter contains a detailed description of all elements and settings available in the "Hardware Configuration" dialog box.

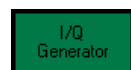
- [Configuring the I/Q Generation](#)..... 59
- [Converting the Baseband Signal](#).....70
- [Attenuating at the DUT Input](#).....74
- [Configuring the DUT](#)..... 75
- [Defining Signal Models](#)..... 81
- [Attenuating the DUT Output](#).....85
- [Converting the RF Signal](#).....86
- [Configuring the I/Q Recorder](#)..... 89

4.3.1 Configuring the I/Q Generation

The "I/Q Generator" component generates the I/Q reference signal or input data for the DUT to work with. The dialog box contains all parameters related to the baseband signal like signal type or signal parameters.

The I/Q Generator component corresponds to the ARB of a signal generator or a stand-alone ARB (like the R&S AMU).

- ▶ Click on the "I/Q Generator" component in the "Hardware Configuration" element.



The "I/Q Generator Properties" dialog box opens.

- [Usage](#).....60
- [Main Settings](#)..... 60
- [Configuring the Internal Stimulus](#)..... 62
- [Configuring a Noise Stimulus](#).....63
- [Configuring a Dual Tone Stimulus](#)..... 65
- [Configuring the Digital Modulation](#)..... 65
- [Configuring a Pulse Stimulus](#).....66
- [Configuring a File Stimulus](#)..... 67
- [Controlling Markers](#).....68
- [Hardware Information](#).....69

4.3.1.1 Usage

Contains basic settings for the signal generator.

0. Usage	
a) ARB available for control?	Yes
b) Reset ARB at start?	Yes

[ARB Available for Control](#)..... 60
[Reset ARB at Start](#)..... 60

ARB Available for Control

Turns control of the signal generator on and off.

When you turn generator control on, the software applies the configuration as defined in the "I/Q Generator" properties (via remote control).

Turning generator control off, implicates that you have to configure the generator manually.

Remote command:

```
CONF : IQGEN : REM : ENAB
```

Reset ARB at Start

Turns an automatic reset of the signal generator prior to a measurement on and off.

When you turn the reset on, the software applies the configuration you have defined for the signal generator each time a measurement starts.

Remote command:

```
CONF : IQGEN : REM : PRES
```

4.3.1.2 Main Settings

Contains general characteristics of the signal generator.

1. Main settings	
a) ARB upload behaviour?	Always
b) I/Q reference signal type	Noise
c) ARB root file name	FS_K130
d) Link clock to system bandwidth?	No

[ARB Upload Behavior](#)..... 60
[I/Q Reference Signal Type](#)..... 61
[ARB Root File Name](#)..... 61
[Link Clock to System Bandwidth](#)..... 61

ARB Upload Behavior

Selects the condition of when to initiate a signal upload.

The upload may take a while, depending on the number of I/Q samples. The number of samples can reach 1.000.000.

An upload is only necessary if the signal has been changed. Therefore you can set up the R&S FS-K130PC to check the signal and upload the waveform only if it has been changed.

- "Always"

- Uploads the signal even if the content is identical to the old one.
- "On Changed Data"
Uploads the signal only if it has been changed.
- "Never (Offline)"
Never uploads the signal.

Remote command:

```
CONF:IQGEN:MAIN:LOAD NEVER | ONCHANGE | ALWAYS
```

I/Q Reference Signal Type

Selects the type and origin of the reference signal.

R&S FS-K130PC supports measurements on nearly any type of signal.

Two signal types are already provided. In addition, it supports the use of customized reference signals.

- "Noise"
Generates a noise signal using multi-carrier technique with constant carrier level and random carrier phases, trimming the phase to match the selected crest factor.
- "Dual Tone"
Generates a two-tone signal with random phase and defined spacing.
- "Digital Modulated"
Generates a digital modulated signal.
- "File"
Imports the signal from a file that contains the signal characteristics. You can choose from various file formats.
- "Pre-recorder Reference Signal"
Uses a signal that has been previously measured and taken from the analyzer while performing a reference measurement.
- "Signal Running on the ARB Generator"
Uses a signal from an ARB file that you have created on a signal generator.
Note that it is not possible to export I/Q data if you use this type of reference signal.

For more information see

- [chapter 4.3.1.8, "Configuring a File Stimulus"](#), on page 67
- [chapter 4.5, "Specifying the File Type"](#), on page 107

Remote command:

```
CONF:IQGEN:MAIN:SIG  
NOISE | DTONE | DMOD | FILE | PREC | ARBWV
```

ARB Root File Name

Defines a file name prefix for any files that are transferred from the ARB generator.

You can specify different file name prefixes for each measurement. The file name is completed depending on its contents, e.g. `_ORIG` in case of the reference signal.

Remote command:

```
CONF:IQGEN:MAIN:NAME 'string'
```

Link Clock to System Bandwidth

Couples or decouples the generator clock rate to the system bandwidth.

If you decouple the generator clock rate from the system bandwidth, you can use signals with a low clock rate and measure them with a higher sampling rate. This allows you to measure nonlinear effects correctly.

For more information see

- "Manual Generator Clock Rate / Resulting Generator Clock Rate" on page 63
- "System Bandwidth" on page 89

Remote command:

```
CONF:IQGEN:MAIN:LINK ON | OFF
```

4.3.1.3 Configuring the Internal Stimulus

Defines the characteristics of the internal stimulus.

2. Internal stimulus settings	
a) Number of samples	4096 Samples
b) Random seed	1
c) Manual generator clock rate	16 MHz
d) Resulting generator clock	16 MHz

Number of Samples.....	62
Random Seed.....	62
Manual Generator Clock Rate / Resulting Generator Clock Rate.....	63

Number of Samples

Defines the number of samples that the test signal consists of.

A number that is a power of 2 will speed up the internal signal processing. Thus, such a number should be specified if no other requirements limit the choice of the sample count.

Note: Defining the number of samples is necessary only if the reference signal type is "Noise" or "Dual Tone". Defining the number of samples is also necessary for the reference signal measurement mode.

For more information see "Duty Cycle" on page 67.

Remote command:

```
CONF:IQGEN:INT:SAMP <numeric value>
```

Random Seed

Defines the value for the random seed that initializes the random generator used during the internal signal generation process.

Any number you enter here generates a different phase distribution and, therefore, a different signal. Values ≥ 0 result in a generation of the same distribution in every measurement. A value of -1 results in the generation of a different distribution in every measurement.

Note: The random seed works only with "Noise" and "Dual Tone" signals.

You can use the random seed, for example, to initialize the multi carrier phases of a noise signal.

Remote command:

```
CONF:IQGEN:INT:SEED <numeric value>
```

Manual Generator Clock Rate / Resulting Generator Clock Rate

Defines the clock rate the I/Q source generates the signal with.

You can either set the generator clock rate manually or couple the generator clock rate to the system bandwidth. In that case, the software shows the resulting generator clock rate in the corresponding field.

For more information see

- "System Bandwidth" on page 89
- "Link Clock to System Bandwidth" on page 61

Note that if the generator clock rate is different from the system bandwidth, the R&S FS-K130PC runs a resampling.

The purpose of the R&S FS-K130PC is to measure nonlinear effects. These generate spectral regrowth (amplitude components in addition to the signal). Therefore you need to select a sampling rate (or recording bandwidth) in order to be able to record the signal and nonlinear effects.

Note: If you generate the signal with a file that already contains clock rate information, R&S FS-K130PC uses the clock rate specified here instead of that specified in the file.

Remote command:

Manual clock rate: `CONF:IQGEN:INT:CLOCK <numeric value>`

Clock rate coupled to system bandwidth (query only): `CONF:IQGEN:INT:GENC?`

4.3.1.4 Configuring a Noise Stimulus

Defines the characteristics of a noise reference signal.

2.1. Noise stimulus settings	
a) Bandwidth	1 MHz
b) Crest factor	10 dB
c) Noise notch width	0 Hz
d) Noise notch offset	0 Hz
e) Initial search cycles	20
f) Adjustment cycles	50
g) Adjustment steps	50
h) Maximum error	0.02 dB

Generator Bandwidth.....	63
Crest Factor.....	64
Noise Notch Width.....	64
Noise Notch Offset.....	64
Initial Search Cycles.....	64
Adjustment Cycles.....	64
Adjustment Steps.....	65
Maximum Error.....	65

Generator Bandwidth

Defines the bandwidth of an internally generated noise reference signal.

If you have selected a "Noise" reference signal, enter the RF bandwidth of the signal.

For more information see

- ["/Q Reference Signal Type"](#) on page 61

Remote command:

```
CONF:IQGEN:NOISE:BW <numeric value>
```

Crest Factor

Defines the crest factor for the signal.

The crest factor shows the average power in relation to the peak power.

Remote command:

```
CONF:IQGEN:NOISE:CREST <numeric value>
```

Noise Notch Width

Defines the width of a notch that you can add to a noise signal.

Within the notch, all carriers of the noise signal have zero amplitude. You can use the noise notch to, for example, determine the noise power ratio (NPR) before and after the DPD.

Remote command:

```
CONF:IQGEN:NOISE:NOTCH:WIDTH <numeric value>
```

Noise Notch Offset

Defines an offset for the noise notch.

The offset moves the noise notch to a position outside the center of the signal. You can use the offset to, for example, generate a one-sided noise signal or to examine asymmetric distortion effects.

Remote command:

```
CONF:IQGEN:NOISE:NOTCH:OFFS <numeric value>
```

Initial Search Cycles

Defines the number of cycles that are performed during the initial search for the signal with a crest factor closest to the one you have defined.

To find the signal with the best crest factor, the software performs an initial signal search. The initial search is an algorithm that uses pure random phase distributions with different initial seed values. When the number of search cycles has been completed, the R&S FS-K130PC uses the signal that resembles most the crest factor you have defined and uses that signal for further optimization of the crest factor.

Remote command:

```
CONF:IQGEN:NOISE:ICYC <numeric value>
```

Adjustment Cycles

Defines the number of test cycles to determine the signal with the crest factor closest to the one you have defined.

The adjustment cycles begin after the initial search has been done.

For more information see ["Initial Search Cycles"](#) on page 64.

Remote command:

```
CONF:IQGEN:NOISE:ACYC <numeric value>
```


Adjustment Steps

Defines the number of different signal combinations used during one (crest factor) adjustment cycle.

Remote command:

```
CONF:IQGEN:NOISE:ASTEPP <numeric value>
```

Maximum Error

Defines the maximum error tolerable for crest factor optimization.

If the difference between the crest factor you have defined and the best crest factor that has been found during the search is bigger than the maximum error you have defined, the R&S FS-K130PC aborts the crest factor optimization.

Remote command:

```
CONF:IQGEN:NOISE:MAXERR <numeric value>
```

4.3.1.5 Configuring a Dual Tone Stimulus

Defines the characteristics of a dual tone reference signal.

2.2. Dual tone settings	
a) Tone spacing	1 MHz

Tone Spacing..... 65

Tone Spacing

Defines the bandwidth of an internally generated dual tone reference signal.

If you have selected a "Dual Tone" reference signal, enter the spacing of the two tones. If you enter, e.g., 1 MHz, R&S FS-K130PC generates two tones, one at +500 kHz and one at -500 kHz.

For more information see

- "I/Q Reference Signal Type" on page 61

Remote command:

```
CONF:IQGEN:DUAL:SPAC <numeric value>
```

4.3.1.6 Configuring the Digital Modulation

Defines the modulation characteristics of a digitally modulated reference signal.

2.3. Digital modulation stimulus settings	
a) Modulation type	16QAM
b) Number of symbols	400
c) Oversampling factor	4
d) Filter type	Root Raised Cosine
e) Filter roll-off	0.22
f) Symbol Rate	4 MHz

Modulation Type..... 66
 Number of Symbols..... 66
 Oversampling..... 66

Filter Type.....	66
Filter Roll-Off.....	66
Symbol Rate.....	66

Modulation Type

Selects the modulation for a digitally modulated stimulus.

Remote command:

```
CONF:IQGEN:DMOD:TYPE QPSK | OQPSK | 8PSK | 3PI_8_8PSK | 16QAM |
32QAM
```

Number of Symbols

Defines the number of symbols that a digitally modulated signal contains.

If you want to generate a 3pi/8-8PSK modulated signal, the number of symbols has to be an integer multiple of 16.

Remote command:

```
CONF:IQGEN:DMOD:SYMB <numeric value>
```

Oversampling

Defines an oversampling factor for digitally modulated signals.

Oversampling decreases the occupied bandwidth of a signal by increasing the signal clock rate.

For DPD measurements, you should use an oversampling factor of 4 or more.

Remote command:

```
CONF:IQGEN:DMOD:OV <numeric value>
```

Filter Type

Selects the pulse shaping filter type for digital modulation.

Remote command:

```
CONF:IQGEN:DMOD:FILT RRC | RC
```

Filter Roll-Off

Defines the roll-off factor for the digital modulation filter.

The roll-off factor defines the shape of the filter slopes.

Remote command:

```
CONF:IQGEN:DMOD:ROLL <numeric value>
```

Symbol Rate

Shows the symbol rate of digitally modulated signals. The symbol rate is the ratio of the clock rate and the oversampling.

Remote command:

```
CONF:IQGEN:DMOD:SRAT <numeric value>
```

4.3.1.7 Configuring a Pulse Stimulus

Defines the characteristics of a pulsed reference signal.

3. Pulsing settings	
a) Duty Cycle	100 %
b) Ramp length	256 Samples

Note that pulse stimulus settings are automatically used if the reference signal is pulsed and its information is contained in a file.

Duty Cycle.....67
 Ramp Length.....67

Duty Cycle

Defines the duty cycle of a pulsed signal.

The duty cycle of a pulse is the ratio of the pulse duration and the actual length of the pulse.

Example:

The pulse duration is 2 μs. The actual length of the pulse is 1 μs. The duty cycle is 1 μs:2 μs = 0.5 or 50%.

Remote command:

```
CONF:IQGEN:PULS:DUTY <numeric value>
```

Ramp Length

Defines the number of samples that are included on each side of the pulse to increase or reduce the power to zero.

Within this range, the signal is repeated and the pulse shaping filter (a cosine filter) is applied.

Remote command:

```
CONF:IQGEN:PULS:RAMP <numeric value>
```

4.3.1.8 Configuring a File Stimulus

Defines the characteristics of a file that contains the reference signal.

For more information see [chapter 4.5, "Specifying the File Type"](#), on page 107.

4. File stimulus settings	
a) File type	IBN file
b) Stimulus file name	
c) Stimulus file name - secondary file	--- (single-file mode)

File Type..... 67
 Stimulus and Response File Name.....68
 Stimulus and Response File Name (Secondary File)..... 68

File Type

Opens the "Data File Format Definition" dialog box to import various standard signal type or generic I and Q data files.

The "Data File Format Definition" dialog box contains functionality to define the file format in case you are using reference signal information from a file.

For more information see

- [chapter 4.5, "Specifying the File Type"](#), on page 107

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:TYPE <TYPE>`

I/Q Recorder: `CONF:IQSINK:FILE:TYPE <TYPE>`

<TYPE>: BIN1 | BIN2 | ASC1 | ASC2 | MAT | M | IQW | IBN | WV |
FSX | SIM | DSUIT

Stimulus and Response File Name

Selects the file that contains the reference or measurement signal information.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:NAME 'string'`

I/Q Recorder: `CONF:IQSINK:FILE:NAME 'string'`

Stimulus and Response File Name (Secondary File)

Select a secondary file that contains the reference or measurement signal information.

Selecting a secondary file is necessary only if you use a file type that requires two files.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:NAME2 'string'`

I/Q Recorder: `CONF:IQSINK:FILE:NAME2 'string'`

4.3.1.9 Controlling Markers

Defines marker characteristics.

5. Marker control	
a) Restart marker	Marker 1
b) Marker 1 offset	0 Samples
c) Marker 2 offset	0 Samples
d) Marker 3 offset	0 Samples
e) Marker 4 offset	0 Samples

Restart Marker	68
Marker 1/2/3/4 Offset	68

Restart Marker

Selects the marker you want to use as the restart marker.

The restart marker is generated by the ARB generator as TTL level signal at the marker output port. The restart marker is positioned on HIGH at the waveform start (sample index 0) and on LOW after half of the waveform length.

Remote command:

`CONF:IQGEN:MARK:REST MARK1 | MARK2 | MARK3 | MARK4`

Marker 1/2/3/4 Offset

Specifies the marker offset relative to the start of the waveform (sample index 0).

R&S FS-K130PC ignores a marker offset if the marker is also the restart marker.

Note: You can define a negative marker offset. A negative offset results in a pre-trigger that positions the marker on HIGH prior to the waveform start.

The length of the HIGH period is 1/100 of the waveform length if there are more than 1000 samples and ½ of the waveform length if there are less than 1000 samples.

Remote command:

CONF:IQGEN:MARK<x>:OFFS <numeric value>

with <x> being a number from 1 to 4.

4.3.1.10 Hardware Information

Shows information about the hardware in use.

3. Hardware Information	
a) VISA Instrument address	
b) Instrument IDN	
c) Instrument Type	
d) Instrument Options	

VISA Instrument Address.....	69
Instrument Type.....	69
Instrument Type.....	69
Instrument Options.....	70

VISA Instrument Address

Shows the VISA address of the instrument currently in use.

For more information see.

- [chapter 4.2, "Configuring Instruments"](#), on page 57

Remote command:

I/Q Generator: CONF:IQGEN:HW:VISA 'string'

Input Mixer: CONF:UPCO:HW:VISA 'string'

Output Mixer: CONF:DOCO:HW:VISA 'string'

Instrument Type

Shows name, serial number and firmware version of the instrument currently in use.

This corresponds to the response to the *IDN command supported by external equipment.

Remote command:

I/Q Generator (query only): CONF:IQGEN:HW:IDN?

Input Mixer (query only): CONF:UPCO:HW:IDN?

Output Mixer (query only): CONF:DOCO:HW:IDN?

Instrument Type

Shows the type of instrument that has been detected.

The instrument type is found out via the instrument IDN. If the instrument is not detected as a Rohde & Schwarz instrument, "unknown" is displayed.

Remote command:

I/Q Generator (query only): CONF:IQGEN:HW:TYPE?

Input Mixer (query only): CONF:UPCO:HW:TYPE?

Output Mixer (query only): CONF:DOCO:HW:TYPE?

Instrument Options

Shows the options that are installed on the instrument currently in use.

This corresponds to the response to the *OPT command supported by external equipment.

Remote command:

I/Q Generator (query only): CONF:IQGEN:HW:OPT?

Input Mixer (query only): CONF:UPCO:HW:OPT?

Output Mixer (query only): CONF:DOCO:HW:OPT?

4.3.2 Converting the Baseband Signal

A true RF DUT needs a baseband signal converted into an RF signal. The corresponding component is the RF section of a vector signal generator or a separate I/Q to RF converter. All settings necessary for the up-conversion are available through the "Input Mixer" dialog box.

- ▶ Click on the "Input Mixer" component in the "Hardware Configuration" element.



The "Input Mixer Properties" dialog box opens.

- [Usage](#).....70
- [Main Settings](#).....71
- [Configuring a Digital IF Shift](#).....72
- [Standalone Options](#).....72
- [Hardware Information](#).....73
- [Special Options](#).....74

4.3.2.1 Usage

Contains basic settings for the input mixer.

0. Usage	
a) Input mixer available for control?	Yes
b) Reset input mixer at start?	Yes
c) Control power?	Yes

- [Input Mixer Available for Control](#).....70
- [Reset Input Mixer at Start](#).....71
- [Control Power](#).....71

Input Mixer Available for Control

Turns control of the input mixer on and off.

When you turn input mixer control on, the software applies the configuration as defined in the "Input Mixer" properties (via remote control).

Turning input mixer control off, implicates that you have to configure the input mixer manually.

Remote command:
`CONF:UPCO:REM:ENAB`

Reset Input Mixer at Start

Turns an automatic reset of the input mixer prior to a measurement on and off.

When you turn the reset on, the software applies the configuration you have defined for the input mixer each time a measurement starts.

Remote command:
`CONF:UPCO:REM:PRES`

Control Power

Turns control of the input power on and off.

When you turn the power control off, the software also turns off the auto leveling mechanism and uses the power level you have defined manually instead.

Remote command:
`CONF:UPCO:REM:POW`

4.3.2.2 Main Settings

Contains general characteristics of the input mixer.

1. Main settings	
a) RF frequency	1 GHz
b) RF Output path	A
c) BB Output path	A
d) Settling delay	100 ms

RF Frequency..... 71
 RF Output Path..... 71
 BB Output Path..... 72
 Settling Delay..... 72

RF Frequency

Shows the frequency at the DUT input.

Note that this field is read only. R&S FS-K130PC calculates the frequency from the DUT properties.

Remote command:
 Query only:
`CONF:UPCO:FREQ?`

RF Output Path

Selects the RF path if more than one is available on the signal generator in use.

Remote command:
`CONF:UPCO:PATH:RF A | B`

BB Output Path

Selects the baseband output path if more than one is available on the signal generator in use.

Remote command:

```
CONF:UPCO:PATH:BB A | B | SMIQ
```

Settling Delay

Defines the time the DUT needs to settle after you have changed a input parameter or have started a measurement.

Any DUT usually has its characteristics settling time. Thus, it is necessary to wait until the DUT has settled after you have changed one of the DUT input parameters and before you can perform further measurements on the DUT output.

Remote command:

```
CONF:UPCO:SETTL <numeric value>
```

4.3.2.3 Configuring a Digital IF Shift

Defines the characteristics of a digital IF shift.

2. Digital IF shift	
a) Digital IF shift	Off
b) IF frequency	10 MHz

Digital IF Shift.....	72
IF Frequency.....	72

Digital IF Shift

Turns the digital IF shift on and off.

Shifting the IF is a method to eliminate interfering signals. The passband remains the same when you shift the frequency.

The IF shift is implemented digitally.

Remote command:

```
CONF:UPCO:IF:MODE OFF | INWV | INHW
```

IF Frequency

Defines the intermediate frequency to generate the baseband I/Q signal with.

Generating a baseband I/Q signal may be required to, for example, move the baseband signal out of the range of influence of the (unwanted) generator DC component.

Note: Make sure to compensate an IF shift in the baseband generation. To compensate the IF shift, apply a corresponding frequency offset in the DUT configuration. The offset sets the measurement frequency of the analyzer to the correct frequency.

Remote command:

```
CONF:UPCO:IF:FREQ <numeric value>
```

4.3.2.4 Standalone Options

Contain miscellaneous options and parameters for the input mixer.

3. Stand-alone options	
a) Signal generator PEP level	0 dBm

Signal Generator PEP Level..... 73

Signal Generator PEP Level

Defines the peak envelope power (PEP) level of the signal generator.

Remote command:

CONF:UPCO:SGEN:PEP <numeric value>

4.3.2.5 Hardware Information

Shows information about the hardware in use.

3. Hardware Information	
a) VISA Instrument address	
b) Instrument IDN	
c) Instrument Type	
d) Instrument Options	

VISA Instrument Address.....73
 Instrument Type.....73
 Instrument Type.....73
 Instrument Options.....74

VISA Instrument Address

Shows the VISA address of the instrument currently in use.

For more information see.

- [chapter 4.2, "Configuring Instruments"](#), on page 57

Remote command:

I/Q Generator: CONF:IQGEN:HW:VISA 'string'

Input Mixer: CONF:UPCO:HW:VISA 'string'

Output Mixer: CONF:DOCO:HW:VISA 'string'

Instrument Type

Shows name, serial number and firmware version of the instrument currently in use.

This corresponds to the response to the *IDN command supported by external equipment.

Remote command:

I/Q Generator (query only): CONF:IQGEN:HW:IDN?

Input Mixer (query only): CONF:UPCO:HW:IDN?

Output Mixer (query only): CONF:DOCO:HW:IDN?

Instrument Type

Shows the type of instrument that has been detected.

The instrument type is found out via the instrument IDN. If the instrument is not detected as a Rohde & Schwarz instrument, "unknown" is displayed.

Remote command:

I/Q Generator (query only): `CONF:IQGEN:HW:TYPE?`

Input Mixer (query only): `CONF:UPCO:HW:TYPE?`

Output Mixer (query only): `CONF:DOCO:HW:TYPE?`

Instrument Options

Shows the options that are installed on the instrument currently in use.

This corresponds to the response to the `*OPT` command supported by external equipment.

Remote command:

I/Q Generator (query only): `CONF:IQGEN:HW:OPT?`

Input Mixer (query only): `CONF:UPCO:HW:OPT?`

Output Mixer (query only): `CONF:DOCO:HW:OPT?`

4.3.2.6 Special Options

Contains various special parameters to configure the input mixer with.

5. Special options	
a) Post-config commands	String[] Array

Post-Config Commands..... 74

Post-Config Commands

Opens a dialog box to define remote control commands that should be processed after the generator has been configured and the waveform data has been loaded.

In the dialog box, you can enter an array of remote commands, one per line. These commands will be sent to the generator in addition to the parameters that you can configure in the R&S FS-K130PC.

Remote command:

`CONF:UPCO:CONF:POST <string>`

4.3.3 Attenuating at the DUT Input

It may be necessary to attenuate the signal at the DUT input because of DUT restrictions and to avoid damage to the DUT.

Specifying the input attenuation also helps to display correct values in the measurement report and to run the model calculation on real measurement values.

- ▶ Click on the "DUT Input Attenuation" component in the "Hardware Configuration" element.



The "DUT Input Attenuation Properties" dialog box opens.

- [Main Settings](#)..... 75

4.3.3.1 Main Settings

Contains general characteristics of the DUT input.

1. Main settings	
a) Fixed attenuation	0 dB

- [Fixed Attenuation](#)..... 75

Fixed Attenuation

Defines the attenuation at the DUT input or output in dB.

Remote command:

Input attenuation: `CONF:IATT:FIX <numeric value>`

Output attenuation: `CONF:OATT:FIX <numeric value>`

4.3.4 Configuring the DUT

The DUT Properties dialog box contains parameters to characterize the DUT you are going to test.

- ▶ Click on the "DUT" component in the "Hardware Configuration" element.



The "DUT Properties" dialog box opens.

- [Main Settings](#)..... 75
- [Test Settings](#)..... 76
- [Maximum DUT Input Ratings](#)..... 77
- [Frequency Conversion Configuration](#)..... 78
- [Auto Leveling](#)..... 79

4.3.4.1 Main Settings

Contains general characteristics of the DUT.

1. Main settings	
a) Input port type	RF
b) Output port type	RF

- [Input Port Type](#)..... 75
- [Output Port Type](#)..... 76

Input Port Type

Selects the port type at the DUT input.

You can choose from various port types like RF, baseband or digital inputs with different standards of interconnection (impedance, ...).

Currently only the RF input port is supported.

Remote command:

```
CONF:DUT:INP:PORT RF
```

Output Port Type

Selects the port type at the DUT output.

You can choose from various port types like RF, baseband or digital inputs with different standards of interconnection (impedance, ...).

Currently only the RF input port is supported.

Remote command:

```
CONF:DUT:OUTP:PORT RF
```

4.3.4.2 Test Settings

Contains general characteristics of the test setup.

2. Test settings	
a) DUT Output RMS level	0 dBm
b) DUT Output frequency	1 GHz
c) Input frequency	1 GHz
d) Post-measurement generator level	Leave in last level config
e) Generator stand-by level	-100 dBm

DUT Output RMS Level.....	76
DUT Output Frequency.....	76
Input Frequency.....	76
Post-Measurement Generator Level.....	77
Generator Stand-by Level.....	77

DUT Output RMS Level

Defines the RMS level at the DUT output.

The RMS level is the output power level the R&S FS-K130PC performs the measurement with.

Remote command:

```
CONF:DUT:OUT:RMS <numeric value>
```

DUT Output Frequency

Defines the frequency at the DUT output.

The measurement frequency is the frequency the R&S FS-K130PC performs the measurement on.

Remote command:

```
CONF:DUT:OUT:FREQ <numeric value>
```

```
alternatively: FREQ:CENT <numeric value>
```

Input Frequency

Calculates and shows the input frequency of the DUT.

The input frequency depends on the output frequency and the [Frequency Conversion Configuration](#). It is calculated according to the following formula:

$$f_{in} = (f_{out} - \text{FrequencyOffset}) * \text{divider} / \text{multiplier}$$

Remote command:

Query only: `CONF:DUT:INP:FREQ? <numeric value>`

Post-Measurement Generator Level

Selects the method of level configuration at the end of the measurement.

In some test setups (e.g. due to thermal restrictions), it may be necessary to reduce the DUT input power after the measurement. The available generator behaviors are as follows:

- "Leave In Last Level Config"
Maintains the level of the last measurement.
- "Power to Stand-by"
Adjusts the level after the measurement according to the [Generator Stand-by Level](#).
- "Switch Off"
Deactivates the generator RF output after the measurement.

Remote command:

`CONF:DUT:POST:MODE LEAVE | STANDBY | OFF`

Generator Stand-by Level

Defines the maximum power level of the signal generator after the measurement is done.

Note that the generator stand-by level is relevant only if you have set the [Post-Measurement Generator Level](#) accordingly.

Remote command:

`CONF:DUT:POST:LEV <numeric value>`

4.3.4.3 Maximum DUT Input Ratings

Defines the level characteristics at the DUT input.

3. Maximum DUT Input Ratings	
a) Maximum peak level	30 dBm
b) Maximum RMS level	30 dBm

[Maximum Peak Level](#).....77

[Maximum RMS Level](#).....78

Maximum Peak Level

Defines the maximum peak power level allowed at the DUT input.

In order to avoid damage to the DUT, you can define the maximum peak power level that is allowed at the DUT input. The value you enter here is also considered during the auto level procedure.

Remote command:

`CONF:DUT:MAX:PEAK <numeric value>`

Maximum RMS Level

Defines the maximum RMS power level allowed at the DUT input.

In order to avoid damage to the DUT, you can define the maximum RMS power level that is allowed at the DUT input. The value you enter here is also considered during the auto level procedure.

Remote command:

```
CONF:DUT:MAX:RMS <numeric value>
```

4.3.4.4 Frequency Conversion Configuration

Defines characteristics of frequency converting DUTs.



The DUT output frequency depends on the input frequency, the multiplier, the divider and the frequency offset.

For more information on how you can calculate the output frequency see "[Input Frequency](#)" on page 76.

4. Frequency conversion configuration	
a) Multiplier	1
b) Divider	1
c) Frequency Offset	0 Hz

Multiplier	78
Divider	78
Frequency Offset	78

Multiplier

Defines the frequency multiplication factor for a frequency converting DUT.

For more information on how the multiplier is used see "[Input Frequency](#)" on page 76.

Remote command:

```
CONF:DUT:FCON:MUL <numeric value>
```

Divider

Defines a frequency division factor for a frequency converting DUT.

For more information on how the divider is used see "[Input Frequency](#)" on page 76.

Remote command:

```
CONF:DUT:FCON:DIV <numeric value>
```

Frequency Offset

Defines the frequency offset for a frequency converting DUT.

For more information on how the frequency offset is used see "[Input Frequency](#)" on page 76.

Remote command:

```
CONF:DUT:FCON:OFFS <numeric value>
```

4.3.4.5 Auto Leveling

Defines the characteristics of the auto level routine.

The R&S FS-K130PC automatically sets the level at the DUT output by performing an auto level routine.



Turning off auto leveling

Note that you can turn off auto leveling by turning off [Control Power](#).

Usually you do not have to modify any auto leveling settings to get correct results. Some DUTs however have special characteristics and the software needs to be set up accordingly.

The auto level routine works as follows:

- **Raw leveling**
 The process begins with an initial power level. This initial level is the sum of DUT Level - Max Gain - Initial Power Reduction
 The software then increases or decreases the power level in even steps until it is close to the requested output level. The software uses the difference to the requested power level as a correction value.
- **Fine leveling**
 When the level comes close to the requested level, the steps are adjusted according to the difference in requested and configured level until the level comes even closer to the requested level.
 The difference between the DUT level and the
 If the maximum number of leveling steps is reached without coming close enough to the requested level, the process is terminated with an error.

5. Auto leveling	
a) Learn gain curve	No
b) Initial power reduction	25 dB
c) Leveling cycles	10
d) Maximum leveling error	0.1 dB
e) Raw adjust step size	4 dB
f) Auto leveling domain	Based on IQ data
g) Maximum number of samples	10000

[Learn Gain Curve](#)..... 79

[Initial Power Reduction](#)..... 80

[Leveling Cycles](#)..... 80

[Maximum Level Error](#)..... 80

[Raw Adjust Step Size](#)..... 80

[Auto Leveling Domain](#)..... 80

[Maximum Number of Samples](#)..... 81

Learn Gain Curve

Turns an algorithm that remembers past gain curves on and off and includes those in the auto leveling process.

Remote command:

```
CONF:DUT:ALEV:LEARN ON | OFF
```

Initial Power Reduction

Defines the power reduction of the DUT.

The power reduction is part of the calculation of the initial power of the auto level process.

If you don't know the exact reduction of the DUT you have to enter an approximate value or the reduction that you expect.

Remote command:

```
CONF:DUT:ALEV:PRED <numeric value>
```

Leveling Cycles

Defines the maximum number of auto-leveling loops that are performed until the auto-level routine stops.

The leveling process may – due to special DUT effects like a negative gradient gain curve or heavy nonlinear effects – end up in an endless loop. The number you enter here defines the maximum number of auto-leveling attempts until R&S FS-K130PC aborts the levelling process.

By setting the maximum number of level loops, you can avoid dead-lock loops on amplifiers with a massive non-linear characteristic.

The number of level loops is the counter during both stages (raw and fine leveling) of the auto level process.

Remote command:

```
CONF:DUT:ALEV:CYC <numeric value>
```

Maximum Level Error

Defines the maximum tolerable level difference between measured and requested output power of the DUT.

R&S FS-K130PC uses the level error to check if the leveling process can be completed successfully.

Remote command:

```
CONF:DUT:ALEV:MAXERR <numeric value>
```

Raw Adjust Step Size

Defines the step size of the generator output power used for the approximation of the output level of the DUT.

Remote command:

```
CONF:DUT:ALEV:STEP <numeric value>
```

Auto Leveling Domain

Selects the type of measurement that the R&S FS-K130PC uses for the auto-leveling process.

- "Time Domain Power Measurement"
Performs the auto level procedure in the time domain (zero span) of the analyzer.
- "Based on I/Q Data"
Performs the auto level procedure on I/Q data.

By default, the R&S FS-K130PC performs the auto-level process in the time domain as it is much faster compared to measurements on I/Q data, especially if you have long I/Q data sets.

Remote command:

```
CONF:DUT:ALEV:DOM IQ | TDOM
```

Maximum Number of Samples

Defines the maximum number of I/Q samples to capture during the auto-level process.

If you have a very large I/Q data set as reference signal, capturing I/Q data for auto-leveling purpose can take a long time.

If you perform the auto level procedure based on I/Q data, you can set a maximum sample count that is used if the complete sample exceeds the value you have entered here.

For more information see

- ["Auto Leveling Domain"](#) on page 80

Remote command:

```
CONF:DUT:ALEV:IQSAM <numeric value>
```

4.3.5 Defining Signal Models

The "Simulation" component generates a simulated signal that you can use instead of the hardware. The dialog box contains settings to characterize such a signal.

- ▶ Click on the "Simulation" component in the "Hardware Configuration" element.

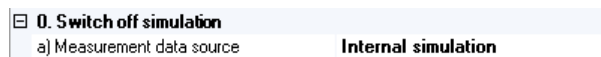


The "Simulation" dialog box opens.

- [Selecting the Data Source](#)..... 81
- [Defining a Signal Model](#)..... 82
- [Including Noise](#)..... 83
- [Defining Signal Impairments](#)..... 84

4.3.5.1 Selecting the Data Source

Selects the data source.



- [Measurement Data Source](#)..... 81

Measurement Data Source

Selects the source of the I/Q data.

You can get the measurement data at the DUT output in three ways:

- "Hardware"
Data recording by measuring the data with an analyzer

- "File"
Import the data you want to measure via a file
- "Internal simulation"
Simulate a DUT according to specification.

Remote command:

```
CONF:IQSINK:SOUR HW | FILE | SIM
```

4.3.5.2 Defining a Signal Model

Defines the characteristics of the signal model.

1. Model	
a) Apply model	Yes
b) Model to be used	Memory polynomial, polynomial
c) Pre-model gain	0 dB
d) Post-model gain	0 dB
e) Use model for DPD	Yes

Apply Model..... 82

Model..... 82

Premodel Gain..... 83

Postmodel Gain..... 83

Use Model For DPD..... 83

Apply Model

Turns the nonlinearity model in the DUT simulation on and off.

Remote command:

```
CONF:DUT:SIM:MOD:STAT ON | OFF
```

Model

Opens a dialog box to select and define the simulation curve.

The software already provides several predefined simulation curves that you can select from the "Predefined Model" dropdown menu. The graphical representation of the model with the corresponding output spectrum is also part of the dialog box.

When you right-click on the diagrams, the corresponding context menus provide functionality similar to that of the context menu for the result diagrams.

- Hardcopy functionality
- Zooming functionality
- Scaling functionality

In the default state, the input peak for all models is 0 dBm. You can change the input peak in steps of 1 dBm.

In the "File" menu of the Simulation Curve Editor, you can

- restore the scaling of the diagrams
- select the signal type (dual tone or noise)

Remote command:

```
CONF:DUT:SIM:MOD:MODEL LINEAR | DING2 | DING1 | DING4 | AGILENT  
| DINGNOMEM | FILTER | GROB | KOKKELER | R4-081509 | R4-082544 |  
TEST_001
```

Premodel Gain

Defines the gain applied to the I/Q baseband signal before the software applies the amplifier model.

Defining a premodel gain may be useful to, for example, move the amplifier model into the saturation region without changing the input level.

Remote command:

```
CONF:DUT:SIM:MOD:PRE <numeric value>
```

Postmodel Gain

Defines the gain applied to the I/Q baseband signal after the software applies the amplifier model.

Defining a postmodel gain may be useful to, for example, simulate a more linear gain (and thus reduce nonlinear effects) without changing the input level.

Remote command:

```
CONF:DUT:SIM:MOD:POST <numeric value>
```

Use Model For DPD

Includes or excludes the DPD from the signal model.

When you turn it on, the software generates the signal at the DUT output with DPD by feeding the DPD signal directly into the selected model.

Takes effect only if you simulate the signal.

Remote command:

```
CONF:DUT:SIM:MOD:MDPD ON | OFF
```

4.3.5.3 Including Noise

Defines characteristics of noise.

2. Noise	
a) Apply noise?	Yes
b) Noise seed	-1
c) Signal-to-Noise ratio	60 dB

Apply Noise..... 83
 Noise Seed.....83
 S/N Ratio..... 84

Apply Noise

Turns noise in the DUT simulation on and off.

Remote command:

```
CONF:DUT:SIM:NOIS:STAT ON | OFF
```

Noise Seed

Defines the value for the random sequence generator that simulates noise.

Remote command:

```
CONF:DUT:SIM:NOIS:SEED <numeric value>
```

S/N Ratio

Defines a signal-to-noise ratio for the simulated signal.

The S/N ratio is the noise power in relation to the main signal power. The lower the S/N ratio, the higher the noise power level.

Remote command:

```
CONF:DUT:SIM:NOIS:SNR <numeric value>
```

4.3.5.4 Defining Signal Impairments

Contains various impairments applied to the signal.

3. Impairments	
a) Apply impairments	Yes
b) Integer timing error	50 Samples
c) Frequency error	100 Hz
d) Phase error	10°
e) I offset	0
f) Q offset	0
g) Gain imbalance	1

Apply Impairments.....	84
Integer Timing Shift.....	84
Frequency Offset.....	84
Phase Offset.....	84
I Offset.....	85
Q Offset.....	85
Gain Imbalance.....	85

Apply Impairments

Turns the impairments in the DUT simulation on and off.

Remote command:

```
CONF:DUT:SIM:IMP:STAT ON | OFF
```

Integer Timing Shift

Defines a timing shift for the simulated signal.

Remote command:

```
CONF:DUT:SIM:IMP:TIME <numeric value>
```

Frequency Offset

Defines a frequency offset that is added to the simulated signal.

Remote command:

```
CONF:DUT:SIM:IMP:FREQ <numeric value>
```

Phase Offset

Defines a phase offset that is added to the simulated signal.

Remote command:

```
CONF:DUT:SIM:IMP:PHA <numeric value>
```

I Offset

Defines an offset for the I branch of the simulated signal.

Remote command:

```
CONF:DUT:SIM:IMP:IOFF <numeric value>
```

Q Offset

Defines an offset for the Q branch of the simulated signal.

Remote command:

```
CONF:DUT:SIM:IMP:QOFF <numeric value>
```

Gain Imbalance

Defines an I/Q gain imbalance for the simulated signal.

The gain imbalance is the difference of the gain in the I and Q branches.

Remote command:

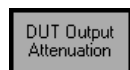
```
CONF:DUT:SIM:IMP:GIMB <numeric value>
```

4.3.6 Attenuating the DUT Output

It may be necessary to attenuate the signal at the DUT output if the power level is very high or due to analyzer restrictions. Attenuation of the signal can avoid damage to the hardware.

In order to display correct power readings, the output attenuation value can be specified.

- ▶ Click on the "DUT Output Attenuation" component in the "Hardware Configuration" element.



The "DUT Output Attenuation Properties" dialog box opens.

- [Main Settings](#)..... 85

4.3.6.1 Main Settings

Contains general characteristics of the DUT input.

1. Main settings	
a) Fixed attenuation	0 dB

- [Fixed Attenuation](#)..... 85

Fixed Attenuation

Defines the attenuation at the DUT input or output in dB.

Remote command:

Input attenuation: `CONF:IATT:FIX <numeric value>`

Output attenuation: `CONF:OATT:FIX <numeric value>`

4.3.7 Converting the RF Signal

When testing a DUT with an RF output you need to convert the RF signal back into a baseband signal. The corresponding component is the RF section of a vector signal analyzer. All settings necessary for the down-conversion are available through the Down Converter dialog box.

- ▶ Click on the "Output Mixer" component in the "Hardware Configuration" element.



The "Output Mixer Properties" dialog box opens.

- [Main Settings](#)..... 86
- [Swapping and Inverting I/Q Data](#)..... 87
- [Hardware Information](#).....87

4.3.7.1 Main Settings

Contains general characteristics of the input mixer.

1. Main settings	
a) RF frequency	1 GHz
b) 10 MHz reference frequency source	Not coupled
c) Use external mixer?	No
d) External mixer band	KA (26.5 - 40 GHz)

- [RF Frequency](#)..... 86
- [10 MHz Reference Frequency Source](#).....86
- [Use External Mixer](#).....87
- [External Mixer Band](#).....87

RF Frequency

Shows the frequency at the DUT output.

This is a read only field. R&S FS-K130PC automatically calculates the frequency from the DUT properties.

For more information see

- [chapter 4.3.4.4, "Frequency Conversion Configuration"](#), on page 78

Remote command:

Query only:

CONF:DOCO:FREQ?

10 MHz Reference Frequency Source

Defines the source of the reference frequency (10 MHz).

Use the reference frequency of the analyzer to get a better frequency accuracy. The full synchronization can compensate the frequency error, but if possible, coupling the reference frequencies is recommended.

You can also supply an external frequency generator to be used as reference frequency (e.g. if the DUT generates its own reference frequency).

Remote command:

```
CONF:DOCO:REF OFF | IQGEN | INPMIX | OUTMIX | IQREC | EXT
```

Use External Mixer

Includes or excludes an external mixer from the test setup.

For more information on external mixers refer to the documentation of the product you are using.

Remote command:

```
CONF:DOCO:MIX:STAT ON | OFF
```

External Mixer Band

Selects the frequency band of the external mixer.

If the external mixer you are using is in a frequency band other than the predefined ones, you can also select a custom band ("User" menu item).

For more information on external mixers refer to the documentation of the product you are using.

Remote command:

```
CONF:DOCO:MIX:BAND <numeric value>
```

4.3.7.2 Swapping and Inverting I/Q Data

Defines the handling of I/Q data.

2. IQ swap and invert	
a) Swap IQ	No
b) Invert I	No
c) Invert Q	No

Swap I/Q.....	87
Invert I/Q.....	87

Swap I/Q

Turns a swap of the inphase and quadrature parts of the signal on and off.

Remote command:

```
CONF:DOCO:IQ:SWAP ON | OFF
```

Invert I/Q

Inverts the inphase (I branch) and quadrature (Q branch) parts of the signal.

Remote command:

```
Invert I: CONF:DOCO:IQ:INVI ON | OFF
```

```
Invert Q: CONF:DOCO:IQ:INVQ ON | OFF
```

4.3.7.3 Hardware Information

Shows information about the hardware in use.

3. Hardware Information	
a) VISA Instrument address	
b) Instrument IDN	
c) Instrument Type	
d) Instrument Options	

VISA Instrument Address.....	88
Instrument Type.....	88
Instrument Type.....	88
Instrument Options.....	88

VISA Instrument Address

Shows the VISA address of the instrument currently in use.

For more information see.

- [chapter 4.2, "Configuring Instruments"](#), on page 57

Remote command:

I/Q Generator: `CONF:IQGEN:HW:VISA 'string'`

Input Mixer: `CONF:UPCO:HW:VISA 'string'`

Output Mixer: `CONF:DOCO:HW:VISA 'string'`

Instrument Type

Shows name, serial number and firmware version of the instrument currently in use.

This corresponds to the response to the `*IDN` command supported by external equipment.

Remote command:

I/Q Generator (query only): `CONF:IQGEN:HW:IDN?`

Input Mixer (query only): `CONF:UPCO:HW:IDN?`

Output Mixer (query only): `CONF:DOCO:HW:IDN?`

Instrument Type

Shows the type of instrument that has been detected.

The instrument type is found out via the instrument IDN. If the instrument is not detected as a Rohde & Schwarz instrument, "unknown" is displayed.

Remote command:

I/Q Generator (query only): `CONF:IQGEN:HW:TYPE?`

Input Mixer (query only): `CONF:UPCO:HW:TYPE?`

Output Mixer (query only): `CONF:DOCO:HW:TYPE?`

Instrument Options

Shows the options that are installed on the instrument currently in use.

This corresponds to the response to the `*OPT` command supported by external equipment.

Remote command:

I/Q Generator (query only): `CONF:IQGEN:HW:OPT?`

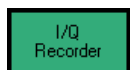
Input Mixer (query only): `CONF:UPCO:HW:OPT?`

Output Mixer (query only): `CONF:DOCO:HW:OPT?`

4.3.8 Configuring the I/Q Recorder

The last hardware component to configure is the I/Q analyzer. Like the I/Q generator, it is part of every measurement configuration. The I/Q recorder measures the signal, records the data at the DUT output and shows the results. Usually you will have a signal or spectrum analyzer as a data sink. The I/Q recording section of the analyzer is the part that corresponds to the I/Q Data Sink component.

- ▶ Click on the "I/Q Recorder" component in the "Hardware Configuration" element.



The "I/Q Generator Properties" dialog box opens.

- [Main Settings](#)..... 89
- [Response File Settings](#)..... 91
- [Configuring ACP Measurements](#).....92

4.3.8.1 Main Settings

Contains general characteristics of the signal analyzer.

1. Main settings	
a) Measurement data source	Hardware
b) System bandwidth	32 MHz
c) Periods to capture	1
d) Trigger mode	Immediate trigger
e) Measurement bandwidth	Auto
f) Use wideband measurement path	Not available

- [Measurement Data Source](#)..... 89
- [System Bandwidth](#)..... 89
- [Periods to Capture](#)..... 90
- [Trigger Mode](#)..... 90
- [Measurement Bandwidth](#)..... 90
- [Use Wideband Measurement Path](#)..... 91

Measurement Data Source

Selects the source of the I/Q data.

You can get the measurement data at the DUT output in three ways:

- "Hardware"
Data recording by measuring the data with an analyzer
- "File"
Import the data you want to measure via a file
- "Internal simulation"
Simulate a DUT according to specification.

Remote command:

```
CONF:IQSINK:SOUR HW | FILE | SIM
```

System Bandwidth

Defines the bandwidth of the system under test.

The system bandwidth is the baseband bandwidth available for signal generation and DPD calculation.

For more information see

- ["Link Clock to System Bandwidth"](#) on page 61
- ["Manual Generator Clock Rate / Resulting Generator Clock Rate"](#) on page 63

Remote command:

```
CONF:IQSINK:BW <numeric value>
```

Periods to Capture

Defines the number of I/Q reference signal data blocks that the R&S FS-K130PC uses for averaging purposes.

The R&S FS-K130PC can average I/Q data in both amplitude and phase. When averaging data, the R&S FS-K130PC increases the recording length in order to capture the number of signal periods that you have defined here within one I/Q recording within the capture buffer.

Remote command:

```
CONF:IQSINK:AVG <numeric value>
```

Trigger Mode

Selects the trigger that initiates the measurement.

Typically, the marker output of the generator is connected to the trigger input of the analyzer to indicate the start of a signal. This trigger may not be available if, for example, you generate the reference signal with an external generator. In that case, you have to increase the recording length to three reference signal periods in order to capture the requested amount of data under all circumstances.

- "Immediate trigger"
The data capture starts as soon as the analyzer is ready.
- "External trigger"
The data capture starts as soon as the analyzer recognizes a trigger event at its input.

Note: The immediate trigger is not available in case of signals that are not periodic. The immediate trigger also slightly slows down the measurement because synchronization takes more time.

Remote command:

```
CONF:IQSINK:TRIG:MODE IMM | EXT
```

Measurement Bandwidth

Defines the resolution bandwidth for I/Q and auto-level measurements.

If you set the resolution bandwidth automatically, R&S FS-K130PC sets the smallest available bandwidth that is greater than 1.5 times the sampling rate.

Note: Some analyzers ignore the measurement bandwidth defined here. Instead they determine the bandwidth directly from the sampling rate you have set. For more information refer to the documentation of the analyzer (→ TRACe:IQ remote commands).

Remote command:

```
CONF:IQSINK:MBW <numeric value>
```

Use Wideband Measurement Path

Turns the wideband path for a higher measurement bandwidth on and off.

Note that a higher measurement bandwidth might add unwanted effects (e.g. increased noise) to the measurement.

Wideband measurement paths are available with hardware options for the R&S FSQ, R&S FSV and R&S FSW. For more information refer to the datasheet of the analyzers.

Remote command:

```
CONF:IQSINK:WBAN ON | OFF
```

4.3.8.2 Response File Settings

Defines the characteristics of a file that contains the characteristics of the reference signal.

2. Response file settings	
a) File type	Binary, 1 file : 32-bit float
b) Response file name	
c) Response file name - secondary file	--- (single-file mode)

File Type.....	91
Stimulus and Response File Name.....	91
Stimulus and Response File Name (Secondary File).....	91

File Type

Opens the "Data File Format Definition" dialog box to import various standard signal type or generic I and Q data files.

The "Data File Format Definition" dialog box contains functionality to define the file format in case you are using reference signal information from a file.

For more information see

- [chapter 4.5, "Specifying the File Type"](#), on page 107

Remote command:

```
I/Q Generator: CONF:IQGEN:FILE:TYPE <TYPE>
```

```
I/Q Recorder: CONF:IQSINK:FILE:TYPE <TYPE>
```

```
<TYPE>: BIN1 | BIN2 | ASC1 | ASC2 | MAT | M | IQW | IBN | WV |  
FSX | SIM | DSUIT
```

Stimulus and Response File Name

Selects the file that contains the reference or measurement signal information.

Remote command:

```
I/Q Generator: CONF:IQGEN:FILE:NAME 'string'
```

```
I/Q Recorder: CONF:IQSINK:FILE:NAME 'string'
```

Stimulus and Response File Name (Secondary File)

Select a secondary file that contains the reference or measurement signal information.

Selecting a secondary file is necessary only if you use a file type that requires two files.

Remote command:

```
I/Q Generator: CONF:IQGEN:FILE:NAME2 'string'
```

```
I/Q Recorder: CONF:IQSINK:FILE:NAME2 'string'
```

4.3.8.3 Configuring ACP Measurements

Defines characteristics for ACP measurements.

3. ACP measurement settings	
a) Number of ACP channels	2
b) Relative ACP channel spacing	1,1
c) Channel bandwidth	(auto)
d) RBW	(auto)
d) Sweep time multiplier	4
e) Sweep time limit	2 s
f) System bandwidth overrides auto-span	No
g) Use noise correction	No

Number of ACP Channels.....	92
Relative ACP Channel Spacing.....	92
Channel Bandwidth.....	92
RBW (Resolution Bandwidth).....	92
Sweep Time Multiplier.....	93
Sweep Time Limit.....	93
System Bandwidth Overrides Auto Span.....	93
Use Noise Correction.....	93

Number of ACP Channels

Defines the number of adjacent channels for ACP measurements.

Each channel you add, adds one channel to the left and one to the right of the Tx channel.

Remote command:

```
CONF:IQSINK:ACP:CHAN <numeric value>
```

Relative ACP Channel Spacing

Defines a (relative) spacing between the channels.

A ratio of

- 1 results in channels being adjacent to each other with no space between but no interference
- < 1 results in channels interfering with each other
- > 1 results in a space between the channels

Remote command:

```
CONF:IQSINK:ACP:SPAC <numeric value>
```

Channel Bandwidth

Defines the bandwidth of the adjacent channels (ACP channels).

By default, the software automatically detects and selects the channel bandwidth for the adjacent channels. This is based on the bandwidth of the transmission channel.

Remote command:

```
CONF:IQSINK:ACP:BWID
```

RBW (Resolution Bandwidth)

Defines the resolution bandwidth used for ACP measurements.

By default, the software automatically detects and defines the resolution bandwidth based on the bandwidth of the adjacent channel.

Remote command:

```
CONF:IQSINK:ACP:RBW
```

Sweep Time Multiplier

Defines a factor to increase the ACP measurement sweep time by.

The basic sweep time ("Multiplier" = 1) is automatically calculated by the software. Changing the multiplier increases the sweep time by the defined factor. Thus, the complete sweep time is calculated according to:

$(\text{ReferenceSignalPeriod} * \text{NumberOfTracePoints}) * \text{SweepTimeMultiplier}$

Increasing the sweep time stabilizes ACP measurement results and decreases noise.

Remote command:

```
CONF:IQSINK:ACP:SWE:MUL <numeric value>
```

Sweep Time Limit

Defines a maximum sweep time to limit the length of measurements.

The sweep time may become very long if the repetition period is long. Thus, limiting the sweep time is a way to keep measurements in a reasonable time frame. If the automatically calculated sweep time exceeds the sweep time limit, the R&S FS-K130PC uses the sweep time limit as the sweep time for subsequent measurements.

Remote command:

```
CONF:IQSINK:ACP:SWE:LIM <numeric value>
```

System Bandwidth Overrides Auto Span

Turns automatic calculation of the displayed frequency range on and off if the system bandwidth is greater than the calculated span.

By default, the software automatically calculates the frequency range that is displayed, regardless of the system bandwidth. In that case, it may be that parts of the signal are not displayed.

To view the complete signal bandwidth, you can expand the displayed frequency range to the value of the system bandwidth by turning the override on.

Remote command:

```
CONF:IQSINK:ACP:SBW ON | OFF
```

Use Noise Correction

Turns noise cancellation on and off.

If you are using noise correction, the results are corrected by the inherent noise of the analyzer you are using. The inherent noise of the analyzer is determined with a reference measurement that is performed before the actual measurement.

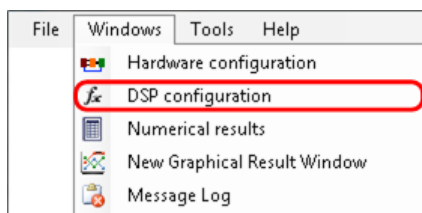
Remote command:

```
CONF:IQSINK:NCOR
```

4.4 Defining the DSP Properties

In order to configure the signal processing, you can adjust various parameters in the DSP properties dialog box.

- ▶ Click on the  button or select the "DSP Configuration" menu item from the "Windows" menu.



The "DSP Properties" dialog box opens.

- [Signal Flow](#)..... 94
- [DSP Options](#)..... 96
- [Signal Synchronization](#)..... 97
- [Error Compensation](#)..... 98
- [Generic Parameter Calculation](#)..... 98
- [Channel Estimation](#)..... 99
- [System Modeling \(General\)](#)..... 100
- [System Modeling \(Polynomial\)](#)..... 102
- [System Modeling \(Spline\)](#)..... 104
- [System Modeling \(Memory Polynomial\)](#)..... 104
- [System Modeling \(Volterra\)](#)..... 105
- [Appendix: Remote Commands to Configure Polynomial Models](#)..... 105

4.4.1 Signal Flow

Controls the main calculation steps that are performed by the software.

1. Signal flow	
a) Sync mode	Off
b) Channel estimation	Using FFT
c) Modelling	Polynomial enhanced
d) Detect pulses in ref signal	No
e) DPD mode	DPD once

- [Sync Mode](#)..... 94
- [Channel Estimation](#)..... 95
- [Modeling](#)..... 95
- [Detect Pulses In Reference Signal](#)..... 96
- [DPD Mode](#)..... 96

Sync Mode

Selects the method of synchronization for the reference and measurement signal. An exact synchronization is necessary to calculate a correct DUT model.

- "Off"

Performs no synchronization. Use this if you, e.g. create both signals with an EDA tool like Matlab and provide them in a file.

- "Timing, Phase and Gain"
Estimates a reduced set of parameters
- "Frequency, Timing, Phase, Gain, IQ Parameter"
Estimates the full set of parameters
In general, it is recommended to select the last configuration, e.g. if the instruments do not have reference frequencies coupled and a full set of parameters is to be estimated.
If the reference frequencies are coupled, you can use "Timing, Phase and Gain". If both signals are already aligned correctly, switch the sync mode off. This also speeds up the signal processing.
Note that only "Frequency, Timing, Phase, Gain, IQ Parameter" supports I/Q averaging.

Remote command:

```
CONF:DSP:FLOW:SYNC OFF | TPG | ALL
```

Channel Estimation

Turns the calculation of amplitude and phase response for the synchronized data on and off.

If you are not interested in the channel impulse response, switch channel estimation off. This also speeds up the signal processing.

Remote command:

```
CONF:DSP:FLOW:CEST OFF | FFT | LIKELI
```

Modeling

Selects the method of DUT model calculation.

The following models are available:

- "Off"
Performs no modeling; useful e.g. if you are interested in the raw EVM only.
- "Polynomial"
Calculates a polynomial model - old version from R&S FS-K130PC Version 1.0
- "Polynomial enhanced"
Calculates a polynomial model with higher performance, more configurability and better stability in high-nonlinear regions.
- "Spline"
Calculates a memory-free model using spline approximation techniques.
- "Memory polynomial"
Calculates a polynomial model with memory effects but no intermix between different delay states.
- "Volterra"
Calculates a polynomial model with memory effects and intermix between different delay states.

Remote command:

```
CONF:DSP:FLOW:MOD OFF | POLY_OLD | POLY | SPLINE | MEMPOLY |  
VOLTERRA
```

Detect Pulses In Reference Signal

Turns pulse detection in the reference signal on and off.

If on, the software tries to detect the On and Off regions of the pulses and their characteristics in unknown signals. This can be useful if you playback previously recorded signals or analyze signals from a file whose characteristics are unknown.

Remote command:

```
CONF:DSP:FLOW:PDET ON | OFF
```

DPD Mode

Selects the mode the DPD (digital predistortion) calculation is based on.

The R&S FS-K130PC uses the DPD to predistort the existing I/Q data that you have to measure the DUT behavior. After applying the DPD to the reference signal and to the DUT, the output signal of the DUT should have a better performance with regards to ACP and/or EVM.

Remote command:

```
CONF:DSP:FLOW:DPD NONE | ONCE
```

4.4.2 DSP Options

Defines general DSP options.

2. Generic options	
a) Resampling post-filter	Yes
b) Resampling cut-off dynamics	80 dB

Resampling Post-Filter	96
Resampling Cut-Off Dynamics	96

Resampling Post-Filter

Turns an additional lowpass filter that, if necessary, is used to process the resampled signal on and off.

The filter removes any unwanted frequency components outside the useful signal bandwidth that may have been generated if the original signal and the resampled signal have a different clock rate.

If the filter is on, the software determines the useful signal bandwidth before resampling the signal. After resampling, the filter removes any frequency components outside of the useful signal bandwidth.

For more information see "[Resampling Cut-Off Dynamics](#)" on page 96.

Remote command:

```
CONF:DSP:GEN:RSAM:STAT ON | OFF
```

Resampling Cut-Off Dynamics

Defines the minimum distance to the peak power that a signal must have in order to be recognized for the calculation of the useful signal bandwidth.

During the calculation of the useful signal bandwidth, the R&S FS-K130PC looks for the first signals to the left and to the right of the main signal that fall below this threshold. These bandwidth between these signals then define the useful signal bandwidth.

The useful signal bandwidth in turn defines the range in which the resampling post-filter may be applied.

For more information see "[Resampling Post-Filter](#)" on page 96.

Remote command:

```
CONF:DSP:GEN:RSAM:CUT <numeric value>
```

4.4.3 Signal Synchronization

Optimizes the matching of the reference signal and the measured signal.

3. Signal synchronization	
a) Periods to analyze	1000
b) Search tolerance	5 %
c) Rough correlation sync domain	Magnitude

Periods to analyze	97
Search Tolerance	97
Rough Correlation Sync Domain	97

Periods to analyze

Defines the maximum number of analyzed reference signal periods within the measurement signal.

When analyzing data from a file, the file content may change over time, e.g. when the file starts with the reference signal but then continues with a different signal content. A case like that would lead to correlation and synchronization errors.

To avoid such errors, you can use this parameter to limit the analysis to a particular number of reference signal periods. For example, setting the periods to analyze to 1, analyzes only one period of the reference signal within the measurement signal.

Remote command:

```
CONF:DSP:SYNC:AVG <numeric value>
```

Search Tolerance

Defines the percentage of reference signal periods to try to sync besides one reference signal period within the measurement signal.

For the typical applications, you should not change the search tolerance.

Remote command:

```
CONF:DSP:SYNC:TOL <numeric value>
```

Rough Correlation Sync Domain

Selects the correction method used for the rough estimation during signal synchronization.

Signal synchronization is a 2-step algorithm. The first step is a rough estimation on only a few parameters. The "Rough Correlation Sync Domain" applies to that step. You can select either "Magnitude" or "IQ" domain.

The second step of the algorithm is a fine estimation that includes all parameters to estimate.

Note: In case of signals that contain AM components only, you have to run the rough estimation on the "Magnitude" of the signal to get stable results. This is because in case of AM signals, the quadrature part of the signal is close to 0.

Remote command:

```
CONF:DSP:SYNC:DOM IQ | MAG
```

4.4.4 Error Compensation

Contains ways to compensate for errors during signal processing.

3.1. Error compensation	
a) Compensate IQ Imbalance	Yes
b) Compensate IQ Offset	Yes
c) Compensate frequency error	Yes
d) Compensate timing offset	Yes
e) Compensate amplitude droop	Yes

[Compensate <DSP Parameter>](#) 98

Compensate <DSP Parameter>

Turns error compensation for one of the DSP parameters from the measurement signal on and off.

You can compensate the following DSP parameters:

- I/Q Imbalance
- I/Q Offset
- Frequency Error
- Timing Offset
- Amplitude Droop

All parameters are estimated during the signal synchronization. Turn off the compensation for each parameter individually, so this error in the measurement signal will no be corrected.

Remote command:

```
I/Q imbalance: CONF:DSP:SYNC:COMP:IQIM ON | OFF
```

```
I/Q offset: CONF:DSP:SYNC:COMP:IQOF ON | OFF
```

```
Frequency error: CONF:DSP:SYNC:COMP:FREQ ON | OFF
```

```
Timing offset: CONF:DSP:SYNC:COMP:TIME ON | OFF
```

```
Amplitude droop: CONF:DSP:SYNC:COMP:DROOP ON | OFF
```

```
Gain: CONF:DSP:SYNC:COMP:GAIN ON | OFF
```

4.4.5 Generic Parameter Calculation

Contains generic DSP characteristics.

4. Generic parameter calculation	
a) Nonlinear estimation order	7

[Nonlinear Estimation Order](#) 99

Nonlinear Estimation Order

Defines the supposed nonlinear order of the DUT used to estimate the nonlinear parameters.

The IP3 or IP5, for example, are derived from parameters of a nonlinear equation. The equation that is used to this end has a specific order that can not be estimated.

The nonlinear estimation order sets the order you need to calculate the equation.

If the order is set too high, too much energy may be spread to high-order terms, leading to wrong measurement results in lower orders and thus errors in the calculation of generic parameters like the IP3.

Remote command:

```
CONF:DSP:GEN:NLORD <numeric value>
```

4.4.6 Channel Estimation

Defines the channel estimation characteristics.

The channel estimation process calculates the amplitude and phase response of the DUT. It also controls that spectral components that do not have enough power do not contribute on the impulse response calculation.

5. Channel estimation	
a) Impulse response taps	1024
b) Impulse response overlap	75 %

Impulse Response Taps	99
Impulse Response Overlap	99

Impulse Response Taps

Defines the number of taps R&S FS-K130PC uses to calculate the impulse response.

The number is the sampling point count for calculating the impulse response from the reference and measurement data.

Remote command:

```
CONF:DSP:CEST:TAPS <numeric value>
```

Impulse Response Overlap

Defines the overlap ratio for the impulse response calculation.

The R&S FS-K130PC calculates the impulse response via time-domain to frequency-domain conversion using FFT. The FFT width is defined with the impulse response taps. If the signal is longer than the number of taps (typical measurement case), the signal processing steps over the signal in a step size defined by the impulse response overlap.

Example:

The number of impulse response taps is 1024, the impulse response overlap is 50 % and the number of reference and measurement samples is 4096. The FFTs are calculated with a length of 1024, and the start points of the individual FFTs are 0, 512, 1024, 1536, 2048, 2560, 3072 and 3584, relative to the 1st measurement sample.

Remote command:

```
CONF:DSP:CEST:OVER <numeric value>
```

4.4.7 System Modeling (General)

Defines general characteristics of the signal model.

6. System modelling	
a) Modelling range	N samples around peak
b) Range size	4096 Samples
c) Pulse detection limit	5 dB
d) Maximum Model EVM degradation	2 dB
e) Maximum DPD EVM degradation	2 dB
f) Upsampling order	2
g) Quantization points	0
h) Curve inversion segments	1000
i) Estimate IQ imbalance	Yes
j) Dual-tone filtering	No

Modeling Range.....	100
Range Size.....	100
Pulse Detection Limit.....	100
Maximum Model EVM and DPD Degradation.....	101
Upsampling Order.....	101
Quantization Points.....	101
Curve Inversion Segments.....	101
Estimate I/Q Imbalance.....	101
Dual-Tone Filtering.....	102

Modeling Range

Selects the range of the signal to perform the modeling and DPD calculation on.

Selecting a range is useful, for example if the complete signal is very long and needs a long time to process. Usually, a small number of samples around the peak is enough for correct model calculation.

Remote command:

```
CONF:DSP:MOD:RANG FULL | PEAK
```

Range Size

Defines the size of the modeling range if the model is applied to a particular range of the model only.

Remote command:

```
CONF:DSP:MOD:SIZE <numeric value>
```

Pulse Detection Limit

Defines the level threshold for pulse detection.

If you have turned the detection of pulses in the reference signal on, the "Pulse Detection Limit" defines the minimum distance between the On and Off regions of supposed pulses. A signal is detected as a pulse if the distance between an On and an Off region is greater than the "Pulse Detection Limit".

Remote command:

```
CONF:DSP:MOD:PDET <numeric value>
```

Maximum Model EVM and DPD Degradation

Defines the maximum distance between any given EVM or DPD that has been calculated for a set of models and the lowest EVM that has been measured in the set of models.

If the distance to the lowest EVM or DPD is greater than the maximum degradation for any model, the model is ignored in the measurement. Instead, the software uses the model

- whose EVM or DPD is within the degradation you have defined and
- whose calculation complexity is lowest.

Remote command:

```
CONF:DSP:MOD:EVM <numeric value>
```

Upsampling Order

Defines an increase in the number of samples of the reference and the measurement signal.

A higher number of samples results in a higher density of samples over the amplitude range. A higher number of samples can also stabilize the spline approximation.

Remote command:

```
CONF:DSP:MOD:UPSAM <numeric value>
```

Quantization Points

Defines the number of points that AM/AM and AM/PM curves are reduced to to lower the complexity of computing.

The curves might consist of a large number of measurement points. To reduce the complexity and thus the time to compute those curves, you can quantize (merge) several measurement points into one. Quantizing is available for memory-free models.

Remote command:

```
CONF:DSP:MOD:QPOIN <numeric value>
```

Curve Inversion Segments

Defines the number of sampling points for AM/AM and AM/PM curves before calculation of the inverse curve.

The software inverts the curve based on a look-up algorithm for a sampled version of the measurement curve and the number of segments you have defined..

Remote command:

```
CONF:DSP:MOD:INVSEG <numeric value>
```

Estimate I/Q Imbalance

Turns estimation of the I/Q imbalance on and off.

Turning off the estimation of the I/Q imbalance can be useful in situations when the I/Q balance can not be calculated for technical reasons. This can happen, for example, if the signal has no Q component (like dual tone signals etc.).

Remote command:

```
CONF:DSP:MOD:ESTIM ON | OFF
```

Dual-Tone Filtering

Turns dual-tone filtering to reduce noise on and off.

If on, the software only uses the dual tone and harmonic frequency bins for further calculation.

Remote command:

```
CONF:DSP:MOD:DTFIL ON | OFF
```

4.4.8 System Modeling (Polynomial)

Defines the characteristics of polynomial models.

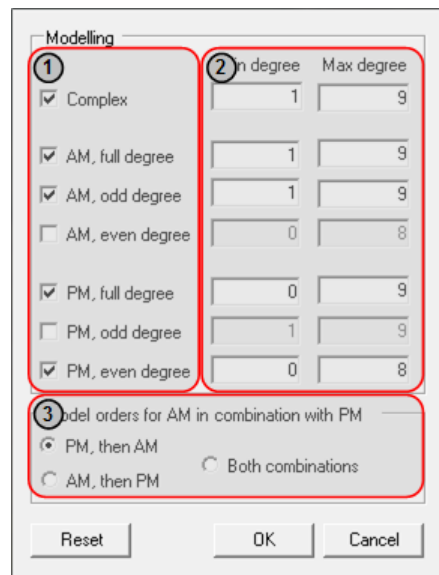
6.1. System modelling - Polynomial	
a) Modelling configuration	Click to edit Model
b) DPD configuration	Click to edit DPD

[Modeling Configuration / DPD Configuration](#)..... 102

Modeling Configuration / DPD Configuration

Opens a dialog box to configure enhanced memory-free polynomial models.

The dialog box contains fields to define the order characteristics and the type of curves to be calculated.



- 1 = Curve type to be calculated
- 2 = Minimum and maximum order of the model
- 3 = Order of calculation

Selecting the curves to be calculated

Generally, you can select the curves that should be calculated by putting a checkmark in front of the modeling type.

- Complex Modeling
Calculates the model's complex gain curve.
- AM Modeling
Calculates the model's AM/AM curves and DPD estimation.
- PM Modeling
Calculates the model's AM/AM curves, DPD estimation and AM/PM curves.

In addition to the type of curve you can also select if the full order of the model is calculated or odd or even factors only.

For AM/AM calculations, even exponents (x^2 , x^4 , ...) cause spectral components that are the same as integer multipliers of the signal's center frequency. For example, if the center frequency is 1 GHz, the variable x^2 would cause intermodulation at 2 GHz, x^4 would cause intermodulation at 3 GHz and so on. Because of the limited bandwidth of the analyzer, these signals cannot be measured. Thus, the calculation of the even exponents is not required. In addition, leaving out even exponents also results in more accurate modeling.

Selecting the degree of the polynomial

The minimum and maximum degree of the model define the degree, complexity and number of terms in the polynomial model. In general, a polynomial of the N^{th} degree looks like this.

$$y = a_0 + a_1x + a_2x^2 + \dots + a_Nx^N$$

The degree of the model is defined by N (as an index or exponent).

Note: The nonlinear effects consume an additional bandwidth proportional to 2 times the number of odd factors in the polynomial, excluding the linear one.

Example:

If the signal bandwidth is 1 MHz and the highest degree is 5, the bandwidth of the resulting signal is increased by 2 times 2 (because there are the variables x_3 and x_5) times 1 MHz which are 4 MHz and leading to a total signal bandwidth of 5 MHz. The configured recording bandwidth must be at least 5 MHz to record all nonlinear effects generated by the DUT.

Selecting the order of model calculation

In case you want to calculate the AM/AM curve and the AM/PM curve, you can select the order in which the curves are calculated.

- AM, then PM
Calculates the curves based on the amplitude of the distorted version of the reference signal.
- PM, then AM
Calculates the curves based on the amplitude of the reference signal.

If both options are selected, the software bases its calculations on both the distorted and undistorted reference signal.

The "Reset" button restores the default configuration in the dialog box.

Remote command:

see [chapter 4.4.12, "Appendix: Remote Commands to Configure Polynomial Models"](#), on page 105

4.4.9 System Modeling (Spline)

Defines the characteristics of a Spline model.

6.2. System modelling - Spline	
a) Spline segments	10
b) Steps per spline	5
c) Equal step quantizer	Yes

Spline Segments	104
Steps Per Spline	104
Equal Step Quantizer	104

Spline Segments

Defines the number of segments in the amplitude range used in the spline calculation.

Remote command:

```
CONF:DSP:MOD:SPL:SEG <numeric value>
```

Steps Per Spline

Defines the number of steps in each spline segment.

Remote command:

```
CONF:DSP:MOD:SPL:STEP <numeric value>
```

Equal Step Quantizer

Turns an equal step quantizer to automatically adjust the spline segment boundaries on and off.

An automatic adjustment of the segment boundaries results in a better interpolation performance or reduces the number of used coefficients and segments without losing interpolation performance.

If the Equal Step Quantizer is on, the spline segments boundaries are distributed equally over the amplitude range.

Remote command:

```
CONF:DSP:MOD:SPL:EDIST ON | OFF
```

4.4.10 System Modeling (Memory Polynomial)

Defines the characteristics of a polynomial model that takes account of memory effects.

6.3. System modelling - Memory Polynomial	
a) Configuration	Click to edit ...

Configuration	104
-------------------------------------	-----

Configuration

Opens a dialog box to configure the memory polynomial model.

Modelling			DPD calculation		
	Min	Max		Min	Max
Polynomial degree	1	9	Polynomial degree	1	9
Tap count	1	9	Tap count	1	9
<input checked="" type="checkbox"/> Use only odd polynomial degrees			<input type="checkbox"/> Use only odd polynomial degrees		
Reset			OK Cancel		

4.4.11 System Modeling (Volterra)

Defines the characteristics of a Volterra model.

6.4. System modelling - Volterra	
a) Volterra structure	7-0-5-0-3-0-1

[Volterra Structure](#)..... 105

Volterra Structure

Opens a dialog box to define the order and memory depth of the model.

Configure the volterra model according to the needs required by the DUT characteristics. The dialog box shows the basic layout of the Volterra kernel. For each polynomial order (or power), you can set the memory depth. Polynomial orders are represented by the position of the number within the configured number sequence. The memory depth is represented by the number at this position. You can select 0 (meaning "do not take this order into account) or any even number (as the model is symmetric in time delay).

Remote command:

```
CONF:DSP:VOLT:STRU <numeric values>, for example: 1-0-1-0-1-0-1-0-1
FETCH:MOD:VOLT:DUT
FETCH:MOD:VOLT:DPD
```

4.4.12 Appendix: Remote Commands to Configure Polynomial Models

Polynomial modeling configuration

Complex (state): CONF:DSP:POLY:MOD:COMP:STAT ON | OFF

Complex min degree: CONF:DSP:POLY:MOD:COMP:MIN <numeric value>

Complex max degree: CONF:DSP:POLY:MOD:COMP:MAX <numeric value>

AM full degree (state): CONF:DSP:POLY:MOD:AM:FULL:STAT ON | OFF

AM full degree min: CONF:DSP:POLY:MOD:AM:FULL:MIN <numeric value>

AM full degree max: CONF:DSP:POLY:MOD:AM:FULL:MAX <numeric value>

AM odd degree (state): CONF:DSP:POLY:MOD:AM:ODD:STAT ON | OFF

AM odd degree min: CONF:DSP:POLY:MOD:AM:ODD:MIN <numeric value>

AM odd degree max: CONF:DSP:POLY:MOD:AM:ODD:MAX <numeric value>
 AM even degree (state): CONF:DSP:POLY:MOD:AM:EVEN:STAT ON | OFF
 AM even degree min: CONF:DSP:POLY:MOD:AM:EVEN:MIN <numeric value>
 AM even degree max: CONF:DSP:POLY:MOD:AM:EVEN:MAX <numeric value>
 PM full degree (state): CONF:DSP:POLY:MOD:PM:FULL:STAT ON | OFF
 PM full degree min: CONF:DSP:POLY:MOD:PM:FULL:MIN <numeric value>
 PM full degree max: CONF:DSP:POLY:MOD:PM:FULL:MAX <numeric value>
 PM odd degree (state): CONF:DSP:POLY:MOD:PM:ODD:STAT ON | OFF
 PM odd degree min: CONF:DSP:POLY:MOD:PM:ODD:MIN <numeric value>
 PM odd degree max: CONF:DSP:POLY:MOD:PM:ODD:MAX <numeric value>
 PM even degree (state): CONF:DSP:POLY:MOD:PM:EVEN:STAT ON | OFF
 PM even degree min: CONF:DSP:POLY:MOD:PM:EVEN:MIN <numeric value>
 PM even degree max: CONF:DSP:POLY:MOD:PM:EVEN:MAX <numeric value>
 Order: CONF:DSP:POLY:MOD:ORDER <numeric value>

Polynomial DPD configuration

Complex (state): CONF:DSP:POLY:DPD:COMP:STAT ON | OFF
 Complex min degree: CONF:DSP:POLY:DPD:COMP:MIN <numeric value>
 Complex max degree: CONF:DSP:POLY:DPD:COMP:MAX <numeric value>
 AM full degree (state): CONF:DSP:POLY:DPD:AM:FULL:STAT ON | OFF
 AM full degree min: CONF:DSP:POLY:DPD:AM:FULL:MIN <numeric value>
 AM full degree max: CONF:DSP:POLY:DPD:AM:FULL:MAX <numeric value>
 AM odd degree (state): CONF:DSP:POLY:DPD:AM:ODD:STAT ON | OFF
 AM odd degree min: CONF:DSP:POLY:DPD:AM:ODD:MIN <numeric value>
 AM odd degree max: CONF:DSP:POLY:DPD:AM:ODD:MAX <numeric value>
 AM even degree (state): CONF:DSP:POLY:DPD:AM:EVEN:STAT ON | OFF
 AM even degree min: CONF:DSP:POLY:DPD:AM:EVEN:MIN <numeric value>
 AM even degree max: CONF:DSP:POLY:DPD:AM:EVEN:MAX <numeric value>
 PM full degree (state): CONF:DSP:POLY:DPD:PM:FULL:STAT ON | OFF
 PM full degree min: CONF:DSP:POLY:DPD:PM:FULL:MIN <numeric value>
 PM full degree max: CONF:DSP:POLY:DPD:PM:FULL:MAX <numeric value>
 PM odd degree (state): CONF:DSP:POLY:DPD:PM:ODD:STAT ON | OFF
 PM odd degree min: CONF:DSP:POLY:DPD:PM:ODD:MIN <numeric value>

PM odd degree max: CONF:DSP:POLY:DPD:PM:ODD:MAX <numeric value>

PM even degree (state): CONF:DSP:POLY:DPD:PM:EVEN:STAT ON | OFF


PM even degree min: CONF:DSP:POLY:DPD:PM:EVEN:MIN <numeric value>

PM even degree max: CONF:DSP:POLY:DPD:PM:EVEN:MAX <numeric value>

Order: CONF:DSP:POLY:DPD:ORDER <numeric value>

4.5 Specifying the File Type

The R&S FS-K130PC allows you to use several file formats for both import and export, e.g. files that contain the reference signal characteristics or files that contain the characteristics of the measurement signal.

- ▶ In the **File Type** field, click the  button.
The "Data File Format Definition" dialog box opens.
In the "Data File Format Definition" dialog box you can specify several characteristics of the file you want to use for import or export. You can define characteristics for the "I/Q Generator" and the "I/Q Recorder" separately.



Parameter groups

Except for the "Basic Settings", the software expands the parameter groups only if they are relevant for the file type you have selected.

For more information see

- ["I/Q Reference Signal Type"](#) on page 61
- ["Measurement Data Source"](#) on page 81
- [Basic Settings](#)..... 107
- [Binary Format Specification](#)..... 108
- [ASCII Format Specification](#)..... 110
- [Matlab Format Specification](#)..... 112
- [Specific Values](#)..... 113

4.5.1 Basic Settings

Contains general file characteristics.

1. Basic settings	
a) File type	Binary, 1 file
b) Data file name	
c) Secondary data file name	--- {single-file mode}

- [File Type](#)..... 108
- [Data File Name](#)..... 108
- [Secondary Data File Name](#)..... 108

File Type

Basic format that is used to read or save data from or to a file.

R&S FS-K130PC supports the following file types:

- **Binary**
One file or two files for I and Q or a separate file for I and Q.
- **ASCII**
One file or two files for I and Q or separate file for I and Q.
- **Matlab**
all Matlab versions. You can specify the signal name you want to load.
- **IQW file**
Format of various analyzer applications, e.g. WLAN or WiMAX analysis software.
- **IBN file**
Format of WinIQSIM software. Only the unencrypted version is supported.
- **WV file**
Format for signal generators. Only the unencrypted format is supported.
- **Data exported with R&S FSx**
Data that you get, e.g. with the R&S FS-K130PCFS-K70 VSA application.
- **Data exported with R&S FSx in SIM format**
The SIM format is a special format. Use it only on special advice from Rohde & Schwarz.

For more information see

- [chapter 4.5.2, "Binary Format Specification"](#), on page 108
- [chapter 4.5.3, "ASCII Format Specification"](#), on page 110
- [chapter 4.5.3, "ASCII Format Specification"](#), on page 110

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:TYPE <TYPE>`

I/Q Recorder: `CONF:IQSINK:FILE:TYPE <TYPE>`

`<TYPE>`: BIN1 | BIN2 | ASC1 | ASC2 | MAT | M | IQW | IBN | WV | FSX | SIM | DSUIT

Data File Name

Opens a dialog box to select a file.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:NAME 'string'`

I/Q Recorder: `CONF:IQSINK:FILE:NAME 'string'`

Secondary Data File Name

Opens a dialog box to select a second file.

Defining a second file is necessary only if the selected file format is defined in two files.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:NAME2 'string'`

I/Q Recorder: `CONF:IQSINK:FILE:NAME2 'string'`

4.5.2 Binary Format Specification

Defines the characteristics for files with binary contents.

2. Binary format specification	
a) Data format	32-bit floating point
b) Data order	IQIQ...IQ
c) Byte order	LSB first (Intel/Little-Endian)
d) Fixed-point scaling	1
e) Fixed-point offset	0
f) Resulting value range	--- (floating point format)

Data Format.....	109
Data Order.....	109
Byte Order.....	110
Fixed Point Scaling.....	110
Fixed Point Offset.....	110
Resulting Value Range.....	110

Data Format

Sets the precision or value range of the binary data in the file.

The R&S FS-K130PC supports:

- Fixed point, 8 Bit unsigned (0...255)
- Fixed point, 16 Bit signed (-32768...32767)
- Fixed point, 32 Bit signed (-2147483648 ... 2147483647)
- Fixed point, 64 Bit signed (-9223372036854775808 ... 9223372036854775807)
- Fixed point, 16 Bit unsigned (0 ... 65535)
- Fixed point, 32 Bit unsigned (0 ... 4294967295)
- Fixed point, 64 Bit unsigned (0 ... 18446744073709551615)
- Floating point, 32 Bit ($\pm 3.4028235E+38$... $\pm 1.401298E-45$)
- Floating point, 64 Bit ($\pm 1.79769313486231570E+308$... $\pm 4.94065645841246544E-324$)

Remote command:

I/Q Generator: CONF:IQGEN:FILE:BIN:FORM UINT8 | INT16 | INT32 | INT64 | UUINT16 | UUINT32 | UUINT64 | FLOAT32 | FLOAT64

I/Q Recorder: CONF:IQSINK:FILE:BIN:FORM UINT8 | INT16 | INT32 | INT64 | UUINT16 | UUINT32 | UUINT64 | FLOAT32 | FLOAT64

Data Order

Defines the order of the data in the file.

The data order is relevant only if you have selected the binary file format that includes both I and Q data in one file.

The R&S FS-K130PC supports:

- **IQIQ...IQ**
Alternating I and Q samples, beginning with an I sample.
- **QIQI...QI**
Alternating I and Q samples, beginning with a Q sample.
- **II...IQ...QQ**
Combined I and Q samples. First all I samples in a block then all Q samples.
- **QQ..QII..I**
Combined I and Q samples. First all Q samples in a block then all I samples.

Remote command:

I/Q Generator: CONF:IQGEN:FILE:BIN:DORD IQIQ | QIQI | IIQQ | QQII

I/Q Recorder: CONF:IQSINK:FILE:BIN:DORD IQIQ | QIQI | IIQQ | QQII

Byte Order

Defines whether MSB or LSB comes first within the bytes of a single value.

The R&S FS-K130PC supports:

- **LSB first (Intel/Little-Endian)**
MSB is the most left value.
- **MSB first (Motorola/Big-Endian)**
LSB is the most right value.

The resulting floating-point value is (Fixed Point - Offset) / Scaling

The resulting fixed-point value is (Floating Point * Scaling) + Offset

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:BIN:BORD LSB | MSB`

I/Q Recorder: `CONF:IQSINK:FILE:BIN:BORD LSB | MSB`

Fixed Point Scaling

Sets a multiplier for fixed-point values in order to convert them to, e.g., Volt values with a fixed resolution.

The value is multiplied to all fixed-point values read in order to generate floating-point values.

The resulting floating-point value is (Fixed Point - Offset) / Scaling

The resulting fixed-point value is (Floating Point * Scaling) + Offset

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:BIN:FSCAL <numeric value>`

I/Q Recorder: `CONF:IQSINK:FILE:BIN:FSCAL <numeric value>`

Fixed Point Offset

Sets an offset for fixed-point values in order to convert them to e.g. Volt values with a fixed resolution.

The value is added to all fixed-point values read in order to generate floating-point values.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:BIN:FOFFS <numeric value>`

I/Q Recorder: `CONF:IQSINK:FILE:BIN:FOFFS <numeric value>`

Resulting Value Range

Shows the range of possible values based on the "Data Format", the "Fixed Point Scaling" and "Offset".

Remote command:

I/Q Generator (query only): `CONF:IQGEN:FILE:BIN:RANGE?`

I/Q Recorder (query only): `CONF:IQSINK:FILE:BIN:RANGE?`

4.5.3 ASCII Format Specification

Defines characteristics for files whose contents are in ASCII format.

3. ASCII format specification	
a) Main data direction	Sample index in row direction (left - right)
b) I/Q data order	Block, Q beside I
c) 1st value is	I
d) Sample separator	;
e) Row separator	<CR-LF>
f) Decimal separator	.



Click on the "Show Example" button to preview an example of the orientation and used separator characters of the data.

[Main Data Direction](#).....111

[I/Q Data Order](#).....111

[1st Value Is](#)..... 112

[Sample Separator](#)..... 112

[Row Separator](#)..... 112

[Decimal Separator](#)..... 112

Main Data Direction

Defines the orientation of the data (row or column).

The R&S FS-K130PC supports:

- **Sample index in row direction (left - right)**
Inserts row(s) when adding additional I/Q samples.
- **Sample index in column direction (top - bottom)**
Inserts column(s) when adding additional I/Q samples.

Remote command:

```
I/Q Generator: CONF:IQGEN:FILE:ASCII:DIR LEFTRIGHT | TOPBOTTOM
I/Q Recorder: CONF:IQSINK:FILE:ASCII:DIR LEFTRIGHT | TOPBOTTOM
```

I/Q Data Order

Defines the order of the data within the rows or columns.

The R&S FS-K130PC supports:

- **Interleaved**
Alternating I and Q; only one row present.
- **Block, Q after I**
Combined I and Q samples; only one row present.
- **Block, Q beside I**
Combined I and Q samples; I samples are in a different row or column than Q samples, depending on the data orientation.

For more information see

- ["Main Data Direction"](#) on page 111

Remote command:

```
I/Q Generator: CONF:IQGEN:FILE:ASCII:IQORD ILEAV | QAFTI | QBESI
I/Q Recorder: CONF:IQSINK:FILE:ASCII:IQORD ILEAV | QAFTI | QBESI
```

1st Value Is

Defines whether the file begins with an I or a Q sample.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:ASCII:FIRST I | Q`

I/Q Recorder: `CONF:IQSINK:FILE:ASCII:FIRST I | Q`

Sample Separator

Defines the character or character combination that separates samples.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:ASCII:SEP:SAMP DOT | COMMA | COLON | SEMICOL | SPACE | TAB | CR | LF | CRLF | REGDEC | REGGRP`

I/Q Recorder: `CONF:IQSINK:FILE:ASCII:SEP:SAMP DOT | COMMA | COLON | SEMICOL | SPACE | TAB | CR | LF | CRLF | REGDEC | REGGRP`

Row Separator

Defines the character or character combination that separates rows.

Separated rows are the equivalent to lines in a text file.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:ASCII:SEP:ROW DOT | COMMA | COLON | SEMICOL | SPACE | TAB | CR | LF | CRLF | REGDEC | REGGRP`

I/Q Recorder: `CONF:IQSINK:FILE:ASCII:SEP:ROW DOT | COMMA | COLON | SEMICOL | SPACE | TAB | CR | LF | CRLF | REGDEC | REGGRP`

Decimal Separator

Defines the character that separates the integral and fractional part of each I and Q sample.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:ASCII:SEP:DEC DOT | COMMA | COLON | SEMICOL | SPACE | TAB | CR | LF | CRLF | REGDEC | REGGRP`

I/Q Recorder: `CONF:IQSINK:FILE:ASCII:SEP:DEC DOT | COMMA | COLON | SEMICOL | SPACE | TAB | CR | LF | CRLF | REGDEC | REGGRP`

4.5.4 Matlab Format Specification

Defines the characteristics for files whose contents are in matlab format.

4. Matlab format specification	
a) Signal name	Signal
b) Matlab format	Default format
c) Main data direction (M format only)	Sample index in row direction (left - right)

Signal Name.....	112
Matlab Format.....	113
Matlab Data Direction.....	113

Signal Name

Sets the name of the variable to store or read from if you use a Matlab file.

If you save a file, the variable within this file gets the specified signal name. This feature can be useful if you want to load reference and measurement files and already want to distinguish both files while loading them, for example.

If you load a file, the loading function queries the variable with this name. It is possible to store multiple I/Q vectors (e.g. reference and measurement signal) in one file and specify the name of the signal to load here.

If the name was not found within the file and there is only one vector, this vector will be loaded. If there is more than one value, an error will be generated.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:MLAB:NAME 'string'`

I/Q Recorder: `CONF:IQSINK:FILE:MLAB:NAME 'string'`

Matlab Format

Sets the version for *.mat files when saving a signal in Matlab format.

As the Matlab format has changed in the past, special user-defined functions for reading Matlab files may require older versions of the file format. If this is the case, you can specify the version here. The parameter is analogous to the parameter of the save function of Matlab.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:MLAB:FORM DEFAULT | V4 | V6 | V7 | V7_3`

I/Q Recorder: `CONF:IQSINK:FILE:MLAB:FORM DEFAULT | V4 | V6 | V7 | V7_3`

Matlab Data Direction

Defines the orientation of the data (row or column).

For more information see "[Main Data Direction](#)" on page 111.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:MLAB:DIR LEFTRIGHT | TOPBOTTOM`

I/Q Recorder: `CONF:IQSINK:FILE:MLAB:DIR LEFTRIGHT | TOPBOTTOM`

4.5.5 Specific Values

Contains specific characteristics for measurements from a file.

5. Specific values	
a) Ignore first	0 Samples
b) Read only	-1 Samples
c) Remove DC	No
d) Signal name	Measurement signal (MEAS)

Ignore First	114
Read Only	114
Remove DC	114
Signal Name	114

Ignore First

Ignores the first N samples when reading data from a file.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:SPEC:IGNO <numeric value>`

I/Q Recorder: `CONF:IQSINK:FILE:SPEC:IGNO <numeric value>`

Read Only

Read only N samples when reading data from a file.

To read all samples, enter -1.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:SPEC:READ <numeric value>`

I/Q Recorder: `CONF:IQSINK:FILE:SPEC:READ <numeric value>`

Remove DC

Remove the DC component from the read I/Q data by calculating the mean I and Q value and removing the complex offset.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:SPEC:REMDC ON | OFF`

I/Q Recorder: `CONF:IQSINK:FILE:SPEC:REMDC ON | OFF`

Signal Name

Name of the signal when reading data exported from R&S FSV-K70.

Remote command:

I/Q Generator: `CONF:IQGEN:FILE:SPEC:NAME REF | MEAS`

I/Q Recorder: `CONF:IQSINK:FILE:SPEC:NAME REF | MEAS`

5 Analyzing Measurement Results

The R&S FS-K130PC provides several functions for a more detailed analysis and evaluation of the measurement results.

The necessary functionality is either part of the toolbar of the result display or the corresponding context menu.

- [Selecting the Evaluation Method](#).....115
- [Configuring Measurement Results](#).....116
- [Scaling the Axis](#).....122
- [Handling Trace Data](#).....122
- [Using the Marker](#).....123

5.1 Selecting the Evaluation Method

The evaluation method selects the way measurement results are displayed. The type or aspect of the results stay the same. Only the way R&S FS-K130PC presents the results changes.

- ▶ Select the evaluation method from the  dropdown menu.

This chapter contains all evaluation methods that the R&S FS-K130PC provides.

Standard

The standard or most typical evaluation method for every result display.

This evaluation method is available for every result display.

- For the Power result display it shows the power level (y-axis) over time (x-axis). By default, the unit for the power is dBm.
- For the Gain result display it shows the gain in % (y-axis) for every measured power level (x-axis).
- For the Constellation result display, it shows the constellation of the I and Q branches of the signal in a diagram. The unit is Volt by default.
- For the AM/AM result display, the standard evaluation method shows the signal's power level at the input of the DUT against the power level at the output of the DUT. The default unit for both axis is dBm.
- For the AM/PM result display, it shows the phase difference in degrees (y-axis) for every measured power level (x-axis).
- For the I and Q result display, it shows the power over time for either the I branch of the signal or the Q branch of the signal. The branch currently shown depends on the selected trace. The unit is Volt by default.
- For the EVM result, it shows the Error Vector Magnitude (y-axis) over time (x-axis). The default unit of the EVM is %.
- For the Channel result, it shows the power level (y-axis) of the channel over time.

The number of data R&S FS-K130PC returns depends on the number of samples. The number of samples you have currently set is displayed in the diagram header.

You can change the unit for all result displays in the [Configuration Dialog](#).

Spectrum

This evaluation method shows the frequency spectrum of the signal. The type of display of the spectrum is adapted to the characteristics of the result display.

Histogram

The histogram is a tool that shows the statistical frequencies of the measured values, e.g. the statistical frequency of measured power levels.

The complete range of measured values is split into a certain number of bins, with each bin representing a particular interval of the whole value range. Each value that has been measured is put into the corresponding interval or bin and then plotted in a diagram. The R&S FS-K130PC then connects the coordinates that the histogram defines. The result is a line chart.

The histogram itself is the basis for the CCDF.

To evaluate the histogram, the Y axis values are taken (without taking the X axis values into account). Then, the range between the minimum and maximum Y axis value is separated in a certain amount of divisions (the so called "bins"), and each Y axis value is put into the corresponding bin. The CCDF is then the number of values within one bin, relative to the total amount of Y axis values.

For more information

CCDF

The Complementary Cumulative Distribution Function (CCDF) is a tool to describe the probability distribution of a specific variable, in case of the R&S FS-K130PC the y-axis values. The result is a measure on the probability of the variable being greater than a certain value.

The CCDF (Complementary Cumulative Distribution Function) can be seen as an integrated histogram.

The CCDF curve starts at $(\min(Y), 1)$ (as all y-axis values are greater compared to the minimum one), falls monotonic (as the y-axis values appear sorted) and ends in $(\max(Y), 1/\text{number of y-axis values})$, as there can only be one maximum value.

5.2 Configuring Measurement Results

The "Configuration" dialog box contains functionality to customize the way the software displays measurement results.



Automatic parameter calculation

Some parameters support automatic calculation of its ideal values ("auto"). For these parameters, the automatic calculation is also the default value.

To select automatic calculation of ideal values, clear the value in the corresponding field and press "Enter".

5.2.1 Generic Configuration

The "Generic Configuration" contains settings that define characteristics for all measurement results and evaluation methods.

1. Generic configuration	
a) Level unit	Volt
b) Relative unit	dB
c) Gain normalization	Yes
d) AM/PM reference axis	Reference signal
e) Agilent 89604 auto-scaling	No

Level Unit

Select the unit of all axes related to an absolute level.

Changing the unit affects result displays with absolute scaling.

Remote command:
not supported

Relative Unit

Select the unit of all axes related to a relative level.

Changing the unit affects result displays with relative scaling.

Remote command:
not supported

Gain Normalization

Switches the correction of a linear gain factor between measurement and reference dependent signals on and off.

Typically, the measurement signal (and derived ones like the model) have a higher amplitude compared to the reference signal. Thus, comparing both signals optical is not easy. To enable a better comparison, you can switch on the gain normalization to remove this gain before displaying the curves.

Remote command:
not supported

AM/PM Reference Axis

Selects whether the x-axis of the AM/PM curve is the level of the reference or the level of the measurement signal.

Remote command:
not supported

Agilent 89604 Auto-Scaling

Turns automatic scaling of the x-axis according to Agilent 89604 on and off.

If on, the x-axis simply covers the range from the first measured value to the last measured value, even if the numbers have decimal places, split up into 10 intervals. If you turn it off, the software rounds the first and last value that has been measured to an integer value and scales the x-axis accordingly.

Remote command:
not supported

5.2.2 Signal Truncation

The "Signal Truncation" contains settings that define the area of the signal that is displayed.

2. Signal truncation	
a) Show wrap around only	False
b) Wrap around size	20
c) Reduce Constellation to OV1	True

Show Wrap Around Only

Set this parameter to Yes, if you want to analyze the wrap-around section of the signal in detail. R&S FS-K130PC then shows only the small part at the beginning and the end of the signal. You can define the length with the "Wrap Around Size" parameter.

This is useful if you want to observe non-cyclic signals in the "Capture Buffer" result display.

Available for the "Standard" evaluation method.

Remote command:

not supported

Wrap Around Size

Defines the number of samples to the left and to the right of the wrap-around that R&S FS-K130PC shows.

Available for the "Standard" evaluation method.

Remote command:

not supported

Reduce Constellation to OV1

Turns reduction of the oversampling to 1 on and off.

You can use this feature if you are measuring a single carrier signal. When you turn the feature on in this case, only the samples of the symbol are displayed in the graphical result display. Samples within the transition period between symbols are not displayed.

The resulting graph allows you to view symbols more easily, without running a "real" digital modulation.

Available for the "Standard" evaluation method.

Remote command:

not supported

5.2.3 Axis Scaling

The "Axis Scaling" contains settings that define the scale of both diagram axes.

9. Axis scaling	
a) X axis min	(auto)
b) X axis max	(auto)
c) Y axis min	(auto)
d) Y axis max	(auto)

X-Axis Minimum

Defines the minimum value of the x-axis.

You can define the minimum x-axis value manually or let the software automatically calculate the ideal minimum value.

Remote command:
not supported

X-Axis Maximum

Defines the maximum value of the x-axis.

You can define the maximum x-axis value manually or let the software automatically calculate the ideal maximum value.

Remote command:
not supported

Y-Axis Maximum

Defines the maximum value of the y-axis.

You can define the maximum y-axis value manually or let the software automatically calculate the ideal maximum value.

Remote command:
not supported

Y-Axis Minimum

Defines the minimum value of the Y-axis.

You can define the minimum Y-axis value manually or let the software automatically calculate the ideal minimum value.

Remote command:
not supported

5.2.4 Window Functions

The "Window Functions" contains settings that select the FFT window function characteristics applied to the signal.

2. Window function	
a) Window function	Rectangle (no win
b) Window factor	0,5

Window Function

Selects the FFT window function.

Available for the "Spectrum" evaluation method.

Remote command:
not supported

Window Factor

Selects the window factor for variant filters.

Available for the "Spectrum" evaluation method.

Remote command:
not supported

5.2.5 Detector

The "Detector" contains settings that define the way samples are processed.

3. Detector	
a) Detector type	None
b) Detector final points	

Detector Type

Selects the detector.

If the number of samples taken during a measurement is higher than the number of measurement points. Thus, it may become necessary to combine several samples. The detector determines the way the software combines and displays the results.

- None
Displays all samples.
- Maximum
Displays the maximum value of a bin.
- Minimum
Displays the minimum value of a bin.
- Average
Calculates and displays the average value of a bin.
- RMS
Calculates and displays the RMS power of a bin.
- Sample
Displays a random value of a bin.
- Median
Calculates and displays the median value of a bin.

Available for the "Spectrum" evaluation method.

Remote command:
not supported

Detector Final Points

Defines the number of measurement points the trace is made up out of.

Thus, if you are using a detector, the final points also define the number of samples included in one measurement point.

Available for the "Spectrum" evaluation method.

Remote command:
not supported

5.2.6 Histogram Evaluation

The "Histogram Parameters" define the way the histogram is evaluated.

2. Histogram parameters	
a) Bins	0
b) Y axis normalization	Sum of all bins is
c) X axis is	Absolute level
d) Eval min limit	(auto)
e) Eval maximum limit	(auto)

Bins

Defines the number of bins used in the histogram.

By default, the software automatically determines the number of bins and their width (value = "0").

For numbers other than 0, the number of bins is adjusted accordingly. The width of a depends on the range of the level range that has been measured.

Available for the "Histogram" evaluation method.

Remote command:
not supported

Y-Axis Normalization

Selects the method of normalization for the histogram.

- Count per bin (no normalization)
Shows the complete measurement data in the histogram.
- Sum of all bins is 100%
- Power density function (integration is 1)

Available for the "Histogram" evaluation method.

Remote command:
not supported

X-Axis Is

Selects the scale of the x-axis.

- Absolute level
Shows the distribution of absolute power levels that have been measured on the x-axis.
- Relative to signal RMS
Shows the distribution of power levels relative to the RMS power of the signal.

Available for the "Histogram" and "CCDF" evaluation method.

Remote command:
not supported

Eval Min / Max Limit

Defines the scale of the horizontal histogram axis.

- (auto)
Scales the x-axis automatically according to the distribution of measured levels.
- <numeric value>
Defines the minimum and maximum values shown on the x-axis.

Available for the "Histogram" evaluation method.

Remote command:
not supported



5.2.7 CCDF Evaluation


The "CCDF Parameters" define the way the CCDF is evaluated.



For more information see "[X-Axis Is](#)" on page 121.

5.3 Scaling the Axis

You can customize each of the result displays to make them look like you want.


By default, the R&S FS-K130PC shows a line trace. The software however does not receive a line, but one point for each pixel on the horizontal axis. It then interpolates those points to get a line trace. If you are more comfortable with the original results, i.e. a dotted trace, you can switch between line trace and dotted trace with the  ("Show Line") and  ("Show Dots") buttons. The R&S FS-K130PC adjusts the result display accordingly.

You can also automatically adjust the vertical axis with the  ("Auto-Scale Always") button. If active, the R&S FS-K130PC automatically adjusts the vertical after each measurement in order for an optimal fit of the trace.

If you are displaying the measurement results in more than one result display, all result displays are updated after each measurement. To compare two results visually, you can freeze one result display with the  ("Freeze") button. The R&S FS-K130PC freezes the result display in which the button is active, but still updates all other result display. With the  ("Update") button, you can update the result display any time, but have to unfreeze it first.

Most of the result displays cover a large span. If you need to see a small area of the trace in more detail, you can zoom in to that area. To do so, mark the area by keeping the mouse button pressed and moving the cursor over the area you need to see in more detail. You can zoom in as far as you want. The R&S FS-K130PC adjusts the horizontal and vertical axis accordingly.

To zoom out again, you have two options:


- Press the  ("Zoom to Fit") button in order to fit the screen size to the size of the trace.
- Press the right mouse button and select "Unzoom" or "Undo all Zoom/Pan" from the context menu.

5.4 Handling Trace Data

You have several options of what to do with the measurement results for further evaluation.


5.4.1 Saving the Graph

For documentation you can save the graph itself in various forms.

- ▶ Click on the  button.
A submenu that offers you several alternatives. You can either
 - Save the trace as a bitmap with the same scaling as in the software.
 - Save the trace as a bitmap two time the size of the original trace.
 - Save the trace as a bitmap three times the size of the original trace.
 - Save the trace as a vector graphic (*.emf format).

5.4.2 Exporting Trace Data

In addition to the graphical export you can copy the trace data in numerical form to the clipboard.

- ▶ Click on the  button.
A submenu that offers you several alternatives. You can either
 - Save the first trace with the x-axis.
 - Save the first trace without the x-axis.
 - Save the x-axis only.

5.5 Using the Marker

The R&S FS-K130PC features a marker. You can get information to any measurement point by moving the mouse cursor over any pixel in the result display. The R&S FS-K130PC shows the corresponding information to that measurement point.

1. Click on the  button.

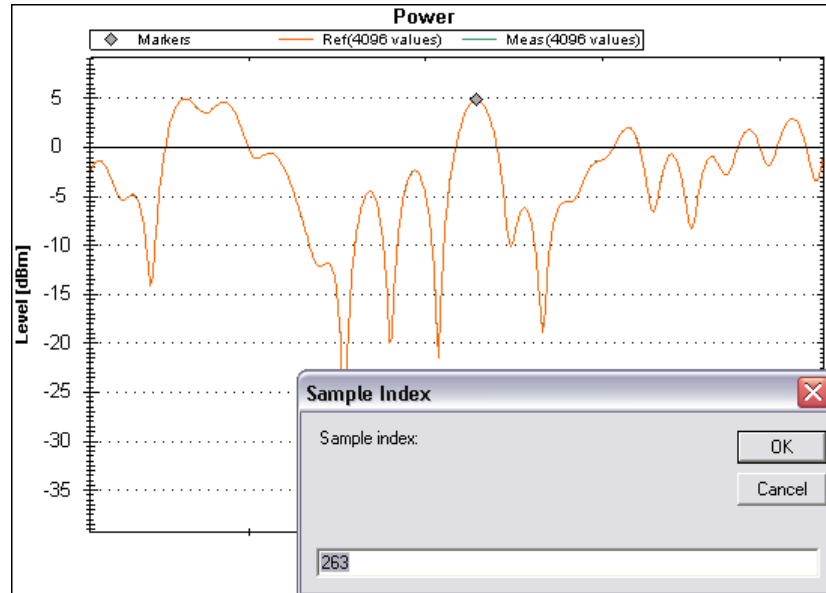
The software activates a marker and opens the "Marker Info" dialog box.

Timing	Index	263
	Absolute	16.44 μ s
Power	Input	4.8 dBm
	Output	4.8 dBm
	Gain	0.0 dB
Phase	Error	-0.02 °
EVM	Error	0.07 %
I/Q	Input	368.19 mV · 121.94 mV i
	Output	368.15 mV · 122.11 mV i

The marker is small grey diamond (◆).

- In the Marker Info dialog box, click on the "Timing Index" result area (highlighted in the picture above).

The software opens an input field to define the marker position.



- Enter a number.

The software moves the marker to the new position.

Note that the software remembers the marker position when you perform a new measurement.

Timing Index

Selects the marker position on the time axis. It is an index with no unit. The timing index length depends on the length of the capture buffer. 0 corresponds to the start of the capture buffer.

Timing Absolute

Shows the absolute marker position in time in seconds. The range depends on the length of the capture buffer. 0 seconds corresponds to the start of the capture buffer.

Power Input

Shows the absolute power at the DUT input at the marker position.

Power Output

Shows the absolute power at the DUT output at the marker position.

Power Gain

Shows the gain between DUT input and output at the marker position.

Phase Error

Shows the phase error at the marker position.

EVM

Shows the EVM at the marker position.

I/Q Input

Shows the voltage at the I/Q input at the moment of the marker position.

I/Q Output

Shows the voltage at the I/Q input at the moment of the marker position.

6 Remote Control Example

The following code shows an example of how you can perform a quick measurement using the remote control functionality of the software.

```
//connect to the VISA DLL
viOpenDefaultRM(0x0600B8F8)
//connect to the software; the software is on the same machine as the remote script
viOpen(0x0600B8F8, "TCPIP::127.0.0.1::5050::SOCKET", 0, 20, 0x06064148)
//set a time-out of 5 seconds
viSetAttribute(0x06064148, TMO_VALUE, 5000)
//use the end character
viSetAttribute(0x06064148, TERMCHAR_EN, VI_TRUE)
//define the end character as 0x0A
viSetAttribute(0x06064148, TERMCHAR, 10)
//send END
viSetAttribute(0x06064148, SEND_END_EN, VI_TRUE)
//do not suppress END
viSetAttribute(0x06064148, SUPPRESS_END_EN, VI_FALSE)
//clear to start in a defined state
viClear(0x06064148)
//read out possible errors
viWrite(0x06064148, "SYST:ERR?.", 10, 10)
viRead(0x06064148, "0","No error"., 1000, 13)
//read out software ID
viWrite(0x06064148, "*IDN?.", 6, 6)
viRead(0x06064148, "Rohde&Schwarz,FS-K130PC,1310.0090K00,2.0.0.300.", 1000, 47)
//define the number of sample to generate
viWrite(0x06064148, "CONF:IQGEN:INT:SAMP 534424.", 27, 27)
//define the noise bandwidth
viWrite(0x06064148, "CONF:IQGEN:NOISE:BW 5805186.16199493.", 37, 37)
//define a frequency error for the DUT simulation
viWrite(0x06064148, "CONF:DUT:SIM:IMP:FREQ -21043.7536239624.", 40, 40)
//start the measurement
viWrite(0x06064148, "INIT:IMM.", 9, 9)
//read out the state of the measurement; "1" indicates the software is busy
viWrite(0x06064148, "INIT:BUSY?.", 11, 11)
viRead(0x06064148, "1.", 1000, 2)
//read out the state of the measurement; "0" indicates the software is in idle mode
viWrite(0x06064148, "INIT:BUSY?.", 11, 11)
viRead(0x06064148, "0.", 1000, 2)
//read out the measurement confidence
viWrite(0x06064148, "FETCH:NUM:SYNC:CONF?.", 21, 21)
viRead(0x06064148, "99.999903877052.", 1000, 16)
//read out the measured frequency error
viWrite(0x06064148, "FETCH:NUM:SYNC:FREQ?.", 21, 21)
viRead(0x06064148, "-21043.7532514334.", 1000, 18)
```

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