

R&S® SFI100A

Wideband IF Vector Signal Generator User Manual



1179678902
Version 02

ROHDE & SCHWARZ
Make ideas real



This document describes the R&S SFI100A, stock no. 1444.4001.02 and the following options:

- R&S®SFI-B1056 IF frequency 16 GHz (1444.3892.xx)
- R&S®SFI-K17 analog I/Q outputs (1444.3286.xx)
- R&S®SFI-K510 ARB memory 2 Gsample (1444.3257.xx)
- R&S®SFI-K517 ARB memory extension 8 Gsample (1444.3270.xx)
- R&S®SFI-K529 extension to 8 GHz RF bandwidth (1444.3263.xx)
- R&S®SFI-K530 extension to 10 GHz RF bandwidth (1444.3434.xx)
- R&S®SFI-K544 user-defined frequency response correction (1444.3292.xx)
- R&S®SFI-K548 crest factor reduction (1444.3305.xx)
- R&S®SFI-K553 frontend control (1444.3311.xx)
- R&S®SFI-K703 100 MHz, 640 MHz, 1 GHz ultra-low-noise REF IN/OUT (1444.3405.xx)
- R&S®SFI-K704 flexible reference input (1444.3357.xx)
- R&S®SFI-K708 8 GHz ultra-low-noise reference input/output (1444.3363.xx)

This manual describes firmware version FW 5.30.132.xx and later of the R&S®SFI100A.

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Throughout this document, R&S® is indicated as R&S.

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1 Safety and regulatory information

The product documentation helps you use the product safely and efficiently. Follow the instructions provided here and in the following sections.

Intended use

The product generates radio frequency (RF) signals for the development, production and verification of electronic components, modules or devices. The product is intended for industrial use, for example for production and conformance testing, maintenance and engineering laboratories.

Use the product only for its designated purpose. Any other use is considered improper use. Observe the operating conditions and performance limits stated in the specifications document.

Target audience

This document targets at all users, including technicians, operators, administrators and maintenance personnel. The required skills and experience of the users depend on the test setup and application of the product.

Where do I find safety information?

Safety information is part of the product documentation. It warns you of potential dangers and gives instructions on how to prevent personal injury or damage caused by dangerous situations. Safety information is provided as follows:

- In [Chapter 1.1, "Safety instructions"](#), on page 9. The same information is provided in many languages in printed format. The printed "Safety Instructions" for "Mains-Powered Products, Not Heavy" (document number 1171.1771.99) are delivered with the product.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation.

1.1 Safety instructions

Products from the Rohde & Schwarz group of companies are manufactured according to the highest technical standards. To use the products safely, follow the instructions provided here and in the product documentation. Keep the product documentation nearby and offer it to other users.

Use the product only for its intended use and within its performance limits. Intended use and limits are described in the product documentation such as the specifications document, manuals and the printed "Safety Instructions" document. If you are unsure about the appropriate use, contact Rohde & Schwarz customer support.

Using the product requires specialists or specially trained personnel. These users also need sound knowledge of at least one of the languages in which the user interfaces and the product documentation are available.

Reconfigure or adjust the product only as described in the product documentation or the specifications document. Any other modifications can affect safety and are not permitted.

Never open the casing of the product. Only service personnel authorized by Rohde & Schwarz are allowed to repair the product. If any part of the product is damaged or broken, stop using the product. Contact Rohde & Schwarz customer support at <https://www.rohde-schwarz.com/support>.

Lifting and carrying the product

The maximum weight of the product is provided in the specifications document. You can lift or carry the product by yourself, if you can manage the weight on your own. Alternatively, you can use lifting or transporting equipment. Follow the instructions provided by the equipment manufacturer.

Choosing the operating site

Only use the product indoors. The product casing is not waterproof. Water that enters can electrically connect the casing with live parts, which can lead to electric shock, serious personal injury or death if you touch the casing.

If Rohde & Schwarz provides accessories designed for outdoor use of your product, e.g. a protective cover, you can use the product outdoors.

You can operate the product up to an altitude of 2000 m above sea level. If a higher altitude is permissible, the value is provided in the specifications document. The product is suitable for pollution degree 2 environments where nonconductive contamination can occur. For more information on environmental conditions such as ambient temperature and humidity, see the specifications document.

Setting up the product

Always place the product on a stable, flat and level surface with the bottom of the product facing down. If the product is designed for different positions, secure the product so that it cannot fall over.

If the product has foldable feet, always fold the feet completely in or out to ensure stability. The feet can collapse if they are not folded out completely or if the product is moved without lifting it. The foldable feet are designed to carry the weight of the product, but not an extra load.

If stacking is possible, keep in mind that a stack of products can fall over and cause injury.

If you mount products in a rack, ensure that the rack has sufficient load capacity and stability. Observe the specifications of the rack manufacturer. Always install the products from the bottom shelf to the top shelf so that the rack stands securely. Secure the product so that it cannot fall off the rack.

Connecting the product

Before connecting the interfaces and measuring inputs of the product to other products or electrical circuits, make sure that the other products or electrical circuits provide

special protection against electric shock. This protection principle is referred to as SELV (safety extra-low voltage) and is based on a low voltage level and increased insulation. Exceptions are indicated by a measurement category on the product and given in the specifications document.

Connecting to power

The product is an overvoltage category II product. Connect the product to a fixed installation used to supply energy-consuming equipment such as household appliances and similar loads. Keep in mind that electrically powered products have risks, such as electric shock, fire, personal injury or even death. Replace parts that are relevant to safety only by original parts, e.g. power cables or fuses.

Take the following measures for your safety:



- Before switching on the product, ensure that the voltage and frequency indicated on the product match the available power source. If the power adapter does not adjust automatically, set the correct value and check the rating of the fuse.
- If a product has an exchangeable fuse, its type and characteristics are indicated next to the fuse holder. Before changing the fuse, switch off the product and disconnect it from the power source. How to change the fuse is described in the product documentation.
- Only use the power cable delivered with the product. It complies with country-specific safety requirements. Only insert the plug into an outlet with protective conductor terminal.
- Only use intact cables and route them carefully so that they cannot be damaged. Check the power cables regularly to ensure that they are undamaged. Also ensure that nobody can trip over loose cables.
- Only connect the product to a power source with a fuse protection of maximum 20 A.
- Ensure that you can disconnect the product from the power source at any time. Pull the power plug to disconnect the product. The power plug must be easily accessible. If the product is integrated into a system that does not meet these requirements, provide an easily accessible circuit breaker at the system level.



Cleaning the product

Use a dry, lint-free cloth to clean the product. When cleaning, keep in mind that the casing is not waterproof. Do not use liquid cleaning agents.

Meaning of safety labels

Safety labels on the product warn against potential hazards.

	<p>Potential hazard Read the product documentation to avoid personal injury or product damage.</p>
	<p>Electrical hazard Indicates live parts. Risk of electric shock, fire, personal injury or even death.</p>


	<p>Hot surface Do not touch. Risk of skin burns. Risk of fire.</p>
	<p>Protective conductor terminal Connect this terminal to a grounded external conductor or to protective ground. This connection protects you against electric shock if an electric problem occurs.</p>

1.2 Labels on R&S SFI100A

Labels on the casing inform about:

- Personal safety, see ["Connecting to power"](#) on page 11.
- Product and environment safety, see [Table 1-1](#).
- Identification of the product, see the serial number on the rear panel.

Table 1-1: Labels regarding R&S SFI100A and environment safety

	<p>Labeling in line with EN 50419 for disposal of electrical and electronic equipment after the product has come to the end of its service life. For more information, see Chapter 16.5, "Disposal", on page 641.</p>
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1.3 Warning messages in the documentation

A warning message points out a risk or danger that you need to be aware of. The signal word indicates the severity of the safety hazard and how likely it will occur if you do not follow the safety precautions.

WARNING

Potentially hazardous situation. Could result in death or serious injury if not avoided.

CAUTION

Potentially hazardous situation. Could result in minor or moderate injury if not avoided.

NOTICE

Potential risks of damage. Could result in damage to the supported product or to other property.

1.4 Where to find key documents on Rohde & Schwarz

Certificates issued to Rohde & Schwarz that are relevant for your country are provided at www.rohde-schwarz.com/key-documents, e.g. concerning:

- Quality management
- Environmental management
- Information security management
- Accreditations

1.5 Korea certification class A



이 기기는 업무용(A급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

2 Welcome to the R&S SFI100A

The R&S SFI100A is a wideband IF vector signal generator in the high-end range developed to meet demanding customer requirements for wideband I/Q and RF testing up to the sub-THz frequency range. Offering excellent signal characteristics and straightforward and intuitive operation, the R&S SFI100A makes signal generation fast and easy.

2.1 Key features

Outstanding key features of the R&S SFI100A are:

- IF signal generation from 11 GHz to 21 GHz
- IF output power of up to 0 dBm
- Perfect IF source for external frontends and frequency converters
- Up to 10 GHz RF modulation bandwidth in a compact form factor
- Wideband analog I/Q output signals with V_{pp} up to 2 V:
 - Differential direct DAC output with up to 5 GHz bandwidth
 - Amplified differential output with up to 2 GHz bandwidth
 - Single-ended output with up to 5 GHz bandwidth
- Fully software-defined option concept to extend the instrument easily with software options
- Internal baseband generator including ARB with maximum sample rate of 16 Gsample/s, maximum ARB memory of 8 Gsample
- Support of waveforms for generation of 5G NR, IEEE 802.11ad/ay, OFDM, custom digital modulation and multicarrier continuous wave signals
- Intuitive operation via 5" touchscreen with block diagram as key element
- Graphical signal monitoring at practically every point in the signal flow
- SCPI macro recorder and code generator for generating executable remote control code from manual operating steps (for MATLAB®, CVI, etc.)

For more information, refer to the specifications document.

2.2 Documentation overview

This section provides an overview of the R&S SFI100A user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/sfi100a

2.2.1 Getting started manual

Introduces the R&S SFI100A and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

2.2.2 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

2.2.3 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: <https://www.youtube.com/@RohdeundSchwarz>

3 Getting started

This chapter contains the same information as the getting started manual.

3.1 Preparing for use

Here, you can find basic information about setting up the product for the first time.

3.1.1 Lifting and carrying

For safety information, see "[Lifting and carrying the product](#)" on page 10.

3.1.2 Unpacking and checking

1. Unpack the R&S SFI100A carefully.
2. Retain the original packing material. Use it to protect the control elements and connectors when transporting or shipping the R&S SFI100A later.
See also [Chapter 15, "Transporting"](#), on page 627.
3. Using the delivery notes, check the equipment for completeness. In particular, check that the delivery includes the two QSFP+ cables.
See "[Cable selection and electromagnetic interference \(EMI\)](#)" on page 18.
4. Check the equipment for damage.

If the delivery is incomplete or equipment is damaged, contact Rohde & Schwarz.

3.1.3 Choosing the operating site

Specific operating conditions ensure proper operation and avoid damage to the product and connected devices. For information on environmental conditions such as ambient temperature and humidity, see the specifications document.

For safety information, see "[Choosing the operating site](#)" on page 10.

Electromagnetic compatibility classes

The electromagnetic compatibility (EMC) class indicates where you can operate the product. The EMC class of the product is given in the specifications document.

- Class B equipment is suitable for use in:
 - Residential environments
 - Environments that are directly connected to a low-voltage supply network that supplies residential buildings

- Class A equipment is intended for use in industrial environments. It can cause radio disturbances in residential environments due to possible conducted and radiated disturbances. It is therefore not suitable for class B environments. If class A equipment causes radio disturbances, take appropriate measures to eliminate them.

3.1.4 Setting up the R&S SFI100A

For safety information, see:

- "Setting up the product" on page 10
- "Intended use" on page 9

3.1.4.1 Placing the R&S SFI100A on a bench top

To place the product on a bench top

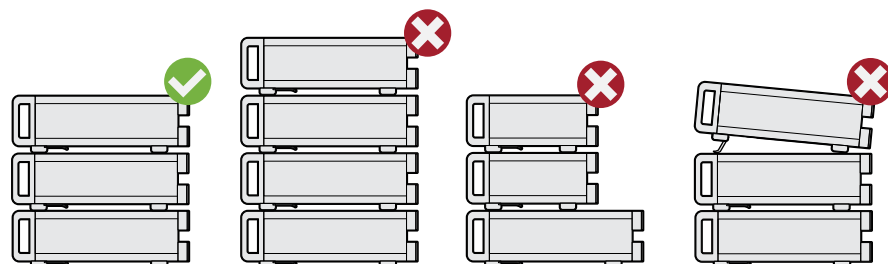
1. Place the product on a stable, flat and level surface. Ensure that the surface can support the weight of the product. For information on the weight, see the specifications document.
2. **CAUTION!** Foldable feet can collapse. For safety information, see "Setting up the product" on page 10.

Always fold the feet completely in or out. With folded-out feet, do not place anything on top or underneath the product.

3. **WARNING!** A stack of products can fall over and cause injury. Never stack more than three products on top of each other. Instead, mount them in a rack.

Stack as follows:

- If the products have foldable feet, fold them in completely.
- All products must have the same dimensions (width and length).
- Do not exceed a total load of 50 kg placed on the product at the bottom of the stack.



- Left = Stacked correctly
 Middle left = Stacked incorrectly, too many products
 Middle right = Stacked incorrectly, different dimensions
 Right = Stacked incorrectly, folded-out feet

4. **NOTICE!** Overheating can damage the product.

Prevent overheating as follows:

- Keep a minimum distance of 10 cm between the fan openings of the product and any object in the vicinity to provide sufficient airflow and ventilation.
- Do not place the product next to heat-generating equipment such as radiators or other products.

3.1.4.2 Mounting the R&S SFI100A in a rack

To prepare the rack

1. Observe the requirements and instructions in "[Setting up the product](#)" on page 10.
2. **NOTICE!** Insufficient airflow can cause overheating and damage the product. Design and implement an efficient ventilation concept for the rack.

To mount the R&S SFI100A in a rack

1. Use an adapter kit that fits the dimensions of the R&S SFI100A to prepare the instrument for rack mounting.
 - a) Order the rack adapter kit designed for the R&S SFI100A. For the order number of the kit, see the specifications document.
 - b) Mount the adapter kit. Follow the assembly instructions provided with the adapter kit.
2. Lift the R&S SFI100A to shelf height.
3. Push the R&S SFI100A onto the shelf until the rack brackets fit closely to the rack.
4. Tighten all screws at the rack brackets with a tightening torque of 1.2 Nm to secure the R&S SFI100A in the rack.

To unmount the R&S SFI100A from a rack

1. Loosen the screws at the rack brackets.
2. Bring the lifting equipment to shelf height.
3. Remove the R&S SFI100A from the rack.
4. If placing the R&S SFI100A on a bench top again, unmount the adapter kit from the R&S SFI100A. Follow the instructions provided with the adapter kit.

3.1.5 Considerations for test setup

Cable selection and electromagnetic interference (EMI)

Electromagnetic interference (EMI) can affect the measurement results.

To suppress electromagnetic radiation during operation:

- Use the two cables 100G QSFP28 Passive Direct Attach Copper Twinax for connecting the Dig. IQ HS interfaces of the instrument. The cables are included in the delivery of the instrument and are available under order number 3708.5920.00. How to: [Chapter 3.1.10, "Establishing the high-speed digital crosslink"](#), on page 22
- Use high-quality shielded cables, for example, double-shielded RF, LAN and USB cables.
- Always terminate open cable ends.
- Ensure that connected external devices comply with EMC regulations.
- Use cables of the same type and equal length for connection to the I/Q interfaces of the instrument.

Signal input and output levels

The specifications document provides information on signal levels. Keep the signal levels within the specified ranges to avoid damage to the R&S SFI100A and connected devices.

Over-the-air (OTA) tests

For over-the-air (OTA) tests, operate the instrument in a shielded environment.

For more information, refer to the specifications document.

3.1.6 Connecting to power

For safety information, see ["Connecting to power"](#) on page 11.

1. Plug the AC power cable into the AC power connector on the rear panel. Only use the AC power cable delivered with the R&S SFI100A.
2. Plug the AC power cable into a power outlet with ground contact.
The required ratings are listed next to the AC power connector.

For more information, refer to the specifications document.

3.1.7 Connecting to LAN

Network environment

Before connecting the product to a local area network (LAN), consider the following:

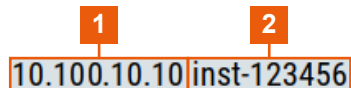
- Install the latest firmware to reduce security risks.
- For internet or remote access, use secured connections if applicable.

- Ensure that the network settings comply with the security policies of your company. Contact your local system administrator or IT department before connecting your product to your company LAN.
- When connected to the LAN, the product may potentially be accessed from the internet, which may be a security risk. For example, attackers might misuse or damage the product.

To connect to LAN

- ▶ Connect the LAN socket on the rear panel via an RJ-45 cable to the LAN.
Using DHCP (dynamic host configuration protocol), the R&S SF100A assigns the IP address automatically.

If connected to the LAN, the R&S SF100A displays the IP address and the host-name at the left bottom of the block diagram.



10.100.10.10 inst-123456

1 = IP address
2 = Hostname

If disconnected from the LAN, the R&S SF100A displays the IP address *0.0.0.0*.

See also [Chapter 12.8, "Setting up remote control"](#), on page 374.

3.1.8 Connecting a monitor

This section describes how to connect a monitor for direct operation of the R&S SF100A. You can skip the following procedure, if you only operate the R&S SF100A remotely.

1. Connect the monitor to the "Display Port" socket of the R&S SF100A on the rear panel.
The "Display Port" socket does not support a dual-mode Display Port (DP++). Use an active adapter if you connect to HDMI cables, for example.
2. At the monitor, connect the cable to one of the following sockets:
 - Display Port: Connect it to the Display Port socket of the monitor.
 - HDMI: You need an active adapter Display Port to HDMI. Passive adapters do not work.
 - VGA: You need an active adapter, Display Port to VGA. Passive adapters do not work.

If the monitor provides touch functionality, an additional connection can be required, for example, a USB connection. Refer to the documentation of your monitor.

3.1.9 Connecting USB devices

You can connect or disconnect all USB devices from the R&S SF100A during operation.

To connect USB storage devices

USB storage devices, such as memory sticks, allow data transfer from or to the R&S SF100A. You can also use them for firmware updates.

1. Connect the USB storage device to the USB type A connector on the front panel.
2. Connect the device directly, without a connecting cable.
Connecting cables can cause electromagnetic radiation and impair a measurement result.

To connect USB devices with an external power supply

1. **NOTICE!** Connected devices with external power supply can feed back current into the 5 V power supply of the USB interface and thus damage the R&S SF100A.
Ensure that there is no connection between the positive pole of the power supply and the +5 V power pin of the USB interface (VBUS).
2. Connect the USB storage device to a USB connector on the rear panel.

To connect a keyboard

- ▶ Connect the USB storage device to a USB connector on the rear panel.

When connected, the R&S SF100A detects the keyboard automatically. A detected keyboard has the default layout English – US.

To connect a mouse

- ▶ Connect the USB storage device to a USB connector on the rear panel.

When connected, the R&S SF100A detects the mouse automatically.

To connect power sensors

Connect power sensors of the R&S NRP families to a USB connector on the rear panel.

See [Chapter 7.5, "Using power sensors"](#), on page 212.

3.1.10 Establishing the high-speed digital crosslink

For correct operation, always connect the "Dig. IQ HS x" connectors to establish the high-speed I/Q data crosslink between the two baseband signal boards BBCV. Connect the connectors as follows:

1. For connection, use the two cables 100G QSFP28 Passive Direct Attach Copper Twinax.
See "[Cable selection and electromagnetic interference \(EMI\)](#)" on page 18.
2. To connect the cable and the interface, proceed as follows:
 - a) Hold the QSFP+ plug of the cable by its panes.
 - b) Turn the QSFP+ cable, so that the release tab shows upwards.
See also (5) in [Figure 3-1](#).
 - c) Insert and push the QSFP+ plug into the QSFP+ cage.

If you hear a clicking sound, the plug engaged correctly with the cage and the cable is connected to the interface.
3. For the I component of the I/Q data crosslink, connect "Dig. IQ HS 1" and "Dig. IQ HS 3".
See also (1) and (3) in [Figure 3-1](#).
4. For the Q component of the I/Q data crosslink, connect "Dig. IQ HS 2" and "Dig. IQ HS 4".
See also (2) and (4) in [Figure 3-1](#).

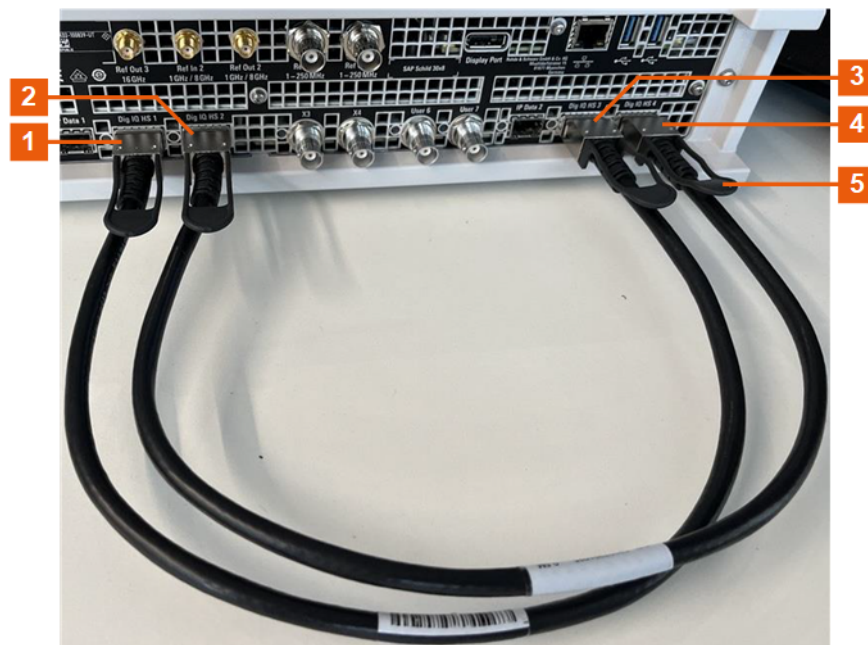


Figure 3-1: QSFP+ connections for I/Q data crosslink

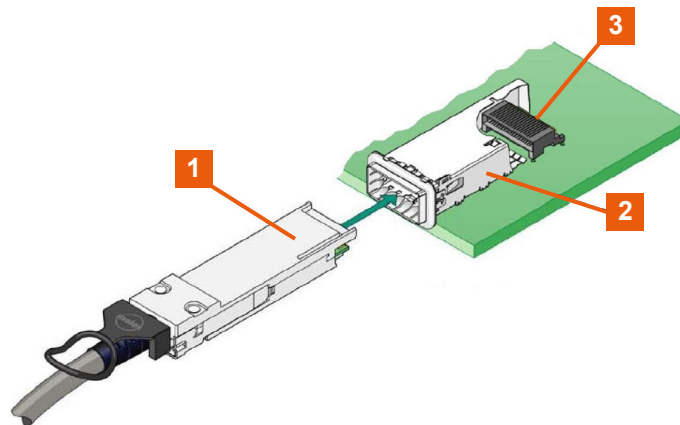
- 1, 3 = I components crosslink with connectors "Dig. IQ HS 1" and "Dig. IQ HS 3"
- 2, 4 = Q components crosslink with connectors "Dig. IQ HS 2" and "Dig. IQ HS 4"
- 5 = Release tab (pull-strap) of the QSFP+ cable

To disconnect from the QSFP+ interface

1. **NOTICE!** If you pull the cable, you can damage the cable and the Dig. IQ HS connector.
Pull the release tab.
2. Pull the QSFP+ plug out of the QSFP+ cage.

About the QSFP+ interface

The "Dig. IQ HS" connector is a QSFP+ (quad small form factor pluggable) interface or QSFP28 interface. The connector socket has two components: a QSFP+ cage and a QSFP+ connector. The QSFP+ cable is equipped with the QSFP+ plug. The interface supports a maximum bandwidth of up to 50 Gsample/s with active optical cables.



- 1 = QSFP+ plug
- 2 = QSFP+ cage
- 3 = QSFP+ connector

3.1.11 Connecting to RF coaxial connectors

Here, you find information on how to prepare and to connect to RF coaxial connectors of the R&S SF100A. Use these RF connectors, for example, for output of the RF signal or for input of an external reference signal.

To prepare for connecting

1. **NOTICE!** Damaged or not clean connections can lead to RF insertion loss and mismatch, and even premature wear of the connectors.
Before connecting to the port, inspect the RF connector visually. Check that it is clean, undamaged and mechanically compatible.

2. **NOTICE!** DC voltage at the RF connector can damage the instrument. Never apply DC voltage to the RF input connectors.
Make sure that the values are within the DC limits given in the specifications document.
3. If your test setup has a DC component at the RF input, insert a DC blocker.
4. Use a high-quality RF cable that matches the RF connector type. See also "[Cable selection and electromagnetic interference \(EMI\)](#)" on page 18.
5. You can connect to two kinds of connectors:
 - "[To connect to screwable connectors](#)" on page 24
 - "[To connect to pluggable connectors](#)" on page 24

To connect to screwable connectors

- **NOTICE!** Excessive tightening can damage the connectors.

To connect the cable with the connector, proceed as follows:

- a) Carefully align the connector of the cable and the connector along a common axis.
- b) Mate the connectors along the common axis until the male pin of the inner connector engages with the female socket of the outer connector.
- c) Turn the nut of the outer connector until the connectors are firmly coupled.
- d) Using a calibrated torque wrench torque the nut to the limit as in the table below. Hold the opposite connector part stationary with a spanner.

The R&S SF100A provides screwable RF connectors as in [Table 3-1](#).

Table 3-1: Connector name, type, size, torque limit and nut opening

Connector		Torque limit		Nut opening	
Type	Name	lb-Inch	Nm	Inch	mm
SMA	I/Q / I/Q bar Ref In 2 Ref Out 2/3 User 1/2/3	5	0.56	5/16	8
2.92 mm	RF Out*)	8	0.9	5/16	8

To connect to pluggable connectors

The R&S SF100A provides pluggable Bayonet Neill-Concelman (BNC) connectors.

- To connect the RF cable with the BNC connector, proceed as follows:
- a) Carefully align the connector of the cable and the BNC connector along a common axis.
 - b) Mate the connectors along the common axis until the male pin of the connector of the cable engages with the female socket of the BNC connector.

For more information on handling and maintaining coaxial RF connectors, see the application note [1MA99](#).

For information on mounting test port adapters onto the RF connector, see the application note [1MA100](#).

3.1.12 Connecting to RF Out

1. Before connecting, disable the RF output:
In the block diagram, switch off the RF block.
2. For connection, use the connector "RF Out" on the front panel.
See ["To connect to screwable connectors"](#) on page 24.

To prevent RF output switch-off

- ▶ **NOTICE!** If you set a too high output level without a load connected to the instrument, the reverse power can exceed a limit forcing the R&S SFI100A to switch off the RF output.

Connect a load with sufficient return loss.

For more information, refer to the specifications document.

3.1.13 Connecting to Ref In/Ref Out

For connection, the R&S SFI100A provides BNC connectors or SMA connectors on the rear panel. See ["To connect to pluggable connectors"](#) on page 24 and ["To connect to screwable connectors"](#) on page 24.

3.1.14 Switching on or off

The following table provides an overview of power states, LEDs and positions of the power switch.

Table 3-2: Overview of power states

State	LED	Position of power switch
Off	● gray	[0]
Standby	● orange	[1]
Ready	● green	[1]

To switch on the R&S SFI100A

The R&S SFI100A is off but connected to power. See [Chapter 3.1.6, "Connecting to power"](#), on page 19.

1. Set the switch on the power supply to position [1] on the rear panel.

The LED of the [On/Standby] key on the front panel is orange.

2. Press the [On/Standby] key on the front panel.

The LED changes to green. The R&S SF100A boots.

After booting, the R&S SF100A starts up displaying the block diagram on the screen on the front panel.

To check startup functions

When starting for the first time, the R&S SF100A starts with the default settings. When restarting, the R&S SF100A recalls the instrument configuration before shut-down.

See [Chapter 10.4.2, "Saving and recalling instrument settings"](#), on page 281.

When switched on, the R&S SF100A monitors the main functions and logs erroneous functions. See the following:

See [Chapter 14.4, "Querying notifications"](#), on page 617.

To shut down the product

The product is in the ready state.

- ▶ Press the [On/Standby] key.

The operating system shuts down. The LED changes to orange.

To disconnect from power

The R&S SF100A is in the standby state.

1. **NOTICE!** Risk of data loss. If you disconnect the product from power when it is in the ready state, you can lose settings and data. Shut it down first.

Set the toggle switch on the power supply to position [0].

The LED of the [On/Standby] key is switched off.

2. Disconnect the R&S SF100A from the power source.

3.2 Instrument tour

This chapter explains the control elements and the connectors of the R&S SF100A. The views of the front panel and the rear panel help you to get familiar with the instrument and to perform the first steps. For specifications of the interfaces, see the specifications document.

The meanings of the labels on the R&S SF100A are described in [Chapter 1.2, "Labels on R&S SF100A"](#), on page 12.

3.2.1 Front panel tour

This section provides an overview of the control elements and connectors of the front panel of the R&S SF100A. On the [rear panel](#), you find all further connectors.

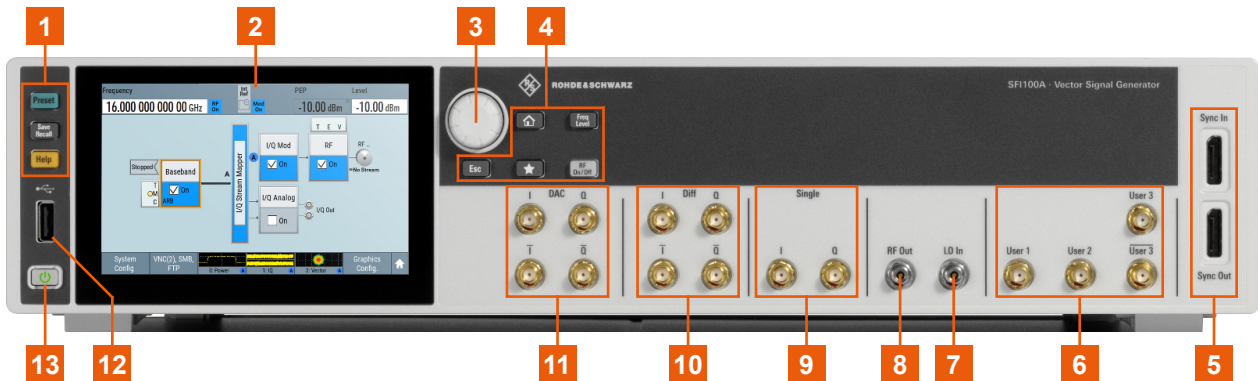


Figure 3-2: Front panel view

- 1 = Utility keys
- 2 = Touchscreen
- 3 = Rotary knob
- 4 = Function keys
- 5 = Sync In/Sync Out
- 6 = User x
- 7 = LO In
- 8 = RF Out
- 9 = Single connectors
- 10 = Diff connectors
- 11 = DAC connectors
- 12 = USB
- 13 = On/Standby key

3.2.1.1 Touchscreen

The screen on the front panel displays the block diagram and the most important settings. Also, the screen display provides status and setting information and allows you to quickly reconfigure the signal flow. The screen is touch-sensitive, offering an alternative means of user interaction for quick and easy handling of the instrument.

Any user interface elements that react to a click by a mouse pointer also react to a tap on the screen, and vice versa. Using the touchscreen, you can perform the following tasks (among others) by the tap of your finger:

- Changing a setting
- Selecting new settings
- Scrolling through a list or a table of parameters
- Saving or recalling settings
- Opening and closing dialogs

See also:

- [Chapter 16.1, "Cleaning"](#), on page 628, for instructions on cleaning the screen.

3.2.1.2 Keys

On/Standby key

The [On/Standby] key switches the instrument from the standby to the ready state or vice versa.

The LED below the [On/Standby] key indicates the instrument state, see [Chapter 3.1.14, "Switching on or off"](#), on page 25.

Utility keys

The utility keys set the instrument to a defined state, provide information on the instrument and provide access to the instrument help.

Table 3-3: Utility keys

Utility key	Assigned functions
[Preset]	Sets the instrument to a defined state.
[Save/Recall]	Opens the file manager to save or load an instrument configuration. Accesses the file manager
[Help]	Opens the "Help" dialog and displays the description for a context-sensitive help topic.

Function keys

Function keys provide access to the most common generator settings and functions.

Table 3-4: Function keys

Function key	Assigned functions
[Home]	Brings the block diagram to the foreground and minimizes opened dialogs.
[Freq/Level]	Pressing once: Enables frequency entry. Pressing twice: Enables level entry. Toggles between frequency and level entry.
[★]	User key with a customizable function.
[RF On/Off]	Switches the RF output on and off. The status bar above the block diagram displays the current RF output state.
[Esc]	For non-edit mode, closes all kinds of dialog boxes analogous to tapping the "Cancel" button. In edit mode, quits this mode and keeps the last entry during editing.

Rotary knob

The rotary knob has several functions:

- Increments (clockwise direction) or decrements (counterclockwise direction) numeric instrument parameters at a defined step size.
- Moves the selection, e.g. to a function block in the block diagram.
- Shifts the selection bar within focused areas (e.g. lists).
- Activates editing of entries or confirms and terminates entries.

- Opens a context-sensitive menu, if you press and hold the knob.

3.2.1.3 Connectors

There are SMA connectors, a USB connector and "Sync" connectors on the front panel.

USB

Female USB (universal serial bus) 2.0 connector of type A (host USB). You can connect, for example, a keyboard, a mouse or a USB memory stick.

How to: [Chapter 3.1.9, "Connecting USB devices"](#), on page 21

Single connectors

Two female SMA connectors for single-ended I/Q output signals.

How to: ["To connect to screwable connectors"](#) on page 24

Diff connectors

Four female SMA connectors for amplified differential I/Q signal output.

"I/Q" Two connectors for the positive differential I/Q output signal.

"I/Q bar" Two connectors for the negative differential I/Q output signal.

How to: ["To connect to screwable connectors"](#) on page 24

DAC connectors

Four female SMA connectors for differential I/Q signal output direct from the D/A converter (DAC) board.

"I/Q" Connectors for the positive differential I/Q output signal.

"I/Q bar" Connectors for the negative differential I/Q output signal.

How to: ["To connect to screwable connectors"](#) on page 24

RF Out

Female 2.92 mm connector for output (50Ω) of the RF signal.

How to: ["To connect to screwable connectors"](#) on page 24

LO In

Female 2.92 mm connector for input (50Ω) of a local oscillator (LO) signal. The connector is for future use.

User x

Four female SMA multipurpose connectors for user-configurable input and output signals.

[Table 3-5](#) lists available User x connectors and their description.

Table 3-5: User x front panel connectors

Connector	Description
User 1	Trigger signal input or output, high-level and low-level control signal output.
User 2	Trigger signal input or output, high-level and low-level control signal output.
User 3 User 3 bar	Differential trigger signal output, high-level and low-level control signal output.

A dedicated LED indicates the connector status:

- ● green: an input connector
- ● yellow: an output connector
- ● no light / gray: the connector is not active

See also [Chapter 4.5, "Configuring global connectors"](#), on page 121.

How to: ["To connect to screwable connectors"](#) on page 24

Sync In/Sync Out

Connector for multi-Instrument setups to synchronize input signals and output signals. For future use.

3.2.2 Rear panel tour

This section provides an overview of the connectors on the rear panel of the instrument. For technical data of the connectors, refer to the specifications document.

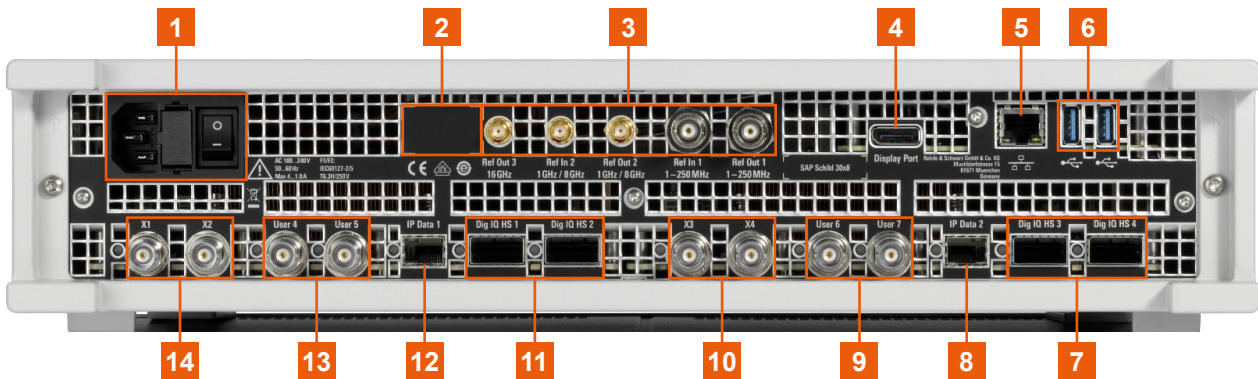


Figure 3-3: Rear panel

- 1 = AC power supply connector and switch
- 2 = Serial number (six digits in the string 1444.4001.02-<serial number>-<checksum>)
- 3 = Ref In/Ref Out
- 4 = Display Port
- 5 = LAN
- 6 = USB
- 7, 11 = Dig. IQ HS x
- 8, 12 = IP Data
- 9, 13 = User x
- 10, 14 = X x

3.2.2.1 Connectors

AC power supply connector and switch

Mains power switch for performing the following tasks:

- Connecting the internal power supply to the power source
- Disconnecting the internal power supply from the power source

The required ratings are listed next to the AC power connector and in the specifications document.

How to:

- [Chapter 3.1.6, "Connecting to power"](#), on page 19
- [Chapter 3.1.14, "Switching on or off"](#), on page 25
- [Chapter 16.2, "Changing fuses"](#), on page 628

Ref In/Ref Out

Input or output for an external reference signal.

For reference signals with frequency f_{ref} of 250 MHz and lower, connect to the BNC female connectors "Ref In 1" and "Ref Out 1".

For reference signals with frequency f_{ref} higher than 250 MHz, connect to the SMA female connectors "Ref In 2", "Ref Out 2" and "Ref Out 3".

How to:

- $f_{ref} \leq 250$ MHz: ["To connect to pluggable connectors"](#) on page 24
- $f_{ref} > 250$ MHz: ["To connect to screwable connectors"](#) on page 24

Display Port

Display Port monitor connector.

How to: [Chapter 3.1.8, "Connecting a monitor"](#), on page 20

LAN

RJ-45 connector to connect the R&S SFI100A to a LAN for remote control, remote operation and data transfer.

How to: [Chapter 3.1.7, "Connecting to LAN"](#), on page 19

USB

Two female USB (universal serial bus) 3.1 connectors of type A (host USB). They have the same functionality as the USB connector on the front panel, but provide higher data rates. See ["USB"](#) on page 29.

How to: [Chapter 3.1.9, "Connecting USB devices"](#), on page 21

Dig. IQ HS x

QSFP+ or QSFP28 interface connectors that provide the high-speed I/Q data link between the two baseband signaling boards BBCV.

For correct operation, always connect the "Dig. IQ HS x" connectors to establish the high-speed I/Q data crosslink between the two baseband signal boards BBCV. Connect the connectors as follows:

- I component of the I/Q link:
Connect "Dig. IQ HS 1" and "Dig. IQ HS 3".

- Q component of the I/Q link:
Connect "Dig. IQ HS 2" and "Dig. IQ HS 4".

How to: [Chapter 3.1.10, "Establishing the high-speed digital crosslink"](#), on page 22

IP Data

"IP Data 1" and "IP Data 2" connectors with an SFP+ (small form factor pluggable) interface. The connectors are for future use.

User x

Four BNC connectors with fixed marker output signal routing.

[Table 3-6](#) lists available User x connectors and their description.

Table 3-6: User x rear panel connectors

Connector	Description
User 4	"Marker 4" output signal
User 5	"Marker 3" output signal
User 6	"Marker 2" output signal
User 7	"Marker 1" output signal

How to: ["To connect to pluggable connectors"](#) on page 24

X x

Four BNC multipurpose connectors for future use.

How to: ["To connect to pluggable connectors"](#) on page 24

3.3 Trying out the instrument

This chapter provides step-by-step instructions to introduce the most important functions and settings of the R&S SFI100A.

Prerequisites

- The R&S SFI100A is equipped with its base unit configuration.
- The R&S SFI100A is connected to the power supply and started up.
See [Chapter 3.1.6, "Connecting to power"](#), on page 19.
- The R&S SFI100A has its default configuration after an instrument preset.
See also ["Overview of the characteristics of the preset functions"](#) on page 273.

Base unit

The R&S SFI100A has the following options when equipped as a base unit:

- Frequency option R&S SFI-B1016
- ARB option R&S SFI-K510 with 4 GHz RF bandwidth and 2 Gsample memory
- Frontend control option R&S SFI-K553
- Reference input and output option R&S SFI-K703

Instrument equipment and screenshots

In this description, the screenshots show a fully equipped instrument. Consider that some settings in the block diagram or in the configuration dialogs can differ from the settings of your instrument.

For the first signal generation tasks, you use the internal baseband and reference signal, so you do not need any additional signal source. More complex signal generation tasks require an instrument equipped with additional options or external signals.

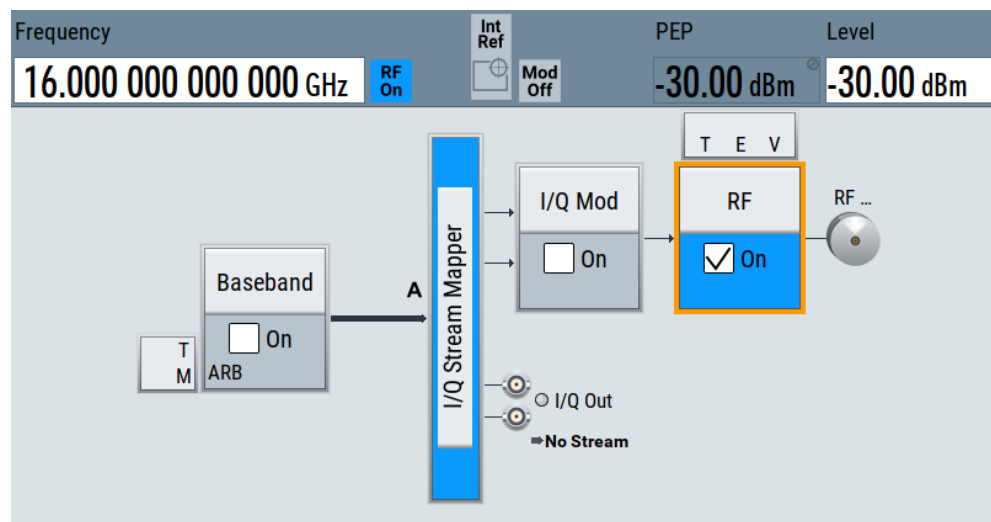
The following sections provide introductory step-by-step instructions using the touch-screen. Each instruction lists the prerequisites to execute the instruction.

- [Generating an unmodulated RF signal](#)..... 33
- [Generating a modulated RF signal](#)..... 34
- [Generating a wideband RF signal](#).....36

3.3.1 Generating an unmodulated RF signal

This step-by-step instruction explains how to generate an unmodulated RF continuous wave signal. This signal is an IF signal in the frequency range of 11 GHz to 21 GHz. The signal is sufficient for generic IF receiver testing, for example for testing chipsets.

1. Connect the RF Out connector of the R&S SF1100A to the RF input connector of the DUT.
See "[To connect to screwable connectors](#)" on page 24.
2. Configure the IF signal:
 - a) In the status bar, select the "Frequency" field to enter a frequency value.
For example, enter *16g* to set an IF frequency value of 16 GHz.
 - b) Select the "Level" field to enter a level value.
For example, enter *-20* to set an IF level value of -20 dBm.
3. In the block diagram, select "RF" > "On" to enable IF signal generation.

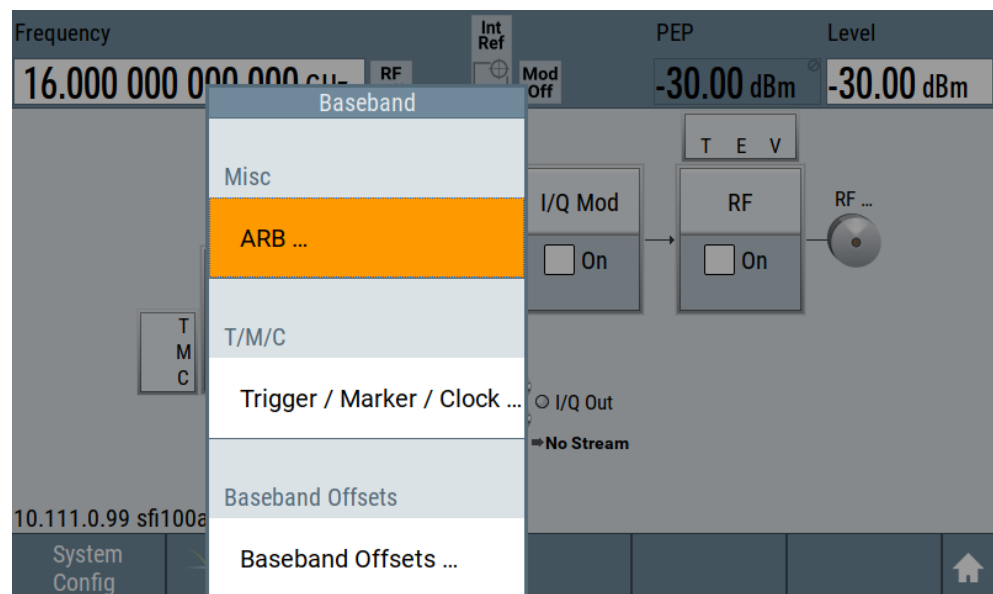


The status bar displays the set frequency and the level of the IF signal. The R&S SF1100A outputs this IF signal at the "RF Out" connector on the front panel.

3.3.2 Generating a modulated RF signal

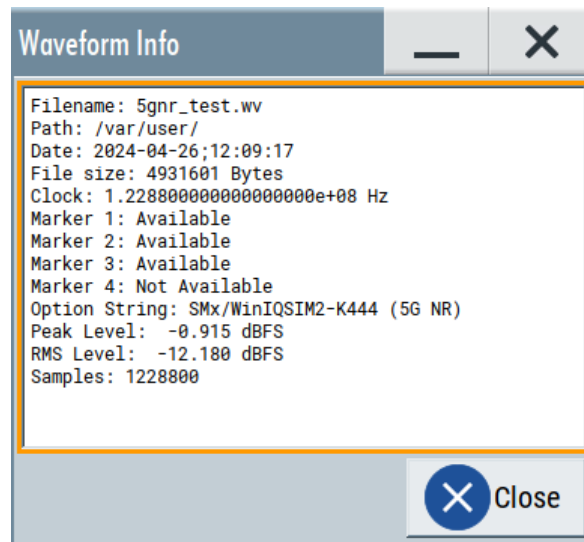
This step-by-step instruction explains how to generate a modulated RF signal. This signal is an IF signal in the frequency range of 11 GHz to 21 GHz. The signal is sufficient for generic IF receiver testing, for example for testing chipsets.

1. Connect the "RF Out" connector of the R&S SF1100A to the RF input connector of the DUT.
See ["To connect to screwable connectors"](#) on page 24.
2. In the block diagram, select "Baseband" > "Misc" > "ARB".



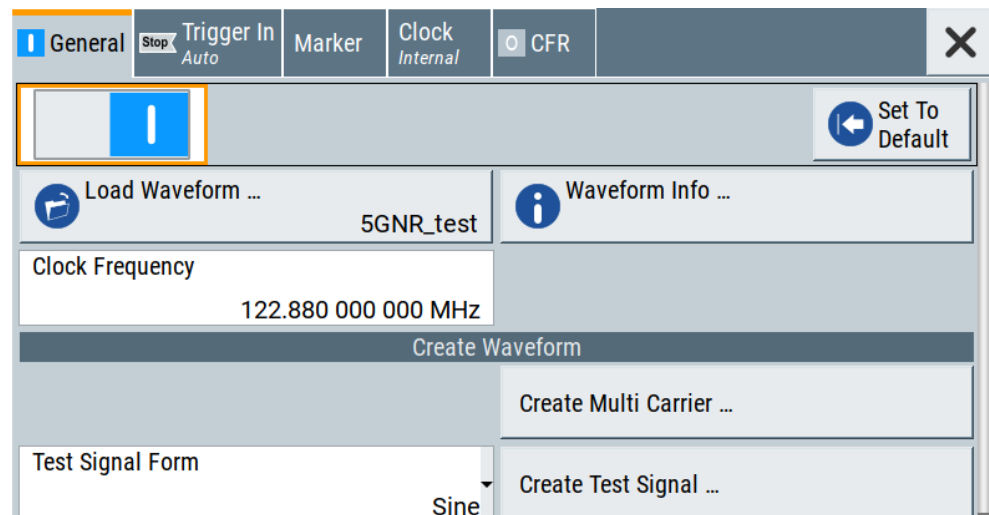
The ARB dialog opens.

3. Load a waveform file. For example, load the file `5G NR_test.wv` that resembles the default configuration of a 5G NR baseband signal.
See section [Chapter 4.3.4.2, "Loading and playing waveform files"](#), on page 84.
4. Optionally, to check the waveform file properties, select "Waveform Info".



The dialog provides detailed information on the waveform file including the file size and the clock frequency.

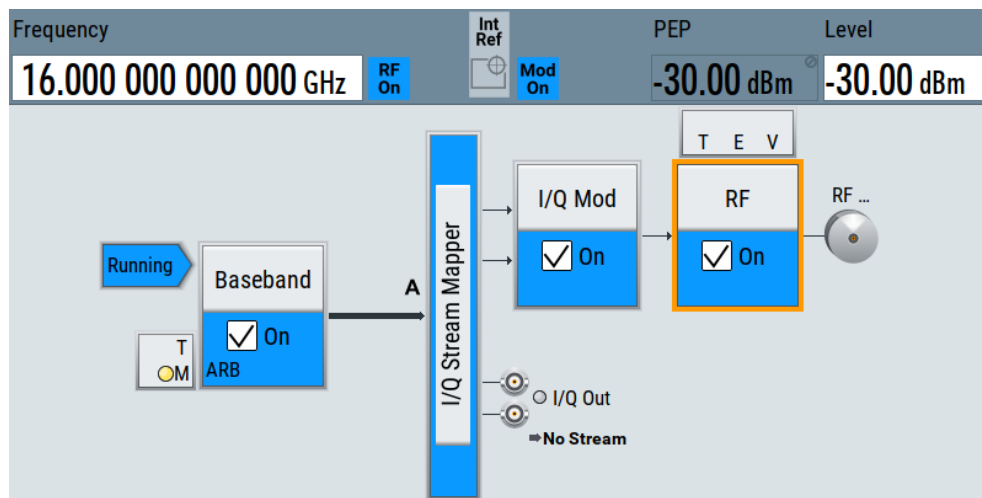
5. Select "State" > "On".



The R&S SFI100A loads the waveform file and starts signal processing.

6. In the status bar, configure the frequency and the level of the IF signal.

- In the block diagram, select "RF" > "On" to enable IF signal generation.



The R&S SF1100A outputs this IF signal at the "RF Out" connector on the front panel.

3.3.3 Generating a wideband RF signal

When operating the R&S SF1100A with a connected external frontend, you can generate upconverted wideband RF signals. For example, with a connected R&S FE170ST, R&S SF1100A generates RF signals in the D band.

This section provides step-by-step descriptions for connecting, controlling and generating RF signals with external frontends. Connecting instructions use the R&S FE170ST as an example. Connecting other external frontend is analogous. The instructions cover the following topics:

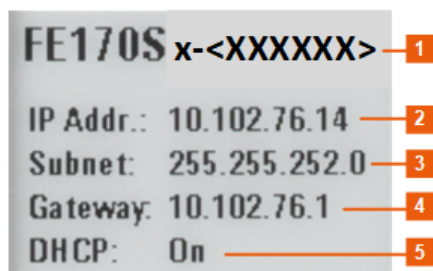
- ["To connect an external frontend"](#) on page 36
- ["To configure the R&S SF1100A for frontend control"](#) on page 37
- ["To output a generated wideband RF signal"](#) on page 39

To connect an external frontend

This step-by-step instruction describes how to connect the R&S SF1100A to an R&S FE170ST. The instruments are switched on and connected to power.

- NOTICE!** Cable selection. Use all cables delivered with the external frontend. Other connections can require additional cables.
For the IF connection, use the IF cable (order number 1348.3850.00). For the reference signal connection, use the reference cable (order number 1347.7569) delivered with the external frontend. For the LAN connection, use a high-quality cable. See also [Chapter 3.1.5, "Considerations for test setup"](#), on page 18.
- Connect the "RF Out" connector of the R&S SF1100A with the "IF In" connector of the R&S FE170ST.
See also ["To connect to screwable connectors"](#) on page 24.

- Connect the "LAN" connector with the "LAN" connector of the R&S FE170ST.
See also [Chapter 3.1.7, "Connecting to LAN"](#), on page 19.
- Check if the host name (1), IP address (2), subnet mask (3) and gateway address (4) of the R&S FE170ST are correct.
Once connected to LAN, the electronic label on the right side panel of the R&S FE170ST displays these network parameters:



For more information, see section "Electronic label" in the manual of the external frontend.

- Connect the "Ref Out 2" connector of the R&S SF1100A with the "Ref In" connector of the R&S FE170ST.
See also ["To connect to screwable connectors"](#) on page 24.

[Table 3-7](#) and [Figure 3-4](#) provide an overview on connections and a test setup.

Table 3-7: R&S SF1100A and R&S FE170ST connections

Signal	R&S SF1100A	R&S FE170ST
Reference	Connector: "Ref Out 2" Frequency: 1 GHz, 8 GHz	"Ref In"
LAN (Control)	"LAN"	"LAN"
IF In	"RF Out"	"IF In"
RF Out	-	"RF Out"

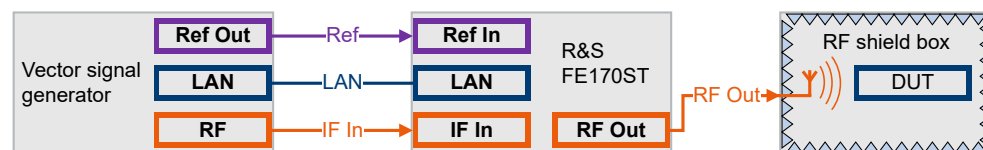


Figure 3-4: Test setup: R&S SF1100A, R&S FE170ST and RF shield box

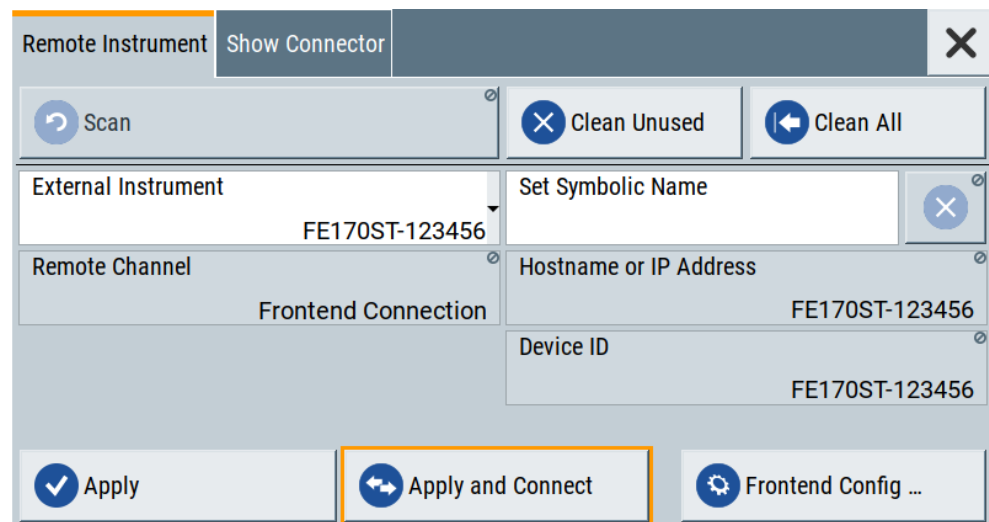
To configure the R&S SF1100A for frontend control

The following procedure describes how to configure the R&S SF1100A to establish a control connection between R&S SF1100A and an external frontend. The R&S SF1100A is connected to the external frontend.

See ["To connect an external frontend"](#) on page 36.

- In the taskbar, select "System Config" > "System Configuration" > "External RF".

2. Select "RF Out" > "External Instrument" > "Config".
The "Remote Instrument" dialog opens.
3. Select the connected external frontend from "External Instrument" selection.
The selection displays available instruments in format
<product>-<serial_number>, for example "FE170ST-123456".
4. In the field "Hostname or IP Address", check if the host name or IP address of the connected external frontend is correct.
If read out correctly, the host name or IP address match with the information displayed on the electronic label of the external frontend.
See step 4) in the section "[To connect an external frontend](#)" on page 36.
5. Select "Apply and Connect".



A message displays if the remote connection to the external frontend is established or not.

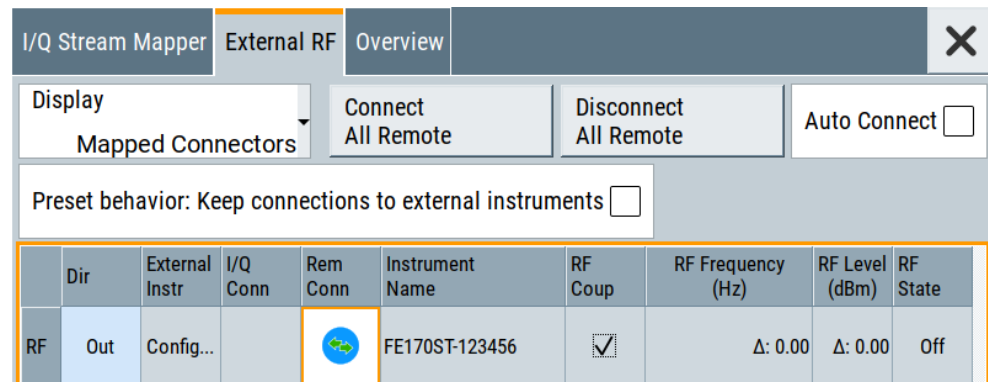


Figure 3-5: Message displaying an established remote connection

If connected successfully, you can configure dedicated frontend settings in the "Frontend Configuration" dialog.

See "[To configure external frontend settings](#)" on page 180.

6. Select "System Config" > "System Configuration" > "External RF".



The dialog displays the settings and state of the connected external instrument. The "RF" > "Rem Conn" field displays an active control connection:



The control connection is established, the LAN LED on the external frontend switches from green to orange.

If you change the network configuration, e.g. the IP address, the connection to the R&S SF100A is aborted. Re-establish a connection to the frontend as in step 3).

If you have connection issues, see the following section:

- [Chapter 7.1.4, "Troubleshooting external frontends"](#), on page 197

To output a generated wideband RF signal

The procedure assumes that a remote control connection between R&S SF100A and R&S FE170ST is established, the frontend settings are configured and a test signal is loaded.

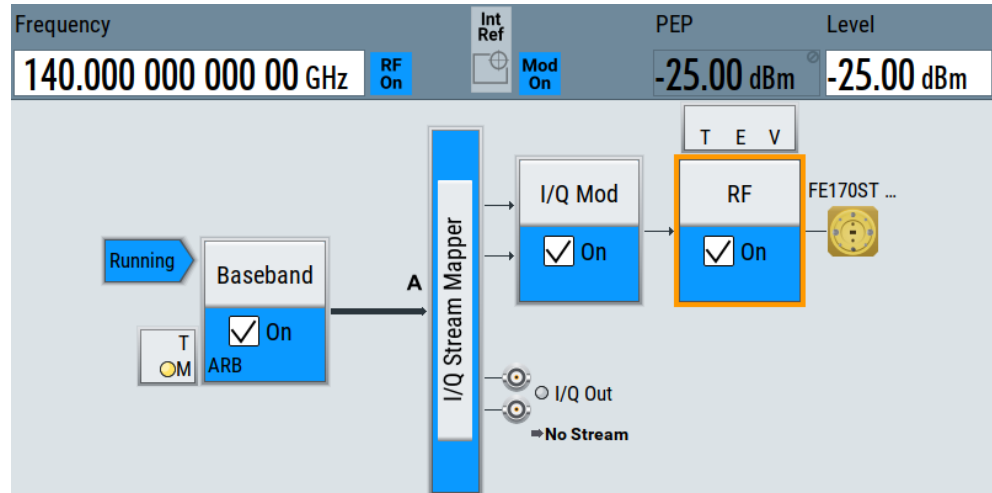
See also [Chapter 3.3.2, "Generating a modulated RF signal"](#), on page 34.

1. Return to the block diagram.
2. Configure the RF output signal.

Once you connect the external frontend, the R&S SF100A sets the "Frequency" in the status bar automatically. In particular, the R&S SF100A and the R&S FE170ST set the lower frequency of the frequency band that is 110 GHz.

 - a) In the status bar of the R&S SF100A, set the frequency of the RF signal, for example to 140 GHz.
 - b) In the status bar of the R&S SF100A, set the level of the RF signal, for example to -25 dBm.

3. In the block diagram, select "RF" > "On".



The RF signal is output at the external frontend.

3.4 Operating the instrument

This chapter provides an overview on basic operating tasks. There are three ways to operate the R&S SF1100A.

Manual operation

Use the touchscreen, keys and rotary knobs, or an optional mouse and/or keyboard. The principles of manual operation are explained in this section.

Remote control

Create programs to automatize repeating settings, tests, and measurements. The instrument is connected to a computer that runs the program.

This way of operation is described in [Chapter 12.1, "Overview of remote access modes"](#), on page 346.

Remote operation

For remote monitoring and operation of the instrument, a VNC server is installed on the R&S SF1100A. You need a LAN connection to the computer, and a VNC client or browser to connect to the instrument.

This way of operation is described in [Chapter 12.1, "Overview of remote access modes"](#), on page 346.

The following sections show how to operate the instrument manually.

- [Means of manual interaction](#).....41
- [Understanding the display information](#).....41
- [Accessing the functionality](#).....46

- [Entering data](#).....47
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3.4.1 Means of manual interaction

For the manual interaction with the R&S SF100A, you have several methods that you can use as an alternative to perform a task:

- Touchscreen:

Touchscreen operation is the most direct way to interact. Almost all control elements and actions on the screen are based on the standard operating system concept. You can tap any user interface element to set parameters in dialog boxes, enter data, scroll within a dialog etc., as if you work with a mouse pointer.

Tapping the screen works like clicking mouse buttons:

 - Touch quickly = click: Selects a parameter or provokes an action.
 - Touch and hold = right-click: Opens a context-sensitive menu.
 - Touch and swipe = drag: Scrolls through the contents of a display element larger than the screen, e.g. a list or a table.
- Function keys and rotary knob:

The front panel provides nearly all functions and controls to operate the instrument in the classic way, without touchscreen.
- Optional mouse and/or keyboard:

These devices work like known from PCs. The navigation keys on the front panel correspond to the keys on the keyboard.

This manual describes the manual interaction with the instrument via the touchscreen. It mentions the alternative methods using the keys on the instrument or the on-screen keypads if it deviates from the standard operating procedures. The usage of the touchscreen and navigation keys is described in [Chapter 3.4.3, "Accessing the functionality"](#), on page 46.

Throughout the manual, the term "select" refers to any of the following methods:

- Using a finger on the touchscreen
- Using a mouse pointer in the display
- Using a key on the instrument or on a keyboard

3.4.2 Understanding the display information

The block diagram of the R&S SF100A displays all main settings and generator states, divided into main operation areas.

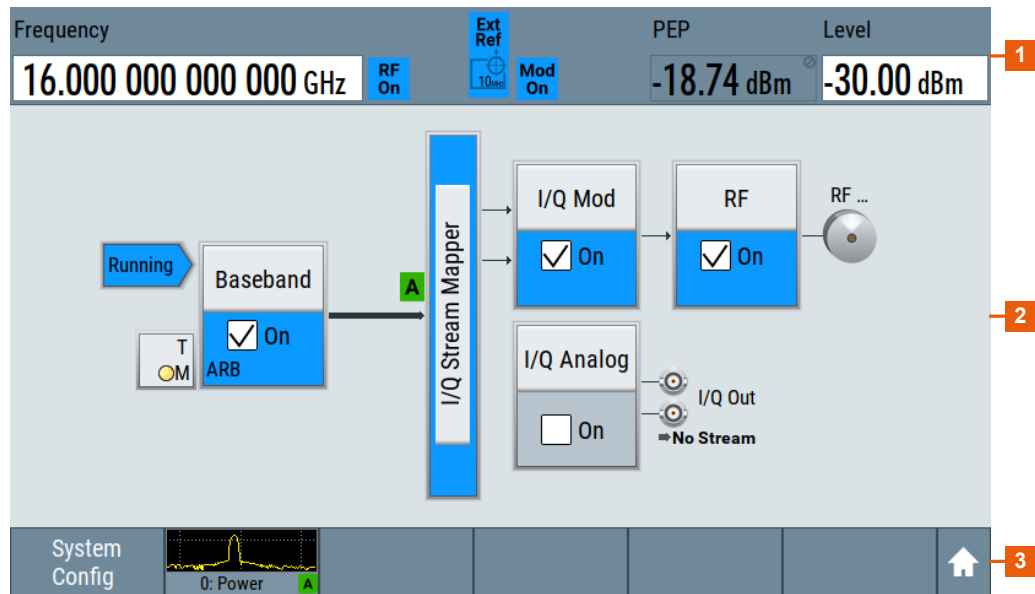


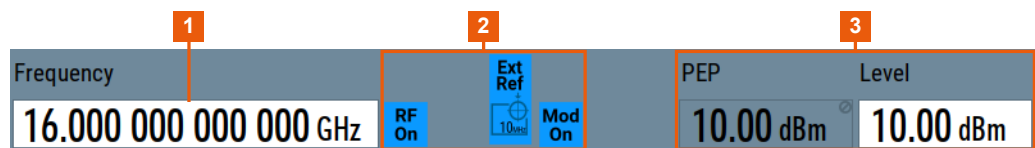
Figure 3-6: Block diagram

- 1 = Status bar
- 2 = Block diagram
- 3 = Taskbar

- [Status bar](#).....42
- [Block diagram](#).....43
- [Taskbar](#).....44
- [Additional display characteristics](#).....45

3.4.2.1 Status bar

The status bar at the top of the screen indicates the RF frequency and the level of the output signal provided to the DUT. You can set both parameters directly here.

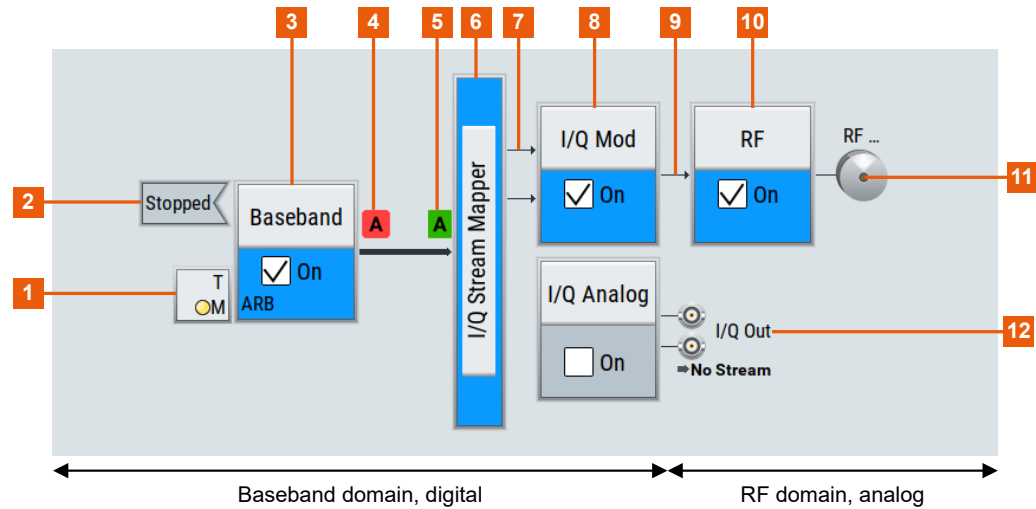


- 1 = Frequency display
- 2 = Status buttons
- 3 = Level display

The status buttons indicate key parameters that are set for the output signal. Most of the status buttons are virtual keys that you can use to open a corresponding menu or dialog.

3.4.2.2 Block diagram

The block diagram shows the current configuration and the signal flow in the generator with the aid of function blocks, connected by signal lines. The following figure displays the most common elements that can appear in the block diagram. However, it does not necessarily represent a useful configuration.



- 1 = Control signal block
- 2 = Status indicator
- 3, 6, 8, 10 = Functional block
- 4, 5 = Graphics indicator
- 7, 9 = Signal line
- 11, 12 = Connector icons (RF, I/Q analog)

Starting from the left up to the "I/Q Mod" functional block, you can see the functional blocks provided in the baseband domain. After the I/Q modulation on the analog RF carrier, the analog section implies the routing to the "RF" functional block.

Legend	Item	Description
1	Control signal block	Indicates information on the control signals like signal content, input or output and provides quick access to the corresponding configuration dialog. A dedicated control block is displayed to the left of the baseband block.
2	Status indicator	Indicates whether the signal is running or waiting for a trigger.
3, 6, 8, 10	Functional block	Represents a basic task in signal generation. The push button provides access to any number of associated actions to accomplish the task. A checkbox and the block label quickly enable the basic task.
4, 5	Graphics indicator	Denotes that the signal is displayed graphically: <ul style="list-style-type: none"> • Baseband signal after the baseband block (4) • Stream signal before mapping (5)

Legend	Item	Description
7, 9	Signal line	Shows the currently configured signal flow.
11, 12	Connector icon	Represents the interfaces for signal output. <ul style="list-style-type: none"> RF signal connector output (11) I/Q analog signal connector output (12)

3.4.2.3 Taskbar

The "Taskbar" contains labeled softkeys and minimized views (thumbnails) of active graphics and dialogs.

Initially, it shows the permanently assigned softkeys. The softkey with the sine wave denotes that no signal is enabled for graphical representation.

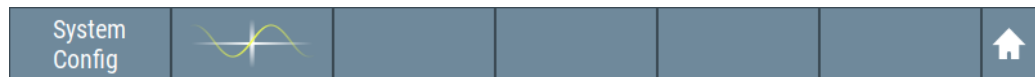


Figure 3-7: Taskbar in default state

Whenever you open a settings or graphics dialog, it is automatically assigned to the "Taskbar". The softkeys shown in the following figure represent the variants.

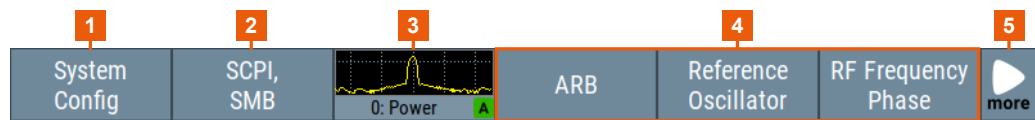


Figure 3-8: Taskbar fully assigned

- 1 = System configuration and setup
- 2 = Remote control connections
- 3 = Graphics
- 4 = Dialogs
- 5 = Show block diagram / more

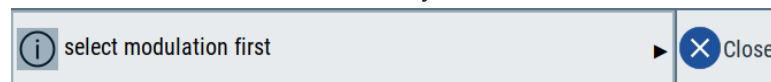
1	System Config	Provides access to general system configurations like setup, display, or remote.
2	Remote control connections	Shows the established remote connections when the instrument is remotely controlled. Tip: An indicator in the status bar shows the current remote control status.
3	Graphics	Shows that a signal is represented graphically.

4	Dialogs	Shows a dialog as a thumbnail, the dialog name, and the name of the signal channel.
5	Show block diagram / more	The show block diagram icon as in Figure 3-7 minimizes all dialogs indicated on the screen. The block diagram is in the foreground. The "More" softkey indicates that more dialogs are open than can be displayed in the taskbar. Use this softkey to open a selection list with the remaining active dialogs, and the "Diagram" function.

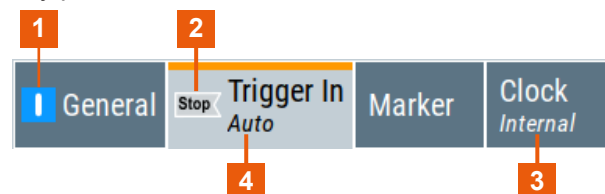
3.4.2.4 Additional display characteristics

The following section provides a short insight on the indication of the screen in general, and significant elements that you see under specific modes, in dialogs or settings.

- **Appearance of active elements**
 - *Active* elements like On/Off switches, state buttons have a **blue** background.
 - *Selected* elements are framed or highlighted **orange**.
 - *Inactive* elements are **gray**.
- **On-screen keypads**
As an additional means of interacting with the instrument either a numerical or alphanumerical on-screen keypad appears when you enable an entry field, see [Chapter 3.4.4, "Entering data"](#), on page 47.
- **Info line**
The "Info line" shows brief status information and error messages. It appears when an event generates a message. If selected, the R&S SF100A shows information on static errors and the error history.



- **Key parameters indicated in tab labels**
Most dialogs are divided into tabs with logically grouped parameters. The tab label expresses the content and can also contain status indicators or the set value of a key parameter.

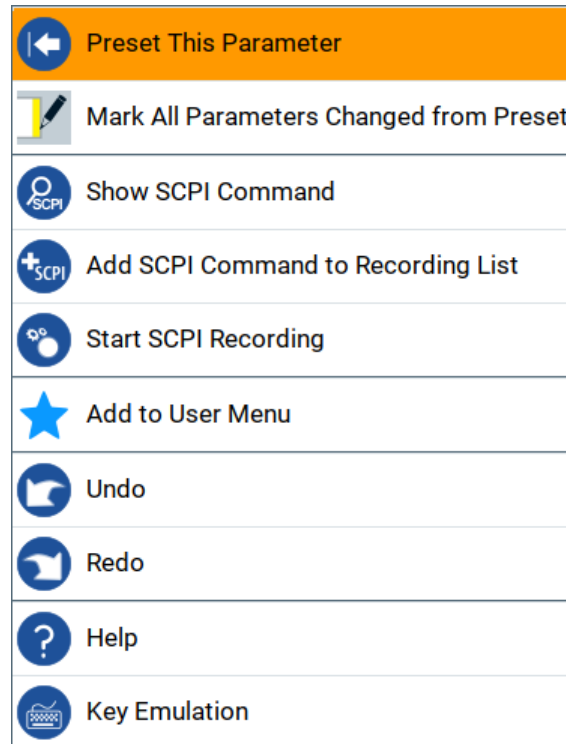


1, 2 = Status indicators
3, 4 = Key parameter values

- **Scrollbar handle**
An arrow icon that appears when you touch a scrollbar helps you to scroll in a dialog or list.
- **Progress indicators**
A busy icon indicates a currently running process. If a process takes some time, a progress bar shows the current state.

- **Context-sensitive menus**

Within the entire screen display, including single parameters, you can access context-sensitive menus that provide some additional functions.



3.4.3 Accessing the functionality

All functionalities are provided in dialog boxes as known from computer programs. You can control the instrument intuitively with the touchscreen. This section provides an overview of the accessing methods.

The instrument's functions and settings can be accessed by selecting one of the following elements:

- System and function keys on the front panel of the instrument
- Taskbar/softkeys on the touchscreen
- Context-sensitive menus for specific elements on the touchscreen, or with the rotary knob (press and hold).
- Elements on the status bar in the touchscreen
- Displayed setting on the touchscreen that means block diagram and all settings available in dialogs.

To open a dialog box

- ▶ Perform one of the following actions:
 - Select the required block, and then the menu entry.

- Select the minimized view (thumbnail) on the taskbar.
- Some of the utility keys access a dedicated dialog, too.

To minimize a dialog box

- ▶ To return to the block diagram, select the "Home" button.

To close a dialog box

To close a dialog box, you have the same controls as you know from computers or devices with touchscreen.

- ▶ Perform one of the following actions:
 - Select the "Close" icon in the upper right corner.
 - Select the [Esc] key on the front panel.
 - Drag and drop a minimized dialog from the taskbar to the block diagram.

To select an option in a dialog box

- ▶ Select the required option.

To select an option in a list

If you can select many options, these options are provided in a list. The current selection is shown on the list button.

1. Select in the list.
2. To navigate through the list, try out the following:
 - Using a mouse, scroll in the list to select the required option.
 - Use the rotary knob.

3.4.4 Entering data

Some parameters have their own key on the front panel. For data input in dialog boxes, the instrument provides on-screen keypads for entering numeric and alphanumeric values. You can always set the parameters via the touchscreen, the front panel or an external keyboard.

To enter numeric values with the on-screen keypad

For numeric settings, the instrument displays the numeric keypad. The units specified correspond to the units of the parameter.

1. Enter the numeric value.

Tip: For a quick entry, you can enter a value in an exponential representation, for example $1e7$ for 10000000 .
2. Tap the unit button to complete the entry.

The unit is added to the entry.

Tip: For a quick unit change, you can enter shortcuts, for example for a frequency value *1e8h* for 100 MHz.

For an overview of shortcuts supported by the R&S SF100A, see [Chapter B, "Unit shortcuts"](#), on page 643.

3. If the parameter does not require a unit, confirm the entered value by pressing "Enter".

If you edit numeric data in tables, enable edit mode first. Press the rotary knob to enable the edit mode.

To enter alphanumeric values

If a field requires alphanumeric input, you can use the on-screen keyboard to enter letters and characters including special characters.

To complete an entry

- ▶ On the on-screen keyboard, press "Enter" .

To correct an entry

1. Using the arrow keys, move the cursor to the right of the entry you want to delete.
2. On the on-screen keyboard, press "Clear".
3. Enter your correction.

To abort an entry

- ▶ Press the [Esc] key.
The dialog box closes without changing the settings.

3.4.5 Undo and redo actions

Accessed via the context-sensitive menus, "Undo" allows you to restore one or more actions on the instrument. Depending on the available memory, the "Undo" steps can restore all actions.



"Redo" restores a previously undone action.

3.4.6 Getting information and help

In some dialog boxes, graphics are included to explain the way a setting works.

For further information, you can use the following sources:

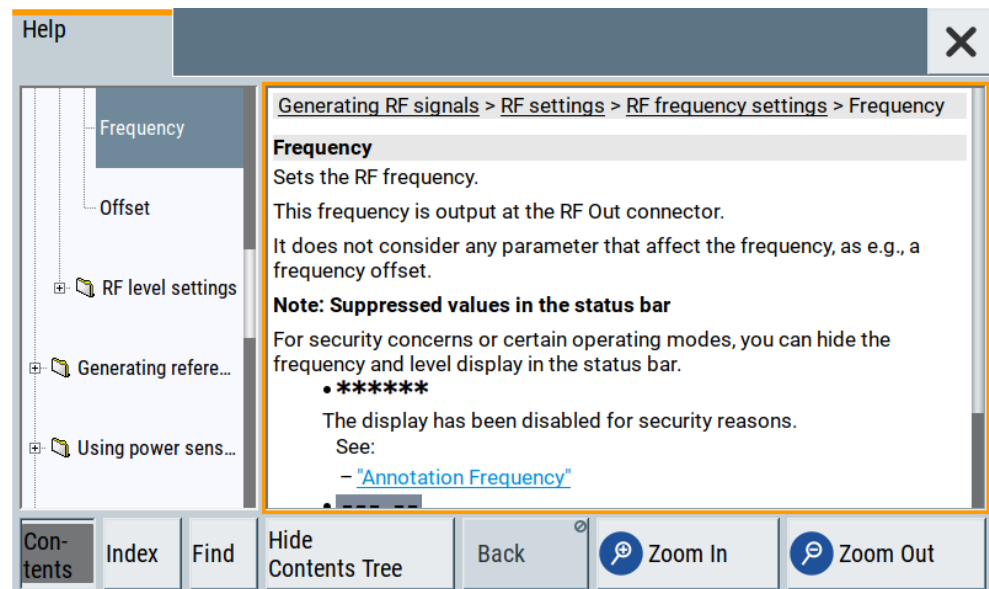
- Tooltips give the value range of the parameter.

- The context help provides a functional description on a setting.
- The general help explains a dialog box, provides instructions, and general information.

To display context help

- ▶ To access a help topic, perform one of the following:
 - a) Tap and hold the parameter for which you need information and tap "Help" in the context menu.
 - b) Tap the parameter and press the [Help] key.

The "Help" dialog opens. You can browse the help for further information.



Contents of the help dialog box

The help dialog box covers two main areas:

- "Contents" - contains a table of help contents
- "Topic" - contains a specific help topic

The help system also provides an "Index" and a "Find" area, and "Zoom" functions that are accessed via the corresponding buttons.

To open general help

- ▶ Press the yellow [Help] key on the front panel.

If a dialog box is opened, the help topic for the current tab is shown. Otherwise the "Contents" page appears.

Navigating in the table of contents and in the help topics

1. To move through the displayed contents entries, tap on an entry and scroll or use a connected mouse.

Entries with a plus sign contain further entries.

2. To display a help topic, tap on the topic name or double-click the topic name.
3. To follow a cross-reference, tap on the link text.
4. To return to the previous page, select "Back".
This function scrolls back all steps that you have performed before.
5. Use the "scroll bars" to shift the visible section of content shown.
6. To maximize the "Topics" area, tap the "Hide Contents Tree" button to hide the contents tree.

Using the index

1. Select the "Index" button.
2. Enter the first characters of the topic that you are interested in.
The entries starting with these characters are displayed.
3. Tap on the index entry.
The corresponding help topic is displayed.

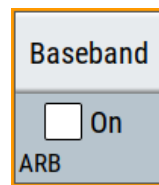
4 Generating baseband signals

This section provides information to configure and generate baseband signals. It covers the following topics:

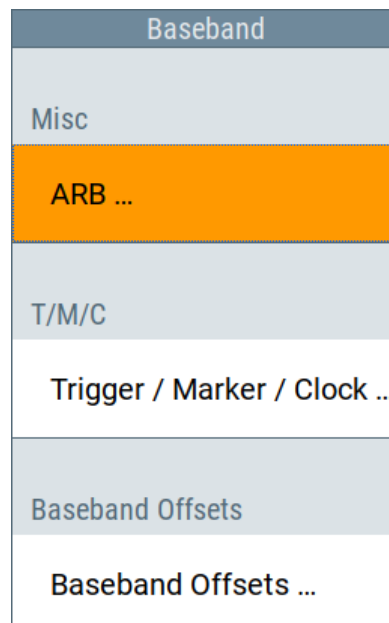
- [Accessing the functions in the baseband domain](#)..... 51
- [Common characteristics of the baseband domain](#)..... 52
- [Using the arbitrary waveform generator \(ARB\)](#)..... 64
- [Generating multicarrier waveform signals](#)..... 103
- [Configuring global connectors](#)..... 121
- [Reducing crest factors](#)..... 130
- [Shifting the baseband signal](#)..... 136

4.1 Accessing the functions in the baseband domain

1. In the block diagram, select the "Baseband" block.



2. Navigate through the context menu.



The "Baseband" block provides all functions and settings concerning the baseband signal.

3. By default, baseband signal generation is off.

To enable the baseband generator, select the "Baseband" block and set "Baseband" > "On".

A short designation indicates the current baseband signal generation source, for example "ARB".

For information on related settings of the selection list, see the following sections:

- [Chapter 4.3, "Using the arbitrary waveform generator \(ARB\)"](#), on page 64
- [Chapter 4.5, "Configuring global connectors"](#), on page 121
- [Chapter 4.7, "Shifting the baseband signal"](#), on page 136

4.2 Common characteristics of the baseband domain

This section provides information on common baseband signals. It covers the following topics:

• About trigger signals	52
• About trigger modes	53
• Impact of additional trigger settings	56
• About marker signals	59
• About clock signals	61
• Methods for optimizing the crest factor	61
• Receiving and providing trigger signals	64

4.2.1 About trigger signals

The R&S SF100A provides several trigger modes, different trigger sources, and some additional trigger settings to suppress or delay the trigger events. This section provides an overview of the provided baseband trigger settings and the impact of the trigger settings on the signal generation.

The current signal generation status ("Running" or "Stopped") is continuously displayed in the corresponding dialog, indicated in the header of the tab and in the block diagram of the instrument. This indication is important when an external trigger is applied.

Trigger signal

The trigger signals are internally generated or externally supplied signals which start signal generation at a particular point in time. However, signal generation can also take place without triggering. In this case, the signal generation starts immediately after the modulation is enabled.

Trigger event

Trigger events occur when receiving external trigger signals. Also, you can trigger signal generation manually. The "Arm" function stops the signal generation until a trigger event occurs.

Trigger source

There are two sources for trigger signals:

- Internal: The instrument generates the internal trigger signal.
- External: The instrument receives an external trigger signal at one of the User x connectors.

Related settings:

- ["Source"](#) on page 78
- [Chapter 4.5, "Configuring global connectors"](#), on page 121

4.2.2 About trigger modes

A trigger event defines the signal generation and depends on the trigger mode. The [Table 4-1](#) provides an overview of the trigger modes and their impact on the signal generation start.

Table 4-1: Impact of the trigger events on the generated signal

"Trigger Mode"	Signal generation mode ¹⁾	1st Trigger event "Exec. Trigger" or "External" trigger signal	Subsequent trigger event "Exec. Trigger" or "External" trigger signal	Trigger event "Arm"
"Auto" See Figure 4-2	Continuous	-	-	-
"Retrigger" See Figure 4-3	Continuous	Initial start	Restart	-
"Armed_auto" See Figure 4-4	Continuous	Initial start	Restart (only after previous "Arm")	Stop
"Armed_retrigger" See Figure 4-5	Continuous	Initial start	Restart	Stop
"Single" See Figure 4-1	Single length determined by "Trigger Signal Duration"	Initial start	Restart	-

¹⁾ the instrument generates a continuous signal or a single signal.

- Single signal generation means that the signal generation stops after one cycle. That is, after the signal with signal length determined by the "Trigger Signal Duration" has been generated.
- Continuous transmission means that the signal is generated repeatedly without delay and until the data generation is stopped explicitly. However, any parameter change within the processing chain (baseband, fading simulator, or stream mapping) causes a signal generation restart.

The following is a list of the trigger modes together with their short description. An example of their impact on the generated signal is given. The provided examples are intended to show the triggering mechanism in principle. To simplify the description, an internal trigger event ("Execute Trigger") is used. An external trigger event has the

same effect on the signal generation. In the examples on the figures bellow, the instrument's processing time is ignored.

- Single

The instrument starts the signal generation only when a trigger event occurs. The signal is generated once. Its signal length is set with the parameter "Trigger Signal Duration".

Every subsequent trigger event causes a restart.

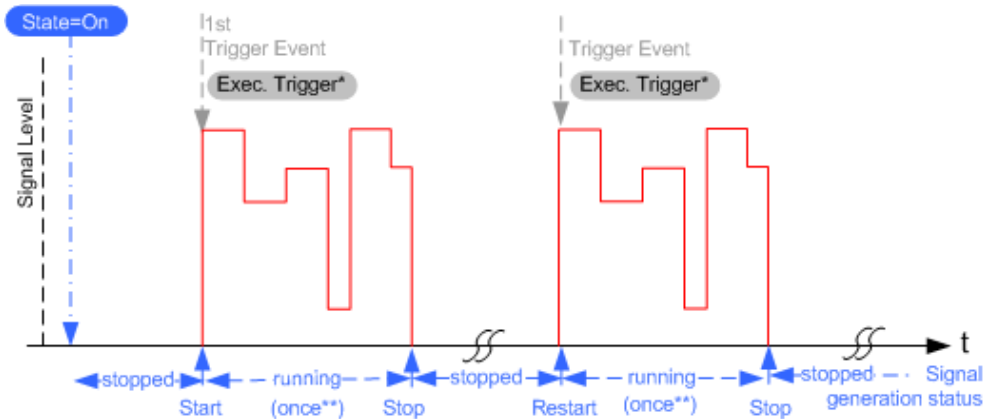


Figure 4-1: Trigger mode single

* = Internal trigger event (to simplify the description)

** = The signal is generated once to the length specified with "Trigger Signal Duration"

- Auto

In auto trigger mode, the instrument generates a continuous signal.

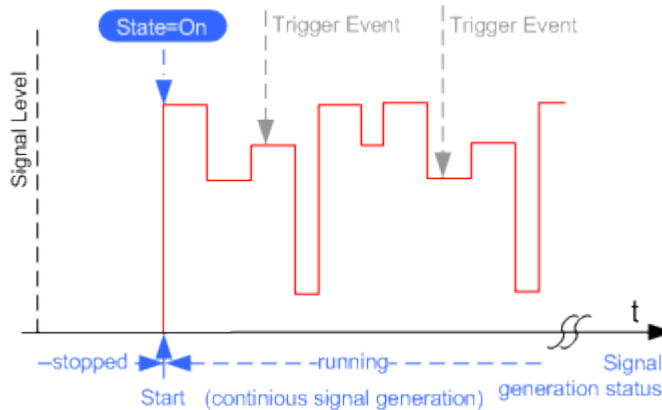


Figure 4-2: Trigger mode auto

- Retrigger

The instrument generates a continuous signal. With enabled retrigger, a new trigger event aborts the current generation cycle and restarts the signal generation from the beginning.

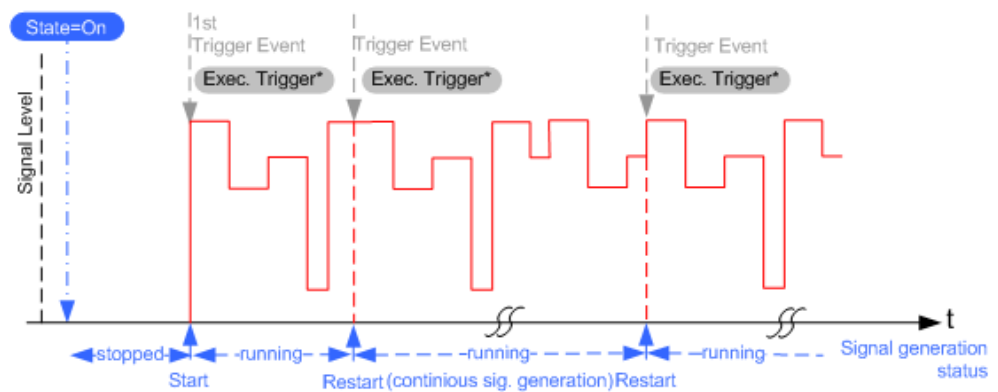


Figure 4-3: Trigger mode retrigger

* = Internal trigger event (to simplify the description)

Compare the shape and the length of the red curve in single mode and in retrigger mode. The first part of the curve in retrigger mode is shorter. The signal generation is interrupted due to the subsequent trigger event.

- **Armed auto**

The instrument starts the signal generation only when a trigger event occurs and then generates a continuous signal. An "Arm" stops signal generation. A subsequent trigger event causes a restart of the signal generation.

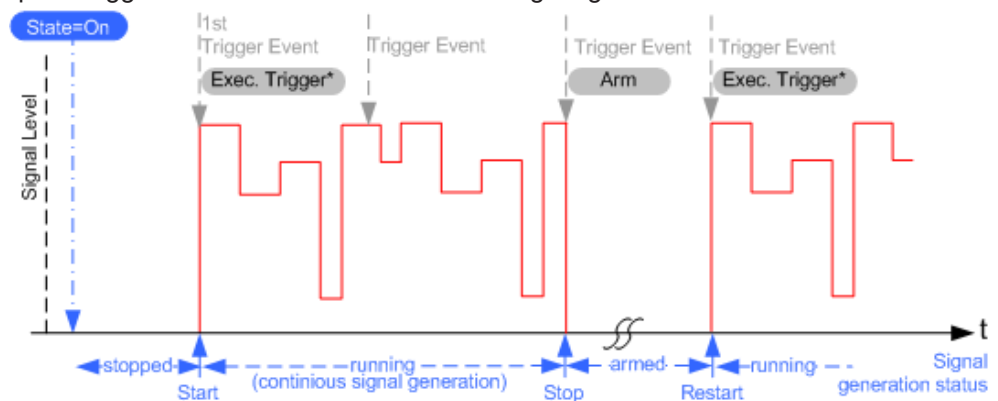


Figure 4-4: Trigger mode armed auto

* = Internal trigger event (to simplify the description)

- **Armed retrigger**

The instrument starts the signal generation only when a trigger event occurs and then generates a continuous signal. Every subsequent trigger event causes a restart of the signal generation. An "Arm" stops the signal generation. A subsequent trigger event causes a restart.

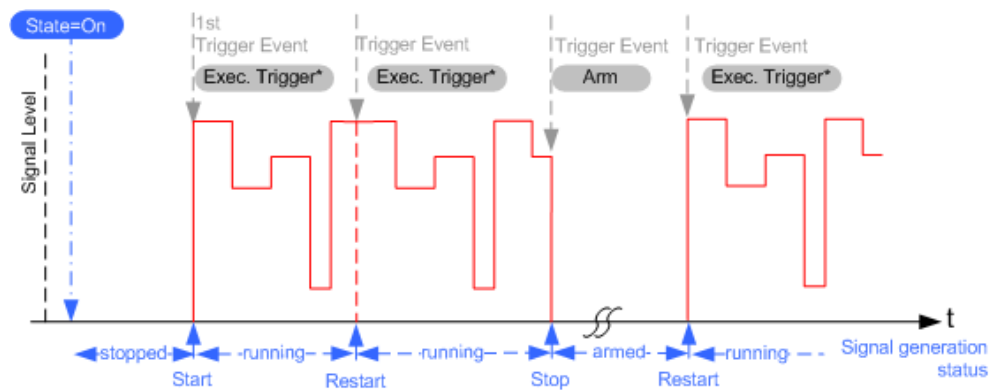


Figure 4-5: Trigger mode armed retrigger

* = Internal trigger event (to simplify the description)

4.2.3 Impact of additional trigger settings

The R&S SF100A provides a set of settings to configure the behavior upon receiving of a trigger signal. For example:

- Suppressing trigger events
- Delaying the instrument's response on trigger events
- Adjusting the signal calculation start time in relation to the trigger event.

Avoiding accidental trigger events

The following trigger settings enhance the flexibility of the trigger system and can help to avoid accidental trigger events.

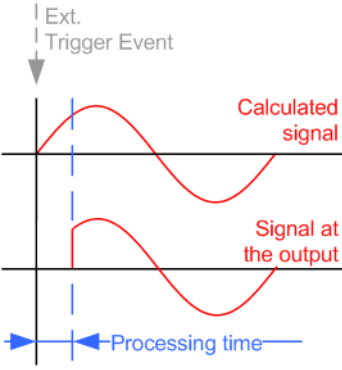
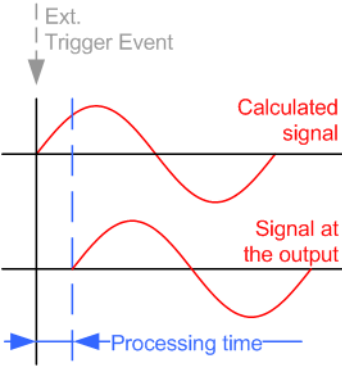
- "Threshold Trigger Input"
Defines the voltage level of the trigger signal where the R&S SF100A generates a trigger event. Trigger signals below the trigger threshold are ignored.
- "Trigger Input Slope"
Specifies the edge (rising or falling edge) of the trigger signal that is to provide the trigger event.
- "Impedance Trigger Input"
Specifies the input impedance of the trigger signal.

Starting the signal generation with the first sample

By default, the instrument starts the signal calculation simultaneously with the receiving of the external trigger event. Because of the signal propagation time and the instrument's processing time, the first samples are cut off and no signal is output.

This default behavior, however, can cause problems if short signal sequences are generated. To overcome this problem, the instrument provides the special parameter "Sync. Output to (External) Trigger". If this parameter is disabled, the signal output begins after elapsing of the processing time and starts with sample 0. That is, the complete signal is output (compare both figures in [Table 4-2](#)).

Table 4-2: Impact of the parameter Sync. Output to (External) Trigger

"Sync. Output to (External) Trigger = On"	"Sync. Output to (External) Trigger = Off"
 <p>Suitable for long signal sequences The output signal is synchronous to the trigger event after elapsing of the internal processing time.</p>	 <p>Suitable for triggering of short signal sequences with signal duration comparable with the processing time of the instrument</p>

Suppressing and delaying trigger events

The main focus of the following features is the mobile communication standards.

- "(External) Trigger Delay"

You can apply a definable number of symbols to delay the **start** trigger event of an externally supplied trigger signal

This feature is useful to:

 - Simulate the time delay between a base station signal and a user equipment signal, for example during base station tests
 - Compensate for known propagation delays or a timing offset in the test setups
- "(External) Trigger Inhibit"

You can suppress the effect of a restarted trigger signal in the "Retrigger" trigger mode for a definable number of symbols.

During base station tests, for example, this feature enables the trigger suppression for a definable number of frames and yet the signal can still be generated synchronously. In each frame, the base station generates a trigger event that restarts the signal generation every time but for the suppression.

Example:

A trigger delay of 1000 samples means that after a trigger event, any subsequent trigger signal is ignored for the space of 1000 samples.

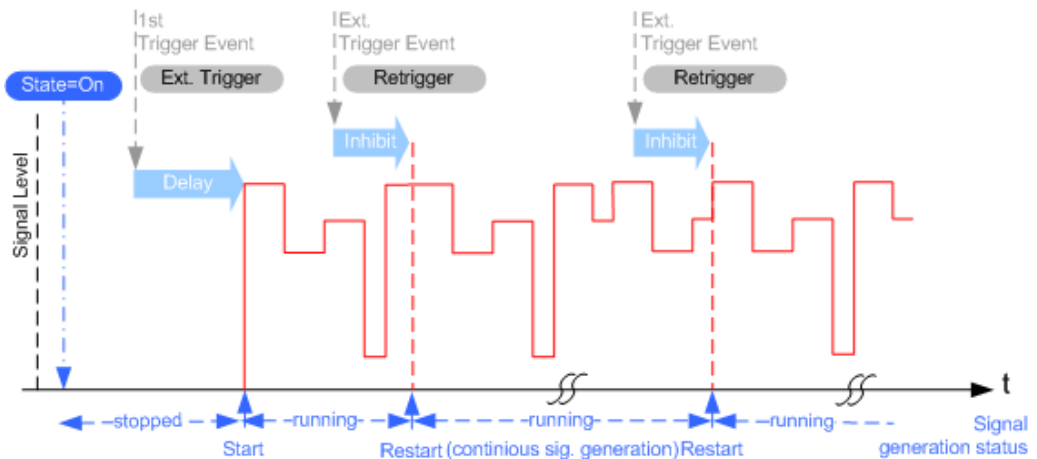


Figure 4-6: Trigger delay and trigger inhibit in trigger mode retrigger

To set delay and inhibit values

Trigger delay and inhibit values are expressed in the units of the generated signal, e.g. in samples or symbols. You can also define the exact delay or inhibit period as a time value, e.g. in seconds.

Trigger delay values t_{delay} depend on the instrument hardware. The table illustrates an exemplary instrument configuration and related t_{delay} values in samples (or symbols) and in seconds.

Option	Max. r_s / MHz	t_{delay} / samples	t_{delay} / s
Base unit	16000	0 to depends on sample rate	0 to depends on sample rate

For more information, refer to the specifications document.

Example: ARB clock frequency and trigger delay

This example describes an ARB signal with 1 MHz clock frequency. It illustrates the relation between the ARB clock frequency and the configurable trigger delay.

1. Select "Baseband" > "ARB" > "Clock Frequency" = "1 MHz".
2. Configure an external, for example, for an armed auto trigger mode.
 - a) Select "ARB" > "Trigger In" > "Mode" > "Armed Auto"
 - b) Select "Source" > "External Global Trigger 1".
 - c) Select "External Delay Unit" > "Samples".
 - d) Set "External Delay" = "100 Samples".

The parameter "Actual External Delay" = "100 us" displays the actual delay in time units.

External Delay Unit	Sample	Processing Time	---
External Delay	100.00 Samples	Actual External Delay	100.000 0 μ s

3. Set the delay in time units.
 - a) Select "External Delay Unit" > "Time".
 - b) Select "Specified External Delay" > "10 µs".

The "Actual External Delay" changes to 10 us.

External Delay Unit Time	Processing Time ---
Specified External Delay 10.000 0 µs	Actual External Delay 10.000 0 µs

4. To check again the delay in samples, select "External Delay Unit" > "Samples".

The external delay and actual delay is 10 samples.

External Delay Unit Sample	Processing Time ---
External Delay 10.00 Samples	Actual External Delay 10.000 0 µs

4.2.4 About marker signals

The R&S SF100A can add additional signals to the generated signal. Marker signals (or markers) are digital signals to synchronize external devices to the generated data stream. For example, with suitable marker settings, you can select a slot clock or frame clock, or mark the start of a particular modulation symbol.

Four marker output signals are available. Output these signals at the User x connectors.

Related settings:

- [Chapter 4.3.3.6, "Marker settings"](#), on page 80
- [Chapter 4.5, "Configuring global connectors"](#), on page 121

4.2.4.1 Marker modes

Marker mode restart

The generated marker signal is a single "On" pulse. The rising edge of this pulse is generated at the signal generation start and at each subsequent signal restart time. This marker can be used to monitor the effects of the selected trigger, e.g. trigger causing restarts of the signal generation.

Marker mode pulse

Periodic marker with consecutive on periods and off periods of equal length. The first on period starts at the beginning of the first generated sample/symbol. The marker frequency is defined by a "Divider". The frequency is derived as follows:

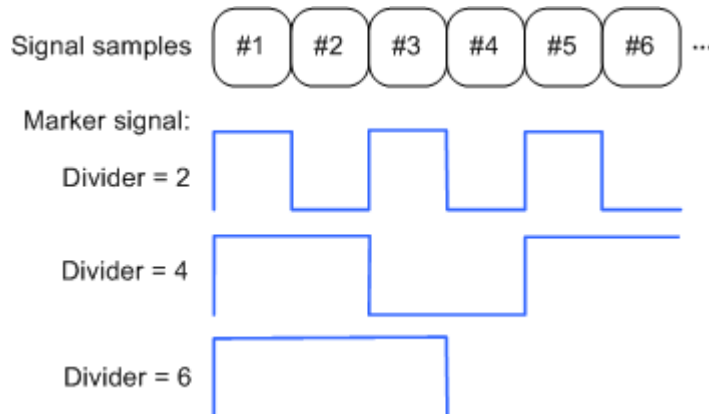
<Frequency> = "Symbol Rate"/"Sample Rate" / "Divider", respectively.

<Frequency> = "Sampling Frequency" / "Divider".

Example:

"Symbol Rate" = "1 Msym/s", "Divider" = "2"

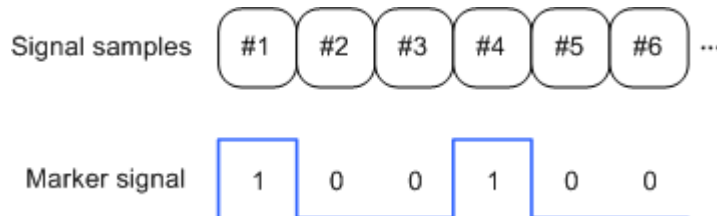
The marker frequency is 500 kHz, corresponding to a marker period of 2 μ s. Each on and off period has a length of 1 μ s, corresponding to one symbol period. With a divider of 4 (6, 8 ...), the length of each on and off period is increased to 2 (3, 4, ...) symbol periods.

**Marker mode pattern**

Periodic marker where each period is defined by a bit pattern with a maximum length of 64 bits. A "1" ("0") in the pattern denotes an on (off) signal segment with a duration of one sample/symbol period.

Example:

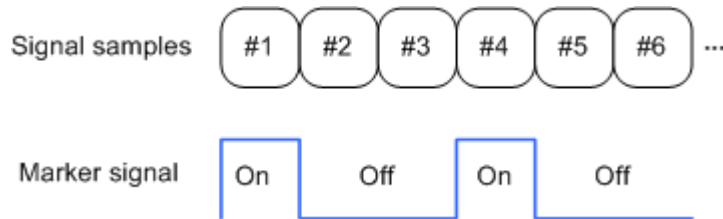
In the following example, the marker signal is defined by a pattern *100100...*

**Marker mode On/Off Ratio**

Similar to "Pulse" but with independent lengths of the on periods and off periods. The length of the periods is entered as several symbols/sample periods.

Example:

In the following example, the marker signal is defined by an "On Time" = "1 sym" and "Off Time" = "2 sym".

**4.2.4.2 Delaying marker signals**

In all the examples listed in [Chapter 4.2.4.1, "Marker modes"](#), on page 59, the marker starts at the beginning of the first generated sample/symbol (sample/symbol no. 1). It is possible though to delay the start of the marker by an integer number of symbols/sample periods.

4.2.5 About clock signals

The instrument uses its internal clock reference to generate the timing pulse. You cannot output this internal signal, for example, as an external symbol clock signal to synchronize instruments.

Synchronizing baseband signal and clock signal

The instrument uses the positive edge of the internal clock signal for signal synchronization. For related settings, see [Chapter 4.3.3.7, "Clock settings"](#), on page 81.

4.2.6 Methods for optimizing the crest factor

Communication standards utilizing higher-order modulation techniques or using multiple carriers and complex signals consisting of the signals of more than one digital standard can feature a high crest factor. The signals of some digital standards can have high crest factors also particularly with many channels and long sequences.

About the crest factor

The crest factor represents the ratio of the peak voltage value to the RMS voltage value, i.e. the peak to average ratio (PAR). The higher the crest factor and the resulting dynamics of a signal, the greater the requirement for a power amplifier fed by the signal to be linear.

A high crest factor arises, for example, when in a multicarrier signal the carriers feature an identical start phase. Multicarrier signals imply periodically superimposed signals with high peak voltages in relation to the RMS voltage values.

High crest factors entail two basic problems:

- The nonlinearity of the power amplifier (compression) causes intermodulation which expands the spectrum (spectral regrowth).
- Since the level of the D/A converter is relative to the maximum value, the average value is converted with a relatively low resolution. This low resolution leads to a high quantization noise.

Both effects increase the adjacent-channel power.

Direct crest factor reduction

At the individual signal generation stages, the R&S SF100A offers different direct approaches to reduce the crest factor. While the corresponding parameters are enabled, the implemented algorithms ensure minimizing the crest factor or achieving of predefined target crest factor by applying of automatic settings. Methods of reducing the crest factor differ regarding both the optimization achievable and the time required for computation.

The provided crest factor reduction methods include:

- Internal calculation of optimized carrier phases for the individual carriers in a multi-carrier signal
- Automatic calculation of the carrier start phases in a multi-carrier continuous wave signal

Applying clipping and filtering

Another common and simple approach for achieving a lower PAR is the combination of clipping and filtering. In several of the firmware options, like 3GPP FDD or CDMA2000, the instrument provides baseband clipping. Also, you can select the baseband filter and adjust the filter characteristics.

- Clipping is a method that applies a wanted distortion to the signal, see [Example "Vector clipping and crest factor"](#) on page 63. This method includes specifying a level limit, finding out the signal peaks and clipping off the peaks that exceed the limit. The level limit is a percentage of the highest peak value. Clipping does not influence the spectrum but the error vector magnitude (EVM) increases.

The instrument offers two clipping modes:

- Vector clipping: $|I + q|$
The clipping limit is related to the amplitude $|I + q|$. This mode maps the I and Q components together and retains the angle between the vectors.
- Scalar clipping $|I| + |q|$
The clipping limit is related to the absolute maximum of all the I and Q values $|I| + |q|$. This mode maps the I and Q components separately, the angle changes between the vectors.

Signal clipping not only changes the peak value but also the average value and the effect on the crest factor is unpredictable.

- Filtering is a method after clipping. The filters are able to filter out the distortion.

Example: Vector clipping and crest factor

The following figures display constellation diagrams that demonstrate the effect of the clipping on the crest factor for typical scenarios.

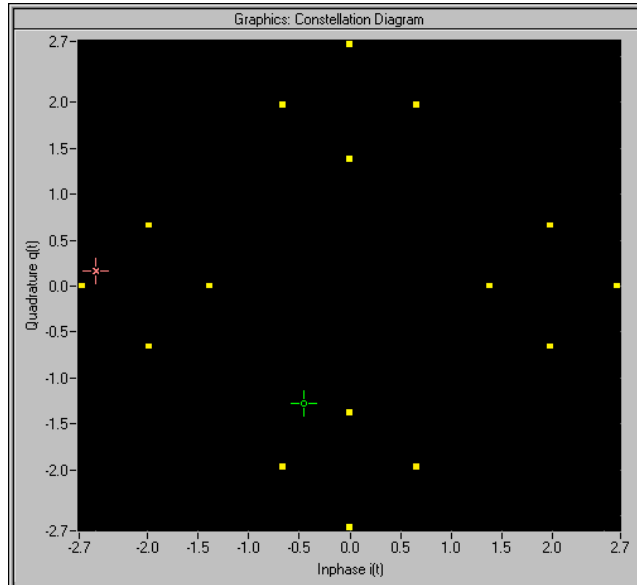


Figure 4-7: I/Q constellation without clipping

The clipping mode in figure [Figure 4-8](#) is vector $|I + q|$ mode and the I/Q signal configuration has two active channels. The circle visualizes the changed constellation points.

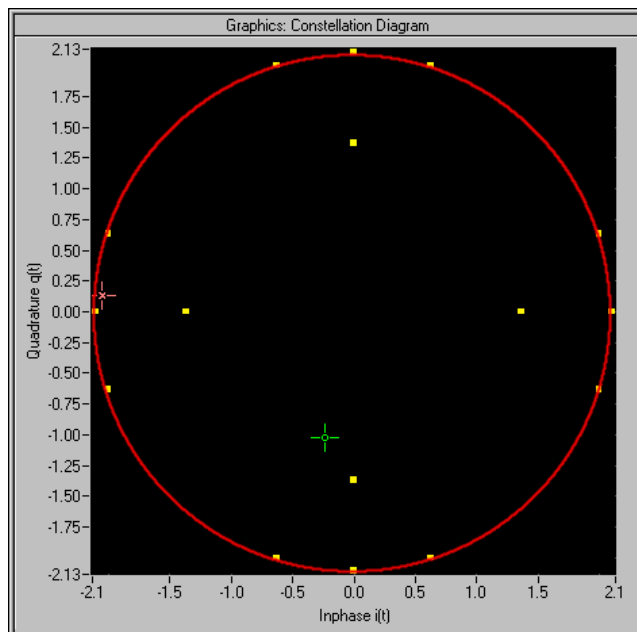


Figure 4-8: I/Q constellation with vector clipping and clipping level 80 %

4.2.7 Receiving and providing trigger signals

In test setups that combine the signal of two or more instruments it is often required that:

- The signal generation starts at a defined moment
- The signal generation starts simultaneously (or with an exactly defined delay) in all involved instruments.

4.3 Using the arbitrary waveform generator (ARB)

The arbitrary waveform generator (ARB) is an I/Q modulation source of the R&S SFI100A. The ARB allows the playback and output of any externally calculated modulation signals in the form of waveform files. The ARB can also generate multicarrier or multi-segment signals from the waveform files.

- [Required options](#)..... 64
- [About ARB](#)..... 64
- [ARB settings](#)..... 69
- [Playing waveform files](#)..... 83
- [Tags for waveforms, data and control lists](#)..... 94

4.3.1 Required options

The equipment layout for processing waveform files includes:

- Base unit, including arbitrary waveform generator (2 Gsample ARB memory, 2 GHz RF bandwidth)
- Digital standard waveform option (R&S SFI-K2xy/-K4xy) to play a waveform file generated by the signal generation software R&S WinIQSIM2.
For example, if you purchase option Digital Standard EUTRA/LTE R&S SFI-K255, you can process an EUTRA/LTE waveform file generated by R&S WinIQSIM2.
- Optional ARB memory extension 8 Gsample (R&S SFI-K517)
- Optional RF modulation bandwidth extension to 8 GHz (R&S SFI-K529) or 10 GHz (R&S SFI-K530) for wideband waveform files above 2 GHz.

You can output waveform signals at several connectors:

- For output at the RF connector the base unit is sufficient.
- For output at the analog I/Q connectors install option R&S SFI-K17.

For more information, refer to the specifications document.

4.3.2 About ARB

This section provides background information on the ARB functionality and the impact of the provided settings.

For more complex waveform signals, see the following sections:

- [Chapter 4.4, "Generating multicarrier waveform signals"](#), on page 103

Related settings

See [Chapter 4.3.3, "ARB settings"](#), on page 69.

Related step-by-step descriptions

See the following sections:

- [Chapter 4.3.4, "Playing waveform files"](#), on page 83
- [Chapter 4.3.4.5, "Defining periodically repeating traces"](#), on page 92
- [Chapter 4.3.4.4, "Creating waveforms with tag file format"](#), on page 88
- [Chapter 4.3.4.6, "Editing waveform files, data and control lists"](#), on page 94

4.3.2.1 About waveform files

The R&S SF100A uses waveform files to obtain the digital I/Q data of the baseband signal. The R&S SF100A can play back a waveform file from the internal storage medium but it can also generate and play back simple waveforms for test purposes.

What is a waveform?

A waveform is a file with a specified file format containing raw I/Q samples. Waveform files have the file extension `*.wv` and contain calculated I/Q values.

When creating waveforms, the instrument inserts a waveform header at the beginning of each created ARB file. The header of the generated I/Q data files consists of tags in braces "{ }". For a detailed description, see [Chapter 4.3.5, "Tags for waveforms, data and control lists"](#), on page 94.

Waveform file sources

The following waveform file sources are available:

- **Internally generated waveforms**
The ARB enables the calculation and the generation of waveform files. The ARB also provides a built-in function to create a test waveform and keep it as a file or in the RAM.
- **Externally generated or created waveforms**
The ARB processes externally created waveform files, for example:
 - The waveform files generated by software R&S WinIQSIM2, the R&S ARB Toolbox or the R&S Pulse Sequencer
 - A mathematical program, for example, MATLAB calculates the waveform signals. See [Chapter 4.3.5, "Tags for waveforms, data and control lists"](#), on page 94.

You can load the externally generated waveform files into the instrument via one of the available interfaces, for example, USB or LAN. Usually, the waveform file is saved on one of the network drives which are accessible for the operating system.

4.3.2.2 ARB test signals

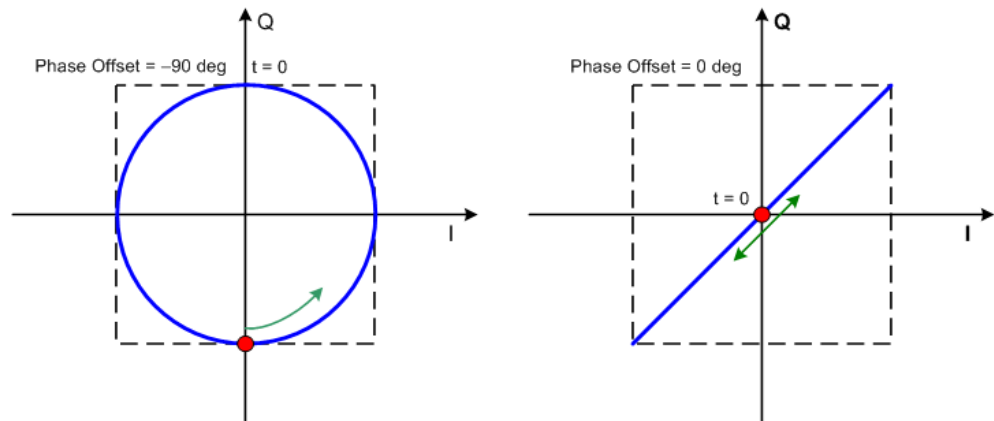
The following test signals are available:

- **"Sine" test signal:** Two sine-wave signals with a selectable (but equal) number of samples per period and equal frequencies. When the generation is triggered, the number of samples per period, together with the frequency of the test signal, determine the ARB clock frequency: "Clock Frequency" = "Frequency" * "Samples per Period".

Note: Because the resulting clock rate must not exceed the maximum ARB clock rate, the number of sample values is automatically restricted depending on the selected frequency.

The first sine signal is mapped on the I samples, the second on the Q samples.

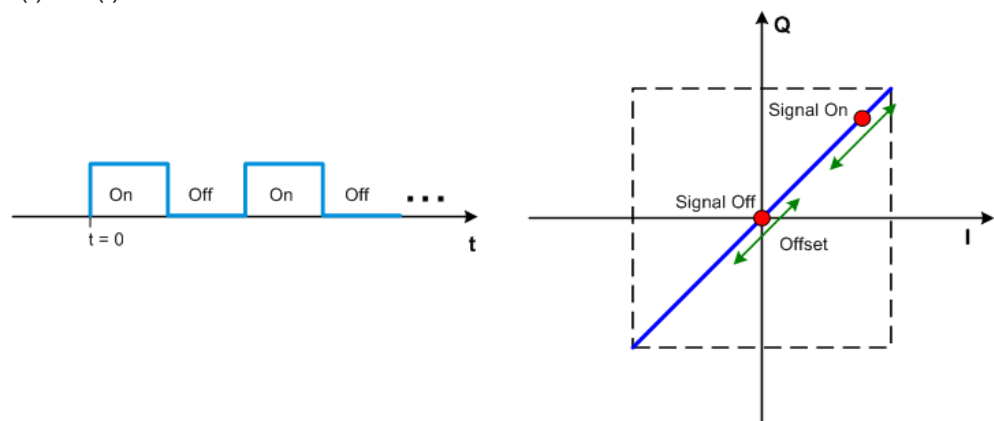
The two signals differ by a selectable phase offset. For a -90 deg offset, the result is a unit vector in the I/Q plane, rotating counterclockwise and starting at $I = 0$, $Q = -1$. For a 0 deg offset, the I and Q samples are on the diagonal of a unit square ($I(t) = Q(t)$).



In general, the I/Q samples are located on a deformed circle which is confined to the dashed square in the upper diagrams.

- **"Rect" test signal:** Rectangle signal with selectable but equal on and off periods and amplitude. The period is defined by the selected frequency: $\langle \text{Period} \rangle = 1 / \text{"Frequency"}$.

The signal is mapped on both the I and Q samples. The mapping results in two distinct points in the I/Q plane. The "Offset DC" shifts both points along the diagonal $I(t) = Q(t)$.



- **"Const I/Q" test signal:** Continuous test signal with constant I/Q and constant clock frequency of 10 kHz. The values for each I and Q components are selectable but constant. They are defined as a decimal number, which is decimal-to-binary converted internally. The signal is provided as a 16-bit wide digital signal for both I and Q channels.
You can output the signal directly at the BNC connectors I and Q outputs of the instrument.

For more information, refer to the specifications document.

4.3.2.3 Waveform sample rate

The Arbitrary Waveform Generator includes a resampling unit that interpolates the input samples to target a certain digital output I/Q sample rate. The input sample rate f_{input} is retrieved from the waveform (the default sample rate tag) or is defined by the corresponding parameter in the ARB user interface.

The [Figure 4-9](#) depicts the stages involved in the processing and resampling of a waveform in the ARB.

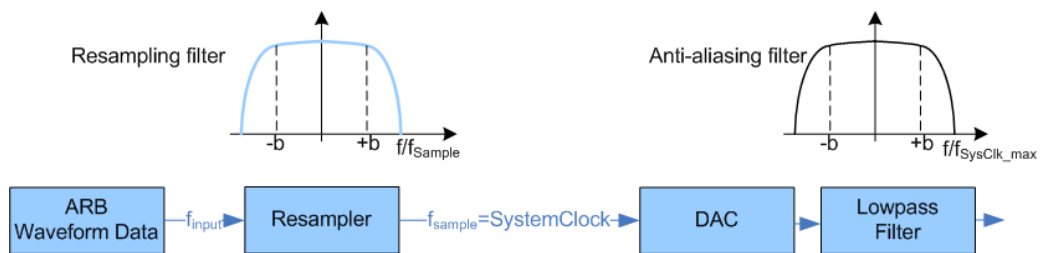


Figure 4-9: Processing of the waveform files in the ARB

f_{input} = Waveform sample rate
 b = Usable bandwidth factor
 f_{SysClk_max} = $SystemClock_{max}$ = $SampleRate_{max}$

Where:

- f_{SysClk_max} = $SystemClock_{max}$ = $SampleRate_{max}$ = 16 GHz
- b = 0.4165

Impact of the resampling filter

As illustrated in [Figure 4-9](#), the filter in the resampling stage is distortion-free for signals with the following maximum baseband bandwidth:

$$Usable_Bandwidth_{max} [MHz] = b * f_{input}$$

The usable bandwidth factor b equals $b = 0.4165$.

An externally created waveform file has to provide a sample rate f_{input} that is high enough for perfect signal reconstruction. For distortion-free resampling the lower bound of the required sample rate f_{input} is then calculated as follows:

$$f_{input} \geq Usable_Bandwidth / b$$

Thus, a modulation signal with a sample rate $f_{input} = 16 \text{ GHz}$ fed in the baseband generator ensures the $Usable_Bandwidth_{max}$. After the DAC, this signal features a $RF_Bandwidth_{max} = 2 * b * f_{input} = 2 * b * 16 \text{ GHz} = 10 \text{ GHz}$.

Impact of the oversampling factor

Waveforms generated by the R&S WinIQSIM2 software can be optimized by choosing a suitable integer oversampling factor.

Conventional ARB often assumes an oversampling factor of 4. The ARB of the R&S SF100A requires low oversampling factors and still provides excellent signal quality in terms of EVM and ACP.

A reduced sample rate saves significantly the amount of memory or allows an increased signal cycle time, and vice versa.

4.3.2.4 Marker signals and waveform length

The R&S SF100A provides the possibility to define marker signals that are sent to the marker outputs in synchronicity with the I/Q output signals. Marker signals can be either predefined or later defined.

The I/Q data and marker data are located in separate memory areas of the SDRAM and can be independently configured. Each marker signal requires 1 bit of the available memory size. Sometimes, it is useful to generate a modulation signal without extra marker signals to increase the maximum waveform length.

The following example explains the dependency between the number of enabled marker signals, the available memory size, and the resulting waveform length.

Example: Calculating the maximum waveform length

The calculation assumes a R&S SF100A base unit with an ARB memory of 2 Gsample, see [Chapter 4.3.1, "Required options"](#), on page 64.

- Total memory size = 512 Gbyte
- Required memory size (per complex sample) = 32 bit + 4 bit = 36 bit = 4.5 byte, where:
 - The raw I/Q samples are saved as 16-bit values. For the length of the I/Q data that is:
 $2 \times 16 \text{ bit} = 32 \text{ bit}$ (16 bit per I/Q channel)
 - Each marker requires one bit. Four enabled markers require 4 bit.
- Maximum waveform length with 3 markers = $512 \text{ Gbyte} / 4.5 \text{ byte} = 113,000 \text{ Msample}$
- Theoretical maximum waveform length (no markers) = $512 \text{ Gbyte} / 4 \text{ byte} = 128,000 \text{ Msample}$

A memory size of 512 Mbyte yields a maximum waveform length of 113 Gsample, if three markers are enabled. The maximum waveform length increases to 128 MGsample, if the internal hardware markers are used, and the complete memory is available for I/Q data.

4.3.3 ARB settings

Access:

- ▶ Select "Baseband" > "ARB".

The "ARB" dialog provides settings to play waveform files and access to settings to create waveform test signals and multicarrier waveform signals.

The remote commands required to define these settings are described in [Chapter 13.16.2, "SOURce:BB:ARbitrary subsystem"](#), on page 531.

Settings:

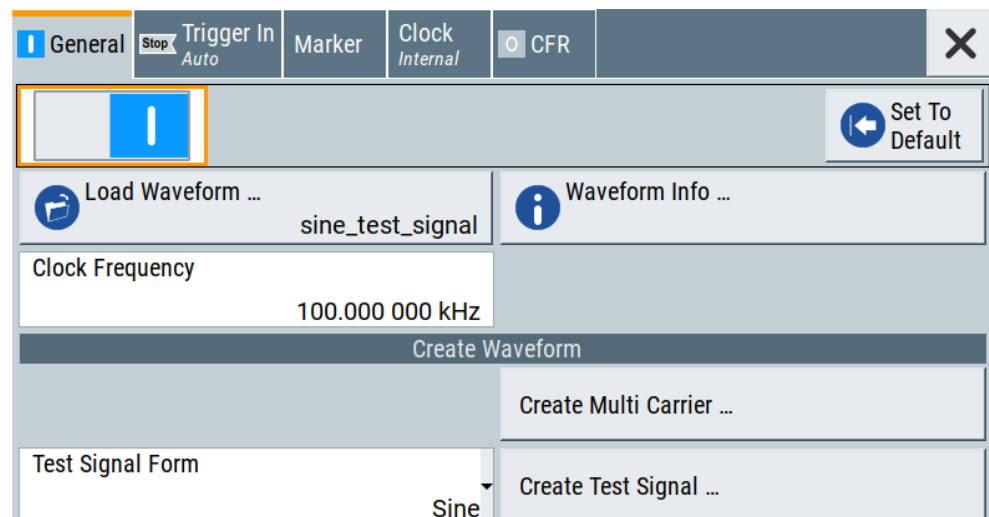
- [ARB general settings](#)..... 69
- [Sine test signal settings](#)..... 72
- [Rectangular test signal settings](#)..... 73
- [Constant IQ test signal settings](#)..... 75
- [Trigger settings](#)..... 76
- [Marker settings](#).....80
- [Clock settings](#).....81
- [Global connector settings](#).....82

4.3.3.1 ARB general settings

Access:

- ▶ Select "Baseband" > "ARB".

This tab provides general settings to select and create a waveform file and enable the ARB.



Settings:

State.....	70
Set To Default.....	70
Load Waveform.....	70
Waveform Info.....	71
Clock Frequency.....	71
Create Multi Carrier.....	71
Test Signal Form.....	71
Create Test Signal.....	72

State

Enables ARB modulation. Switching on the ARB turns off all the other digital standards and digital modulation types in the same signal path.

The output is based on the waveform file that is loaded. The name of the waveform file is displayed next to "Load Waveform". When a multi-segment waveform is loaded, the display expands and lists more settings, grouped in the "Multi Segment Waveform Options" section.

Note: ARB stays disabled.

You cannot enable the ARB in the following cases:

- **No or empty waveform file**
By default, no waveform file is loaded. The "Load Waveform" button displays "None".
Remedy: Select a waveform file, before activating the ARB.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:STATe` on page 535

Set To Default

Calls default settings, see [Table 4-3](#).

Table 4-3: ARB default settings

Parameter	Value
State	Off
Clock Frequency	1 MHz
Trigger Mode	Auto
Trigger Source	Internal
Marker State	Off
Marker Mode	Unchanged
Clock Source	Internal

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:PRESet` on page 535

Load Waveform

Opens the standard "File Select" function of the instrument. The provided navigation possibilities in the dialog are self-explanatory.

The waveform files have a predefined file extension *.wv. If you select a file, the dialog displays short information about the selected waveform.

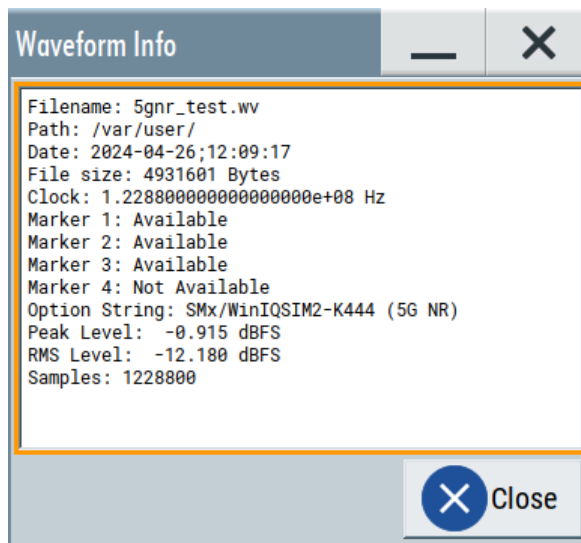
Enable the ARB to trigger the instrument to load and process the selected waveform file.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:WAVeform:SElect` on page 540

Waveform Info

Opens a dialog with detailed information about the currently selected waveform. The display depends on whether the selected waveform file is a multisegment one or not. All parameters are read only.



Remote command:

n.a.

For non-multi-segment waveform files, use the `Tag` commands. See [Chapter 4.3.5, "Tags for waveforms, data and control lists"](#), on page 94.

Clock Frequency

Displays or sets the ARB output clock rate.

The value of this parameter is set to the clock rate defined in the loaded waveform file (`{CLOCK}` tag). The value can be changed afterwards.

Note: The clock frequency must match the value of the externally applied clock source.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:CLOCK` on page 542

Create Multi Carrier

Opens the dialog for creating multicarrier waveforms, see [Chapter 4.4, "Generating multicarrier waveform signals"](#), on page 103.

Test Signal Form

Selects the form of the test signal. A choice between a sinusoidal, rectangular, AWGN or test signal with constant I/Q is provided.

To access further settings, select [Create Test Signal](#).

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:SIGNa1:TYPE` on page 536

Create Test Signal

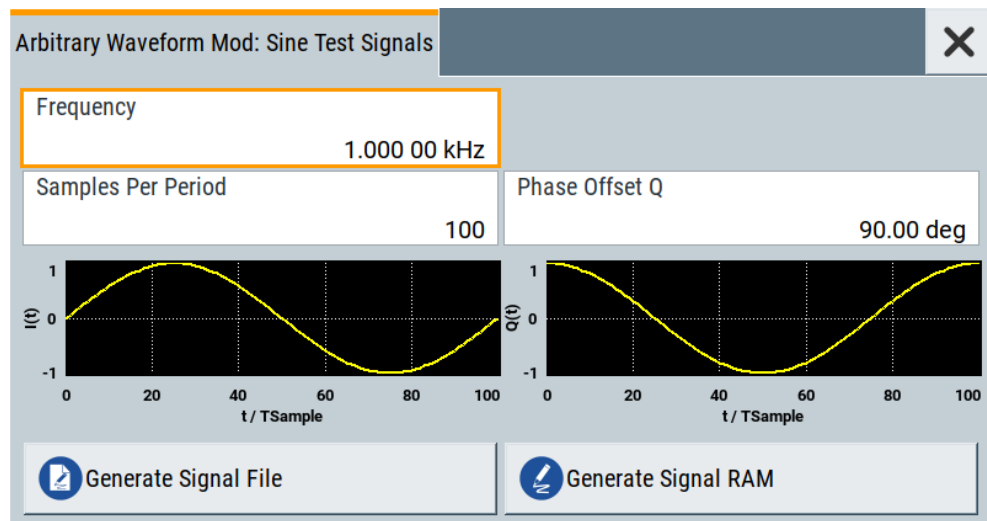
Opens a dialog with further test signal settings. Provided are the following test signals:

- [Chapter 4.3.3.2, "Sine test signal settings"](#), on page 72
- [Chapter 4.3.3.3, "Rectangular test signal settings"](#), on page 73
- [Chapter 4.3.3.4, "Constant IQ test signal settings"](#), on page 75

4.3.3.2 Sine test signal settings

Access:

1. Select "Baseband" > "ARB" > "General".
2. Select "Test Signal Form" > "Sine".
3. Select "Create Test Signal".



This dialog provides settings to configure a sinusoidal test signal. A sine wave is generated on the I path, and a sine wave of the same frequency but phase-shifted is generated on the Q path. For more information, refer to [Chapter 4.3.2.2, "ARB test signals"](#), on page 66.

The dialog displays the characteristic of the currently selected signal.

Settings:

Frequency	73
Samples per Period	73
Phase Offset Q	73
Generate Signal File	73
Generate Signal RAM	73

Frequency

Enters the frequency of the test signal.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:SINE:FREQuency](#) on page 537

Samples per Period

Enters the number of sample values required from the sine wave per period.

The maximum allowed value is determined by the maximum ARB clock rate and the selected frequency.

For more information, refer to the specifications document.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:SINE:SAMPles](#) on page 538

Phase Offset Q

Enters the phase offset of the sine-wave signal on the Q channel relative to the sine-wave signal on the I channel.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:SINE:PHASe](#) on page 538

Generate Signal File

Generates a signal and saves it as a waveform file on the hard disk. Use the standard "File Select" function to save the file.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:SINE:CREate:NAMed](#) on page 538

Generate Signal RAM

Generates a signal and uses this signal as output straight away. The instrument saves the file using a predefined filename.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:SINE:CREate](#) on page 539

4.3.3.3 Rectangular test signal settings

Access:

1. Select "Baseband" > "ARB" > "General".
2. Select "Test Signal Form" > "Rect".

3. Select "Create Test Signal".

Arbitrary Waveform Mod: Rect Test Signal

Frequency: 1.000 00 kHz

Samples Per Period: 100

Amplitude: 0.800 FS

Offset DC: 0.000 FS

Generate Signal File Generate Signal RAM

This dialog provides settings to configure a rectangular test signal. A rectangular test signal with a duty factor of 0.5 is created. Amplitude and offset are adjustable. Both paths, I and Q, use the same signal.

For more information, refer to [Chapter 4.3.2.2, "ARB test signals"](#), on page 66.

Settings:

Frequency.....	74
Samples per Period.....	74
Amplitude.....	74
Offset DC.....	75
Generate Signal File.....	75
Generate Signal RAM.....	75

Frequency

Enters the frequency of the test signal.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:TSIGnal:RECTangle:FREQuency` on page 536

Samples per Period

Enters the number of sample values required for the rectangular signal per period.

The maximum allowed value is determined by the maximum ARB clock rate and the selected frequency.

For more information, refer to the specifications document.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:TSIGnal:RECTangle:SAMPLes` on page 537

Amplitude

Enters the digital amplitude of the rectangular wave. The abbreviation FS means full-scale.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:TSIGnal:RECTangle:AMPLitude` on page 536

Offset DC

Enters a DC component.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:RECTangle:OFFSet](#) on page 537

Generate Signal File

Generates a signal and saves it as a waveform file on the hard disk. Use the standard "File Select" function to save the file.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:RECTangle:CREate:NAMed](#) on page 538

Generate Signal RAM

Generates a signal and outputs it straight away. The instrument saves the file using a predefined filename.

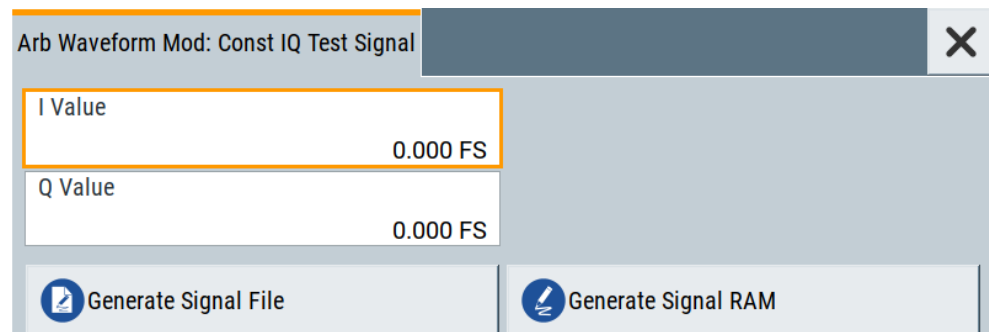
Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:SINE:CREate](#) on page 539

4.3.3.4 Constant IQ test signal settings

Access:

1. Select "Baseband" > "ARB" > "General".
2. Select "Test Signal Form" > "Const IQ".
3. Select "Create Test Signal".



This dialog provides settings to configure a continuous test signal with constant IQ. The I and Q values for each path are adjustable but constant. For more information, refer to [Chapter 4.3.2.2, "ARB test signals"](#), on page 66.

Settings:

I Value/Q Value	76
Generate Signal File	76
Generate Signal RAM	76

I Value/Q Value

Sets the value for the I component and Q component of the test signal.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:CIQ:I](#) on page 536

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:CIQ:Q](#) on page 536

Generate Signal File

Generates a signal and saves it as a waveform file on the hard disk. Use the standard "File Select" function to save the file.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:CIQ:CREate:NAMed](#) on page 538

Generate Signal RAM

Generates a signal and uses this signal as output straight away. The instrument saves the file using a predefined filename.

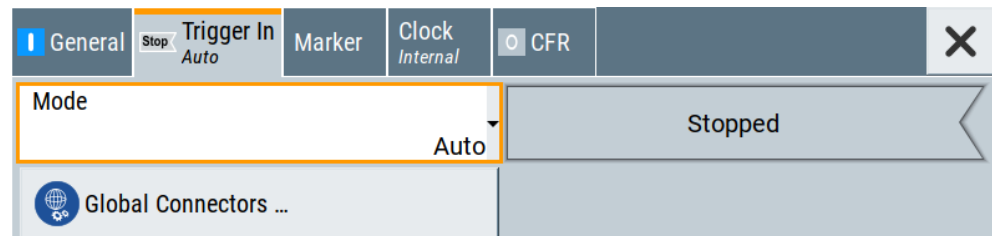
Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:TSIGnal:CIQ:CREate](#) on page 539

4.3.3.5 Trigger settings

Access:

- ▶ Select "Baseband" > "ARB" > "Trigger In".



The tab provides settings to select and configure the trigger, like trigger source, trigger mode and trigger delays, and to arm or trigger an internal trigger manually.

The header of the tab displays the status of the trigger signal and trigger mode. As in the tabs "Marker" and "Clock", this tab also provides access to the settings of the related connectors.

Routing and activating a trigger signal

1. Define the effect of a trigger event and the trigger signal source.
 - a) Select "Trigger In" > "Mode".
 - b) Select "Trigger In" > "Source".
2. For external trigger signals, define the connector for signal input. See [Chapter 4.3.3.8, "Global connector settings"](#), on page 82.

Global connector settings allow you to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.

3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

The R&S SFI100A starts baseband signal generation after the configured trigger event.

About baseband trigger signals

This section focuses on the available settings.

For detailed information, see [Chapter 4.2, "Common characteristics of the baseband domain"](#), on page 52.

Settings:

Mode.....	77
Signal Duration Unit.....	78
Signal Duration.....	78
Running/Stopped.....	78
Arm.....	78
Execute Trigger.....	78
Source.....	78
Sync. Output to External Trigger/Sync. Output to Trigger.....	79
External Inhibit/Trigger Inhibit.....	79
(External) Delay Unit.....	79
Processing Time.....	79
(Specified) External Delay/(Specified) Trigger Delay.....	79
Actual Trigger Delay/Actual External Delay.....	80

Mode

Sets the trigger mode.

See also [Chapter 4.2.2, "About trigger modes"](#), on page 53.

"Auto"	Generates the signal continuously.
"Retrigger"	Generates the signal continuously. A trigger event restarts the signal generation.
"Armed Auto"	Generates the signal only if a trigger event occurs. After the event, signal generation is continuous. Arming the trigger stops the signal generation. If armed, a following trigger event restarts the signal generation.
"Armed Retrigger"	Generates the signal only if a trigger event occurs. After the event, signal generation is continuous. Every following trigger event restarts the signal generation. Arming the trigger stops the signal generation. If armed, a following trigger event restarts the signal generation.
"Single"	Generates the signal once, if a trigger event occurs. You can set the signal duration that equals the length of the generated signal. A following trigger event restarts the signal generation.

Remote command:

[\[:SOURce<hw>\]:BB:ARBitrary\[:TRIGger\]:SEQuence](#) on page 556

Signal Duration Unit

Requires trigger mode "Single".

Selects the unit the sequence length of the generated signal.

Remote command:

[\[:SOURce<hw>\]:BB:ARBitrary:TRIGger:SLUNit](#) on page 558

Signal Duration

Requires trigger mode "Single".

Enters the sequence length of the generated signal after a single trigger event. To set the unit of the sequence length, see ["Signal Duration Unit"](#) on page 78.

Remote command:

[\[:SOURce<hw>\]:BB:ARBitrary:TRIGger:SLENgth](#) on page 557

Running/Stopped

With enabled modulation, displays the status of signal generation for all trigger modes.

- "Running"
The signal is generated; a trigger was (internally or externally) initiated in triggered mode.
- "Stopped"
The signal is not generated and the instrument waits for a trigger event.

Remote command:

[\[:SOURce<hw>\]:BB:ARBitrary:TRIGger:RMODe?](#) on page 557

Arm

Stops the signal generation until subsequent trigger event occurs.

Remote command:

[\[:SOURce<hw>\]:BB:ARBitrary:TRIGger:ARM:EXECute](#) on page 558

Execute Trigger

For internal trigger source, executes the trigger manually.

Remote command:

[\[:SOURce<hw>\]:BB:ARBitrary:TRIGger:EXECute](#) on page 558

Source

Selects the trigger source.

The following sources of the trigger signal are available:

- "Internal"
The trigger event is internal. Tap "Execute Trigger" to trigger signal generation manually.
- "External Global Trigger"
The trigger event is the active edge of an external trigger signal provided and configured at the User x connectors.

The polarity, the trigger threshold and the input impedance of the input connectors can be configured in the connector settings dialog.

How to: ["Routing and activating a trigger signal"](#) on page 76

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:SOURce` on page 557

Sync. Output to External Trigger/Sync. Output to Trigger

Enables signal output synchronous to the trigger event.

See also [Chapter 4.2.3, "Impact of additional trigger settings"](#), on page 56.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger[:EXTErnal]:SYNChronize:OUTPut` on page 558

External Inhibit/Trigger Inhibit

Applies for an external trigger signal.

Sets the duration with that any following trigger event is suppressed. In "Retrigger" mode, for example, a new trigger event does not cause a restart of the signal generation until the specified inhibit duration does not expire.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger[:EXTErnal]:INHibit` on page 560

(External) Delay Unit

Determine whether the trigger delay is expressed in samples or directly defined as a time period (seconds).

To specify the delay, use the [\(Specified\) External Delay/\(Specified\) Trigger Delay](#)

The parameter [Actual Trigger Delay/Actual External Delay](#) displays the delay converted in time.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:DELAy:UNIT` on page 559

Processing Time

Displays the internal processing time.

The processing time is the elapsed time between the input of the external trigger event and the output of the baseband signal. An additional delay applies to the RF signal with respect to the baseband signal depending on the RF frequency.

For more information, see ["Starting the signal generation with the first sample"](#) on page 56.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:PTIME?` on page 559

(Specified) External Delay/(Specified) Trigger Delay

The name of the parameter and the units the delay is expressed in, changes depending on the parameter [\(External\) Delay Unit](#).

Delays the trigger event provided by:

- The external trigger source

Use the settings to:

- Synchronize the instrument with the device under test (DUT) or other external devices

The parameter [Actual Trigger Delay/Actual External Delay](#) displays the delay converted in time.

For more information, see [Chapter 4.2.3, "Impact of additional trigger settings"](#), on page 56.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger [:EXTernal] :DELay` on page 559

`[:SOURce<hw>] :BB:ARBitrary:TRIGger [:EXTernal] :TDELay` on page 560

Actual Trigger Delay/Actual External Delay

Displays the time (in seconds) an external trigger event or a trigger event from the other path is delayed with.

See also [Chapter 4.2.3, "Impact of additional trigger settings"](#), on page 56.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger [:EXTernal] :RDELay?` on page 560

4.3.3.6 Marker settings

Access:

- ▶ Select "Baseband" > "ARB" > "Marker".

This tab provides settings to select and configure the marker output signal including marker mode and marker delay.

Routing and activating a marker signal

1. To define the signal shape of an individual marker signal "x", select "Marker" > "Marker x" > "Mode".
2. Optionally, define the connector for signal output. See [Chapter 4.3.3.8, "Global connector settings"](#), on page 82.
You can map marker signals to one or more User x connectors.
3. Enable baseband signal generation. In the block diagram, set "Baseband" > "On".
The R&S SFI100A adds the marker signal to the baseband signal. Also, R&S SFI100A outputs this signal at the configured User x connector.

About marker output signals

This section focuses on the available settings.

For detailed information, see [Chapter 4.2, "Common characteristics of the baseband domain"](#), on page 52.

Mode	81
Delay	81
Delay (Time)	81

Mode

Sets the marker mode that defines the shape and periodicity of the marker signal.

You can configure individual marker modes for each marker signal. The number of available markers is 4. The marker configuration changes with the selected marker mode.

For more information on marker modes, see [Chapter 4.2.4, "About marker signals"](#), on page 59.

Note: Setting an ARB marker mode that is different than "Unchanged" does not change the marker trace in the loaded waveform file. But, when playing the waveform file the instrument uses the configured ARB marker mode.

The instrument routes the generated marker signals to the selected output connectors.

See also [Chapter 4.5, "Configuring global connectors"](#), on page 121.

"Unchanged" The waveform file with its configured marker traces defines the marker signal of the ARB baseband signal.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:OUTPut<ch>:MODE` on page 561

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:OUTPut<ch>:PULSe:DIVider`
on page 562

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:OUTPut<ch>:PULSe:FREQuency?`
on page 562

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:OUTPut<ch>:PATtern` on page 561

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:OUTPut<ch>:OFFTime` on page 561

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:OUTPut<ch>:ONTime` on page 561

Delay

Delays the marker signal at the marker output relative to the signal generation start.

Variation of the parameter "Marker x" > "Delay" causes signal recalculation.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:OUTPut<ch>:DELay` on page 562

Delay (Time)

Shows the marker delay time in microseconds, milliseconds or seconds depending on the marker delay.

Remote command:

`[:SOURce<hw>] :BB:ARBitrary:TRIGger:OUTPut<ch>:DINSec?` on page 563

4.3.3.7 Clock settings

Access:

- ▶ Select "Baseband" > "ARB" > "Clock".

This tab provides settings to select and configure the clock signal, like the clock source and clock mode.

Defining the clock

1. Select "Clock" > "Source" to define the source of the clock signal.
2. For external clock signals, define the connector for the signal input. See [Chapter 4.3.3.8, "Global connector settings"](#), on page 82.
Global connector settings allow you to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".
The R&S SF100A starts baseband signal generation with a symbol rate that equals the clock rate.

About clock signals

This section focuses on the available settings.

For detailed information, see [Chapter 4.2, "Common characteristics of the baseband domain"](#), on page 52.

[Clock Source](#).....82

Clock Source

Selects the clock source.

- "Internal"
The instrument uses its internal clock reference.

Remote command:

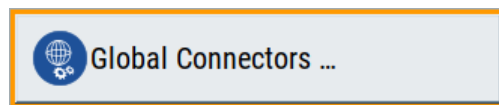
[\[:SOURce<hw>\]:BB:ARbitrary:CLOCK:SOURce](#) on page 563

4.3.3.8 Global connector settings

Opens a dialog to configure global connectors.

The button is available in the following dialogs or tabs:

- "Trigger / Marker / Clock" dialog that is accessible via the "TM" block in the block diagram.
- "Trigger In", "Marker" and "Clock" tabs of baseband signal configuration dialogs that you can open via the "Baseband" block in the block diagram. These tabs are available, for example, for "ARB" baseband signals.



See also [Chapter 4.5, "Configuring global connectors"](#), on page 121.

4.3.4 Playing waveform files

This section provides step-by-step instructions to create, generate and play waveform files on the R&S SFI100A. Provided the R&S SFI100A is equipped with the required option, you can load this waveform file and process it with the instrument.

For details on individual functions and settings, see [Chapter 4.3.3, "ARB settings"](#), on page 69.

Some test cases do not require a real-time signal generation according to a digital standard. For these test cases, the replay of a previously generated waveform is sufficient. Generate these waveform files as follows:

- Internal generation with the "Create Test Signal" function, see [Chapter 4.3.4.1, "Generating ARB test signals"](#), on page 83.
- External waveform generation with Rohde & Schwarz software products:
 - For R&S WinIQSIM2, see [Chapter 4.3.4.3, "Working with R&S WinIQSIM2"](#), on page 84.
 - For R&S ARB Toolbox, see 1GP88.
- External waveform generation with MATLAB, see [Chapter 4.3.4.4, "Creating waveforms with tag file format"](#), on page 88 and 1GP60.

This section provides examples on the internal waveform file generation and on the external generation with R&S WinIQSIM2.

• Generating ARB test signals	83
• Loading and playing waveform files	84
• Working with R&S WinIQSIM2	84
• Creating waveforms with tag file format	88
• Defining periodically repeating traces	92
• Editing waveform files, data and control lists	94

4.3.4.1 Generating ARB test signals

If your test case requires a simple sine signal or square signal, use the ARB test signals.

To generate a sine test signal

1. Select "Baseband" > "ARB"
2. Select "Create Test Signal" > "Sine".
3. Adjust the "Sine Test Signal" settings as required.
4. Select "Generate Signal File".
A standard file select dialog opens.
 - a) Navigate to the directory in that you want to save the file, for example /var/user/.
 - b) Enter a filename, for example `sine_waveform`.
 - c) Click "Save".

The R&S SFI100A saves the generated waveform file and automatically loads it in the ARB.

5. Select "ARB" > "State" > "On".

The R&S SFI100A processes the waveform file.

4.3.4.2 Loading and playing waveform files

Irrespectively on how you generate a waveform, you can transfer it to the instrument, load it in the ARB and play it.

To load and play a waveform file

1. Transfer an externally created waveform file to the instrument.
See [Chapter 10.8, "Transferring files from and to the instrument"](#), on page 289.
2. Select "Baseband" > "ARB".
3. Select "Load Waveform".
A standard file select dialog opens.
 - a) Navigate to the directory that the waveform file contains.
 - b) Select the waveform file, for example `/var/user/lte_waveform`.
 - c) Click "Select".

The "ARB" dialog confirms that the waveform file is loaded.

4. Select "ARB" > "State" > "On".

The R&S SFI100A processes the waveform file.

4.3.4.3 Working with R&S WinIQSIM2

The following example illustrates how to use R&S WinIQSIM2 simulation software to generate an EUTRA/LTE waveform and load it in the ARB of the R&S SFI100A.

The workflow consists of three main steps, each described in a separate step-by-step instruction:

- Configuring the connection between the R&S WinIQSIM2 and the R&S SFI100A
- Generating of a waveform file with the required settings
- Transferring the waveform file to and playing it with the R&S SFI100A.



This section does not describe the R&S WinIQSIM2 simulation software but focuses on the task-related settings. For a description of the simulation software, see the R&S WinIQSIM2 user manual.

To define the R&S SFI100A as destination instrument

In this example, we assume that the R&S WinIQSIM2 is installed on a remote controller. This remote controller is connected over LAN to the R&S SFI100A.

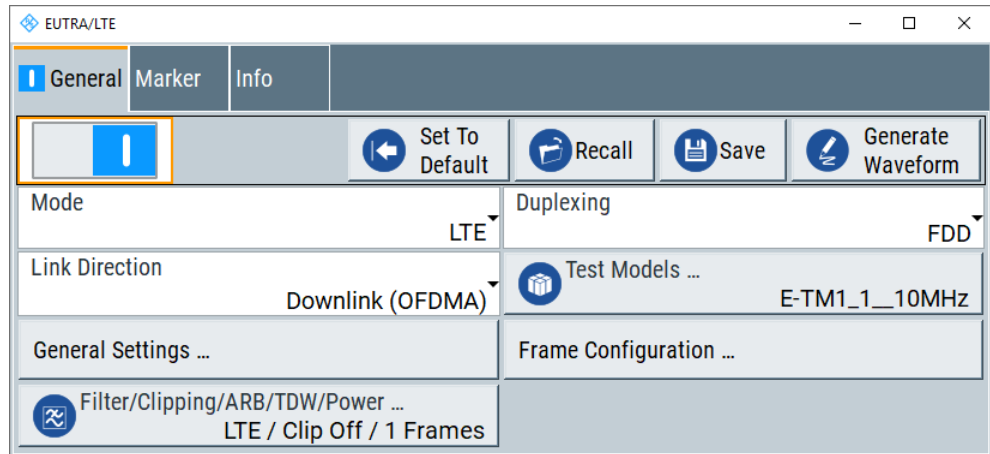
The general instrument settings of the destination instrument affect various functions, for example, the maximum size of the file the waveform is saved in. We recommend that you configure the destination instrument before you generate the waveform with the R&S WinIQSIM2.

1. In the R&S WinIQSIM2, select "File" > "New" to preset the software.
2. In the block diagram, select "Vector Sig Gen" > "Instruments".
The "Configure Instruments" dialog opens. The list of configured instruments is empty.
3. Select "Configure Instruments" > "Scan".
The software scans the network for connected and active instruments. Alternatively, use the "New" function to add the R&S SF1100A manually to the list of instruments.
4. Close the dialog.
5. In the block diagram, select "Vector Sig Gen" block and select the R&S SF1100A from the list.
6. In the block diagram, select "ARB Sig Gen" block and select the R&S SF1100A from the list.
The two lines to the "Vector Sig Gen" and "ARB Sig Gen" blocks on the block diagram confirm that a remote connection to the R&S SF1100A is established.

To generate a waveform file with R&S WinIQSIM2

1. In the block diagram of R&S WinIQSIM2, select "Baseband" > "EUTRA/LTE/IoT".
2. Adjust the settings as required, for example:
 - a) Select "Link Direction" > "Downlink (OFDMA)"
 - b) Select a predefined test model, for example, "Test Models" > "E-TM1_1__10MHz".
3. Select "EUTRA/LTE/IoT" > "State" > "On".

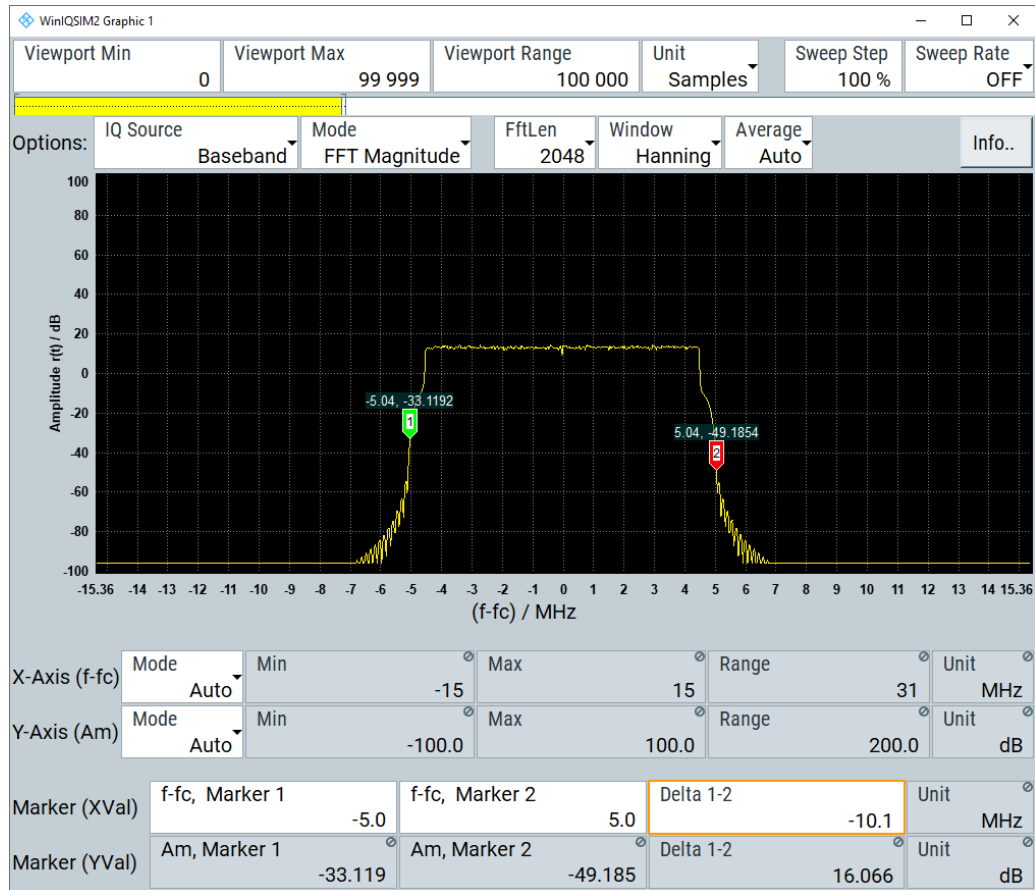
Using the arbitrary waveform generator (ARB)



R&S WinIQSIM2 calculates the signal and displays important signal parameters, for example, number of samples "Samples" and "Sample Rate".



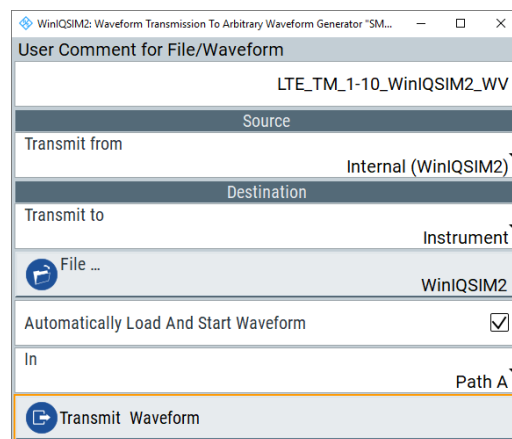
Select "Graphics" > "Graphic 1 (Complete)" to check for more information on the generated signal.



The display confirms the expected EUTRA/LTE 10 MHz spectrum.

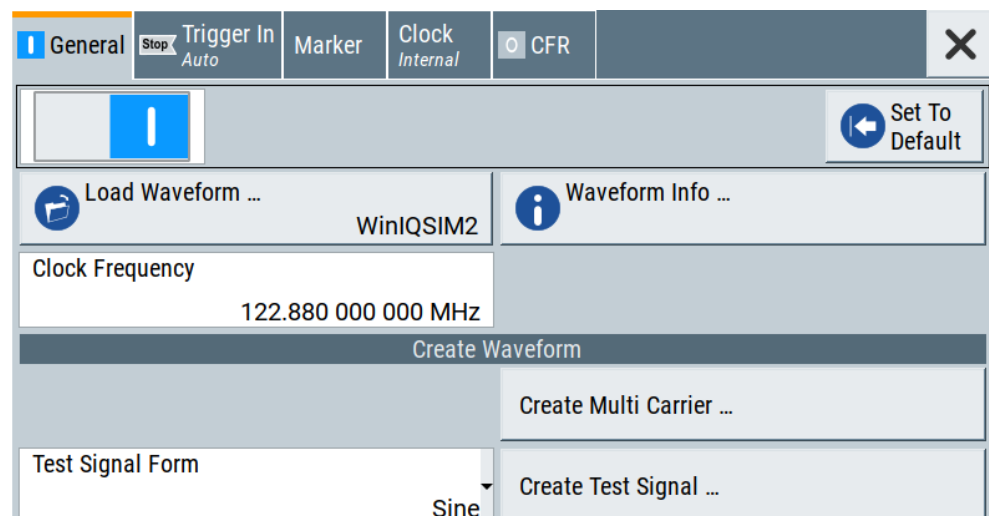
To transfer the waveform file to the R&S SF100A

1. At R&S WinIQSIM2, select "Transmission" > "Transmit".
2. In the "Waveform Transmission to Arbitrary Waveform Generator" dialog, proceed as follows:
 - a) "Transmit from" > "Internal (WinIQSIM2)".
 - b) "Transmit to" > "Instrument".
 - c) Select "File".
 - d) Define the filename of the transmitted file.
 - e) Activate "Automatically Load and Start Waveform".
 - f) Select the required baseband, for example "Path A".
 - g) Add a comment to the waveform, for example as follows:
"User Comment for File/Waveform" > "LTE_TM_1-10_WinIQSIM2_WV"
 - h) Select "Transmit".



R&S WinIQSIM2 transmits the waveform to the default directory of the R&S SF100A.

3. In the R&S SF100A, select "Baseband" > "ARB".



The dialog confirms that the ARB is active and plays the transmitted waveform.

4.3.4.4 Creating waveforms with tag file format

The provided example uses a sine function in the I channel and a cosine function in the Q channel, each with 20 points. The example uses a short program written in the programming language C to calculate the sine and cosine values (see [Example "C-program for creating a waveform file"](#) on page 91). They are saved in the file `SICO.txt`. The decimal values in `SICO.txt` are normalized such that they are between -1.0 and $+1.0$. The data is converted into binary format. The appropriate mandatory tags are added and the data is packed into the `WAVEFORM` tag. As result, the waveform file `SICO.wv` is generated.

This example follows the general principle of creating of a waveform manually, using the tag file format. The [Figure 4-10](#) illustrates this general workflow.

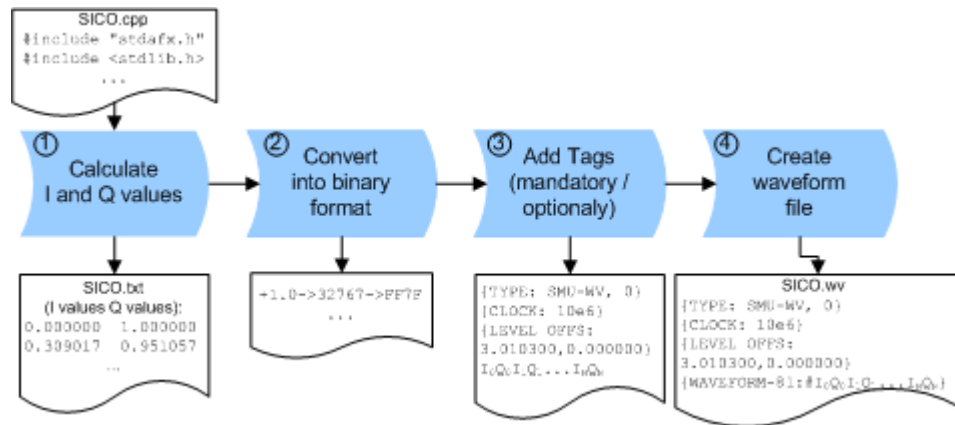


Figure 4-10: Principle of creating a waveform manually

The following steps outline how to create the waveform file `SICO.wv`:

1. Calculate the sine and cosine values. For example, use the `SICO.cpp` program.
The result is saved in the file `SICO.txt`.

Using the arbitrary waveform generator (ARB)

```

0.000000  1.000000
0.309017  0.951057
0.587785  0.809017
0.809017  0.587785
0.951057  0.309017
1.000000 -0.000000
0.951057 -0.309017
0.809017 -0.587785
0.587785 -0.809017
0.309017 -0.951057
-0.000000 -1.000000
-0.309017 -0.951056
-0.587785 -0.809017
-0.809017 -0.587785
-0.951056 -0.309017
-1.000000  0.000000
-0.951056  0.309017
-0.809017  0.587785
-0.587785  0.809017
-0.309017  0.951057

```

Figure 4-11: Contents of SICO.txt: first column Sine (I), second column Cosine (Q)

- Convert the values from the file `SICO.txt` into binary format consisting of 16-bit signed integer numbers. The numeric range between -1.0 and $+1.0$ corresponds to the modulation range of the waveform 16-bit D/A converter of -32767 to $+32767$.

```

+1.0 -> 32767 -> = 0x7FFF
0.0 -> 0 -> = 0x0000
-1.0 -> -32767 -> = 0x8001

```

The [Figure 4-12](#) shows the calculation and conversion steps. The highlighted columns contain the resulting I and Q values represented in Little endian format.

Using the arbitrary waveform generator (ARB)

Sample n	deg = 360°/20 * n	I = sin(deg)	I _{quant,dec} = I * FS = I * (2 ¹⁵ -1)	I _{quant,hex}	I _{quant,hex} (little-endian waveform file representation)	Q = cos(deg)	Q _{quant,dec} = I * FS = I * (2 ¹⁵ -1)	Q _{quant,hex}	Q _{quant,hex} (little-endian waveform file representation)
0	0	0.000000	0	0000	0000 I ₀	1.000000	32767	7FFF	FF7F Q ₀
1	18	0.309017	10126	278E	8E27	0.951057	31163	79BB	BB79
2	36	0.587785	19260	4B3C	3C4B	0.809017	26509	678D	8D67
3	54	0.809017	26509	678D	8D67	0.587785	19260	4B3C	3C4B
4	72	0.951057	31163	79BB	BB79	0.309017	10126	278E	8E27
5	90	1.000000	32767	7FFF	FF7F	0.000000	0	0000	0000
6	108	0.951057	31163	79BB	BB79	-0.309017	-10126	D872	72D8
7	126	0.809017	26509	678D	8D67	-0.587785	-19260	B4C4	C4B4
8	144	0.587785	19260	4B3C	3C4B	-0.809017	-26509	9873	7398
9	162	0.309017	10126	278E	8E27	-0.951057	-31163	8645	4586
10	180	0.000000	0	0000	0000	-1.000000	-32767	8001	0180
11	198	-0.309017	-10126	D872	72D8	-0.951057	-31163	8645	4586
12	216	-0.587785	-19260	B4C4	C4B4	-0.809017	-26509	9873	7398
13	234	-0.809017	-26509	9873	7398	-0.587785	-19260	B4C4	C4B4
14	252	-0.951057	-31163	8645	4586	-0.309017	-10126	D872	72D8
15	270	-1.000000	-32767	8001	0180	0.000000	0	0000	0000
16	288	-0.951057	-31163	8645	4586	0.309017	10126	278E	8E27
17	306	-0.809017	-26509	9873	7398	0.587785	19260	4B3C	3C4B
18	324	-0.587785	-19260	B4C4	C4B4	0.809017	26509	678D	8D67
19	342	-0.309017	-10126	D872	72D8	0.951057	31163	79BB	BB79

Figure 4-12: I and Q values calculation and conversion

- Use an ASCII editor which is able to handle binary data. Create and add the following mandatory tags before this binary data set can be further processed:

- CLOCK
- LEVEL OFFS

An example of the SICO.wv file contents could be:

```
{TYPE: SMU-WV, 0}{CLOCK: 10e6}{LEVEL OFFS: 3.010300,0.000000}
0000FF7F8E27BB79 ... 72D8BB79
```

To simplify the example, the checksum is set to 0, i.e. the instrument does not evaluate a checksum.

Tip: The tags TYPE, CLOCK, LEVEL OFFS and WAVEFORM are mandatory for each waveform. All other tags are optional and can be inserted after the TYPE tag in arbitrary order.

- Pack the binary data into a WAVEFORM tag with the described structure.

```
{WAVEFORM-Length: #I0Q0I1Q1I2Q2 ... InQn}
```

- Calculate the Length
Length = Number of I/Q pairs * 4 + 1 = 20*4 + 1 = 81 bytes
- Place the string {WAVEFORM-81: # at the beginning of the data set
- Place the symbol } at the end of the data set

The contents of the waveform file SICO.wv for 20 I/Q pairs is now ready for operation and reads:

```
{TYPE: SMU-WV, 0}
{CLOCK: 10e6}
{LEVEL OFFS: 3.010300,0.000000}
{WAVEFORM-81: #I0Q0I1Q1...InQn}
```

There is no readable representation for binary values in this document. This example uses the sequence $I_0Q_0I_1Q_1 \dots I_nQ_n$ to characterize the binary code. The following figure shows this waveform in a data editor.

Example: C-program for creating a waveform file

C-program `SICO.cpp` for creating the file `SICO.txt` containing 20 sine and cosine pairs, converting them into binary data and creating the waveform file `SICO.wv`.

```
// SICO.cpp
// Defines the entry point for the console application

#include "stdafx.h"
#include <stdlib.h>
#include <stdio.h>
#include <math.h>

int _tmain(int argc, _TCHAR* argv[])
{
    const unsigned int samples = 20;
    const float pi = 3.141592654f;
    int i;

    // SICO.txt
    // Creating the file SICO.txt containing 20 sine and cosine pairs
    float grad, rad;
    FILE *fp;
    fp = fopen("SICO.txt", "w");
    if (fp == 0)
        return;
    for (i=0; i<samples; i++)
    {
        grad = (360.0f / (float)samples) * (float)i;
        rad = grad * (pi / 180.0f);
        fprintf(fp, "%f %f\n", sin(rad), cos(rad));
    }
    fclose(fp);
}
```

```

// SICO.wv
// Generating a binary data set from the I/Q pairs in the file SICO.txt
// and storing the result to file SICO.wv
FILE *fp_sour, *fp_dest;
float i_float, q_float;
unsigned short i_usint, q_usint;
fp_sour = fopen("SICO.TXT", "rt");
if (fp_sour == 0)
    return -1;
fp_dest = fopen("SICO.WV", "wb");
if (fp_dest == 0)
{
    fclose(fp_sour);
    return -1;
}
// Write required tags to waveform file
fprintf(fp_dest, "{TYPE: SMU-WV,0}");
fprintf(fp_dest, "{CLOCK: 10e6}");
fprintf(fp_dest, "{SAMPLES: %d}", samples);
// RMS, Peak
fprintf(fp_dest, "{LEVEL OFFS: %f,%f}", -1.0f * 20.0f * log10(1.0f/sqrt(2.0f)), 0.0f);
fprintf(fp_dest, "{WAVEFORM-%d:#", (samples * 4) + 1);
for (i=0; i<samples; i++)
{
    // Read I/Q pair from ASCII file
    if (fscanf(fp_sour, "%f %f", &i_float, &q_float) == EOF)
        break;
    // Convert I/Q pair to unsigned short
    i_usint = (unsigned short)floor((i_float * 32767.0) + 0.5);
    q_usint = (unsigned short)floor((q_float * 32767.0) + 0.5);
    // Write converted I/Q pair to waveform file
    fwrite(&i_usint, 2, 1, fp_dest);
    fwrite(&q_usint, 2, 1, fp_dest);
}
fprintf(fp_dest, "}");
fclose(fp_dest);
fclose(fp_sour);
return 0;
}

```

4.3.4.5 Defining periodically repeating traces

If your test setup requires marking an event, for example, each frame start, it is sufficient to define the trace once and repeat it over the length of a waveform. Repeating is useful for long waveforms with periodical marker signals.

The following examples use marker traces. You can use control lists analogously.

To define periodical marker trace

The waveform in the example below consists of three frames, each frame has a length of 100 samples. Waveform processing is continuous via "Trigger Mode" > "Auto".

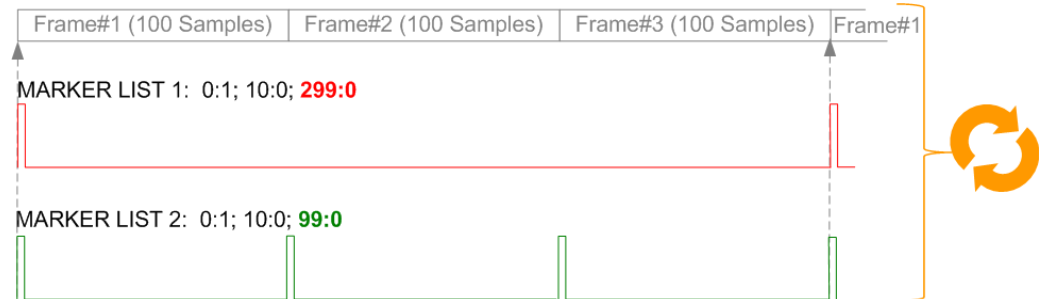


Figure 4-13: Example: Defining marker traces without CONTROL LENGTH tag

To define a restart marker and a frame start marker, use the following tags:

1. The waveform is 300 samples long, i.e. set `{SAMPLES: 300}`.
2. Set two [TRACE] LIST tags:
 - For Marker 1 that acts as a restart marker:
`{MARKER LIST 1: 0:1; 10:0; 299:0}`
 - For Marker 2 that marks each frame start:
`{MARKER LIST 2: 0:1; 10:0; 99:0}`
3. Do not use the CONTROL LENGTH tag.

The length of the repeated patterns is determined by the last sample number in the [TRACE] LIST that is the last {Pos:State}.

Example: CONTROL LENGTH tag and trace processing

In the example below, use the same marker traces and set the CONTROL LENGTH tag, for example `{CONTROL LENGTH: 150}`.

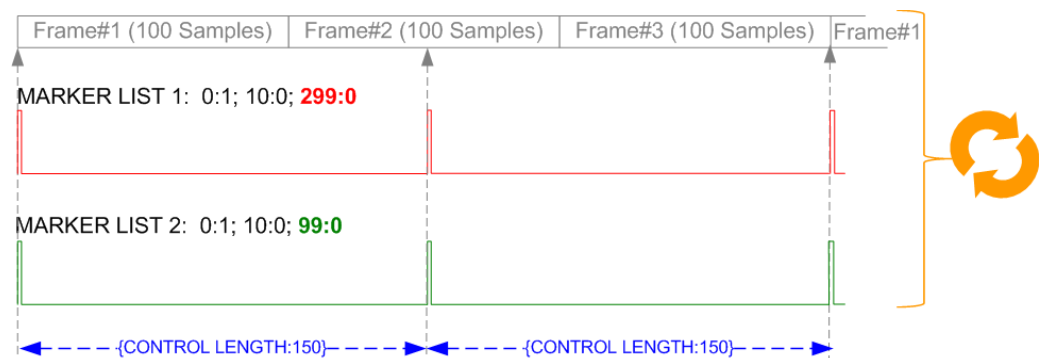


Figure 4-14: Example: Processing control signals with CONTROL LENGTH tag

The length of **all** control signals is determined by the CONTROL LENGTH. Observe how the marker traces are processed. In this example, both marker traces are repeated every 150 samples.

4.3.4.6 Editing waveform files, data and control lists

You can edit the internally and externally created waveform files, data and control lists. The waveform, data and control lists files contain binary and ASCII data.

Consider the following rules while editing files with binary data.

Rules for editing binary data

- **Use hex data editor**
Always use a hex data editor to edit files containing binary data. Editing of binary data file with a text editor, even if you only change the ASCII part of the file, corrupts the file.
- **Adapt the length information in the {EMPTYTAG}**
If you change the content of a waveform file, change also the {EMPTYTAG-Length} value.
For example, change this value, if you add a tag or add bytes to an existing tag. Reduce the value by the number of newly introduced bytes.

4.3.5 Tags for waveforms, data and control lists

The instrument uses a simple tag-oriented format for externally or internally generated waveforms, data and control lists. Files with this format can be transmitted from an external computer to the instrument and vice versa.

The instrument transmits these files as a binary data block, using the following SCPI command:

- `[:SOURce<hw>] :BB:ARBitrary:WAVeform:DATA`

Tag general format

Tags are self-contained information units, enclosed in braces { }. Their general format is {Name: Data} or {Name-Length: Data}. The colon separates the name part and the data part. The colon can be followed by a space for the sake of readability.

- The **Name** identifies the tag. It is always expressed in capital letters.
- The **Data** is tag-specific, and usually it is in ASCII plain text.
- The **Length** specifies the number of bytes in a WAVEFORM tag, DATA LIST tag, or EMPTYTAG
Length is an ASCII integer value, defining the number of bytes from the colon : to the end brace }

Rules

Each waveform file must begin with the TYPE tag. The sequence of the remaining tags is arbitrary. For each tag, an indication shows whether it must be included in the file concerned (mandatory) or can be included (optional).

Unknown tags are not analyzed by the R&S SF100A; they are left unchanged and saved without an error message for a possible further read back.

R&S SMU waveforms can also be loaded on the instrument, where they are converted internally into an R&S SFI100A waveform.



In all examples of file contents listed in this section, the tags have been separated by line breaks for better reading.

Tag description

This section describes the **mandatory TYPE tag** followed by a description of all other tags, grouped per file type and listed in an alphabetical order. Some tags are valid for all three file types. If a tag is valid only for a single file type, e.g. only for a waveform, this fact is indicated in the description.

Related step-by-step descriptions

See:

- [Chapter 4.3.4.5, "Defining periodically repeating traces"](#), on page 92
- [Chapter 4.3.4.4, "Creating waveforms with tag file format"](#), on page 88
- [Chapter 4.3.4.6, "Editing waveform files, data and control lists"](#), on page 94

Supported tags:

- [Common tags](#).....95
- [Tags for waveforms](#).....97

4.3.5.1 Common tags

The following tags are common to all file types. For all tags, see "[Supported tags:](#)" on page 95.

Common tags

{TYPE: magic, xxxxxxxx}	95
{COMMENT: string}	96
{COPYRIGHT: string}	97
{DATE: yyyy-mm-dd;hh:mm:ss}	97

{TYPE: magic, xxxxxxxx}

(mandatory, must be the first tag in the file)

Identifies the file as a valid R&S SFI100A file. It must be present and must be the first in the waveform. If a file of the same name exists on the target medium, it is overwritten.

Setting parameters:

magic Designates the file type and has the following values:

SMU-WV

A valid R&S SFI100A waveform.

SMU-MWV

A valid R&S SFI100A multi-segment waveform.

SMU-DL

A valid R&S SFI100A data list.

SMU-CL

A valid R&S SFI100A control list.

xxxxxxx

Is an ASCII-coded checksum of the data part of the `WAVEFORM` tag in the file. This value is always 0 for data lists and control lists.

The checksum for waveforms is used for detecting transmission errors. If the `TYPE` tag contains 0 or a non-numeric value for the checksum, it is ignored.

It is calculated in accordance with the algorithm given below, where:

`start` is a pointer to the first byte after the `#` character in the `WAVEFORM` tag

`length` is the number of bytes between `start` and the closing curly bracket (excluding the latter; `length` must be divisible by 4 without a remainder.

```
UINT32 checksum(void *start, UINT32 length)
{
    UINT32 i, result = 0xA50F74FF;
    for(i=0; i < length/4; i++)
        result = result ^ ((UINT32 *)start)[i];
    return(result);
}
```

The checksum is currently not verified when waveforms are loaded.

Example:

```
{TYPE: SMU-WV,106656}
BB:ARB:WAV:TAG? 'TYPE'
Queries the content of the TYPE tag.
Response: 'SMU-WV,106656'
This is a valid waveform.
```

{COMMENT: string}

The tag contains a plain text ASCII string of arbitrary length. The string is not analyzed in the R&S SFI100A. It is used to describe the file. The string is allowed to contain all printable ASCII characters except the closing curly bracket.

Example: `{COMMENT: File with data for 3GPP enhanced channels}`
`BB:ARB:WAV:TAG? 'COMMENT'`
 Queries the content of the `COMMENT` tag of the selected waveform file.
 Response: 'File with data for 3GPP enhanced channels'
 The comment on the waveform reads "File with data for 3GPP enhanced channels".

Usage: Setting only

{COPYRIGHT: string}

The tag contains an ASCII string of arbitrary length. The string is not analyzed in the R&S SF100A. It is used to save copyright information about the file content.

Example: `{COPYRIGHT: Rohde&Schwarz}`
`BB:ARB:WAV:TAG? 'COPYRIGHT'`
 Queries the content of the `COPYRIGHT` tag of the selected waveform file.
 Response: 'Rohde&Schwarz'
 Copyright resides with Rohde & Schwarz.

Usage: Setting only

{DATE: yyyy-mm-dd;hh:mm:ss}

(optional)

The tag contains the date and time at which the file was created. Enter the year as four digits. The instrument does not analyze this tag.

Example: `{DATE: 2009-04-02;14:32:12}`
`BB:ARB:WAV:TAG? 'DATE'`
 Queries the content of the `DATE` tag of the selected waveform file.
 Response: '2009-04-02;14:32:12'
 The waveform was created on April 2, 2009 at 14 hrs 32 min.

Usage: Setting only

4.3.5.2 Tags for waveforms

The following tags apply to waveforms exclusively. For all tags, see "[Supported tags:](#)" on page 95.

Waveform tags

{CLOCK: frequency}	98
{CONTROL LENGTH: ControlLength}	98
{EMPTYTAG-Length: #EmptySequence}	99

{LEVEL OFFS: RMSOffset_dB,PeakOffset_dB}.....	100
{MARKER MODE [#]: GENERATOR}.....	101
{SAMPLES: Samples}.....	101
{BURST LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}.....	102
{CW MODE LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}.....	102
{HOP LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}.....	102
{LEVATT LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}.....	102
{MAP LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}.....	102
{MARKER LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}.....	102
{[TRACE] LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}.....	102
{WAVEFORM-Length: #I0Q0I1Q1...IxQx...IN-1QN-1...}.....	103

{CLOCK: frequency}

(mandatory for waveforms)

The tag specifies the clock frequency at which the waveform has to be output, in Hz (on multi-segment waveforms this tag contains the maximal clock of all segments).

A query of `ARB:CLOCK?` after loading the waveform returns the value set using the `CLOCK` tag. This value can later be altered with the command `ARB:CLOCK?`.

Example:

```
{CLOCK: 54000000}
BB:ARB:WAV:TAG? 'CLOCK'
Queries the content of the CLOCK tag.
Response: 54000000
The clock frequency is set to 54 MHz.
```

Usage: Setting only

{CONTROL LENGTH: ControlLength}

(optional / recommended for marker and control lists)

The tag specifies the length of *all* control or marker list in ASCII format.

The control length influences the way the marker and control lists are processed, in particular the way traces are repeated; see [Figure 4-15](#).

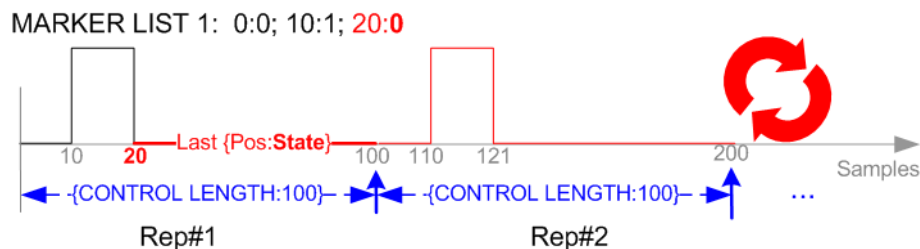


Figure 4-15: Example: Processing of MARKER TRACE if CONTROL LENGHT is specified

If the `CONTROL LENGTH` tag is not used, the marker and control list length are determined by the last position, that is the last `{Pos:State}` couple, defined in the particular `[TRACE] LIST` tag; see [Figure 4-16](#).

Using the arbitrary waveform generator (ARB)

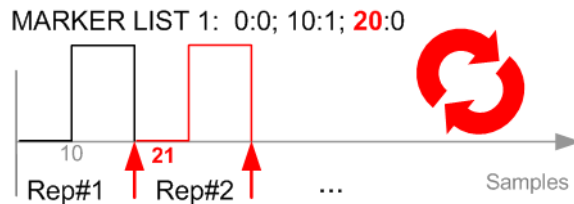


Figure 4-16: Example: Processing of MARKER TRACE if CONTROL LENGTH is not used

To maintain marker signals and waveform data synchronized, set the `CONTROL LENGTH` to be equal to the number of samples specified with the tag `SAMPLES`.

See also [Chapter 4.3.4.5, "Defining periodically repeating traces"](#), on page 92.

Example:

```
{CONTROL LENGTH: 500}
SOURCE:BB:ARBITRARY:CLIST:TAG? 'CONTROL LENGTH'
Queries the length of the control list.
Response: 500
```

{EMPTYTAG-Length: #EmptySequence}

(mandatory in automatically generated one and multi-segment waveforms)

This tag is empty, i.e. contains no data, and is used as placeholder.

Setting parameters:

Length	An ASCII integer value that specifies the number of bytes in the <code>EMPTYTAG</code> , i.e. defines the number of bytes from the colon <code>:</code> to the end brace <code>}</code> Note: If you change the content of a waveform file, change also the <code>{EMPTYTAG-Length}</code> value. For example, if you add a tag or add bytes to a tag, reduce the length by the number of newly introduced bytes.
EmptySequence	An empty sequence containing blanks only. The number of used blanks is calculated as the difference between the hex addresses of the <code>{WAVEFORM}</code> tag and the hash sign <code>#</code> in the <code>{EMPTYTAG}</code> . The <code>{WAVEFORM}</code> tag always starts at hex address <code>#4000</code> .

Example:

```
{TYPE:SMU-WV, 837236424}
{COPYRIGHT:2003 Rohde&Schwarz SMU}
{DATE:2012-07-11;14:38:01}
{SAMPLES:80000}
{CLOCK:8666666.666666666}
{VECTOR MAX:1.000000038569158}
{LEVEL OFFS:3.333553817875577e-07,0}
{MARKER LIST 1:0:1;1:0;1249:0}
{MARKER LIST 2:0:1;1:0;1249:0}
{MARKER LIST 3:0:1;1:0;1249:0}
{MARKER LIST 4:0:1;1:0;1249:0}
{EMPTYTAG-15947:# ...}
{WAVEFORM-320017:#IQIQIQ...}
```

The example waveform file contains 436 (0x1b4) bytes before the # sign in the EMPTYTAG; the hex address of the # sign is 0x1b5. The {WAVEFORM} starts at 0x4000. The EMPTYTAG contains 15946 blanks and has a length of (15946+1) bytes.

Usage: Setting only

{LEVEL OFFS: RMSOffset_dB,PeakOffset_dB}

(recommended for waveforms)

The tag determines the level of the ARB signal in the waveform file. The offset levels define the offset of RMS and peak value relative to the 16-bit full scale modulation (-32767 to + 32767) = 0 dB.

Setting parameters:

RMSOffset_dB Defines the RMS level offset of the signal relative to full scale ARB signal in the WAVEFORM tag. The offset is defined in ASCII float format. The value is always positive.
A 3 dB value indicates that the RMS level of the signal is 3 dBs below the full scale.
full scale = max. amplitude of vector of I/Q samples = $|S_{IQ}|_{max} = \sqrt{I^2+Q^2}_{max} = 0$ dB

PeakOffset_dB Defines the peak level offset of the signal relative to full scale for the ARB signal in the WAVEFORM tag. The offset is defined in ASCII float format.
The value usually equals 0 dB as usually the I/Q samples (signed 16-bit integer values) are modulated to full scale: Full scale = 0 dB = max. amplitude of vector of I/Q samples = $|S_{IQ}|_{max} = \sqrt{I^2+Q^2}_{max} = (2^{15})-1 = 32767$.
A positive PeakOffset_dB value indicates that a headroom to full scale is provided when generating the waveform. A negative PeakOffset_dB value indicates that overrange is likely for some samples, i.e. clipping might occur.
The crest factor can be calculated from the two values as follows:

Using the arbitrary waveform generator (ARB)

$$\text{Crest Factor} = |\text{PeakOffset_dB} - \text{RMSOffset_dB}|$$
Example:

```
{LEVEL OFFS: 3.45,2}
```

```
BB:ARB:WAV:TAG? 'LEVEL OFFS'
```

Queries the content of the LEVEL OFFS tag of the selected waveform file.

```
Response: 3.45,2
```

The level of the waveform is below full scale, clipping does not occur.

Usage:

Setting only

{MARKER MODE [#]: GENERATOR}**(Optional for waveforms)**

The tag defines how the marker signals are generated. The tag is included in the waveforms, created by the R&S WinIQSIM2 software.

- Tag not used

The marker signals defined with the tag **MARKER LIST** are converted into a separate binary control list. When the waveform is loaded into the ARB, this control list is also loaded automatically and processed synchronous with the waveform.

Note: This method reduces the maximum waveform length (given as number of samples). The number of available samples is limited, because each marker requires 4 bits per I/Q sample, additionally to the 32 bits required to describe an I/Q sample.

- Tag is used

The marker signals defined with the tag **MARKER LIST** are processed internally; additional control list is not created. If the tag is used for **all 4 markers**, the whole ARB memory is available for the I/Q samples.

Note: If this tag is used, the maximum number of marker states defined with the tag **MARKER LIST** is 64, i.e. Pos₆₃:State₆₃

Setting parameters:

[#] 1 to 4

Sets the marker number.

Example:

```
{MARKER MODE 1: GENERATOR}
```

```
{MARKER MODE 2: GENERATOR}
```

```
{MARKER MODE 3: GENERATOR}
```

Usage:

Setting only

{SAMPLES: Samples}**(recommended for waveforms)**

The tag contains the number of I/Q samples in the waveform in ASCII format.

On multi-segment waveforms, this tag contains the total I/Q samples of all segments.

Example: `{SAMPLES: 1000}`
`BB:ARB:WAV:TAG? 'SAMPLES'`
 Queries the content of the `SAMPLES` tag of the selected waveform file.
 Response: 1000
 The waveform contains 1000 I/Q samples.

Usage: Setting only

See also [Chapter 4.3.4.5, "Defining periodically repeating traces"](#), on page 92.

{BURST LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}
{CW MODE LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}
{HOP LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}
{LEVATT LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}
{MAP LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}
{MARKER LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}
{[TRACE] LIST [#]: Pos0:State0; Pos1:State1; ...PosN-1:StateN-1}
 (mandatory for control lists / optional for waveforms)

The tag contains the data for the marker and control signals in the control list or the marker signals of ARB waveforms.

Depending on the control length, the instrument processes traces differently, see `{CONTROL LENGTH: ControlLength}` on page 98.

How to: [Chapter 4.3.4.5, "Defining periodically repeating traces"](#), on page 92

Also, the processing of the marker traces (`MARKER LIST`) depends on the presence of the marker mode tag. See `{MARKER MODE [#]: GENERATOR}` on page 101.

Setting parameters:

<code>[TRACE]</code>	MARKER BURST LEVATT CW MODE HOP MAP Name of the marker or control signal. For ARB waveforms, it is only meaningful to define marker signals; in the ARB multi-segment waveforms these tags are ignored.
<code>[#]</code>	1 to 4 Sets the marker or control trace number; supported is only <code>LEVATT LIST 1</code> .
<code>Pos</code>	Specifies in ASCII format the position (i.e. sample number or data value), with the effect from which the binary <code>State</code> of the marker or of the control signal changes. If you use the marker mode tag, the maximum number of marker states is 64, i.e. <code>Pos₆₃:State₆₃</code> . See <code>{MARKER MODE [#]: GENERATOR}</code> on page 101.
<code>State</code>	0 1 Specifies the binary state of the marker or of the control signal from <code>Pos_N</code> to <code>Pos_{N+1}</code> exclusive in ASCII format.

- Example:** `{MARKER LIST 1: 0:0;10:1;20:0;30:1}`
`BB:DM:CLIS:TAG? 'MARKER LIST 1'`
 Queries the content of the `MARKER LIST 1` tag of the selected control list file.
 Response: `'0:0;10:1;20:0;30:1'`
 The marker setting for samples 0 to 9 = 0 (low), for 10 to 19 = 1 (high) and for 20 to 29 = 0. From sample 30 onward, the marker setting is 1 (high).
- Example:** `{LEVATT LIST 1: 0:0;10:1;20:0;30:1}`
`BB:DM:CLIS:TAG? 'LEVATT LIST 1'`
 Queries the content of the `LEVATT LIST 1` tag of the selected control list file.
 Response: `'0:0;10:1;20:0;30:1'`
 Level attenuation applies to data values 10 to 19 (high) and from data value 30 onward.
- Usage:** Setting only

{WAVEFORM-Length: #I0Q0I1Q1...IxQx...IN-1QN-1...}

(mandatory for waveforms)

Setting parameters:

- Length** Sets the number of bytes in a `WAVEFORM` tag and is calculated as follows:

$$\text{Length} = \text{Number of I/Q pairs} * 4 \text{ (2 bytes per I and 2 bytes per Q value)} + 1 \text{ byte (the length of the \#)}$$
- IxQx** `IxQx...` represents binary data (16-bit signed integer in 2's complement notation) containing the I and Q component alternately and starting with the I component. Each component consists of 2 bytes in little endian format representation, i.e the least significant byte (LSB) first.
 The values of the 2 bytes in an I component and a Q component are in the range 0x0 to 0xFFFF (-32767 to +32767). This value is transferred to the D/A converter.
- Example:** **One segment waveform**
`{WAVEFORM-401:#I0,Q0,I1,Q1,I2,Q2,...I99,Q99}`
 100 I/Q pairs with 4 bytes each are transmitted - none multi-segment.
- Usage:** Setting only

4.4 Generating multicarrier waveform signals

To simulate complex multicarrier scenarios with different baseband signals, the R&S SF100A provides the possibility to generate multicarrier waveforms. These wave-

forms can consist of up to 512 carriers, each modulated by the same or by different user-selectable baseband signal.

The multicarrier waveform is a practical solution for the generation of a complex broadband signal, for example:

- Multicarrier waveforms build from signals of different communication standards (e.g. CDMA2000 or 3GPP FDD)
- Multicarrier waveforms composed of several signals from the same communication standard as in LTE Advanced.

4.4.1 Required options

See [Chapter 4.3.1, "Required options"](#), on page 64.

Multicarrier waveform files require the corresponding digital standard options (R&S SFI-K2xx) of all included standards.

4.4.2 About the multicarrier waveforms

This chapter provides background information on the ARB functionality for generating of multicarrier signals and the impact of the provided settings. See [Chapter 4.4.4, "Using the multicarrier function"](#), on page 119 for information on how to use the provided settings to configure a multicarrier signal.

The multicarrier waveforms are a convenient way to configure the broadband test signals required for transmitter or receiver tests. Even complex multicarrier scenarios composed of signals from different digital standards can be created and used for these tests.

Because the multicarrier files are processed by the ARB, the composed waveform file must be created before it is loaded to and played by the ARB. The R&S SFI100A saves the created multicarrier waveform file under a user-definable name; as with the single carrier waveforms, the used file extension is *.wv. The instrument appends additional information to the header of the composed waveform file. When the created waveform is loaded, the graphical interface displays information on clock rate, number of samples and creation day.

General principle for composing the multicarrier signal

The following is a list of the general steps used for composing the multicarrier signal:

- In the default mode, the up to 512 carriers are equally spaced and centered toward the RF frequency or the baseband DC line.
The carrier spacing is adjustable within the total available bandwidth. Make sure that the total RF bandwidth of the composed multicarrier signal does not exceed the available RF bandwidth.
- Another possibility is to define the center frequency of each of the carrier individually, see also [Chapter 4.4.2.1, "Defining the carrier frequency"](#), on page 105.
- Define each carrier separately in terms of power, phase and modulated input signal.

To define the leveling of the composed multicarrier signal, use the parameter "Power Reference", see "Power Reference" on page 110.

- Optionally, optimize the crest factor of the multicarrier output signal, see [Chapter 4.4.2.2, "Optimizing the crest factor"](#), on page 106.
- After all multicarrier processing steps are completed, the instrument calculates the resulting peak and RMS power over the total signal. This value is then written in the waveform file.

For more information, refer to the specifications document.

4.4.2.1 Defining the carrier frequency

There are two ways to define the carrier frequency of the individual carriers in the multicarrier signal:

- Enable the arbitrary carrier frequency distribution and specify the carrier frequency of each carrier individually.
- Use the built-in equidistant carrier spacing distribution function.

About equidistant carrier spacing

Equidistant carrier spacing implies a uniform distribution around the RF frequency. This method derives the carrier frequencies automatically from the selected number of carriers and the carrier spacing.

The maximum carrier spacing Δf_{max} is a function of the available total bandwidth f_{tot} and the selected number of carriers n . Calculate Δf_{max} as follows:

$$\Delta f_{max} = \frac{f_{tot}}{n - 1}$$

The method rounds the value of the carrier spacing Δf_{round} so that the carrier that is closest to the center RF frequency shows no phase jump. Also, this method holds for unmodulated carriers only. Rounding includes the output signal duration t_{output} and the actual carrier spacing Δf as follows:

- For an odd number of carriers:

$$\Delta f_{round} \simeq \frac{1}{t_{output}} * [\Delta f * t_{output}]$$

- For an even number of carriers:

$$\Delta f_{round} \simeq \frac{2}{t_{output}} * [0.5 * \Delta f * t_{output}]$$

To avoid wrap-around problems, you can slightly modify the effective applied carrier spacing. See also "Mode" on page 108.

4.4.2.2 Optimizing the crest factor

An introduction to the topic is provided in [Chapter 4.2.6, "Methods for optimizing the crest factor"](#), on page 61. This section focuses on the settings provided for and related to the multicarrier signals.

The R&S SF100A provides a crest factor reduction by an automatic optimization upon selected values for the following parameters:

- "Crest Factor Mode":
This mode offers multicarrier output signals with minimized or maximized target crest factor values via internal phase corrections of the single carriers. For a disabled mode ("Off"), there are no phase corrections.
- "Clipping":
Clipping reduces the peak power of the output multicarrier signal. The clipped peak power level is the sum of the RMS level of the unclipped multicarrier signal and the parameter "Target Crest Factor".
Because clipping also reduces the RMS level, the resulting crest factor of the clipped signal is slightly above the "Target Crest Factor".
- "Target Crest Factor":
Sets the target crest factor. A value above the crest factor of the unclipped multicarrier signal has no effect.
- "Filter Cut Off Frequency":
This frequency is the lowpass filter frequency. If the cutoff frequency equals half of the output sample rate, a final lowpass filter improves the spectrum of the clipped multicarrier signal. But lowpass filtering can also increase the resulting crest factor.

4.4.3 Multicarrier settings

Access:

- ▶ Select "Baseband" > "ARB" > "General" > "Create Multi Carrier".

The "ARB: Multi Carrier" dialog opens. It provides general settings to configure the carrier distribution around the center frequency and to improve the output signal characteristics.

The tab "Carrier Table" allows selecting a waveform file per carrier. Use the "Carrier Graph" to visualize the configured signal.

The remote commands to define these settings are described in [Chapter 13.16.2.5, "Multicarrier commands"](#), on page 543.

Settings:

- [General settings](#)..... 107
- [Output settings](#)..... 112
- [Carrier table settings](#)..... 113
- [Carrier table assistant](#)..... 115
- [Carrier graph](#)..... 118

4.4.3.1 General settings

Access:

- ▶ Select "Create Multi Carrier" > "General" > "General Settings".

This tab provides settings to select the output waveform file, to enable signal generation and to configure the distribution of the carriers.

Settings:

Set to Default.....	107
Save/Recall.....	108
Mode.....	108
Number of Carriers.....	108
Carrier Spacing.....	108
Crest Factor Mode.....	109
Clipping.....	109
Target Crest Factor.....	109
Filter Cut Off Frequency.....	109
Signal Period Mode.....	110
Signal Period Mode.....	110
Power Reference.....	110
Create/Create and Load.....	112

Set to Default

Calls the default settings.

Parameter	Value
"Number of Carriers"	"1"
"Carrier Spacing"	"0.00 Hz"
"Crest Factor Mode"	"Off"
"Signal Period Mode"	"Longest File Wins"

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:PRESet](#) on page 544

Save/Recall

Opens the standard "Save"/"Recall" dialog that is the standard instrument function for saving and recalling the complete dialog-related settings.

Save multicarrier settings in files with file extension `*.arb_multcarr`. Define the file-name and the directory of the file.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:SETTing:CATalog?](#) on page 544

[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:SETTing:LOAD](#) on page 544

[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:SETTing:STORE](#) on page 545

Mode

Selects the way that the carriers are distributed within the available bandwidth.

"Equidistant Carrier Spacing"

Sets an equidistant carrier spacing distribution, i.e. the carriers are equally spaced and centered toward the RF frequency. The carrier frequencies are automatically calculated depending on the selected number of carriers and the carrier spacing.

"Arbitrary Carrier Frequency"

Set the carrier frequency of each carrier individually.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:CARRier:MODE](#) on page 545

Number of Carriers

Sets the number of carriers for the multicarrier waveform. By default the multicarrier table lists one carrier. A maximum of 512 carriers can be configured and activated.

When the number of carriers is increased, new lines are added at the end of the table. If these carriers already have been defined before, the settings are preset according to the former settings. Otherwise the parameters are preset with the default values.

See also [Chapter 4.4.2.1, "Defining the carrier frequency"](#), on page 105.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:CARRier:COUNT](#) on page 545

Carrier Spacing

Sets the frequency spacing between adjacent carriers of the multicarrier waveform.

The distribution of the carriers is symmetric around the RF carrier. See also [Chapter 4.4.2.1, "Defining the carrier frequency"](#), on page 105.

For more information, refer to the specifications document.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CARRier:SPACing` on page 545

Crest Factor Mode

Selects the mode for optimizing the crest factor by calculating the carrier phases. See also [Chapter 4.4.2.2, "Optimizing the crest factor"](#), on page 106.

The following modes are available:

- | | |
|------------|--|
| "Off" | There is no automatic setting for minimizing or maximizing the crest factor. The "Phase" setting as defined in the carrier table is in use. |
| "Minimize" | The crest factor is minimized by internally calculating optimized carrier phases. The phase setting displayed in the carrier table is invalid. |
| "Maximize" | The crest factor is maximized by internally calculating optimized carrier phases. The phase setting displayed in the carrier table is invalid. |

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CFACTOR:MODE` on page 546

Clipping

Enables baseband signal clipping.

Clipping reduces the peak power of the resulting multicarrier signal according to the input parameter "Target Crest Factor". See also, [Chapter 4.4.2.2, "Optimizing the crest factor"](#), on page 106.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CLIPping[:STATe]` on page 547

Target Crest Factor

Requires "Clipping" > "On".

Sets the value of the target crest factor. A "Target Crest Factor" above the crest factor of the unclipped multicarrier signal has no effect. See also [Chapter 4.4.2.2, "Optimizing the crest factor"](#), on page 106.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CLIPping:CFACTOR` on page 547

Filter Cut Off Frequency

Requires "Clipping" > "On".

Sets the cutoff frequency of the lowpass filter before the output of the multicarrier signal.

See also [Chapter 4.4.2.2, "Optimizing the crest factor"](#), on page 106.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CLIPping:CUTOFF` on page 547

Signal Period Mode

Defines the way the resulting signal period of the multicarrier waveform is calculated. The resulting period is always calculated for all carriers in the carrier table irrespective of their state (ON/OFF). Use the "Carrier Table" > "Info" function to obtain information on the sample rate and file length data of each carrier.

Note: Wrap-around and timing problems can occur when I/Q signals of different length are used. Thus, demodulation of a carrier can be difficult or even impossible.

We recommend that you proceed as follows:

- Consider the timing when creating the input I/Q files.
- Adjust the signal duration to the carrier which is then demodulated.
Other carriers interfere with the signal.

These problems do not arise with signals of the same standard, for example, 3GPP signals.

The following modes are available:

"Longest File Wins"

The longest I/Q file in the carrier table defines the resulting signal period. Shorter I/Q files are periodically repeated.

"Shortest File Wins"

The shortest I/Q file in the carrier table defines the resulting signal period. Longer I/Q files only use the first part.

"User"

Sets the signal period manually, see ["Signal Period Mode"](#) on page 110. Repeats shorter I/Q files periodically and uses only the first part of longer I/Q files.

"Least Common Multiple"

The output file duration is the least common multiple of all input file durations.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:TIME:MODE` on page 548

Signal Period Mode

Sets the signal period in signal duration mode "User". Repeats shorter I/Q files periodically and for longer I/Q files, uses only the first part.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:TIME` on page 546

Power Reference

Sets the method of leveling individual carriers in a composed multicarrier signal. The difference between the provided modes is especially important if signals with different crest factors are composed together into a multicarrier signal.

"RMS" The individual carriers are leveled based on their RMS power and the configured "Carrier Gain".

Example:

A multicarrier signal is composed from two waveform files.

First carrier "Gain" = 0 dB

Second carrier "Gain" = -3 dB

In the resulting multicarrier signal, the *RMS power* of the second carrier signal is 3 dB lower than the RMS power of the first carrier signal.

"Peak" The individual carriers are leveled based on their peak power and the configured "Carrier Gain".

Example:

A multicarrier signal is composed from two waveform files.

First carrier "Gain" = 0 dB

Second carrier "Gain" = -3 dB

In the resulting multicarrier signal, the *peak power* of the second carrier signal is 3 dB lower than the peak power of the first carrier signal.

Example: Multicarrier signal composed of waveforms with different crest factor

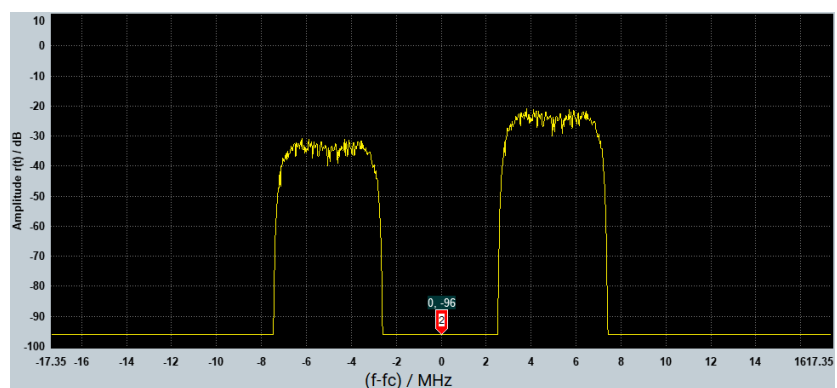
A multicarrier signal is composed from two waveform files with the following characteristics:

3GPP FDD signals with the same "Sample Rate" but *different "Crest Factors"*.

"Peak" = 0 dBFS

"Carrier Gain" = 0 dB

State	Carrier Freq. Offs. / MHz	Gain / dB	Phase / deg	Delay / ns	File	Info	!!!
0 On	-5.000 000	0.00	0.00		0 /var/user/te1	Info...	
1 On	5.000 000	0.00	0.00		0 /var/user/te2	Info...	



The peak values of the carrier signals are equal, but the RMS values are different.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:POWer:REFErence](#) on page 548

Create/Create and Load

Creates a multicarrier waveform defined by the multicarrier table and general setting entries.

If you start the calculation with the "Create and Load" function, the instrument creates the waveform and loads it in the ARB.

Also, saves this multicarrier waveform with filename as set in "Output File". Depending on the configuration of the multicarrier waveform, calculation can take some time. To stop the calculation, use the "Abort" function.

Remote command:

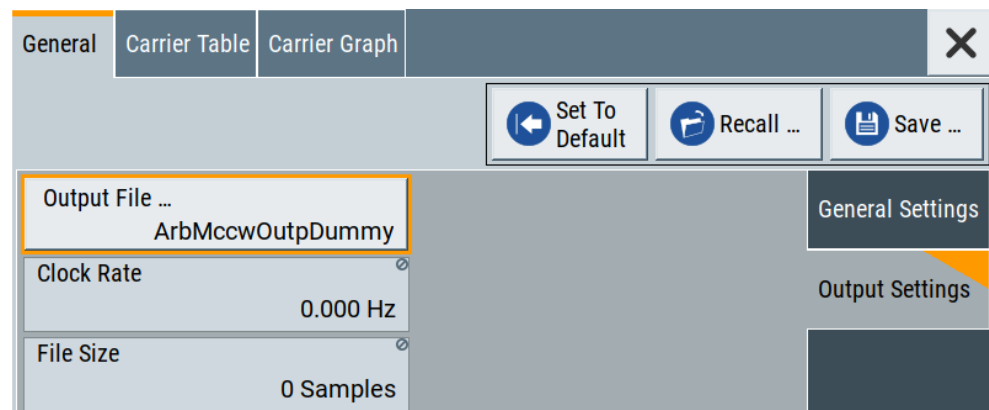
[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:CREate](#) on page 549

[\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:CLoad](#) on page 548

4.4.3.2 Output settings

Access:

- ▶ Select "Create Multi Carrier" > "General Settings" > "Output Settings"



This tab displays settings of the output file and related output multicarrier signal. These settings include the output filename, the clock rate and the file size.

Settings:

Output File	112
Clock Rate	113
File Size	113

Output File

Opens a standard "File Select" dialog to set the output filename of the multicarrier waveform to be calculated. As with normal waveforms, the file extension is *.wv.

To trigger the calculation and storage of this multicarrier waveform, select "Create" or "Create and Load".

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:OFILe` on page 548

Clock Rate

Displays the resulting sample rate during the output of the multicarrier waveform is output at the ARB.

The output clock rate depends on the following:

- Number of carriers
- Carrier spacing
- Input sample rate of the leftmost or rightmost carriers.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CLOCK?` on page 549

File Size

Displays the resulting number of samples of the multicarrier waveform.

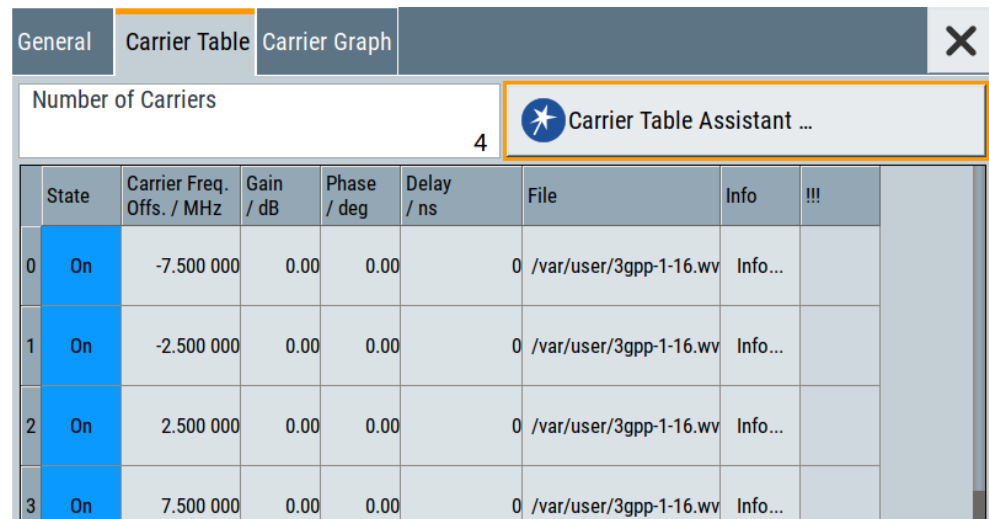
Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:SAMPles?` on page 546

4.4.3.3 Carrier table settings

Access:

- ▶ Select "Create Multi Carrier" > "Carrier Table"



State	Carrier Freq. Offs. / MHz	Gain / dB	Phase / deg	Delay / ns	File	Info	!!!
0 On	-7.500 000	0.00	0.00		0 /var/user/3gpp-1-16.wv	Info...	
1 On	-2.500 000	0.00	0.00		0 /var/user/3gpp-1-16.wv	Info...	
2 On	2.500 000	0.00	0.00		0 /var/user/3gpp-1-16.wv	Info...	
3 On	7.500 000	0.00	0.00		0 /var/user/3gpp-1-16.wv	Info...	

This tab provides the settings to configure the number of carriers and set individual carrier characteristics in a table. The number of lines equals the number of carriers. Note that valid phase settings "Phase (deg)" require disabled crest factor optimization: "Crest Factor Mode" > "Off".

Optionally, use the "Carrier Table Assistant" for simplified configuration of the individual carriers, see [Chapter 4.4.3.4, "Carrier table assistant"](#), on page 115. Use the "Carrier

Graph" tab to visualize the configured multicarrier signal including its individual carriers, see [Chapter 4.4.3.5, "Carrier graph"](#), on page 118.

Settings:

Number of Carriers.....	114
Carrier number.....	114
State.....	114
Carrier Freq. Offs. (MHz).....	114
Gain (dB).....	114
Phase (deg).....	114
Delay (ns).....	115
File.....	115
Info.....	115
!!!.....	115

Number of Carriers

Defines the number of carriers of the multicarrier waveform, see ["Number of Carriers"](#) on page 108.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:CARRier:COUNT` on page 545

Carrier number

Displays the number of an individual carrier. The numbering of these carriers ranges from 0 to the number of carriers - 1.

Remote command:

Set via suffix `CARRier<ch>`.

State

Enables an individual carrier.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:CARRier<ch>:STATE` on page 549

Carrier Freq. Offs. (MHz)

Displays the carrier frequency offset. This offset indicates

Note: The carrier frequency can only be set in "Arbitrary Carrier frequency" mode. For "Equidistant Carrier Spacing", the carrier spacing is determined automatically.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:CARRier<ch>:FREQUENCY`
on page 550

Gain (dB)

Sets the gain of a carrier.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:CARRier<ch>:POWER` on page 550

Phase (deg)

Sets the starting phase of a carrier.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CARRier<ch>:PHASe` on page 550

Delay (ns)

Sets the starting delay of a carrier.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CARRier<ch>:DELay` on page 551

File

Opens the standard "File Select" function for selecting the input file. The input file contains the I/Q signal that is modulated onto the carrier.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CARRier<ch>:FILE` on page 551

Info

Opens a waveform information dialog. This dialog lists the sample rate, the number of I/Q value pairs (number of samples) and the signal period.

Remote command:

n.a.

!!!

Indicates a conflict with a warning triangle. A conflict arises when the carriers overlap and is also indicated in the header of the "Carrier Table" tab.

Remote command:



`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CARRier<ch>:CONFLICT?`
on page 551

4.4.3.4 Carrier table assistant

Access:

1. Select "Create Multi Carrier" > "Carrier Table"

2. Select "Carrier Table Assistant".

Number of Carriers	4	
Carrier Start	0	Carrier Stop 0
Carrier State	<input checked="" type="checkbox"/>	
Gain Start	0.00 dB	Gain Step 0.00 dB
Phase Start	0.00 deg	Phase Step 0.00 deg
Delay Start	0 ns	Delay Step 0 ns
 Input Waveform File ...		3gpp-1-16
 Apply Assistant Settings		

The "Carrier Table Assistant" dialog enables the configuration of a selectable subset of carrier. The provided settings are an optional way to create a multicarrier scenario within a specified carrier range.

Settings:

Carrier State.....	116
Carrier Start.....	116
Carrier Stop.....	117
Gain Start.....	117
Gain Step.....	117
Phase Start.....	117
Phase Step.....	117
Delay Start.....	117
Delay Step.....	118
Input Waveform File.....	118
Apply Assistant Settings.....	118

Carrier State

Enables the carriers in the range "Carrier Start" to "Carrier Stop".

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:STATe` on page 551

Carrier Start

Sets the carrier start that is the first individual carrier for which the carrier assistant settings apply.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:START` on page 552

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:STOP` on page 552

Carrier Stop

Sets the carrier stop that is the last individual carrier for which the carrier assistant settings apply.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:START` on page 552

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:STOP` on page 552

Gain Start

Sets the gain of the carrier marked by "Carrier Start".

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:POWer [:START]`

on page 552

Gain Step

Sets the step size that is used to increment the gain.

The resulting carrier gain in the carrier table equals:

$$\text{Gain} = \text{"Gain Start"} + n * \text{"Gain Step"}$$

n is a value between 0 and the difference of "Carrier Stop" and "Carrier Start".

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:POWer:STEP`

on page 552

Phase Start

Sets the phase of the carrier marked by "Carrier Start".

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:PHASe [:START]`

on page 553

Phase Step

Sets the step size that is used to increment the phase.

The resulting phase in the carrier table equals:

$$\text{Phase} = \text{"Phase Start"} + n * \text{"Phase Step"}$$

n is a value between 0 and the difference of "Carrier Stop" and "Carrier Start".

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:PHASe:STEP`

on page 553

Delay Start

Sets the delay of the carrier marked by "Carrier Start".

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:DELay [:START]`

on page 554

Delay Step

Sets the step size that is used to increment the delay.

The resulting delay in the carrier table equals:

$$\text{Delay} = \text{"Delay Start"} + n * \text{"Delay Step"},$$

n is a value between 0 and the difference of "Carrier Stop" and "Carrier Start".

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:DELay:STEP`

on page 553

Input Waveform File

Opens the standard "File Select" function for selecting the input file. The input file contains the I/Q modulation signal for all carriers of the selected carrier range.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:FILE` on page 554

Apply Assistant Settings

Transfers the assistant settings to the carrier table.

Remote command:

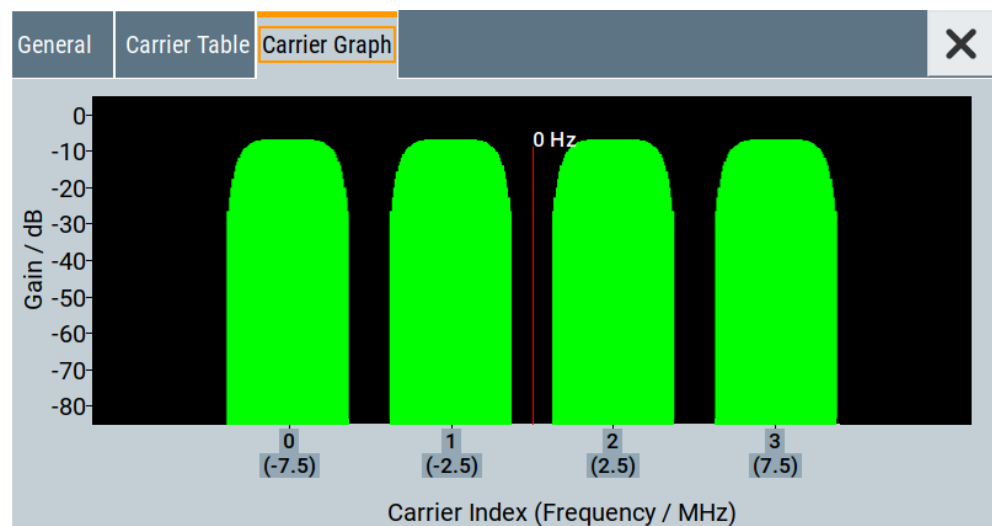
`[:SOURce<hw>] :BB:ARbitrary:MCARrier:EDIT:CARRier:EXECute`

on page 554

4.4.3.5 Carrier graph

Access:

- ▶ Select "Create Multi Carrier" > "Carrier Graph".



The carrier graph is a graphical representation of the current multicarrier configuration in the frequency domain.

The height of the bars corresponds to the gain of each individual carrier. The bars width indicates the bandwidth of the carriers signals.

4.4.4 Using the multicarrier function

This section provides step-by-step instructions on how to configure and use the multicarrier settings.

To create a multicarrier waveform file

1. To configure the general settings, select "Baseband" > "ARB" > "General".
2. To configure the carrier table, select "ARB" > "Multi Carrier" > "Carrier Table"
3. To enter the filename of the multicarrier waveform, select "ARB" > "Multi Carrier" > "Output File"
4. To save or load a multicarrier waveform, select "ARB" > "Multi Carrier" > "Create" or "Create and Load".


To generate a multicarrier signal for standard transmitter tests

High-power amplifiers of multicarrier base stations face increased requirements in terms of linearity and acceptable intermodulation performance.

To set up a standard transmitter test, proceed as follows:


1. Open the "Baseband" > "3GPP FDD" dialog. Proceed as follows:
 - a) Select "3GPP FDD" > "Basestations" > "Test Setups/Models".
 - b) Select "3GPP FDD: Downlink/Test Model" > "Test_Model_1_16channels".
 - c) To confirm, tap "Select".
2. To enable signal generation, select "3GPP FDD" > "General" > "On".
3. To create a 3GPP ARB file, select "3GPP FDD" > "Generate Waveform".
Enter the name of the waveform that you want to generate, for example:
3gpp_1_16.
4. Confirm with "Save"
5. To set up a multicarrier scenario with 4 carriers and a carrier spacing of 5 MHz, select "Baseband" > "ARB" > "Create Multi Carrier".
Perform the following:
 - a) In the "General" dialog, select "Number of Carriers" = "4" and "Carrier Spacing" = "5 MHz".
 - b) To load the generated waveform file to all 4 carriers, select "Carrier Table" > "Carrier Table Assistant".
 - c) Select "Carrier Start" = "0" and "Carrier Stop" = "3".
 - d) To load the generated waveform file to all 4 carriers, select "ARB Multi Carrier Table" > "Input Waveform File".
 - e) Select the generated waveform file 3gpp_1_16.

- f) Select "ARB Multi Carrier Table" > "Carrier State" > "On".

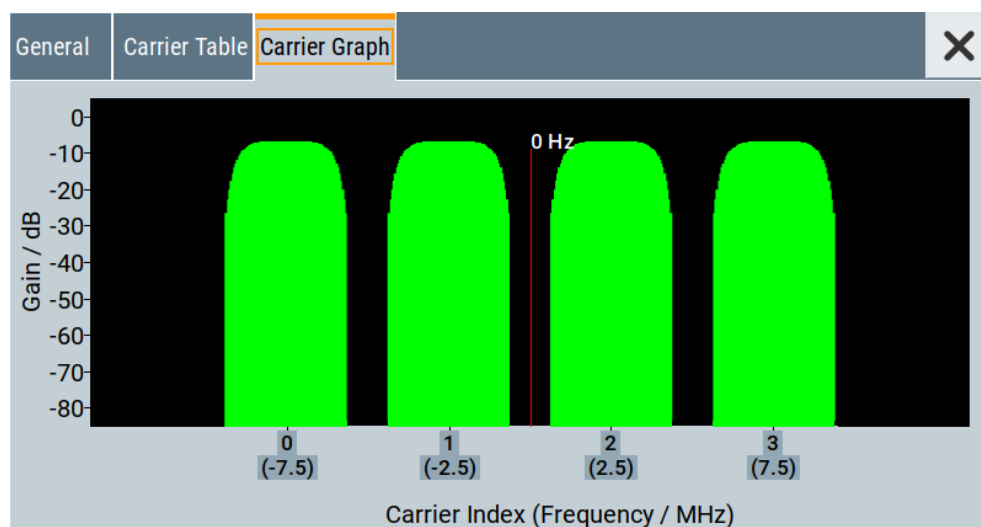
Number of Carriers	4	
Carrier Start	0	Carrier Stop 0
Carrier State	<input checked="" type="checkbox"/>	
Gain Start	0.00 dB	Gain Step 0.00 dB
Phase Start	0.00 deg	Phase Step 0.00 deg
Delay Start	0 ns	Delay Step 0 ns
 Input Waveform File ...		3gpp-1-16
<input checked="" type="checkbox"/> Apply Assistant Settings		

- g) Select "ARB Multi Carrier Table" > "Apply Assistant Settings".
h) Close the dialog.

The "ARB: Multi Carrier" > "Carrier Table" dialog confirms the configuration.

General		Carrier Table	Carrier Graph						X
Number of Carriers		4	 Carrier Table Assistant ...						
State	Carrier Freq. Offs. / MHz	Gain / dB	Phase / deg	Delay / ns	File	Info	!!!		
0	On	-7.500 000	0.00	0.00	0 /var/user/3gpp-1-16.wv	Info...			
1	On	-2.500 000	0.00	0.00	0 /var/user/3gpp-1-16.wv	Info...			
2	On	2.500 000	0.00	0.00	0 /var/user/3gpp-1-16.wv	Info...			
3	On	7.500 000	0.00	0.00	0 /var/user/3gpp-1-16.wv	Info...			

6. Select "ARB: Multi Carrier" > "Carrier Graph" to visualize the configuration.



7. Select "ARB: Multi Carrier" > "General" > "Output Settings" > "Output File".
8. Enter the name of the output file, for example `4x5MHz_3gpp_1_16`.
9. To load the waveform in the ARB, select "ARB: Multi Carrier" > "General" > "Create" or "Create and Load".
10. Select "ARB" > "General" > "Load Waveform", to select the multicarrier output file.
11. Select "ARB" > "State" > "On" to enable the ARB.

4.5 Configuring global connectors

The R&S SF100A is equipped with four "User" multipurpose bidirectional connectors that require no options.

This section provides background information on signal mapping and related settings. Also, it describes how to configure and work with these connectors. It covers the following topics:

- [About global connectors](#).....121
- [Trigger / Marker / Clock settings](#)..... 123
- [RF connectors settings](#)..... 125
- [Global connectors settings](#)..... 126
- [Routing signals to the connectors](#)..... 129

4.5.1 About global connectors

Signal to connector mapping

As described in [Chapter 4.2, "Common characteristics of the baseband domain"](#), on page 52, the R&S SF100A can generate control signals internally and process

external control signals. To handle these signals, the R&S SF100A introduces the concept of signal to connector mapping.

The available signals are not dedicated to a particular connector but can be mapped to several "User" connectors. The signal mapping and the polarity, the trigger threshold and the input impedance of the input connectors are configurable parameters.

How to: ["To map the signal to a connector"](#) on page 129

Related settings: [Global connectors settings](#).

4.5.1.1 Global connectors

The R&S SF100A is equipped with "User x" connectors that you can assign freely to a selection of input signals or output signal.

You can configure threshold, and input impedance is effective for all trigger and clock signal inputs provided at the "User" connectors. The settings influence the custom digital modulations, the generation of waveforms or multicarrier signals, and all digital standards.

The table [Table 4-4](#) provides an overview of the available input signals and output signals that you can map with the User connectors.

Table 4-4: Mapping control signals to the User x connectors

Connector	Direction	Signal	Remark
"User 1" to "User 2"	"Input"	"Global Trigger"	Use the connectors "User 1" to "User 2" for a global trigger input signal. You cannot use "User 3" as an input signal connector.
"User 1" to "User 3"	"Output"	"Triggered" "Always 0" "Always 1"	Use the connectors "User 1" to "User 3" for non-marker output signals. Per default, the signal is an output signal "Always 0".
"User 1" to "User 3"	"Not Used"	"None"	No signal is input or output. The setting implies a switched-off connector.
"User 4" to "User 7"	"Output"	"Baseband Marker"	Use the connectors "User 4" to "User 7" for marker output signals. The signal routing is fixed: <ul style="list-style-type: none"> • "Marker 1" to "User 7" • "Marker 2" to "User 6" • "Marker 3" to "User 5" • "Marker 4" to "User 4"

4.5.1.2 Trigger, marker, clock and RF connectors

The [Trigger / Marker / Clock settings](#) and [RF connectors settings](#) dialogs provide an overview of the current mapping of the logical signals to the corresponding connectors. The dialogs are summary representation of related settings, as configured with the [Global connectors settings](#) settings.

4.5.1.3 Status indicators

Connector status LEDs

A dedicated LED indicates the connector status:

- ● green: an input connector
- ● yellow: an output connector
- ● no light / gray: the connector is not active

TM block



For a quick overview of the control signal sources, the block diagram provides the "TM" block on the left side of the "Baseband" block.

If the baseband generator is enabled, a dedicated LED indicates the status of the control signal:

- ● Green: Uses an external signal.
- ● Yellow: Uses the signal as an output signal.

4.5.2 Trigger / Marker / Clock settings

Access:

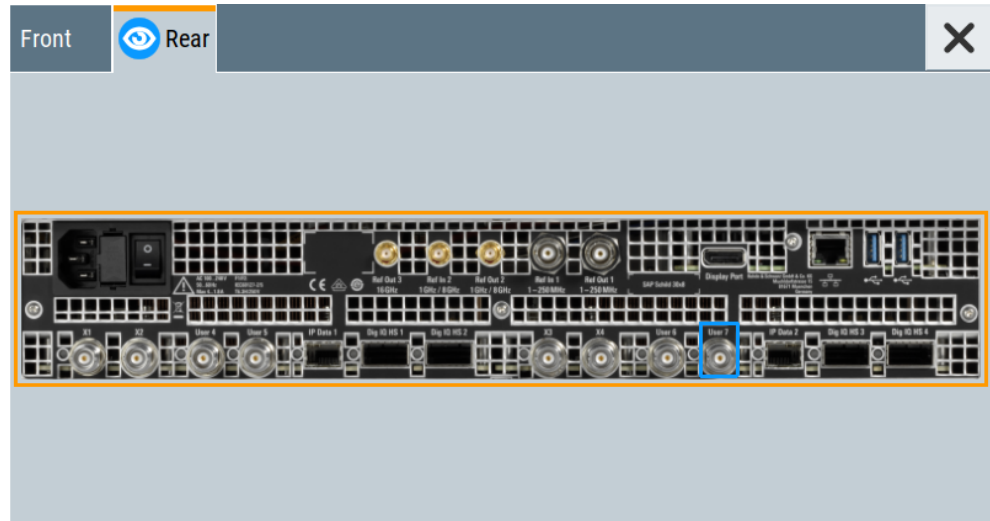
- In the block diagram, select the "TM" block to the left side of the "Baseband" block. The "Trigger / Marker / Clock" dialog opens. It provides an overview of the current mapping of the logical signals to the connectors, as configured in the [Global Connectors](#) dialog. Clicking the connector name directly accesses the related connector settings.


	Logical Signal	Connector	Show
Trigger Source	Internal		
Clock Source	Internal		
Clock Output			
Marker 1	Unchanged	User 7	...
Marker 2	Unchanged	User 6	...

Diagram Legend
 T = Trigger
 M = Marker
 C = Clock
● = Signal Source is external
● = Signal is available at Output Connector

- Use the built-in "Show Connector" function to display the physical location of the selected connector. See ["Show Connector"](#) on page 124.

A blinking LED on the rear panel indicates the selected connector:



The eye icon  in the tab header indicates the location of the connector on the panel (front, rear or both).

4.5.2.1 Overview table

Logical Signal

Displays the logical signal, as configured in the "Trigger In", "Marker" or "Clock" tab of the active baseband signal. Only the signals as configured in the "Baseband" > "ARB" tabs are applied. See for example [Chapter 4.3.3, "ARB settings"](#), on page 69.

Connector

Displays the assigned connector.



Show Connector

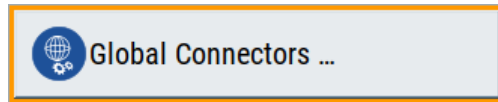
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

4.5.2.2 Global connector settings

Opens a dialog to configure global connectors.

The button is available in the following dialogs or tabs:

- "Trigger / Marker / Clock" dialog that is accessible via the "TM" block in the block diagram.
- "Trigger In", "Marker" and "Clock" tabs of baseband signal configuration dialogs that you can open via the "Baseband" block in the block diagram. These tabs are available, for example, for "ARB" baseband signals.



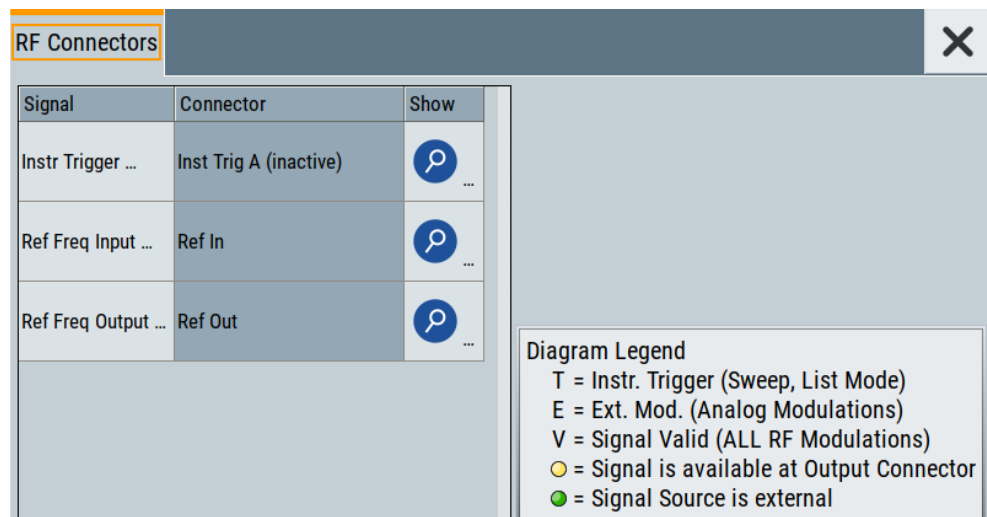
See also [Chapter 4.5, "Configuring global connectors"](#), on page 121.

4.5.3 RF connectors settings

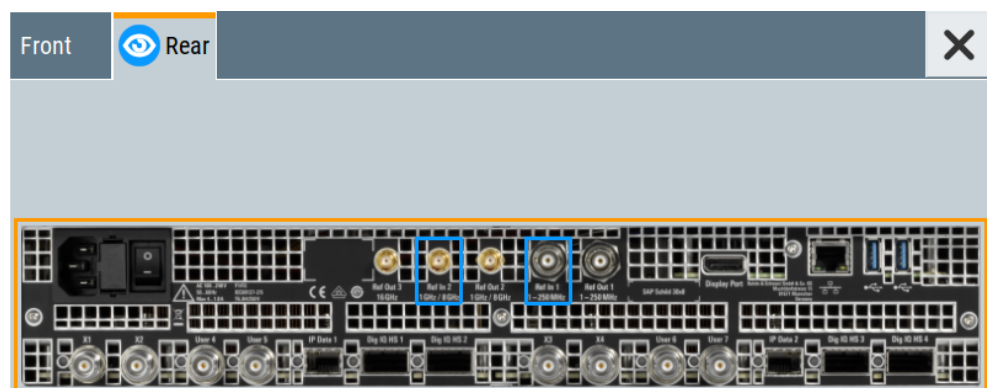
Access:


1. In the control signal block next to the "RF" block, select "T E V".

The "RF Connectors" dialog gives an overview of the mapping of the logical signals to the connectors; the displayed connectors depend on the installed options.



2. Select the signal type ("Signal") to open the dialog with related signal settings.
3. Use the built-in [Show Connector](#) function to display the physical location of the selected connector.



The eye icon  in the tab header indicates, if the connector is on the front panel or rear panel. A blinking blue rectangle marks the connector or multiple connectors, if supported.

Settings:

Signal.....	126
Connector.....	126
Show Connector.....	126

Signal

Opens the dialog with the corresponding settings.

Connector

Displays the assigned connector.



Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

4.5.4 Global connectors settings

Access:

1. In the block diagram, select the **TM block**.
2. Select "Global Connectors".

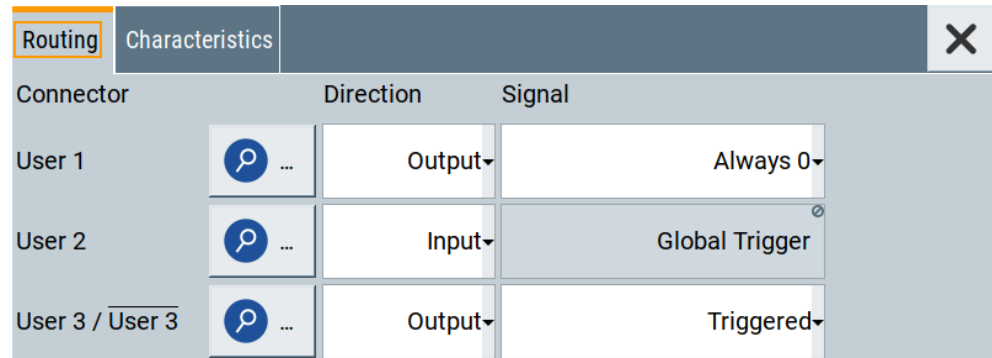
Alternatively, select for example "Baseband" > "ARB" > "Trigger In" > "Global Connectors".

The "Global Connectors" dialog provides settings to configure the signal to connector routing and the physical characteristics of the input connectors for trigger, clock and control signals.

Settings:**4.5.4.1 Signal routing settings**

Access:

- ▶ Select "Global Connectors" > "Routing".



The tab provides settings to configure the signal to connector routing.

Use the built-in [Show Connector](#) function to display the physical location of the selected connector. Also, a blinking LED on the rear panel indicates the selected connector.

Settings:

Show Connector	127
Direction	127
Signal	127

**Show Connector**

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

Direction

Sets the direction of the signal at the connector that can be an input or an output.

If you do not use the connector, select "Not Used".

Remote command:

`[:SOURce] : INPut : USER <ch> : DIRection` on page 470

`: OUTPut : USER <ch> : DIRection` on page 470

Signal

Sets the control signal type for input or output at the selected connector.

To define the signal direction at the connector, see ["Direction"](#) on page 127. For an overview on available control signals, see [Table 4-4](#).

"Global Trigger"

Input of an external trigger signal to start the ARB baseband signal generation.

The ARB trigger source is an external global trigger event, see [Chapter 4.3.3, "ARB settings"](#), on page 69.

"Triggered"

Output of the internal trigger signal or output of a received external trigger signal.

"Always 0"/"Always 1"

Control signal with a constant low level or high level.

"None"

No input signal or output signal at the connector.

Remote command:

[:OUTPut:USER<ch>:SIGNa1](#) on page 470

4.5.4.2 Signal characteristics settings

Access:

- ▶ Select "Global Connectors" > "Characteristics".

Routing	Characteristics	
	Threshold User 1 Input	1.0 V
	Logic Level User 1	3.3 V
	Impedance User 1	100 kΩ / GND
	Trigger Input Slope	Positive
	Threshold User 2 Input	1.0 V
	Logic Level User 2	3.3 V
	Impedance User 2	100 kΩ / GND

The tab provides settings to configure the physical characteristics of the input connectors for trigger and clock signals.

Settings:

Threshold User 1 Input/Threshold User 2 Input	128
Logic Level User 1/Logic Level User 2	129
Impedance User 1/Impedance User 2	129
Trigger Input Slope	129

Threshold User 1 Input/Threshold User 2 Input

Sets the high threshold or low threshold for the input signal at the User 1 connector or User 2 connector.

Remote command:

[\[:SOURce\]:INPut:USER:TRIGger:LEVel](#) on page 471

Logic Level User 1/Logic Level User 2

Sets the logic level for the output signal at the User 1 connector or User 2 connector.

Remote command:

[\[:SOURce\]:INPut:USER<ch>:CLOCK:LLEVel](#) on page 471

Impedance User 1/Impedance User 2

Selects the input impedance for the input signal.

Set "100 kΩ / GND" for high-frequency input signals.

Remote command:

[\[:SOURce\]:INPut:TRIGger:IMPedance](#) on page 471

Trigger Input Slope

Sets the polarity of the active slope of an applied external trigger signal at the User 1 connector.

Remote command:

[\[:SOURce\]:INPut:USER:TRIGger:SLOPe](#) on page 472

4.5.5 Routing signals to the connectors

This chapter provides step-by-step instructions to route control signals from input connectors or to output connectors of these signals. It covers the following topics:

- ["General workflow"](#) on page 129
- ["To map the signal to a connector"](#) on page 129
- ["To find out the input connector location"](#) on page 130

General workflow

The table [Table 4-5](#) shows the main configuration steps and related settings.

Table 4-5: Mapping signal to connector workflow

Workflow task	Related settings
Checking the signal to connector mapping	"Trigger Marker Clock" "Global Connectors" > "Routing"
Configuring and enabling the control signal	"Trigger In", "Marker" or "Clock" tabs of the base-band signal dialog
Cabling the connector and the source or sink of the control signal	-

To map the signal to a connector

To map the signal to the connector, proceed as follows:

1. Check the current connector configuration.
2. If necessary, change the signal direction and the signal type.
3. Configure the control signal, for example a trigger signal or a marker signal.

4. Enable the control signal.
5. Connect a suitable external instrument or device to the connector of the control signal.

To find out the input connector location

Proceed as follows:

1. In the block diagram, select the "TM" block to open the "Trigger / Marker / Clock" dialog.
2. For the corresponding connector, select the "Show Connector" icon.

The "Show Connectors" dialog opens and displays the location of the selected connector on the front panel or rear panel of the instrument.

If enabled, the LED next to the connector is green or yellow, see [Chapter 4.5.1.3, "Status indicators"](#), on page 123.

4.6 Reducing crest factors

Option R&S SFI-K548 is a software option that allows you to generate baseband signals with reduced crest factor.

R&S SFI-K548 key features

- Reduces crest factors of baseband signals by clipping the high signal peaks and filtering the waveform afterwards.
- Reduces crest factors of waveform files played at the arbitrary waveform generator.
- Uses an iterative process to reach a desired crest factor delta.
- Provides simple and enhanced filtering:
 - Simple filtering allows you to configure channel spacing and signal bandwidth.
 - Enhanced filtering allows you to configure lowpass filter parameters stopband frequency, passband frequency and maximum filter order.

4.6.1 About the crest factor reduction

Communication standards utilizing higher order modulation techniques or using multiple carrier and complex signals consisting of the signals of more than one digital standard can feature a high crest factor. The signals of some digital standards can have high crest factors also particularly with many channels and long sequences.

About crest factors

The crest factor represents the ratio of the peak voltage value to the RMS voltage value, i.e. the peak to average ratio (PAR). The higher the crest factor and the resulting

dynamics of a signal, the greater the requirement for a power amplifier fed by the signal to be linear.

A high crest factor arises, for example, for a multi carrier signal that has carriers with an identical start phase. The carriers are periodically superposed that leads to high peak voltages in relation to the RMS voltage values.

High crest factors entail two basic problems:

- The nonlinearity of the power amplifier (compression) causes intermodulation which expands the spectrum (spectral regrowth).
- Since the level of the digital to analog (D/A) converter is relative to the maximum value, the average value is converted with a relatively low resolution. This low resolution leads to a high quantization noise.

Both effects increase the adjacent-channel power.

Clipping and filtering algorithm

A common and simple approach for achieving a lower PAR is the combination of clipping and filtering.

- Clipping is a technique that applies a wanted distortion to the signal. The principle includes specifying a threshold, finding out the signal peaks once the defined limits are exceeded and clipping them off. The level limit is specified as a percentage of the highest peak value. Because clipping is done before filtering, the procedure does not influence the spectrum. The error vector magnitude (EVM) however increases. However, signal clipping not only changes the peak value but also the average value and the effect on the crest factor is unpredictable.
- Filtering is applied after clipping. The used filters are specially designed so that they filter out the distortion.

Peak cancellation algorithm

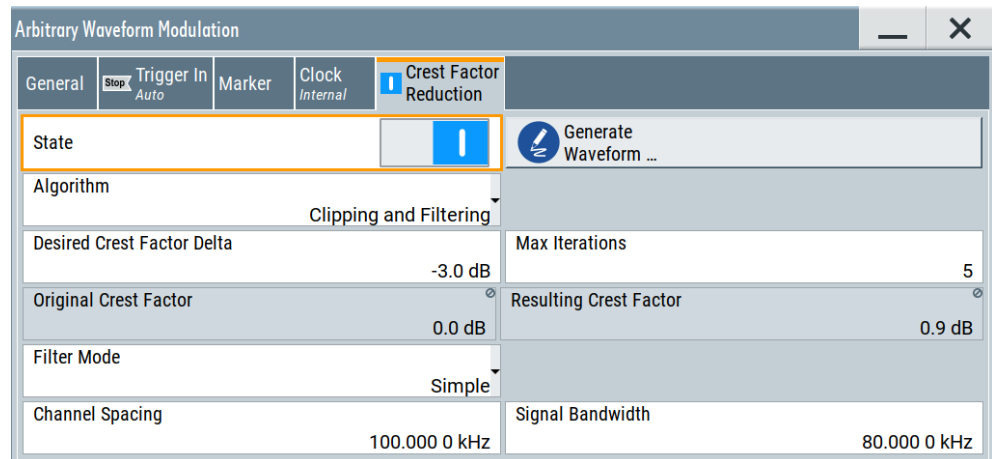
The peak cancellation algorithm uses Blackman windowed sinc pulses and subtracts them from the original baseband signal wherever the signal amplitude exceeds a defined threshold. This threshold equals maximum peak of the baseband signal minus a user-definable crest factor difference ("Desired Crest Factor Delta").

This algorithm often provides better EVM results of the output signal versus out of band noise introduced by the pulses, compared to the clipping and filtering method. The cancellation pulse bandwidth is configurable and the cancellation pulse transition bandwidth. The achieved resulting crest factor can be higher than expected, because of filters in the signal processing chain increasing the crest factor again after a previous crest factor reduction.

4.6.2 Crest factor reduction settings

Access:

- ▶ Select "Baseband" > "ARB" > "Crest Factor Reduction".



The dialog provides settings to configure and enable crest factor reduction.

Enabling crest factor reduction

Crest factor reduction requires an enabled "ARB" state and a valid waveform file loaded to the ARB application.

1. Load a waveform file.
 - a) Select "ARB" > "General" > "Load Waveform".
 - b) In the file-select dialog, select the waveform file from the directory.

See also chapter "Loading and playing waveform files" in the R&S SF1100A user manual.

2. Select "General" > "State" > "On".
3. Select "Crest Factor Reduction" > "State" > "On".

The remote commands required to define these settings are described in [Chapter 13.16.2.9, "Crest factor reduction commands"](#), on page 563.

Settings:

State	133
Generate Waveform	133
Algorithm	133
Desired Crest Factor Delta	133
Max Iterations	133
Original Crest Factor	134
Resulting Crest Factor	134
Filter Mode	134
Channel Spacing	135

Signal Bandwidth.....	135
Stopband Frequency.....	135
Passband Frequency.....	135
Maximum Filter Order.....	136
Cancellation Pulse Bandwidth.....	136
Transition Bandwidth.....	136

State

Requires an active "ARB" state, see "Enabling crest factor reduction" on page 132.

Activates crest factor reduction calculation.

Note: You cannot activate the crest factor reduction and the notch filter simultaneously. Enabling the notched filter automatically disables the crest factor reduction.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:CFR[:STATE]` on page 565

Generate Waveform

With enabled signal generation, triggers the instrument to save the current settings of an arbitrary waveform signal in a waveform file with predefined extension *.wv. You can define the filename and the directory, in that you want to save the file.

Using the ARB modulation source, you can play back waveform files and/or process the file to generate multi-carrier or multi-segment signals.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:CFR:WAVEform:CREate` on page 569

Algorithm

Defines the algorithm for crest factor reduction.

"Clipping and Filtering"

This algorithm performs a hard clipping. It is followed by a lowpass filtering of the result in an iterative manner until the target crest factor is reached. You can define the settings of the filter that is used for the calculation.

"Peak Cancellation"

This algorithm subtracts Blackman windowed sinc pulses from the signal wherever the amplitude is above a defined threshold.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:CFR:ALGorithm` on page 565

Desired Crest Factor Delta

Sets the value difference by which you want to change your crest factor.

Remote command:

`[:SOURCE<hw>] :BB:ARbitrary:CFR:DCFDelta` on page 566

Max Iterations

Requires "Algorithm" > "Clipping and Filtering".

Sets the number of iterations that are used for calculating the resulting crest factor. The iteration process is stopped when the desired crest factor delta is achieved by 0.1 dB.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:CFR:ITERations` on page 567

Original Crest Factor

Displays the original crest factor of the waveform after the calculation of the resulting crest factor is completed. The original crest factor is calculated as an average over the whole waveform, including any idle periods that can be present in TDD waveforms.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:CFR:OCFactor?` on page 567

Resulting Crest Factor

Displays the resulting crest factor of the waveform after the calculations are completed. The resulting crest factor is calculated as an average over the whole waveform, including any idle periods that can be present in TDD waveforms.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:CFR:RCFactor?` on page 568

Filter Mode

Requires "Algorithm" > "Clipping and Filtering".

Selects which filter mode is used for the filtering.

"Simple"

You can specify the RF bandwidth and channel spacing of the signal. The lowpass filter is designed to pass through frequency components inside the signal bandwidth and suppress components in the adjacent channel.

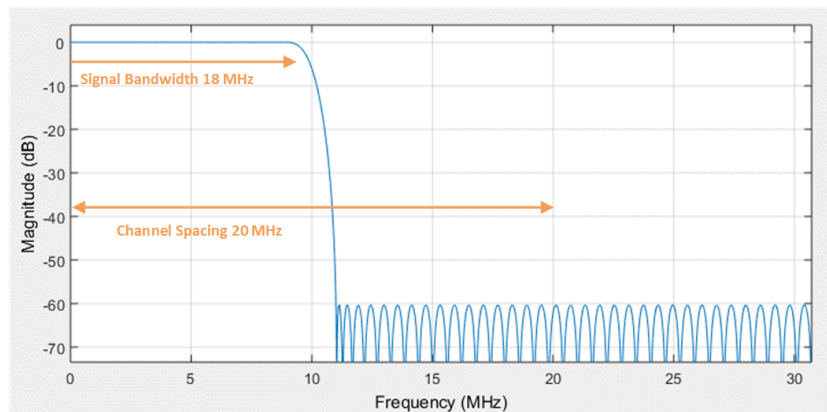


Figure 4-17: Simple filter mode

"Enhanced" In the enhanced filter mode, you can specify the passband and stopband frequencies of the lowpass filter.

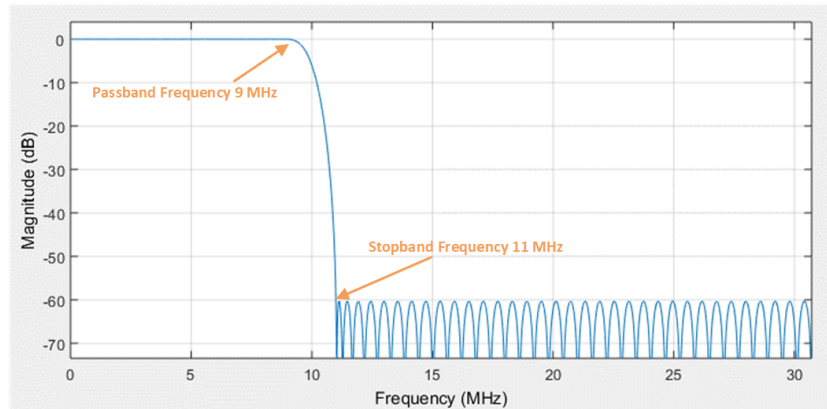


Figure 4-18: Enhanced filter mode

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:CFR:FILTer` on page 566

Channel Spacing

Requires "Algorithm" > "Clipping and Filtering" and "Filter Mode" > "Simple".

Sets the channel spacing.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:CFR:CSPacing` on page 566

Signal Bandwidth

Requires "Algorithm" > "Clipping and Filtering" and "Filter Mode" > "Simple".

Sets the signal bandwidth. Set a value that is lower than the value of the "Channel Spacing".

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:CFR:SBANdwidth` on page 568

Stopband Frequency

Requires "Algorithm" > "Clipping and Filtering" and "Filter Mode" > "Enhanced".

Sets the stopband frequency of the filter. Frequency components higher than the stopband frequency are filtered out by the lowpass filter.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:CFR:SFReq` on page 569

Passband Frequency

Requires "Algorithm" > "Clipping and Filtering" and "Filter Mode" > "Enhanced".

Sets the passband frequency. Frequency components lower than the passband frequency are passed through unfiltered.

Remote command:

`[:SOURce<hw>] :BB:ARbitrary:CFR:PFReq` on page 568

Maximum Filter Order

Requires "Algorithm" > "Clipping and Filtering" and "Filter Mode" > "Enhanced".

Sets the maximum filter order.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:CFR:FORDER](#) on page 566

Cancellation Pulse Bandwidth

Requires "Algorithm" > "Peak Cancellation".

Sets the bandwidth of the cancellation pulse.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:CFR:CPBandwidth](#) on page 565

Transition Bandwidth

Requires "Algorithm" > "Peak Cancellation".

Sets the transition bandwidth of the cancellation pulse.

Remote command:

[\[:SOURce<hw>\]:BB:ARbitrary:CFR:TBANDwidth](#) on page 569

4.7 Shifting the baseband signal

The R&S SF100A provides settings to apply a frequency offset or a phase offset to the baseband signal.

4.7.1 About baseband offsets

The applied baseband frequency offset and phase offset affect the signal on the output of the "Baseband" block. The shifting of the central frequency of the baseband signal is one of the tasks of the resampler.

4.7.1.1 Impact of the frequency offset

For some applications, it is helpful to shift the baseband signal with a user-defined baseband frequency offset to a different center frequency to improve signal characteristics.

The frequency-offset function shifts the center frequency of the wanted baseband signal. The function also provides a quick way to shift the used frequency band in the RF frequency domain without modifying the RF settings.

See [Chapter 4.7.3, "Improving signal characteristics by shifting the baseband signal"](#), on page 139.

Limitations

The complex I/Q bandwidth of the shifted signal cannot exceed the total available baseband bandwidth. The setting range of the frequency offset is then calculated as follows:

$$-(\text{TotalBasebandBandwidth}/2) + f_{\text{use}}/2 \leq f_{\text{offset}} \leq (\text{TotalBasebandBandwidth}/2) - f_{\text{use}}/2,$$

where the following applies:

f_{use} is the complex useful bandwidth of the I/Q signal before the offset

f_{offset} is the frequency offset

The [Figure 4-19](#) illustrates the setting range of the frequency offset.

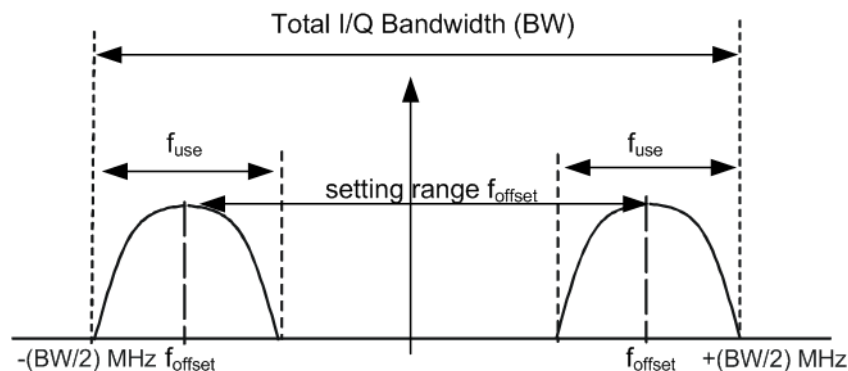


Figure 4-19: Setting range of frequency offset

For more information, refer to the specifications document.

To observe the effect of offsetting the frequency

Use the built-in real-time graphical display. Select "System Config" > "Graphics" > "Power Spectrum" and observe the power spectrum of the signal with and without frequency offset.

4.7.1.2 Impact of the phase offset

The "Phase Offset" determines the phase offset between the different baseband signals. A phase offset rotates each point of an I/Q constellation diagram by the specified phase offset.

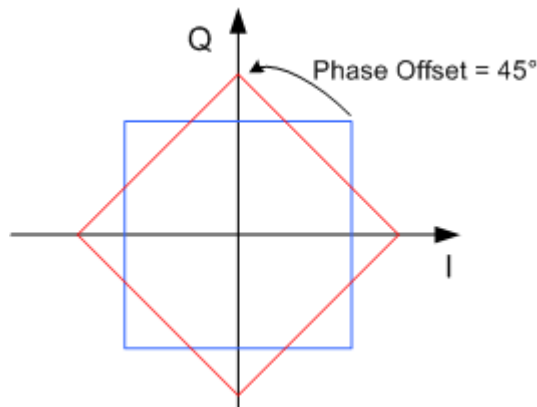


Figure 4-20: I/Q constellation diagram: Effect after offsetting the phase by an angle of 45 °

To observe the effect of offsetting the phase

Use the built-in real-time graphical display. Select "System Config" > "Graphics" > "Constellation" and observe that the points on the I/Q constellation diagram are turning counterclockwise.

4.7.2 Baseband offset settings

Access:

- ▶ Select "Baseband" > "Baseband Offsets".

Baseband Offsets		
	Frequency Offset (Hz)	Phase Offset (deg)
Baseband	0.00	5.00

The "Baseband Offsets" dialog provides settings to offset the frequency or phase of the baseband signal.

The block diagram shows an icon Δf on the signal path. This icon indicates an enabled frequency offset.

Settings:

Frequency Offset

Sets the frequency offset of the baseband signal and shifts the useful baseband signal in the center frequency.

Use this function, for example, to shift the baseband signal relative to an AWGN signal.

See also the following sections:

- [Chapter 4.7.3, "Improving signal characteristics by shifting the baseband signal"](#), on page 139
- [Chapter 4.7.3, "Improving signal characteristics by shifting the baseband signal"](#), on page 139

Remote command:

`[:SOURce<hw>] :BB:Foffset` on page 529

Phase Offset

Sets the phase offset for a baseband signal. This phase offset affects the signal after the "Baseband" block.

Use this parameter, for example, to change the start phase of the baseband signal.

See also [Chapter 4.7.1.2, "Impact of the phase offset"](#), on page 137.

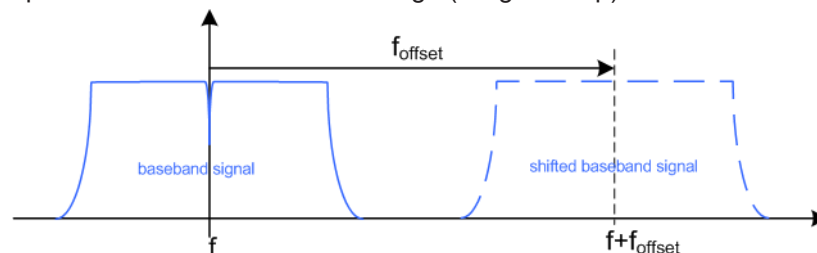
Remote command:

`[:SOURce<hw>] :BB:POffset` on page 530

4.7.3 Improving signal characteristics by shifting the baseband signal

Shifting of the generated baseband signal is useful in the following cases:

- You analyze the generated signal with a signal analyzer and the displayed signal spectrum indicates a carrier leakage (a signal drop) at the current RF frequency.



Shifting the baseband signal to a different center frequency can eliminate the carrier leakage problem.

In the following examples, we assume that:

- The R&S SFI100A generates a baseband signal
- A spectrum analyzer is connected to the R&S SFI100A, the analyzed is configured and measures the required signal characteristics.

To shift the generated baseband signal

1. Select "Baseband" > "Baseband Offsets".
2. To apply an offset to the baseband signal, select for example "Frequency Offset" = "10 MHz".

To verify characteristics of the generated signal

- ▶ Use the built-in real-time graphical display.

To observe the effect of applied frequency offset and gain

- ▶ Use the built-in real-time graphical display.

5 Signal routing and system configuration

The settings in this dialog comprise the I/Q stream mapping and the processing of the generated I/Q streams. From this dialog, you can control and configure the connections to external instruments connected to the RF connector.

Prerequisites for connections to external instruments

Connecting external instruments to the R&S SF100A requires the following signals and connections.

Signal	Interface	Remark
Control	LAN or USB	The control connection is enabled.
Input Output	Analog I/Q or digital I/Q Analog I/Q, digital I/Q or RF	The physical input signal or output signal is present at the interface.
Reference	Reference input or output	The external instrument and the R&S SF100A have a common reference frequency signal.

Required options

The signal routing settings and system configuration settings require a base unit configuration, see "[Base unit](#)" on page 32.

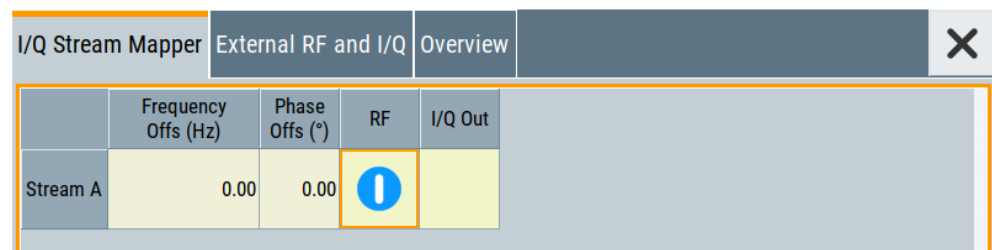
Settings:

- [I/Q stream mapper settings](#)..... 141
- [External RF settings](#)..... 142
- [External instrument settings](#)..... 146
- [Overview](#)..... 149

5.1 I/Q stream mapper settings

Access:

- ▶ In the block diagram, select "I/Q Stream Mapper".



The dialog provides the settings for routing of the signal streams to the available output connectors.

Settings:

Frequency Offset.....	142
Phase Offset.....	142
Map stream x to connector.....	142

Frequency Offset

Sets an absolute frequency offset f_{offset} .

Tip: Use this parameter to shift the used frequency band in the RF frequency section without modifying the RF settings.

Remote command:

:SCONfiguration:OUTPut:MAPPING:STReam<st>:FOFFset on page 462

Phase Offset

Sets the phase offset of the corresponding stream.

Remote command:

:SCONfiguration:OUTPut:MAPPING:STReam<st>:POFFset on page 462

Map stream x to connector

The mapping of the generated stream to the output connectors is represented as a stream matrix. A blue circle at a matrix element routes the stream to the selected connector.

Remote command:

:SCONfiguration:OUTPut:MAPPING:RF:STReam<st>:STATE on page 461

5.2 External RF settings

Access:

- ▶ On the taskbar, select "System Config" > "System Configuration" > "External RF".

Dir	External Instr	I/Q Conn	Rem Conn	Instrument Name	RF Coup	RF Frequency (Hz)	RF Level (dBm)	RF State
RF	Out	Config...		FE170ST-123456	<input checked="" type="checkbox"/>	Δ: 0.00	Δ: 0.00	Off

The tab provides settings to configure and establish the connection to external RF instruments. An overview of all available RF input and output connectors and comprises the settings necessary to establish the connection to the external instruments.

Displayed is an overview of the currently connected external instruments together with relevant information like the connection status and the RF level and frequency that these external instruments use.

For step-by-step instructions to connect and control external frontends, see [Chapter 7.1.2, "Operating external frontends"](#), on page 179.

Settings:

Display.....	143
Auto Connect.....	143
Connect/Disconnect All Remote.....	144
Preset behavior: Keep connections to external instruments.....	144
Connector Name.....	144
Direction.....	144
External Instrument.....	145
I/Q Conn.....	145
Rem Conn.....	145
Instrument Name.....	146
RF Coup.....	146
(Delta) RF Frequency/ RF Level.....	146
RF State.....	146

Display

Filters the displayed connectors upon one of the following criteria:

"All Connectors"

Displays all available connectors. No filter is applied.

"Mapped Connectors"

Displays the connectors to which a stream is mapped.
See ["Map stream x to connector"](#) on page 142.

Note: To prevent faults, use this filter before you further configure the external instruments.

"Input Connectors/Output Connectors"

Displays the connectors according to connector direction.

Remote command:

`:SCONfiguration:EXTernal:DISPlay` on page 463

Auto Connect

"Auto Connect > On": The instrument automatically detects connected external instruments and establishes the required connection.

"Auto Connect > Off": After a R&S SF100A startup you have to revise the test setup and perform the following:

- Check whether the necessary connections between the R&S SF100A and the external instruments are still existing.

- Prove that the remote control of the particular instruments is required.
- Trigger the "Connect All Remote" function.

Remote command:

[:SCONfiguration:EXTernal:ACONnect](#) on page 463

Connect/Disconnect All Remote

Triggers the instrument to:

- Establish the remote connections to all configured external instruments.
- Terminate all existing remote connections.
The external instruments are not removed from the list of external instruments.
Only the remote connection status changes.

You can toggle the remote connection status with the parameter "Rem Conn".

Note:

External instruments connected to the R&S SF100A are preset ([:DEVice:PRESet](#)) whenever:

- The connection to the external instrument is established or terminated ("Connect/Disconnect All Remote" or "Rem. Conn > On/Off")
- The R&S SF100A is preset ([Preset]).

To ensure that the remote connections to the external instruments will be automatically established after instrument's start-up or a reboot, enable "Auto Connect > On".

Remote command:

[:SCONfiguration:EXTernal:REMOte:CONNect\[:ALL\]](#) on page 463

[:SCONfiguration:EXTernal:REMOte:DISConnect\[:ALL\]](#) on page 463

Preset behavior: Keep connections to external instruments

Sets the effect of R&S SF100A preset ([Preset] or *RST) on the following:

- The connection status between the instrument and the connected external instruments.
- The connected instruments.

"Preset behavior..."	Off	On
R&S SF100A and preset values	Standard R&S SF100A preset See Table 10-1 .	Depends on the connected external frontend: <ul style="list-style-type: none"> • RF "Frequency" <ul style="list-style-type: none"> – R&S FE170ST: 110 GHz – R&S FE110ST: 75 GHz • RF "Level" = -30 dBm • "RF > Off"
Connection status	Terminated ("Disconnect All Remote")	Unchanged
Connected instruments	External instrument preset (:DEVice:PRESet)	External instrument preset

Remote command:

[:SCONfiguration:EXTernal:PBEHaviour](#) on page 463



Connector Name

Displays the connector name.

Direction

Displays the connector direction as a color coded field.

The color is determined by the configuration in the "I/Q Stream Mapping" dialog.

Connector	Direction/Color	Enabled in the "I/Q Stream Mapping"
RF		Yes
		-

Remote command:

`:SCONfiguration:EXTernal:RF<ch>:DIRection?` on page 464

External Instrument

Opens a dialog with settings to establish the connection to the external instrument for the selected signal path.

See [Chapter 5.3, "External instrument settings"](#), on page 146.

See also ["Prerequisites for connections to external instruments"](#) on page 141.

I/Q Conn

Not applicable for R&S SFI100A.

Remote command:

n.a.

Rem Conn

Indicates the status of the remote connection. Click the status indicator to toggle the remote connection status.

To connect or disconnect all external instruments, use the functions "Connect All Remote" or "Disconnect All Remote".

Note:

External instruments connected to the R&S SFI100A are preset (`:DEvice:PRESet`) whenever:

- The connection to the external instrument is established or terminated ("Connect/Disconnect All Remote" or "Rem. Conn > On/Off")
- The R&S SFI100A is preset ([Preset]).

Note: An active "Rem. Conn." and an "RF State > On" do not mean that an I/Q stream is mapped to this connector.

Use the "System Configuration" > "External RF and I/Q" > "Display" > "Mapped Connectors" filter to list only the connectors with a mapped I/Q stream.

See also ["Prerequisites for connections to external instruments"](#) on page 141.

Remote command:

`:SCONfiguration:EXTernal:RF<ch>:RCONnection:STATe?` on page 464

`:SCONfiguration:EXTernal:RF<ch>:REMote:DISConnect` on page 467

`:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?` on page 466

Instrument Name

Displays useful information on the connected external instrument, like the instrument designation and the RF path the RF settings are coupled to.

See also "[Prerequisites for connections to external instruments](#)" on page 141.

Remote command:

`:SCONfiguration:EXTernal:RF<ch>:INAME?` on page 464

`:SCONfiguration:EXTernal:RF<ch>:REMOte:INFO?` on page 466

RF Coup

Not applicable for R&S SFI100A.

Remote command:

n/a

(Delta) RF Frequency/ RF Level

Not applicable for R&S SFI100A.

Remote command:

n/a

RF State

Displays the RF output state of the R&S SFI100A.

Remote command:

`:SCONfiguration:EXTernal:RF<ch>:RF:STATe` on page 464

5.3 External instrument settings

Access:

1. In the taskbar, select "System Config" > "System Configuration".
2. Select "External RF" > "External Instrument" > "Config...".

The dialog provides settings to configure the connection to the external instrument and to control to the external instrument. Also you can find out the related connector at the R&S SFI100A.

Settings:

- [Remote Instrument settings](#)..... 146
- [Show connector](#)..... 149

5.3.1 Remote Instrument settings

Access:

1. Select "External Instrument" > "Config...".

2. Select "Remote Instrument".

Settings:

Scan.....	147
Clean Unused/Clean All.....	147
External Instrument.....	147
Set Symbolic Name.....	147
Remote Channel.....	148
Hostname or IP Address.....	148
Device ID.....	148
Apply.....	148
Apply and Connect.....	148
Frontend Configuration.....	149

Scan

Not applicable for R&S SFI100A.

Remote command:

n/a

Clean Unused/Clean All

Removes partly or fully the configuration of external instruments the R&S SFI100A controls via the LAN interface.

"Clean Unused"

Removes external instrument configurations from unused LAN connections. The configurations for used LAN connections remain. These connections are the enabled and configured control connections. Also, this function allows you to update the external instruments list for a new pool of valid instruments.

Remote command:

`:SCONfiguration:EXTernal:REMote:PURGe` on page 467

"Clean All"

Disconnects and removes all connections of configured external instruments. Also removes all instruments from the list of external instruments.

Remote command:

`:SCONfiguration:EXTernal:REMote:CLEan` on page 468

External Instrument

Lists all available instruments, found by the "Scan" function.

See also "[To configure the R&S SFI100A for frontend control](#)" on page 37.

Remote command:

`:SCONfiguration:EXTernal:REMote:LIST?` on page 465

`:SCONfiguration:EXTernal:REMote:ADD` on page 465

`:SCONfiguration:EXTernal:RF<ch>:REMote:ISElect` on page 466

Set Symbolic Name

Sets the alias name of the instrument.

Remote command:

[:SCONfiguration:EXTernal:REMote:ADD](#) on page 465

[:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?](#) on page 466

Remote Channel

Displays or selects the remote or hardware channel for control of the external instrument.

"Frontend Connection"

Fixed remote channel for control of external frontends via the LAN interface.

Remote command:

[:SCONfiguration:EXTernal:REMote:ADD](#) on page 465

[:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?](#) on page 466

Hostname or IP Address

Displays or sets the hostname or IP address of the connected external instrument.

See also "[Prerequisites for connections to external instruments](#)" on page 141.

Remote command:

[:SCONfiguration:EXTernal:REMote:ADD](#) on page 465

[:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?](#) on page 466

Device ID

Sets/displays the device identifier that is a unique string with the following structure:

`<frontend type>-<serial number>`

For a defined "External Instrument", the information is read out automatically.

Remote command:

[:SCONfiguration:EXTernal:REMote:ADD](#) on page 465

[:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?](#) on page 466

Apply

Confirms the settings and displays the external instrument in the "External RF" dialog.

Also, connection is established for a short period of time to retrieve identification data from the external instrument.

Remote command:

[:SCONfiguration:EXTernal:RF<ch>:REMote:ISElect](#) on page 466

Apply and Connect

Confirms the settings and triggers the connection establishment. In the connected instruments, the status of this active remote connection is displayed by the "Remote" indication.

Remote command:

[:SCONfiguration:EXTernal:RF<ch>:REMote:ISElect](#) on page 466

[:SCONfiguration:EXTernal:RF<ch>:REMote:ICONnect](#) on page 466

Frontend Configuration

Accesses the "RF Frontend" dialog to configure settings of the connected external frontend.

See [Chapter 7.1.3, "RF frontend settings"](#), on page 185.

5.3.2 Show connector

Access:

1. Select "Taskbar > System Config > System Configuration > External RF".
2. Navigate to the required connector.
Select "External Instruments > Config ...".
3. Select the "Show Connector" tab.

The dialog displays the location of the selected connector.

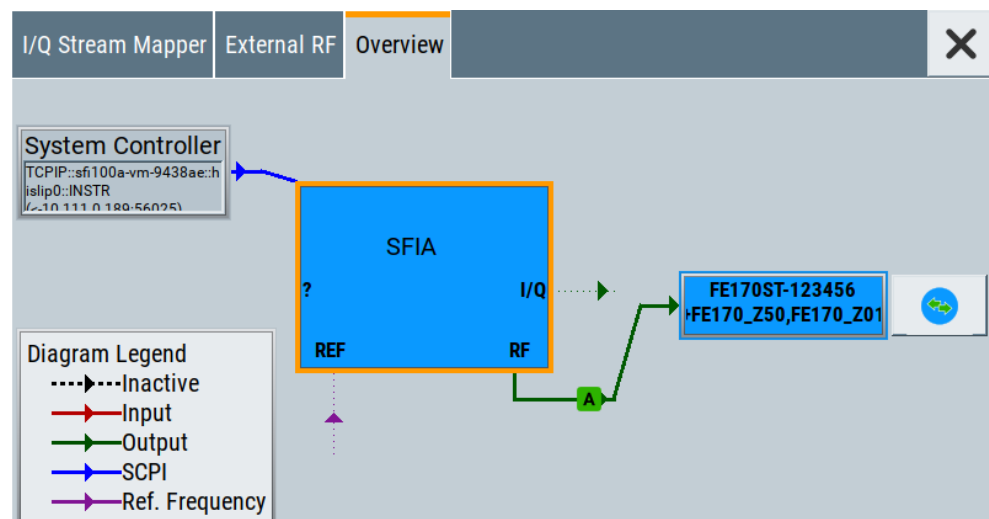
The "Show Connector" function triggers the instrument to identify the connector on the rear panel.

5.4 Overview

You can check current connections, interfaces, input signals and output signals of the R&S SF1100A in the "Overview" tab.

Access:

- ▶ Select "System Configuration" > "Overview".



The overview tab shows information on the following:

- Input signals and output signals: Type (RF, reference, I/Q) and state (active, inactive)

- Input and output interfaces
- Current stream mapping to the output interfaces.
See [Chapter 5.1, "I/Q stream mapper settings"](#), on page 141.
- Connected controller ("System Controller") and connection ("SCPI").
See [Chapter 5.2, "External RF settings"](#), on page 142.
- Connections for remote control of connected external devices

Hotspots for fast access to the required settings

Several of the displayed elements are hotspots, for example the "A" on the green background. Select an element to access the related dialog.

6 Applying I/Q vector modulation

The R&S SF100A offers I/Q modulation with the internally generated digital signal. You can add digital impairments to this internal signal before the I/Q modulator. Also, you can correct the frequency response of the I/Q modulation signal.

Required options

The equipment layout for I/Q modulation includes the base unit with the frequency option R&S SFI-B1016.

Impairing I/Q samples

For a description on applying digital impairments, see [Chapter 6.4, "Impairing the signal"](#), on page 156.

Correcting the frequency response

For a description on correcting the frequency response, see [Chapter 6.5, "Correcting the frequency response"](#), on page 161.

- [About the I/Q modulator](#)..... 151
- [I/Q modulator settings](#)..... 151
- [Optimizing I/Q modulation performance](#)..... 154
- [Impairing the signal](#)..... 156
- [Correcting the frequency response](#)..... 161

6.1 About the I/Q modulator

The R&S SF100A offers I/Q modulation with internal baseband signals.

Input signal of the I/Q modulator

The input signal for the I/Q modulator is the internal baseband signal.

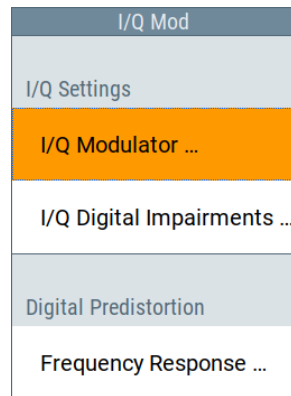
Table 6-1: Physical input signals of the I/Q modulator

Input signal	GUI parameter
Internal baseband signal	"Baseband" > "On"

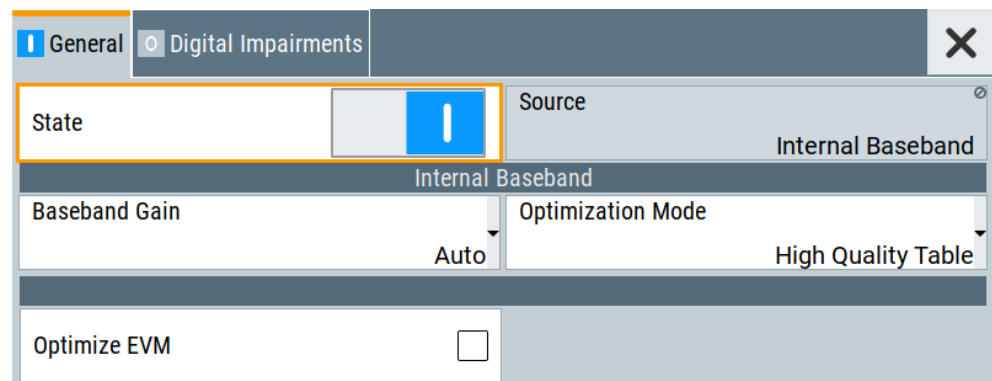
6.2 I/Q modulator settings

Access:

- ▶ Select "I/Q Mod" > "I/Q Settings" > "I/Q Modulator".



The "I/Q Modulator" dialog opens.



The dialog provides the I/Q modulator settings and settings for applying digital impairments.

The remote commands required to define these settings are described in [Chapter 13.15.6, "SOURce:IQ subsystem"](#), on page 493.

For a description on applying digital impairments and correcting the frequency response, see the following sections:

- [Chapter 6.4, "Impairing the signal"](#), on page 156
- [Chapter 6.5, "Correcting the frequency response"](#), on page 161

Settings:

State	152
Source	153
Baseband Gain	153
Optimization Mode	153
Optimize EVM	154

State

Enables I/Q modulation.

If you use the internal baseband signal as the input signal and enable baseband signal generation, the I/Q modulator is enabled automatically. You can disable I/Q modulation, for example, if you want to route the baseband signal directly to the I/Q output connectors.

Remote command:

`[:SOURce<hw>] :IQ:STATe` on page 494

Source

Selects the input signal for the I/Q modulator.

"Internal Baseband"

Selects the internal baseband signal.

Remote command:

`[:SOURce<hw>] :IQ:SOURce` on page 493

Baseband Gain

Sets the baseband gain for a wide dynamic range.

You can attenuate this level (negative gain) to optimize the I/Q modulation performance. The optimization is a trade-off between signal distortion and signal-to-noise ratio (SNR).

"-12 dB"/"-9 dB"/"-6 dB"/"-3 dB"

Attenuates the baseband signal internally to minimize signal distortions and optimize the intermodulation characteristics of the modulated signal. But the SNR decreases, the signal noise increases.

"0 dB"

No changes on the baseband signal, applies no optimization.

"Auto"

The R&S SFI100A automatically sets an optimized gain value. The configured sample rate, the crest factor and the PEP value of the modulated signal affect this gain value.

Remote command:

`[:SOURce<hw>] :BB:IQGain` on page 494

Optimization Mode

Selects the optimization mode for I/Q modulation of the internal baseband signal.

How to: [Chapter 6.3, "Optimizing I/Q modulation performance"](#), on page 154

If equipped with option R&S SFI-K544, the optimization mode applies for the I/Q modulation performance and for the user-defined frequency response corrections.

See the user manual "R&S SFI-K544 User-Defined Frequency Response Correction".

For more information, refer to the specifications document.

"High Quality Table"

This mode further improves the frequency response while maintaining setting time. There is no signal interruption. Select this mode in setups to generate phase coherent signals with an RF modulation bandwidth of up to 10 GHz.

"Fast"

Fast optimization by compensating for I/Q skew. This mode is suitable in time sensitive environments and for narrowband signals.

Remote command:

`[:SOURce<hw>] :BB:IMPairment:OPTimization:MODE` on page 576

Optimize EVM

Enables further optimization of the EVM performance of I/Q modulated RF signals.

Enable "Optimize EVM", if your test setup requires the lowest EVM values. For example, if you need to generate 5G NR signals, LTE signals or IEEE 802.11 signals that require optimized EVM performance.

How to: "[To optimize the EVM value](#)" on page 155

Remote command:

`[:SOURce<hw>] :CORRection:OPTimize:EVM` on page 478

6.3 Optimizing I/Q modulation performance

The following step-by-step instructions help you to execute general I/Q modulation tasks with dedicated I/Q modulator settings:

- "[To apply predefined frequency response correction](#)" on page 154
- "[To improve RF signal flatness](#)" on page 154
- "[To optimize the EVM value](#)" on page 155

To apply predefined frequency response correction

For RF signals with larger I/Q modulation bandwidth, the R&S SF100A provides a predefined frequency response correction. This correction helps you to improve the signal flatness of the RF signal over the whole I/Q modulation bandwidth.

The R&S SF100A provides the optimization mode "High Quality Table" for I/Q modulation. To improve signal quality, this mode features the following:

- Frequency response correction for larger modulation bandwidth signals
- Correction of internally generated baseband signals by predefined correction values
- Absolute level correction at center frequency
- Correction in real time, no signal interruption

To improve RF signal flatness

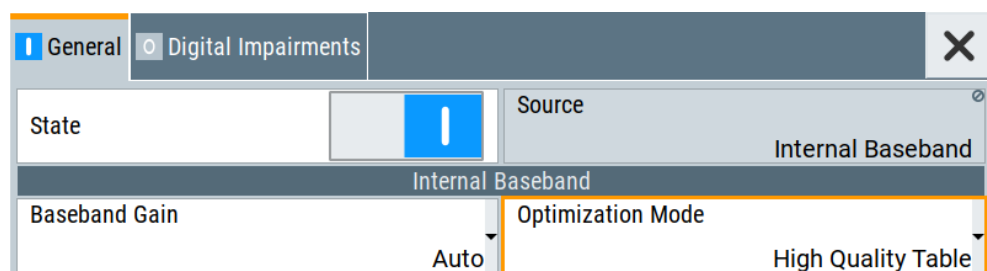
In the following step-by-step instruction, we assume that:

- The R&S SF100A generates an RF signal. The I/Q modulator modulates a baseband signal onto the RF carrier.
- A spectrum analyzer is connected to the R&S SF100A. The analyzer is configured and measures the required signal characteristics.

In the following step-by-step instruction, we assume that you configured signal parameters of your baseband signal and RF signal. Also,

1. In the block diagram, enable baseband and RF signal generation:

- a) "Baseband" > "On".
 - b) Select "RF" > "On"
2. Select "I/Q Mod" > "On".
The I/Q modulator is enabled and modulates the internal baseband signal onto the RF carrier.
 3. Select "I/Q Mod" > "I/Q Mod" > "I/Q Modulator".
The general settings dialog of the I/Q modulator opens. By default, the R&S SF100A uses fast optimized I/Q modulation ("Optimization Mode" > "Fast") to compensate for I/Q skew.
 4. Select "Optimization Mode" > "High Quality Table".



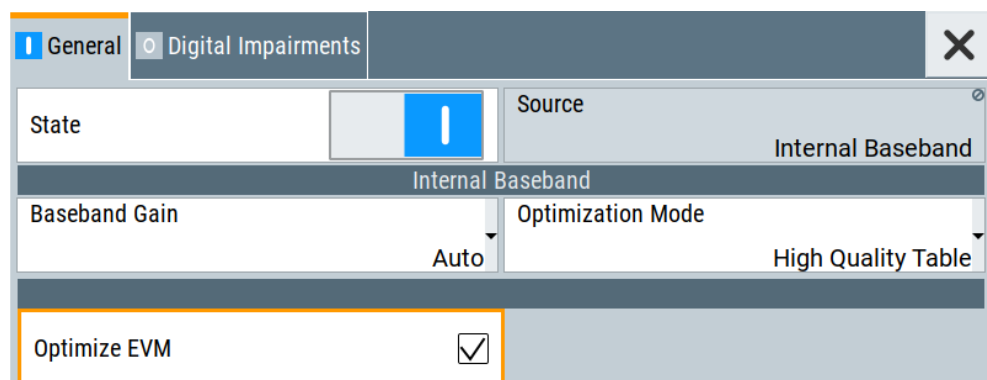
The R&S SF100A uses predefined values from the instrument calibration to correct the frequency response. This correction results in a flat signal over the whole I/Q modulation bandwidth.

5. On a connected signal analyzer, monitor the signal characteristics.

To optimize the EVM value

Use the function "Optimize EVM", if your test setup requires the lowest EVM values. For example, if you need to generate 5G NR signals, LTE signals or IEEE 802.11 signals that require optimized EVM performance.

1. Select "I/Q Mod" > "I/Q Mod" > "I/Q Modulator".
2. Select "Optimize EVM" > "On".



If enabled, the frequency section of the status bar displays the enabled EVM optimization state as in [Figure 6-1](#).

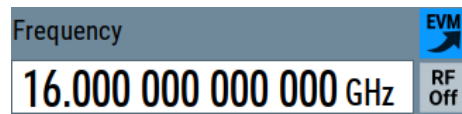


Figure 6-1: Optimize EVM enabled

3. Select "I/Q Mod" > "On".
4. Select "RF" > "On".
5. On a connected signal analyzer, monitor the signal characteristics.

6.4 Impairing the signal

In the R&S SF1100A, you can add digital linear impairments to the signal, for example an I/Q imbalance and a quadrature error.

6.4.1 Required options

The base unit is sufficient for impairing I/Q signals. Impairing these signals does not require additional options.

6.4.2 About the digital I/Q impairments

I/Q signal impairments are well-defined arithmetic modifications of the data. The impairment method is to modify every data sample in the same way by impairing the I/Q samples linearly.

These linear impairments simulate frequent sources of distortions in a real signal processing chain. Add impairments, for example, to simulate dirty transmitter conditions for receiver tests.

I/Q streams

The R&S SF1100A offers to impair the internal I/Q signal, the baseband signal for the following I/Q streams:

- Impair I/Q samples before the I/Q modulator
- Impair I/Q samples to the analog I/Q output signal

I/Q impairments

- [Gain and gain imbalance](#)..... 157
- [I and Q offset](#).....157
- [Quadrature offset](#)..... 158

6.4.2.1 Gain and gain imbalance

An I/Q gain is a multiplication of all I/Q amplitudes by a common factor. The effect is equivalent to two identical I and Q gain factors. The effect of an increased gain factor in the I/Q constellation diagram is shown on [Figure 6-2](#).

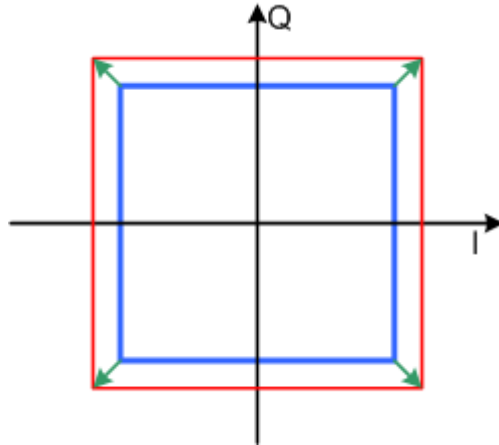


Figure 6-2: Effect of an increased amplitude in the I/Q constellation diagram

An I gain multiplies the I amplitudes by a factor, leaving the Q amplitudes unchanged. A Q gain has the opposite effect. Different I and Q gain factors result in an I/Q imbalance, which is due to different gains of the amplifiers in the I and Q channels of the I/Q modulator. The effect of a positive and negative gain imbalance is shown on [Figure 6-3](#).

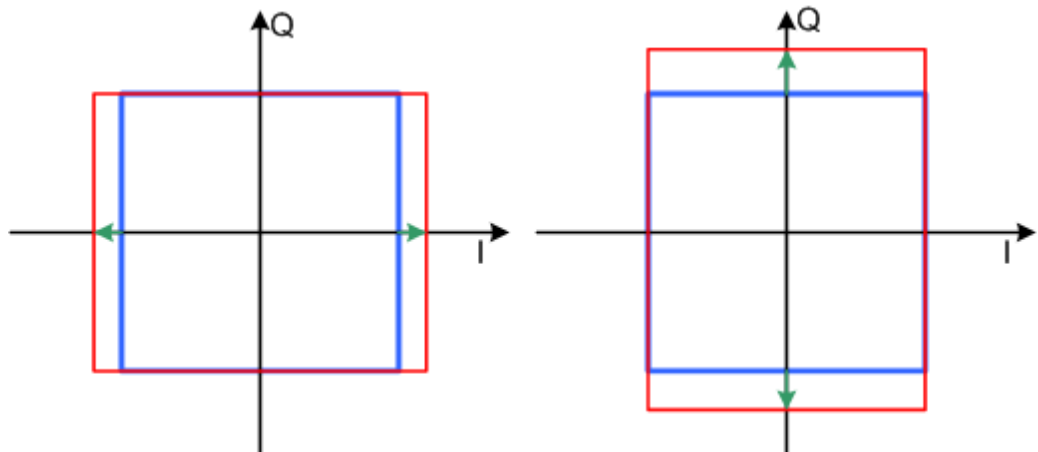


Figure 6-3: Negative gain imbalance (left) and positive gain imbalance (right) in the I/Q constellation diagram

6.4.2.2 I and Q offset

An I offset adds a constant value to all I amplitudes, leaving the Q amplitudes unchanged. A Q offset has the opposite effect. A combination of I and Q values results in an I/Q offset, which is due to carrier feedthrough in the I/Q modulator. Possible rea-

sions are interfering signals at the RF carrier frequency, e.g. an unsuppressed RF carrier subchannel. The effect of a positive I and Q offset in the I/Q constellation diagram is shown on [Figure 6-4](#).

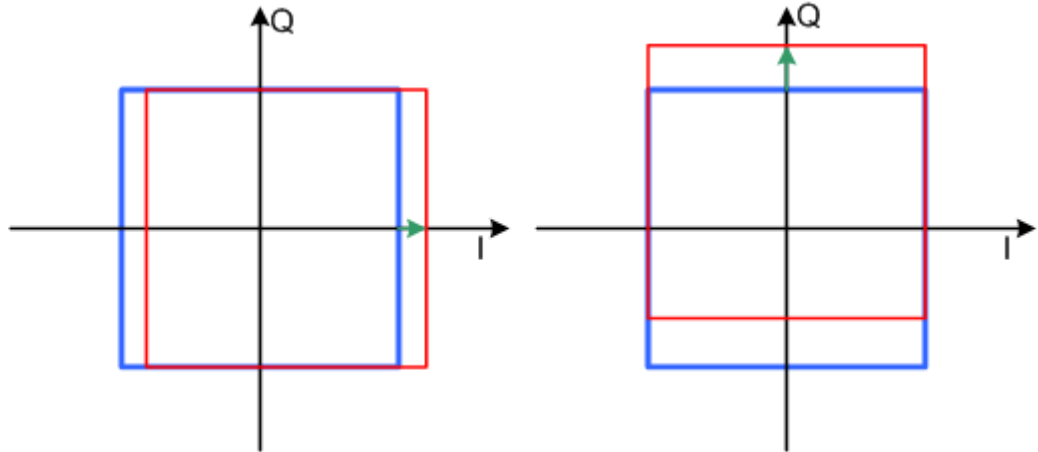


Figure 6-4: I offset (left) and Q offset (right) in the I/Q constellation diagram

6.4.2.3 Quadrature offset

Changes the phase angle between the I and the Q vectors from the ideal 90 degrees, while the amplitudes are maintained. A positive quadrature offset results in a phase angle greater than 90 degrees. The effect of a positive quadrature offset in the I/Q constellation diagram is shown on [Figure 6-5](#).

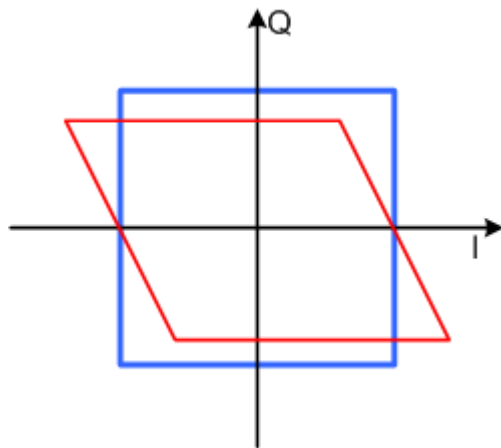


Figure 6-5: Positive quadrature offset in the I/Q constellation diagram

6.4.3 Digital impairments settings

You can add digital impairments to each internal generated I/Q stream.

See also [Chapter 6.4.2, "About the digital I/Q impairments"](#), on page 156.

Access:

- ▶ Select "I/Q Mod" > "I/Q Settings" > "Digital Impairments".

General		Digital Impairments	
State		<input type="checkbox"/>	
I Offset	0.00 %	Q Offset	0.00 %
Gain Imbalance	0.000 dB	Quadrature Offset	0.00 deg

The tab provides settings for I/Q impairment, like leakage, imbalance and offset.

The remote commands required to define these settings are described in [Chapter 13.16.4, "SOURCE:BB:IMPAIRment subsystem"](#), on page 572.

Settings:

State.....	159
I Offset/Q Offset.....	159
Gain Imbalance.....	160
Quadrature Offset.....	160
Skew.....	160
IQ Delay.....	160
Phase Offset.....	160

State

Enables the impairment of the I/Q signal.

If enabled, the settings for the I/Q offset, the I/Q imbalance and the quadrature offset become effective.

Remote command:

`[:SOURCE] :BB:IMPAIRment:RF<ch>:STATE` on page 573

`[:SOURCE] :BB:IMPAIRment:IQOutput<ch>:STATE` on page 573

I Offset/Q Offset

Sets a carrier offset (in percent) of the amplitudes (scaled to the peak envelope power (PEP)) for the I and/or Q signal component. An ideal I/Q modulator suppresses the carrier offset completely (offset = 0 percent).

For more information, see [Chapter 6.4.2.2, "I and Q offset"](#), on page 157.

Remote command:

`[:SOURCE] :BB:IMPAIRment:RF<ch>:LEAKage:I` on page 575

`[:SOURCE] :BB:IMPAIRment:RF<ch>:LEAKage:Q` on page 575

`[:SOURCE] :BB:IMPAIRment:IQOutput<ch>:LEAKage:I` on page 575

`[:SOURCE] :BB:IMPAIRment:IQOutput<ch>:LEAKage:Q` on page 575

Gain Imbalance

Sets the imbalance of the I and Q vector.

The entry is made in dB (default) or %, where 1 dB offset is roughly 12% according to the following:

$$\text{Imbalance [dB]} = 20 \log (| \text{GainQ} | / | \text{GainI} |)$$

Positive values mean that the Q vector is amplified more than the I vector by the corresponding percentage. Negative values have the opposite effect.

For more information, see [Chapter 6.4.2.1, "Gain and gain imbalance"](#), on page 157.

Remote command:

`[:SOURce] :BB:IMPairment:RF<ch>:IQRatio[:MAGNitude]` on page 574

`[:SOURce] :BB:IMPairment:IQOutput<ch>:IQRatio[:MAGNitude]`

on page 574

Quadrature Offset

Sets the quadrature offset.

For more information, see [Chapter 6.4.2.3, "Quadrature offset"](#), on page 158.

Remote command:

`[:SOURce] :BB:IMPairment:RF<ch>:QUADrature[:ANGLE]` on page 575

`[:SOURce] :BB:IMPairment:IQOutput<ch>:QUADrature[:ANGLE]`

on page 575

Skew

Sets the delay between the Q vector and the I vector of the corresponding signal stream.

Set this delay in the I/Q modulator or at the I/Q analog output.

Remote command:

`[:SOURce] :BB:IMPairment:RF<ch>:SKEW` on page 575

`[:SOURce] :BB:IMPairment:IQOutput<ch>:SKEW` on page 575

IQ Delay

Sets or displays the time delay of both I and Q vectors relative to the selected trigger and marker. A positive value means that the I and Q vectors delay relative to the marker or trigger. A negative delay implies the other way around.

Set this time delay in the I/Q modulator or at the I/Q analog output.

Remote command:

`[:SOURce] :BB:IMPairment:RF<ch>:DELay` on page 574

`[:SOURce] :BB:IMPairment:IQOutput<ch>:DELay` on page 574

Phase Offset

Adds a phase offset after the stream mapper.

You can shift the signal phase at the different stages in the signal generation flow:

- For "Baseband Offsets" > "Phase Offset", see ["Phase Offset"](#) on page 139.
- For "I/Q Stream Mapper" > "Phase Offset", see ["Phase Offset"](#) on page 142.

Remote command:

[:SOURce] :BB:IMPairment:RF<ch>:POFFset on page 576

[:SOURce] :BB:IMPairment:IQOutput<ch>:POFFset on page 576

6.5 Correcting the frequency response

- [About frequency response correction](#)..... 161
- [Applying user-defined FRC](#)..... 165
- [User-defined FRC configuration and settings](#)..... 169

6.5.1 About frequency response correction

The I/Q modulation frequency response or the I/Q flatness is an important signal quality parameter for any vector signal generator, in particular when signals with large bandwidth are generated. The I/Q modulation frequency response affects for example:

- Error vector magnitude (EVM) of digitally modulated signals
- Relative carrier power of multicarrier signals distributed over a large bandwidth

Without any additional option, the R&S SF100A is equipped with a high-performance I/Q modulator that, if configured to, generates an optimized flat signal. With activated high-quality optimization mode, the instrument uses an internal correction method and digital baseband filters to compensate for frequency response variations and I/Q skew within its signal processing chain. Signal correction is performed in real time.

Components and system flatness

The signal at the RF output and the analog I/Q outputs of the R&S SF100A is flat. However, the DUT is rarely connected directly to the outputs of the generator. You are likely to use connecting cables between the R&S SF100A and the DUT as it is likely that the test setup includes further measurement equipment, connected at the DUT's outputs. Especially at microwave frequencies and with complex test setups, components like cables, power combiners, switches or mixers can severely affect the I/Q flatness.

Principle of user-defined frequency response correction

If equipped with the option R&S SF1-K544, you can load scattering parameters (S-parameters) files and frequency response (FR) files to compensate for output signal deviations. These deviations stem from components in the signal chain. see "[Components and system flatness](#)" on page 161.

The R&S SF100A retrieves correction values from these files to pre-process the signal. During pre-processing, the R&S SF100A compensates signal magnitude variations and signal phase variations for the resulting frequency response.

You can obtain S-parameters files by measuring the components with a vector network analyzer (VNA). If S-parameters files are unavailable, you can also retrieve correction values from FR files. Obtain these files with R&S NRP power sensors or by converting an equalizer file.

Real-time compensation

The compensation filters are implemented in hardware. Thus, corrections are applied in real time, irrespectively of the baseband signal. If the baseband signal is reconfigured, the compensation is applied on that signal, too. Logically though, if parts of the setup like components or cables are changed, these newly introduced parts have to be measured and their S-parameter files included in the compensation.

Difference between the S-parameters and FR files

The **S-parameters files** contain transmission S-parameters (S-parameters) that characterize the component's frequency response. They compensate the frequency response of the S-parameters network, regarding **magnitude and phase**, while taking reflections into consideration.

FR files with file extension `*.fres` contain magnitude and phase corrections but do not contain reflection corrections. Use user correction files with file extension `*.uco` to compensate the signal magnitude at the center frequency. If you load a frequency response (FR) list that contains several files, these files also compensate the magnitude frequency response over the modulation frequency. User correction files do not contain phase corrections or reflection corrections.

6.5.1.1 Required options

The equipment layout includes:

- Base unit
- Option user-defined frequency response correction (R&S SFI-K544)

6.5.1.2 Supported file formats

The following file formats are supported:

Extension	File type	Description
<code>*.s<n>p</code>	Touchstone S-parameters files	See " S-parameters (touchstone) files " on page 162.
<code>*.uco</code>	User correction files	See " Frequency response (FR) files " on page 164.
<code>*.fres</code>	Frequency and phase of the transmission path in a touchstone format	See " Frequency response (FR) files " on page 164.
<code>*.freqresp</code>	Save or recall a file that contains the configuration in the dialog	See " Save/Recall " on page 172.

`*.freqresp`

S-parameters (touchstone) files

The R&S SFI100A can extract and apply scattering matrix corrections from S-parameters data files. These data files are also known as touchstone files and exist in two format versions, V1.0 and V2.0.

R&S SFI-K544 supports the touchstone file format in version V1.0.

File extension

S-parameters files are files with predefined structure and file extension `*.s<n>p`, where the following applies :

- `<n>` is an integer value that is equal or higher than 1
- `<n>` is the number of measured ports
- `<n>2` = number of S-parameters that the file contains

An `*.s1p` file, for example, contains a one-port measurement and one S-parameter while the file `*.s3p` contains a three-port measurement and nine S-parameters.

For the frequency response compensation, the most meaningful S-parameter is `S21`. It characterizes the frequency response of a component. Measure S-parameters with a vector network analyzer, for example, the R&S ZNB.

File format

Touchstone files contain a **header**, a **comment section**, and the **actual trace data**. The following is an extract of the file content of file created by the R&S ZNB.

```
# HZ S RI R 50.00
! Rohde & Schwarz Vector Network Analyzer
! Rohde-Schwarz,ZNB8-4Port,1311601044100005,1.93.1.42
! Created: UTC 9/17/2013, 9:13:56 AM
! freq[Hz] re:S11 im:S11
1.0000000000000000E5 -4.897128641605377E-1 3.767784312367439E-2
4.2599500000000000E7 -5.450598597526550E-1 3.608805686235428E-2
...
```

indicates the beginning of the **header line**. The top of the file requires this header line that consists of the following data elements:

- **<Frequency unit>**: HZ / KHZ / MHZ / GHZ, Rohde & Schwarz analyzers usually use Hz.
- **<Data file type>**: S for S-parameter files
- **<Data format>**:
 - RI = Re/Im
 - MA = linear magnitude-phase
 - DB = Mag-Phase in decibels
- **<Reference resistance>**: specifies the impedance system underlying the trace data, given as a real, positive resistance (default 50 Ω)

Comment lines start with the exclamation mark (!) and can contain any text used for documentation of the trace data file. Any number of comment lines can be inserted before or after the header line.

The following information is displayed in the comments section:

- VNA identification (comment line 2 in the above example)
- Timestamp (comment line 3)

- Port-specific renormalization information (comment lines 4ff, if applied)
- Headings for included data tables (comment lines right above the data tables, starting with ! freq)

The **trace data** section corresponds to a set of single-ended S-parameters. It depends on the number of ports and the data format.

For real and imaginary values (<Data format> = RI) the trace data for each stimulus frequency is arranged as indicated in the lowermost comment lines:

- **1-port files (*.s1p)**

```
! freq[Hz] re:S11 im:S11
```

You can replace S_{11} by any S-parameter. The *.s1p file format can contain an arbitrary data trace representing an S-parameter. The file lists all values arranged in one line.

- **2-port files (*.s2p)**

```
! freq[Hz] re:S11 im:S11 re:S21 im:S21 re:S12 im:S12 re:
S22 im:S22
```

The file lists all values arranged in one line.

- **n-port files (*.snp), $2 < n \leq 4$**

```
! freq[Hz] re:S11 im:S11 re:S12 im:S12 ... re:S1n im:S1n
! re:S21 im:S21 re:S22 im:S22 ... re:S2n im:S2n
! ...
```

```
! re:Sn1 im:Sn1 re:Sn2 im:Sn2 ... re:Snn im:Snn
```

The file lists all values arranged in n lines.

- **n-port files (*.snp), $n > 4$**

```
! freq[Hz] re:S11 im:S11 ... re:S14 im:S14
! re:S15 im:S15 ...
! ...
! ... re:Snn im:Snn
```

The file lists all values arranged in m lines, where $m = n^2/4$. The first m-1 data lines contain exactly four value pairs.

The stimulus frequencies are in ascending order. For linear magnitude-phase and magnitude-phase in decibels values (<Data format> = MA or DB), the trace data the real and imaginary S-parameter values re:Sij im:Sij are replaced by mag:Sij ang:Sij or db:Sij ang:Sij, respectively.

Cascading files

If you load several S-parameter files, the R&S SF100A processes these files in a cascading manner. Each S-parameters file defines the S-parameter origin and the destination ports. You can configure or reverse the orientation of the signal chain. The first entry in the signal chain is the R&S SF100A, the last entry is the DUT.

Frequency response (FR) files

This description provides information on frequency response (FR) files.

FR file extensions

The R&S SF1100A can extract and apply frequency response and level corrections from the following FR file types:

- *.uco files
- *.fres files.

These files types contain transmission parameters, in magnitude and phase. The order of the files in the file list is not relevant but the file processing assumes a perfect matching of the single files.

*.fres files

These files contain user-defined transmission frequency response values and are created manually, in one of the following ways:

- From existing user data describing the transmission characteristics of the channel or the device, like, for example, the S21 S-parameter set. The *.fres file format is the same as the file format of the one port S-parameter files; merely changed is the file extension.
See "[S-parameters \(touchstone\) files](#)" on page 162.
- Obtained through conversion of an equalizer file.
Equalizers are special filters in spectrum analyzers like, for example, the R&S®FSW. The analyzer uses these filters to compensate for the frequency response of the received signal. You can query the equalizer characteristics or filter tabs with remote control commands.
For more information, see R&S®FSW user manual.

*.uco files

User correction files can be created manually or obtained by a power sensor for example R&S NRP.

These types of files can also be used with the user correction functionality in the RF block. Corrections affect one or a sequence of discrete frequencies. For narrowband signals, this approach can achieve sufficient results but it is not effective for wideband signals.

The user-defined frequency response corrections are applied digitally and on the current baseband signal, thus compensating the magnitude of the signal in the modulation frequency range.

For information on the user correction function, file format and on how to acquire the frequency response characteristics of the transmission channel by R&S NRP power sensor, see the following:

- [Chapter 7.6, "Applying user correction"](#), on page 228

6.5.2 Applying user-defined FRC

This chapter describes how to use the R&S SFI-K544 functionality and load S-parameters files for compensating for the frequency response of a test setup.

We assume that you have characterized the components (cable, combiners, DUT), for example with vector network analyzer, and have created the required S-parameters files. We also assume that the frequency response files are created.

To generate the baseband and RF signal

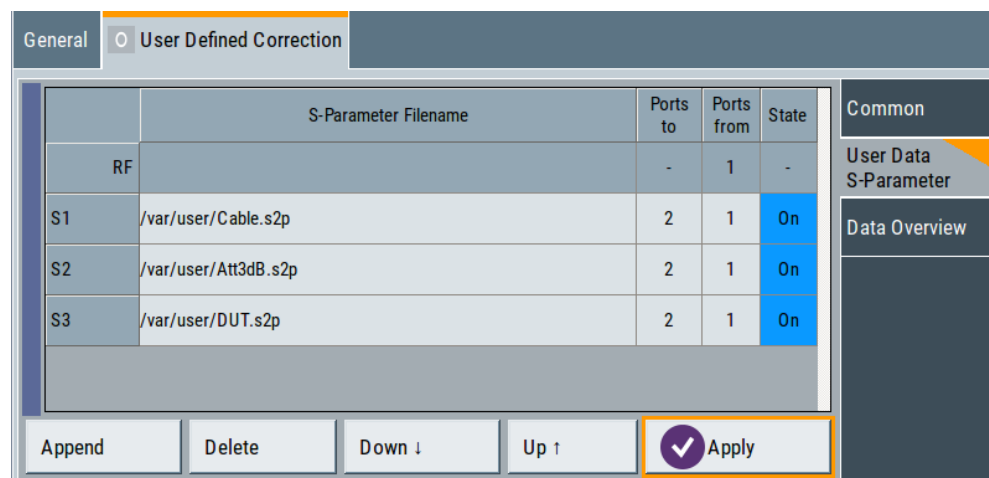
Configure the baseband signal and enable signal generation, for example as follows:

1. In the block diagram, select "Baseband" > "ARB" > "State" > "On".
2. In the status bar, set the frequency and level, for example, "Frequency" = "5 GHz" and "Level" = "-15 dB".
3. In the block diagram, select "RF" > "On".

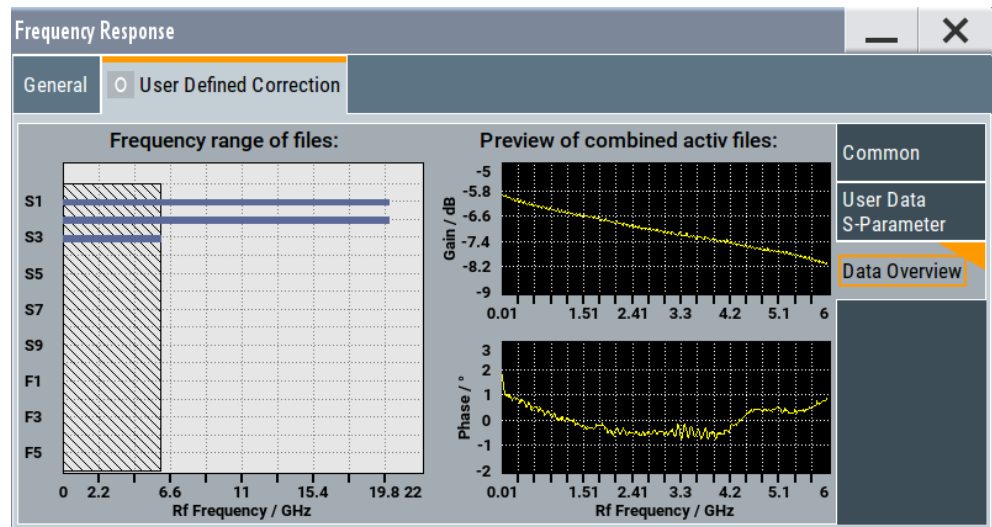
To apply S-parameters file corrections

We assume that you have characterized the components (cable, combiners, DUT), for example with vector network analyzer, and have created the required S-parameters files. We also assume that the frequency response files are created.

1. Use any of the file transfer methods to save the S-parameters files in the /var/user/ directory of the R&S SF1100A.
2. Select "I/Q Mod" > "Frequency Response".
3. Select "General" > "Optimization Mode" > "High Quality".
4. Select "User Defined Correction" > "User Data S-parameter".
 - a) In the S-parameter table, select "S1" > "S-Parameter Filename".
 - b) Navigate to the S-parameter file.
5. If you use several files, select "Append".
6. Load these files in the same manner.
7. For each of the files, select "State" > "On".
8. Select "Apply".

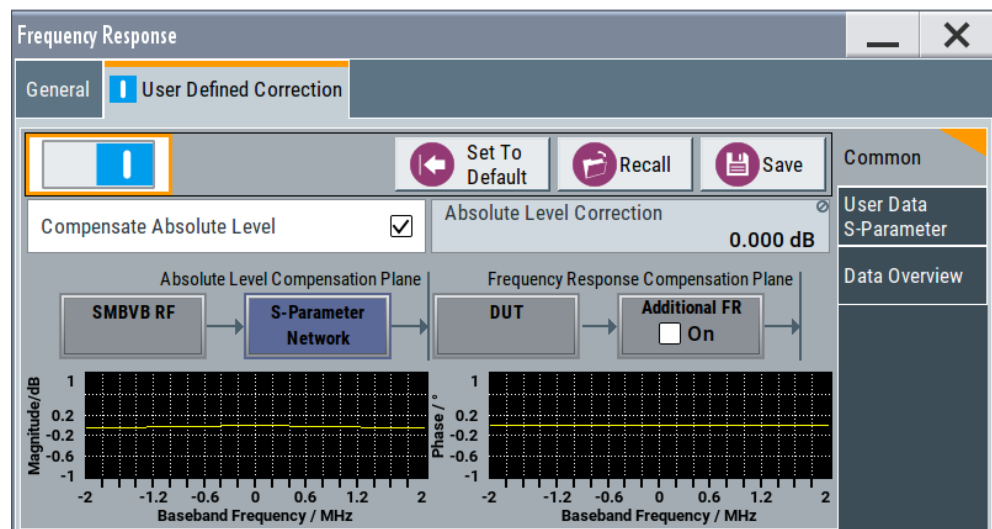


9. Select "User Defined Correction" > "Data Overview" to observe the frequency range covered by the loaded files.



The dialog also shows an overview of the aggregated correction data of all active files.

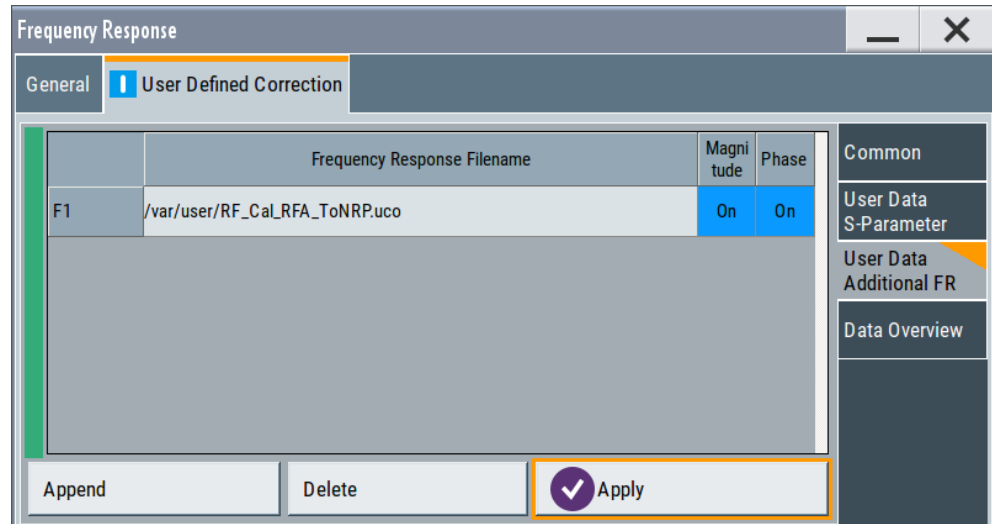
10. Select "User Defined Correction" > "Common" > "State" > "On".
11. Optionally, select "Compensate Absolute Level" > "On".



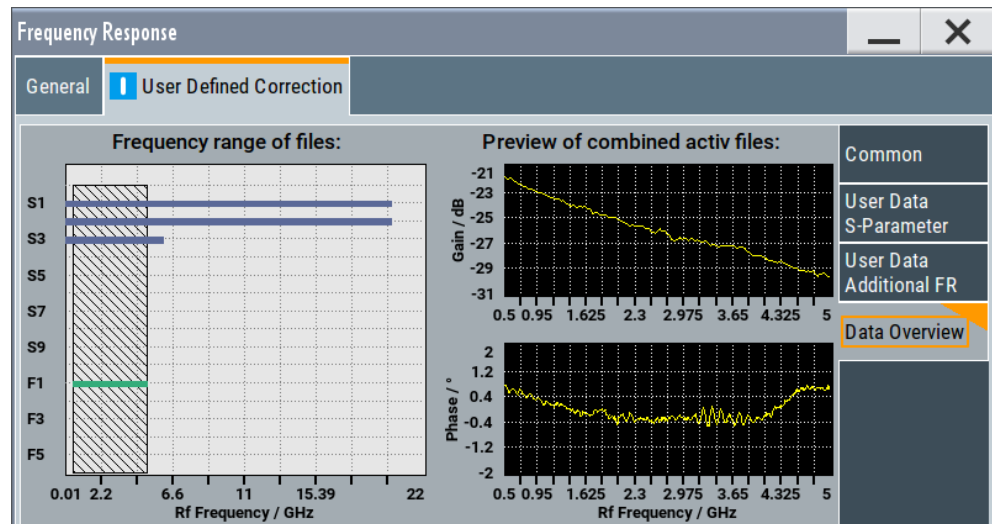
To use additional frequency correction data

1. Select "User Defined Correction" > "Common" > "Additional FR" > "On".
2. Select "User Defined Correction" > "User Data Additional FR":
 - a) In the frequency response table, select "F1" > "Frequency Response File-name".
 - b) Navigate to the *.uco file.

3. If you use several files, select "Append".
4. Load the files in the same manner.
5. For each of the files, select "Magnitude" > "On" and "Phase" > "On".
6. Select "Apply".



7. Select "User Defined Correction" > "Data Overview" to observe the frequency range covered by all loaded files.



The dialog also shows an overview of the aggregated correction data of all active files.

6.5.3 User-defined FRC configuration and settings

Access:

- ▶ In the block diagram of the R&S SF1100A, select "I/Q Mod" > "Frequency Response".

The dialog provides settings to configure the frequency responses.

The remote commands to define these settings are described in [Chapter 13.15.3, "SOURCE:CORREction:FRES subsystem"](#), on page 482.

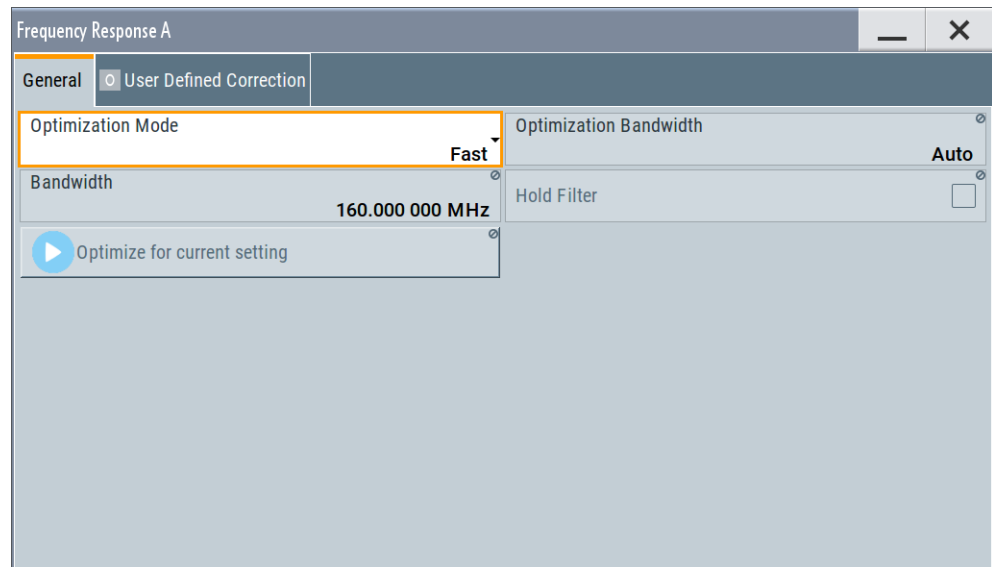
For step-by-step instructions, see [Chapter 6.5.2, "Applying user-defined FRC"](#), on page 165.

- [General settings](#)..... 169
- [User-defined correction settings](#)..... 171

6.5.3.1 General settings

Access:

- ▶ Select "I/Q Mod" > "Frequency Response" > "General".



Settings:

- [Optimization Mode](#)..... 170
- [Optimization Bandwidth](#)..... 170
- [Bandwidth](#)..... 170
- [Hold Filter](#)..... 170
- [Optimize for current setting](#)..... 171

Optimization Mode

Selects the optimization mode for I/Q modulation of the internal baseband signal.

How to: [Chapter 6.5.2, "Applying user-defined FRC"](#), on page 165

For more information, refer to the specifications document.

"Fast" Fast optimization by compensating for I/Q skew. This mode is suitable in time sensitive environments and for narrowband signals.

"High Quality Table"

This mode further improves the frequency response while maintaining setting time. There is no signal interruption. Select this mode in set-ups to generate phase coherent signals with an RF modulation bandwidth of up to 10 GHz.

Remote command:

`[:SOURce<hw>] :CORRection:FRESponse:RF:OPTimization:MODE`
on page 484

Optimization Bandwidth

Requires "Optimization Mode" > "High Quality Table".

Sets the method to determine the signal bandwidth. The instrument uses this signal bandwidth to compensate for the frequency response.

"Auto" Automatic signal bandwidth setting that is based on the sample rate of the baseband signal.

"Manual" Manual signal bandwidth setting via "Bandwidth". See ["Bandwidth"](#) on page 170.

Remote command:

`[:SOURce<hw>] :CORRection:FRESponse:RF:OPTimization:BANDwidth:MODE` on page 485

Bandwidth

Displays or sets the signal bandwidth to compensate for the frequency response.

Setting requires "Optimization Mode" > "High Quality Table" and "Optimization Bandwidth" > "Manual".

For "Optimization Bandwidth" > "Auto", displays the automatically derived signal bandwidth.

See ["Optimization Bandwidth"](#) on page 170.

Remote command:

`[:SOURce<hw>] :CORRection:FRESponse:RF:OPTimization:BANDwidth[:VALue]` on page 485

Hold Filter

Requires "Optimization Mode" > "High Quality Table".

Retains the last calculated correction values as long as one of the following holds:

- Select "Optimize for current setting".
- Select "Hold Filter" > "Off".

Remote command:

`[:SOURce<hw>] :CORRection:FRESponse:RF:OPTimization:HOLD[:STATe]`
on page 486

Optimize for current setting

Requires "Optimization Mode" > "High Quality Table".

Optimizes correction for the current frequency and bandwidth. Use this function to trigger recalculation of the compensation values for the enabled hold filter ("Hold Filter" > "On").

Remote command:

`[:SOURce<hw>] :CORRection:FRESponse:RF:OPTimization:LOCal`
on page 486

6.5.3.2 User-defined correction settings

Access:

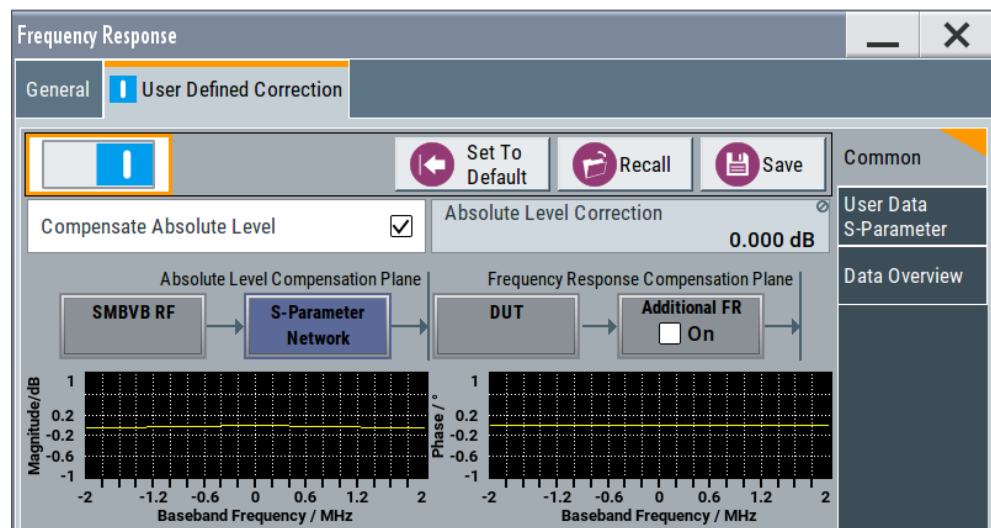
► Select "I/Q Mod" > "Frequency Response" > "User Defined Correction".

- [Common settings](#)..... 171
- [User data S-parameter settings](#)..... 173
- [User data additional FR settings](#)..... 175
- [Data overview](#)..... 177

Common settings

Access:

► Select "User Defined Correction" > "Common".



This dialog provides default settings, "Save"/"Recall" settings and settings that are common for the particular FRC setup.

Settings:

State.....	172
Set To Default.....	172
Save/Recall.....	172
Compensate Absolute Level.....	172
Absolute Level Correction.....	173
Additional FR.....	173

State

Enables the user-defined frequency response correction. Enabling requires "Optimization Mode" > "High Quality".

See "[Optimization Mode](#)" on page 170.

Remote command:

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:USER\[:STATe\]](#) on page 487

Set To Default

Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Value
State	Off
Compensate absolute level	Off
Additional FR	Off

Remote command:

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:USER:PRESet](#) on page 487

Save/Recall

Accesses the "Save/Recall" dialog, that is the standard instrument function for saving and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The settings are saved in a file with predefined extension. You can define the filename and the directory, in that you want to save the file.

Remote command:

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:USER:STORe](#) on page 487

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:USER:LOAD](#) on page 487

Compensate Absolute Level

If S-parameters files are loaded, absolute level compensation at the current center frequency can also be enabled. Current correction value is indicated.

If enabled, the absolute level is compensated for the signal until the DUT inputs. Level compensation in the transmission channel, i.e. if FR files are used, is not supported. You recognize active absolute level correction by the "Lev Fcor" icon in the status bar.

To apply corrections from S-parameters files, select [User Data S-Parameter](#), load suitable files, activate them and select "Apply".

You cannot enable absolute level compensation and user correction simultaneously. These functions exclude each other.

See also ["About UCOR"](#) on page 229.

Remote command:

```
[ :SOURce<hw> ] :CORRection:FRESponse:RF:USER:ALEVEL[:STATe]
on page 488
```

Absolute Level Correction

Indicates the current level correction value, if absolute level correction is enabled.

Remote command:

```
[ :SOURce<hw> ] :CORRection:FRESponse:RF:USER:ALEVEL:VALue?
on page 488
```

Additional FR

Enables user-defined corrections. The instrument uses FR files to apply these corrections to compensate for the channel response of the transmission channel.

To apply such corrections, select the "User Data Additional FR" tab, load RF files, enable them and select "Apply". See ["User data additional FR settings"](#) on page 175.

Observe the shift of the compensation plane in the illustration in the dialog.

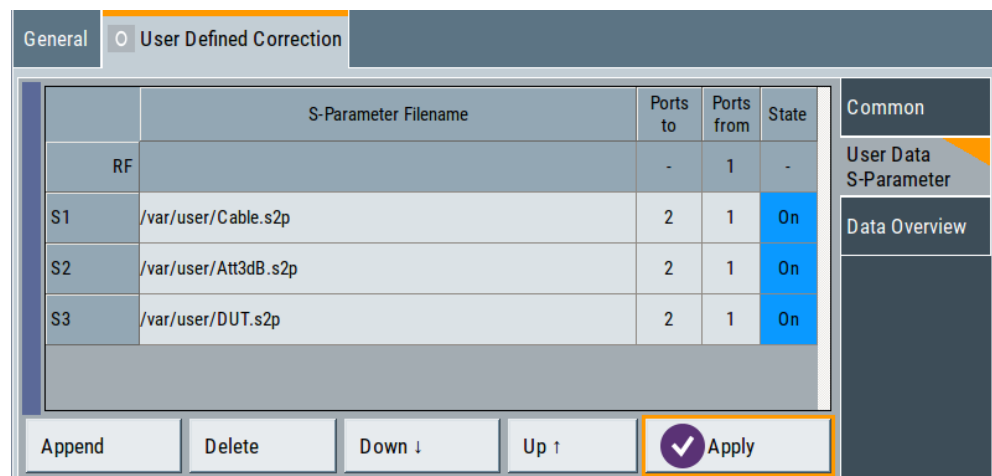
Remote command:

```
[ :SOURce<hw> ] :CORRection:FRESponse:RF:USER:FLIST[:STATe]
on page 489
```

User data S-parameter settings

Access:

- ▶ Select "I/Q Mod > Frequency Response > User Defined Correction > User Data S-Parameter".



In this dialog, you can load S-parameters files. If activated, the transmission S-parameter values are extracted from the file and used to pre-process the generated signal. At the DUT, the signal is as if the DUT is directly connected to the output of the R&S SF1100A. The frequency response of the related components is compensated.

Also to or instead of S-parameters files if the latter are for example unavailable for particular components, you can also load frequency response RF files, see "[User data additional FR settings](#)" on page 175.

To activate loaded files, enable them ("State" > "On") and select "Apply". A warning icon appears if you change any setting in the dialog but "Apply" is not executed.

Settings:

S1 to S10.....	174
S-Parameter Filename.....	174
Ports to/Ports from.....	174
State.....	175
Append / Delete/Up/Down.....	175
Apply.....	175

S1 to S10

S-parameter file number indicating the loaded files. You can load up to 10 files.

Remote command:

Via `SLIST<ch> suffix`

S-Parameter Filename

Access the standard "File Select" dialog for loading S-parameters (Touchstone) files. S-parameters files are files with predefined extension (`*.s<n>p`) and file format.

See "[S-parameters \(touchstone\) files](#)" on page 162.

Use the standard "File Manager" function to transfer external data lists to the instrument.

Remote command:

`[:SOURCE<hw>] :CORRection:FRESponse:RF:USER:SLIST<ch>:SElect`
on page 489

Ports to/Ports from

Sets the origin and destination ports, i.e. the port number from that the signal is coming and the port to that it is going. Use this parameter to change the orientation of the signal chain.

Remote command:

`[:SOURCE<hw>] :CORRection:FRESponse:RF:USER:SLIST<ch>:PORTs:FROM`
on page 490

`[:SOURCE<hw>] :CORRection:FRESponse:RF:USER:SLIST<ch>:PORTs:TO`
on page 490

State

If activated, the file is used for frequency response compensation. Thus, you can load files that are excluded from the current frequency response compensation scenario, exchange files or temporarily deactivate files.

Note: However, files are of the S-parameter used until you execute **"Apply"**. Observe the indication in the side tab. A warning icon appears if you change any setting in the "Use Data S-Parameter" dialog but "Apply" is not executed.

Remote command:

```
[ :SOURce<hw> ] :CORRection:FRESponse:RF:USER:SLISt<ch> [ :STATe ]
on page 490
```

Append / Delete/Up/Down

Standard functions for handling the table rows.

Apply

Applies the values from the active S-parameters files and uses them to pre-process the signal.

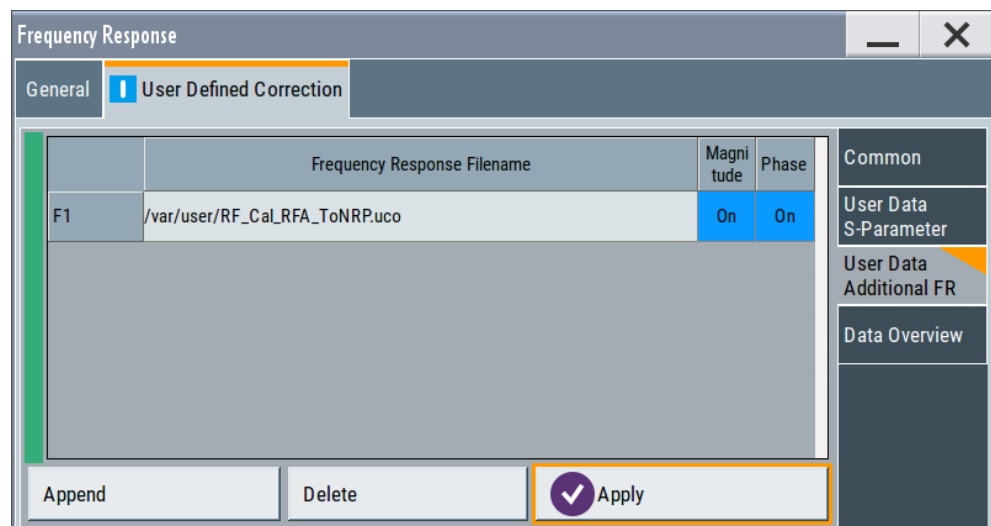
Remote command:

```
[ :SOURce<hw> ] :CORRection:FRESponse:RF:USER:APPLy on page 489
```

User data additional FR settings

Access:

1. Select "I/Q Mod > Frequency Response > User Defined Correction > Common".
2. Select "Additional Frequency Response (FR) > On".
3. Select "User Data Additional FR".



In this dialog, you can load user-defined frequency response (FR) files. If activated, the frequency response values are extracted from the file and used to pre-process the generated signal.

You can use FR files or S-parameters files. To activate loaded files, enable them and select "Apply". A warning icon appears if you change any setting in the dialog but "Apply" is not executed.

Settings:

F1 to F5.....	176
Frequency Response Filename.....	176
Magnitude/Phase.....	176
Append/Delete.....	176
Apply.....	176

F1 to F5

FR file number indicating the loaded files. You can load up to five files.

Remote command:

Via `FLIST<ch> suffix`

Frequency Response Filename

Access the standard "File Select" dialog for loading FR files. FR files are files with pre-defined extension (`*.uco` or `*.fres`) and file format.

See "Frequency response (FR) files" on page 164.

Use the standard "File Manager" function to transfer external data lists to the instrument.

Remote command:

`[:SOURCE<hw>] :CORRection:FRESponse:RF:USER:FLIST<ch>:SElect`
on page 490

`[:SOURCE<hw>] :CORRection:FRESponse:RF:USER:FLIST:CATalog?`
on page 490

Magnitude/Phase

Enables using the phase and magnitude information from the loaded FR file.

Note: However, files are of the FR used until you execute "Apply".

Observe the indication in the side tab. A warning icon appears if you change any setting in the "Use Data Additional RF" dialog but "Apply" is not executed.

Remote command:

`[:SOURCE<hw>] :CORRection:FRESponse:RF:USER:FLIST<ch>:MAGNitude [:STATE]` on page 490

`[:SOURCE<hw>] :CORRection:FRESponse:RF:USER:FLIST<ch>:PHASE [:STATE]` on page 490

Append/Delete

Standard functions for handling the table rows.

Apply

Retrieves the values from the active FR files and pre-processes the signal with them.

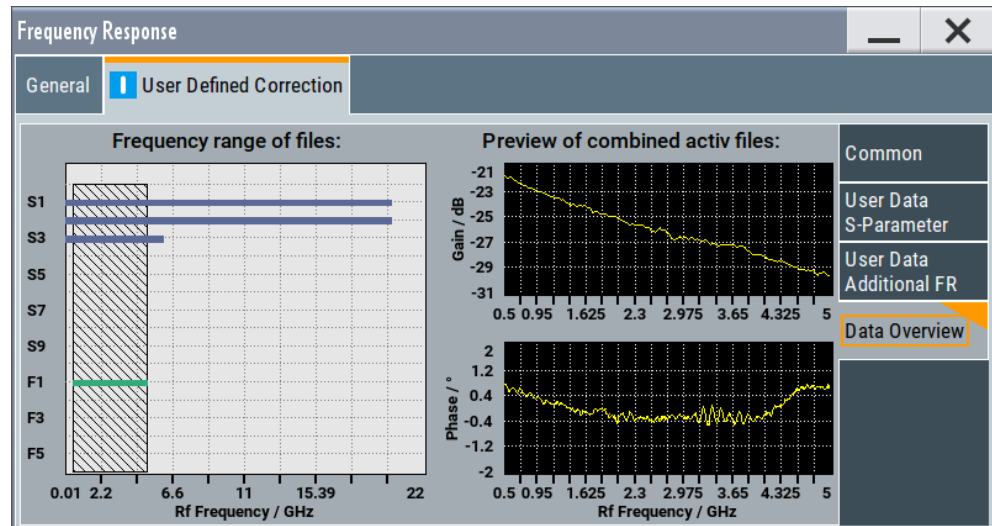
Remote command:

`[:SOURCE<hw>] :CORRection:FRESponse:RF:USER:APPLY` on page 489

Data overview

Access:

- ▶ Select "I/Q Mod > Frequency Response > User Defined Correction > Data Overview".



This dialog provides a graphical overview of the combined user-defined frequency response corrections.

The first graph represents the frequency range covered by each of the files and highlights the common frequency region. The graphs on the right indicate the aggregated frequency response corrections for both the magnitude and phase corrections over the common frequency range.

In both cases, considered are the active ("State > On") rather than all loaded files.

7 Generating RF signals

The wideband IF vector signal generator R&S SFI100A generates RF signals within the frequency range from 11 GHz up to 21 GHz. These signals can have up to 10 dBm output power and an adjustable signal level over a wide range.

In addition to real-time CW signals, you can generate RF signals from externally created waveform files which you can load into the R&S SFI100A.

The main application field of the R&S SFI100A is the use as an IF source for external frontends and frequency converters. The RF output signal of the R&S SFI100A is therefore referred to as the IF input signal for the connected external instruments.

The R&S SFI100A also provides functions to improve the RF output signal performance:

- **User correction (UCOR)**
The user correction function allows you to compensate frequency responses of external setups (e.g. losses of cables) and achieve a stable input signal over frequency directly at the DUT.
See ["About UCOR"](#) on page 229.
- **Power sensors**
The R&S SFI100A supports R&S NRP power sensors, e.g. to monitor the output level of the generator. The sensor readings enable you to determine level correction values. Thus you can adjust the RF output power of the generator until you reach the target level at the DUT.
See [Chapter 7.5, "Using power sensors"](#), on page 212.
- [Generating upconverted RF signals](#)..... 178
- [Configuring RF signals](#)..... 199
- [RF settings](#)..... 200
- [Generating reference signals](#)..... 205
- [Using power sensors](#)..... 212
- [Applying user correction](#)..... 228
- [Improving the RF signal performance](#)..... 239

7.1 Generating upconverted RF signals

To expand the frequency range of the R&S SFI100A, you can add external frontends to your test setup. External frontends can upconvert the output frequency of the R&S SFI100A for wideband signal generation, for example D band signals (110 GHz to 170 GHz).

7.1.1 About external frontends

Working with external frontends for upconversion is supported via the frontend control option R&S SFI-K553 integrated in the base unit of the R&S SFI100A.

Supported external frontends

The R&S SF100A supports the following external frontends:

- R&S FE110ST
- R&S FE170ST

External frontend basics

When using a signal generator in complex test setups, long RF cables between the DUT and the signal generator are often necessary. When measuring high-frequency signals, long RF cables can lead to unwanted loss. Using an external frontend with smaller physical dimensions in your test setup allows for testing closer to the DUT, which reduces the effect of the loss on the measurement.

The test signal is transferred (TX mode) from the R&S SF100A to the external frontend on a lower intermediate frequency (IF). The external frontend upconverts the IF signal to the higher frequency RF signal, which is transferred for processing at the DUT. For upconversion, the external frontend uses either its internal local oscillator (LO) or you can apply an external LO signal.

Using an external frontend for upconversion has the following advantages:

- **Extended frequency range**
The external frontend can process RF data in a higher frequency range than the R&S SF100A itself supports. For example, using an R&S FE110ST external frontend in your test setup, you can generate RF signals in a range of 70 GHz to 110 GHz.
- **Minimized RF cable loss**
You can place the external frontend as close as possible to the DUT using shorter RF cables. Therefore, the cabling between the R&S SF100A and the external frontend is not as vulnerable to distortion effects and power loss. Since the IF cable is usually part of the fixed setup, any existing frequency response can be calculated in advance. The R&S SF100A can then adapt signal generation automatically. See also [Chapter 7.1.3.4, "Cable correction settings"](#), on page 190.

A typical application is a test setup involving a DUT placed in an RF shield box. The external frontend is connected directly to the RF shield box, while the R&S SF100A is placed in a measurement rack elsewhere in the laboratory.

7.1.2 Operating external frontends

This chapter provides an overview on step-by-step instructions related to connecting and configuring external frontends.

It includes the following:

- [Connecting external frontends](#)..... 180
- [Controlling external frontends](#)..... 180
- [Adding external devices to the external frontend](#)..... 181
- [Test setups with multiple external frontends](#)..... 183
- [Generating RF output signals](#)..... 184

7.1.2.1 Connecting external frontends

For a step-by-step description of how to connect an external frontend, see ["To connect an external frontend"](#) on page 36.

7.1.2.2 Controlling external frontends

This chapter provides step-by-step descriptions for controlling and operating external frontends with the R&S SFI100A. Configuring procedures are summarized for the R&S FE170ST as an example. The configuration procedure is analogous for all other external frontends.

For the following procedures, it is assumed that a network connection is established.

- For information on how to configure the R&S SFI100A for frontend control, see ["To configure the R&S SFI100A for frontend control"](#) on page 37
- ["To configure external frontend settings"](#) on page 180
- ["To configure frequency band settings for the external frontend"](#) on page 181

To configure external frontend settings

The following procedure describes how to configure external frontend settings at the R&S SFI100A.

See also [Chapter 7.1.3.1, "General settings"](#), on page 186.

The R&S SFI100A is connected to an external frontend and a remote control connection between R&S SFI100A and the external frontend is established.

See ["To configure the R&S SFI100A for frontend control"](#) on page 37.

1. Select one of the following in the block diagram:
 - Select the icon of the connected external frontend to the right of the "RF Out" block.
 - Select "RF Out" > "RF Frontend" > "Frontend Device".
2. Set the frequency of the reference signal between R&S SFI100A and external frontend, e.g., "1 GHz".
3. Optionally, change the "Connection Mode".
For "Connection Mode" > "Auto", the R&S SFI100A reads out the frontend information automatically, for example intermediate frequency (IF) and frequency band configuration.
4. Set the "Frequency Band Configuration".
See ["To configure frequency band settings for the external frontend"](#) on page 181.

Also, the R&S SFI100A sets and reads out the following parameters automatically at the external frontend:

- "Intermediate Frequency / Sideband": Frequency of the IF input signal input
- "Active RF Connector": RF output connector
- "Frequency Band x": Frequency ranges of the RF output signal

For more information, refer to the specifications document.

To configure frequency band settings for the external frontend

Test setups typically require a defined setting of the frequency band configuration. Configure this setting in the "RF Frontend" dialog of the R&S SFI100A.

Note: This procedure describes configuring the R&S FE170ST as an example. Configuring the R&S FE110ST is analogous.

- ▶ Set the "Mode" for the "Frequency Band Configuration".
 - a) Select "Mode > Auto" to use the internal "Frequency band config" of the R&S SFI100A.
 - b) Select "Mode > Manual" to configure, for example, a test setup with multiple external frontends.

"Frequency Band Config > SFI" uses the internally defined frequency band configuration of the R&S SFI100A.

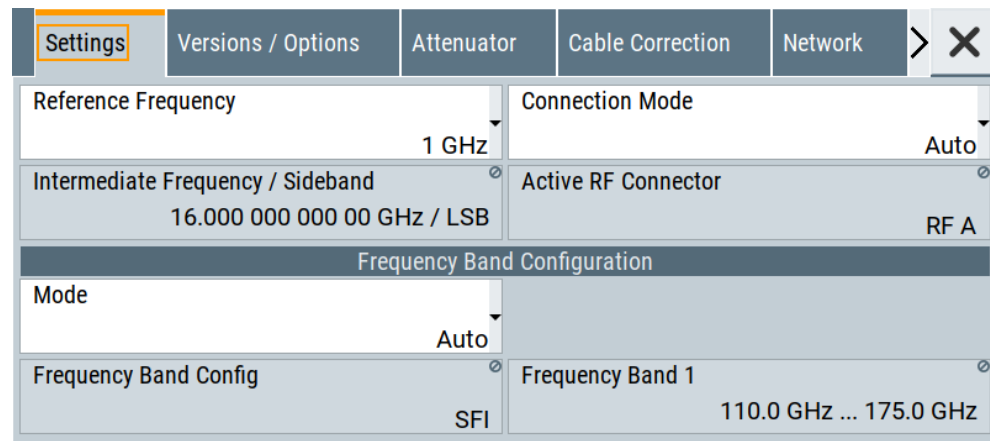


Figure 7-1: Example: Frontend configuration FE170ST

7.1.2.3 Adding external devices to the external frontend

You can add accessories, for example a bandpass filter or an amplifier, as external devices to a test setup with R&S SFI100A and an external frontend. The external devices transmit the RF input via their waveguide connector. Power and device data is transmitted via an IX type B connector with an SPI interface.

The IX type B connector allows you to connect external devices to the external frontend. External devices can amplify or filter the upconverted RF signal. Using an IX cable, correction data and device information for the external device is transferred to the external frontend and to the connected R&S SFI100A. Thus, the R&S SFI100A cannot only detect the external devices, but also consider their correction data in the RF measurement.

See also the installation instructions and specifications document of the external frontend.

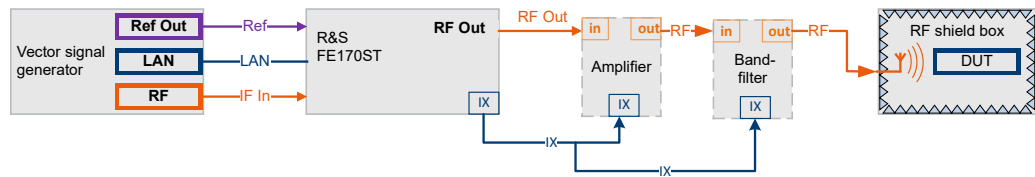


Figure 7-2: Test setup: Vector signal generator with R&S FE170ST and external devices

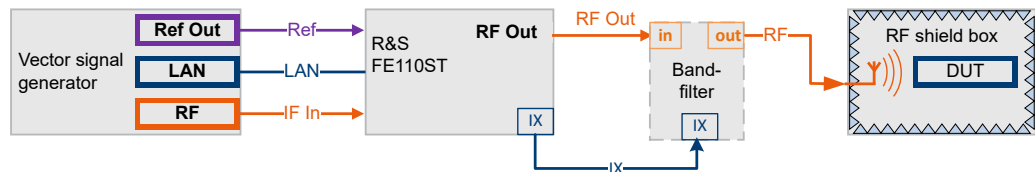


Figure 7-3: Test setup: Vector signal generator with R&S FE110ST and external device

Choosing an external filter

The supported frequency ranges of the available external filters overlap. For best results regarding image suppression and LO feedthrough, see the specifications document of the external device.

See the R&S FE170-Zxx or R&S FE110-Zxx accessories specifications document:

- www.rohde-schwarz.com/brochure-datasheet/fe170st
- www.rohde-schwarz.com/brochure-datasheet/fe110st

To connect an external device

1. Connect the RF output of the external frontend to the RF input of the external device.
2. Connect the IX connector of the external frontend with the cable provided with the device to the IX type B connector on the external device.
To connect two external devices, connect the IX Y-cable provided with the external frontend to both external devices.

Note: You can add only one external device of the respective type to the test setup.

3. Connect the RF output of the external device to the DUT.
4. Connect the external frontend to the R&S SFI100A.
See "[To connect an external frontend](#)" on page 36.

To check for external devices

You can check which external devices are connected in the signal path between the DUT and the external frontend.

1. Select one of the following in the block diagram:
 - Select the "FE..." icon to the right of the "RF Out" block.
 - Select "RF Out" > "RF Frontend" > "Frontend Device".

2. Select the "External Devices" tab.

The devices that are connected to the external frontend via the IX type B connector and which were detected by the R&S SF1100A are indicated.

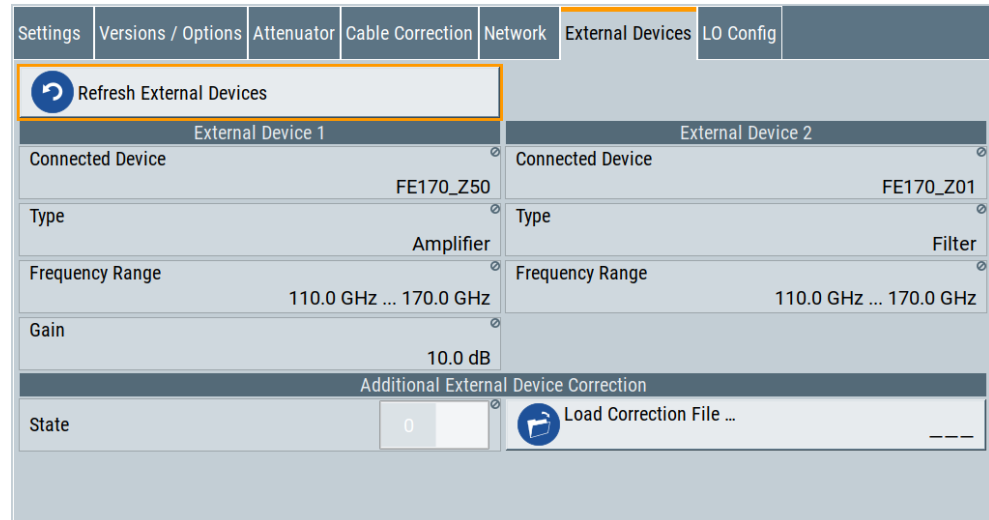


Figure 7-4: Example: External devices connected to an R&S FE170ST

3. If necessary, update the display by selecting "Refresh External Devices".

Alternatively:

- a) Select "I/Q Stream Mapper" in the block diagram.
- b) Select "External RF and I/Q" > "External Instrument" > "Config".
- c) Select "Clean All".
This step removes all connected external Instruments.
- d) Select "External Instrument".
- e) Select a device from the list.
- f) Click "Apply and Connect".

See [Chapter 7.1.3.6, "External devices settings"](#), on page 194.

7.1.2.4 Test setups with multiple external frontends

In a test setup with more than one external frontend, you can build a phase coherent test setup when using the same LO signal for all connected frontends.

See also [Chapter 7.1.3.7, "LO config settings"](#), on page 196.

To configure LO settings with multiple external frontends

1. Select one of the following in the block diagram:
 - Select the icon of the external frontend to the right of the "RF Out" block.
 - Select "RF Out" > "RF Frontend" > "Frontend Device".
2. Select the "LO Config" tab.

Settings	Versions / Options	Attenuator	Cable Correction	Network	External Devices	LO Config
<div style="border: 1px solid orange; padding: 5px;"> <div style="display: flex; justify-content: space-between; align-items: center;"> Mode Internal </div> <div style="display: flex; justify-content: space-between; align-items: center; margin-top: 5px;"> Out State Off </div> </div>						

3. Select the "Mode".
 - a) If the external frontend connected to the vector signal generator provides the LO signal in your test setup, select "Internal".
 - b) If the external frontend connected to the vector signal generator receives the LO signal in your test setup, select "External".
The "Mandatory LO IN Frequency" is displayed.
4. Select the "Out State".
 - a) If the external frontend connected to the vector signal generator provides the LO signal in your test setup, select "On".
The "LO OUT Frequency" is displayed.
 - b) If the external frontend connected to the vector signal generator receives the LO signal in your test setup, select "Off".

7.1.2.5 Generating RF output signals

With the R&S FE170ST connected to the R&S SF1100A, you can generate RF signals with frequencies in the high D band.

The procedure assumes that a remote control connection between R&S SF1100A and R&S FE170ST is established and the frontend settings are configured.

In this example, you generate an ARB signal from a waveform file stored on the R&S SF1100A, with RF frequency = 140 GHz and RF level = -25 dBm.

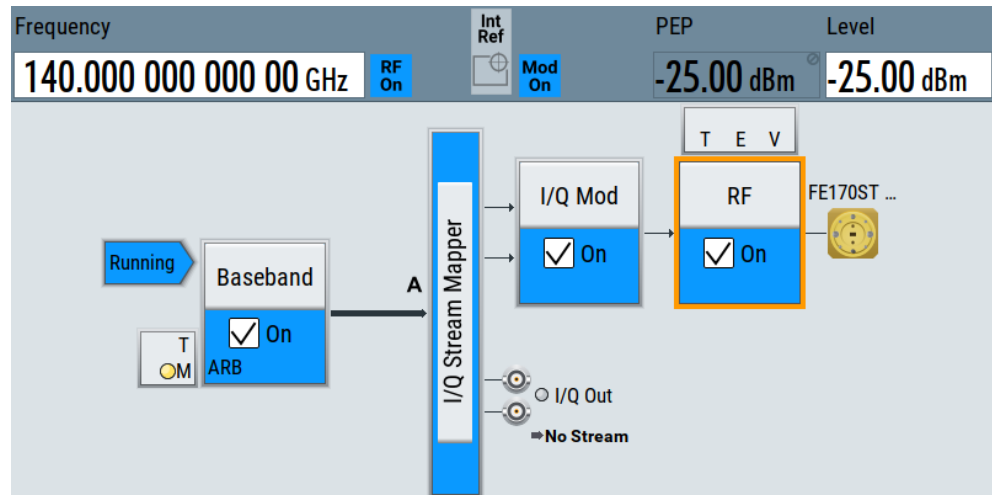
1. Select "Baseband > ARB".
2. In the "General" tab, select "Load Waveform".
3. Select the waveform file with file extension `*.wv` from the respective directory, for example `/var/user/testsignal`.
4. Click "Select".
The waveform file is loaded.
5. Select "ARB" > "State" > "On".
When loading a modulated test signal, the I/Q modulation is automatically switched on.
6. Return to the block diagram.
7. Configure the RF output signal.

Once you connect the external frontend, the R&S SF100A sets the "Frequency" in the status bar automatically. In particular, the R&S SF100A + R&S FE170ST sets the lower frequency of the frequency band, i.e. 110 GHz.

- a) In the status bar of the R&S SF100A, adjust the frequency of the RF signal.
- b) In the status bar of the R&S SF100A, adjust the level of the RF signal.

8. In the block diagram, select "RF > On".

The RF signal is output at the external frontend.



7.1.3 RF frontend settings

Access:

- ▶ Select one of the following in the block diagram:
 - Click the "FE ..." icon to the right of the "RF Out" block. For example, the icon displays "FE170ST" for an R&S FE170ST connected to the R&S SF100A.
 - Select "RF Out" > "RF Frontend" > "Frontend Device".

The remote commands required to define the settings are described in [Chapter 13.15.10, "SOURCE:EFRontend subsystem"](#), on page 514 in the chapter "Remote commands".

For information on how to connect external frontends, see [Chapter 5.2, "External RF settings"](#), on page 142.

To operate an external frontend with the R&S SF100A

See [Chapter 7.1.2, "Operating external frontends"](#), on page 179.

Settings:**7.1.3.1 General settings**

Access:

1. Select "RF Out" > "RF Frontend" > "Frontend Device".
2. Select "Settings".

Settings	Versions / Options	Attenuator	Cable Correction	Network
Reference Frequency	1 GHz	Connection Mode	Auto	
Intermediate Frequency / Sideband	16.000 000 000 00 GHz / LSB	Active RF Connector	RF A	
Frequency Band Configuration				
Mode	Auto			
Frequency Band Config	SFI	Frequency Band 1	110.0 GHz ... 175.0 GHz	

The "Settings" tab provides settings to configure reference frequency and connection settings for the connected external frontend.

Settings:

Reference Frequency.....	186
Connection Mode.....	186
Intermediate Frequency / Sideband.....	187
Active RF Connector.....	187
Mode.....	187
Frequency Band Config.....	187
Frequency Band x.....	188

Reference Frequency

Sets the frequency of the reference signal between R&S SF100A and frontend.

The R&S SF100A provides reference frequencies of 10 MHz and 1 GHz.

Remote command:

[:SOURce<hw>] :EFRontend:FREQuency:REFerence on page 522

[:SOURce<hw>] :EFRontend:FREQuency:REFerence:LIST? on page 522

Connection Mode

Sets the mode of the SSL control connection between R&S SF100A and external frontend.

There is one communication channel to control the external frontend meaning that one instrument controls the external frontend exclusively.

Once the external frontend is locked, the R&S SF100A firmware reads out external frontend characteristics such as intermediate frequency (IF) and frequency bands.

- "Auto" The R&S SF100A locks the external frontend, when activating the RF output at the R&S SF100A ("RF" > "On") for output of the IF signal.
 The R&S SF100A unlocks the external frontend, when deactivating the RF output at the R&S SF100A ("RF" > "Off").
- "Lock" The external frontend is locked permanently. No other instrument can take over control.
- "Simultaneous RX/TX"
 Not available for R&S SF100A (grayed out).

Remote command:

[\[:SOURce<hw>\]:EFRontend:CMODE](#) on page 520

Intermediate Frequency / Sideband

Displays the frequency of the IF signal that is the frequency at the "RF Out" connector of the R&S SF100A.

Also, the sideband of the IF signal is displayed after the frequency. "USB" means upper sideband, "LSB" means lower sideband.

If the lock of the communication channel is missing, the intermediate frequency displays "Unavailable due to missing lock".

Remote command:

[\[:SOURce<hw>\]:EFRontend\[:FREQuency\]:IFRequency\[:VALue\]?](#)

on page 522

[\[:SOURce<hw>\]:EFRontend:FREQuency:IFRequency:SIDeband?](#) on page 523

Active RF Connector

Displays the RF output connector that is active at the connected external frontend. The RF output signal is the up-converted RF signal.

"RF A" RF output connector at the R&S FE170ST or R&S FE110ST.

Remote command:

[\[:SOURce<hw>\]:EFRontend:RFConnector](#) on page 525

Mode

Sets the mode for frequency band configuration of the external frontend.

See also ["Frequency Band Config"](#) on page 187.

- "Auto" Configures the frequency band automatically.
- "Manual" Configures the frequency band configuration manually as defined with the parameter "Frequency Band Config".

Remote command:

[\[:SOURce<hw>\]:EFRontend:FREQuency:BAND:CONFIg:MODE](#) on page 521

Frequency Band Config

Define the intermediate frequency (input) range of the external frontend.

The used "Intermediade Frequency / Sideband" and the resulting "Frequency Band x" are indicated for reference.

"SFI"

The external frontend uses the R&S SFI100A specific intermediate frequency of 16 GHz.

For available options, see the specifications document.

Remote command:

[:SOURce<hw>] :EFRontend:FREQuency:BAND:CONFig:CATalog? on page 520

[:SOURce<hw>] :EFRontend:FREQuency:BAND:CONFig:SElect on page 521

Frequency Band x

Displays the ranges of the frequency bands of the upconverted frequency depending on the connected external frontend.

For supported frequency ranges, see the specification document.

Remote command:

[:SOURce<hw>] :EFRontend:FREQuency:BAND:COUNT? on page 520

[:SOURce<hw>] :EFRontend:FREQuency:BAND<ch>:LOWer? on page 521

[:SOURce<hw>] :EFRontend:FREQuency:BAND<ch>:UPPer? on page 521

7.1.3.2 Versions and options information

Access:

1. Select "RF Out" > "RF Frontend" > "Frontend Device".
2. Select "Version / Options".

Settings	Versions / Options	Attenuator	Cable Correction	Network	External Devices
Firmware					
Package	Version				
Frontend Control Server	00.00.01				
Frontend Control Library	01.34.06				
Hardware Config					
Assembly	Part Number	Serial Number	Revision		
FE170ST	1234.5678.00	123456	01.01		
FE170ST-123456-Mic			00.00.00		
FE170ST_Synthesizer	1338.6570.02	100000	01.00		
FE170ST_Frontend	1347.7223.02	101220	02.00		
FE170_Z50	1348.0045.00	123456	01.00		
FE170_701	1348.0045.00	123456	01.00		

The "Versions / Options" tab displays information on the firmware and hardware of the connected external frontend.

Settings:

Firmware..... 189
 Hardware Config..... 189

Firmware

Displays firmware information on the control server and control library of the external frontend. The information is displayed in a table and consists of installed packages and versions.

"Package" Comprises the frontend control server and frontend control library.

"Version" Denotes the version of the installed package.

Remote command:
 n.a.

Hardware Config

Displays hardware information of the hardware components of the external frontend. The information is displayed in a table and consists of component name, its part number and serial number, and revision version.

"Assembly" Displays the assembly part name for hardware component.

"Part Number" Displays the part number for each hardware component.

"Serial Number" Displays the serial number for each hardware component.

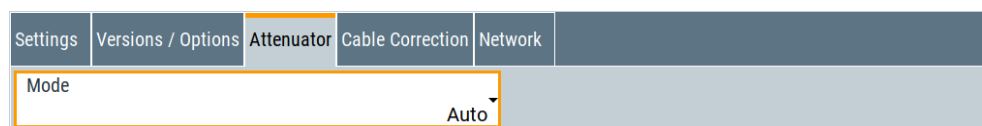
"Revision" Displays the revision version for each hardware component.

Remote command:
[\[:SOURce<hw>\]:EFRontend:IDN?](#) on page 522

7.1.3.3 Attenuator settings

Access:

1. Select "RF Out" > "RF Frontend" > "Frontend Device".
2. Select "Attenuator".



The "Attenuator" tab provides settings to configure attenuation.

Settings:

Mode..... 190
 Attenuation..... 190
 Offset..... 190

Mode

Sets the attenuator mode of the external frontend.

"Auto" Sets the attenuation value automatically.
The frontend control connection provides this attenuation value from the connected external frontend.

"Auto & Offset" Requires frontend R&S FE170ST or R&S FE110ST.
You can define an offset value which adds to the attenuation value provided from the connected external frontend.

"Manual" Sets an attenuation value manually.

Remote command:

[\[:SOURce<hw>\]:EFRontend:AMODE](#) on page 519

Attenuation

Requires "Mode > Manual".

Sets the attenuation of the external frontend.

Remote command:

[\[:SOURce<hw>\]:EFRontend:POWer:ATTenuation](#) on page 524

Offset

Requires frontend R&S FE170ST or R&S FE110ST.

Requires "Mode > Auto & Offset".

Adds an offset value to the attenuation value provided from the external frontend.

Remote command:

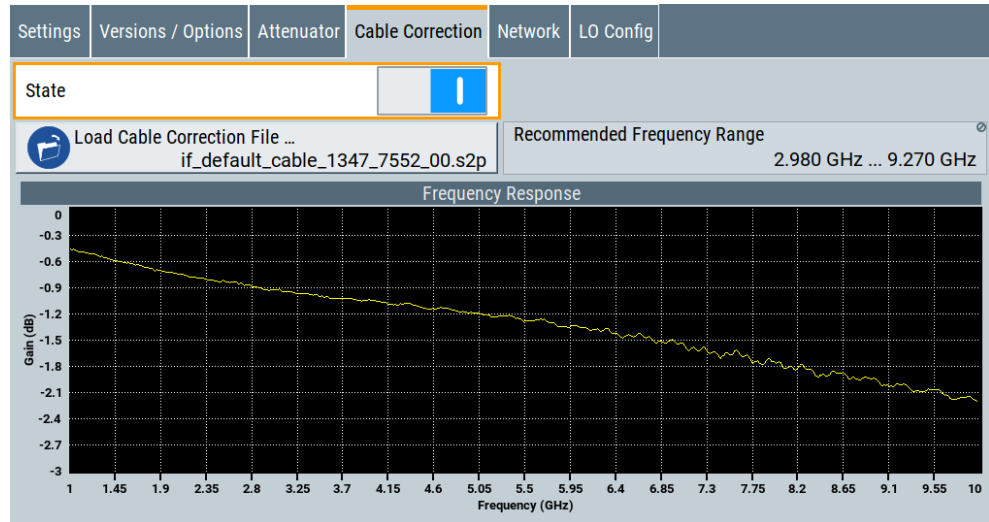
[\[:SOURce<hw>\]:EFRontend:POWer:OFFSet](#) on page 525

7.1.3.4 Cable correction settings

Access:

1. Select "RF" > "RF Frontend" > "Frontend Device".

2. Select "Cable Correction".



The "Cable Correction" tab provides settings necessary to configure the frequency response correction of the IF signal path.

You can load correction data to compensate for signal losses in the cable occurring at different IF signal frequencies. Files containing correction data have the extension *.s2p or *.uco. The following descriptions are exemplary with *.s2p files. Working with *.uco files is analogous.

Settings:

State..... 191
 Load Cable Correction File..... 191
 Recommended Frequency Range..... 192

State

Activates correction of the IF signal for different IF signal frequencies.

Activation requires loading of a valid cable correction file, see "Load Cable Correction File" on page 191.

Remote command:

[:SOURce<hw>] :EFRontend:ALIGnment [:STATe] on page 519

Load Cable Correction File

Accesses a standard file-select dialog to load correction data to compensate for signal losses in the cable occurring at different IF signal frequencies.

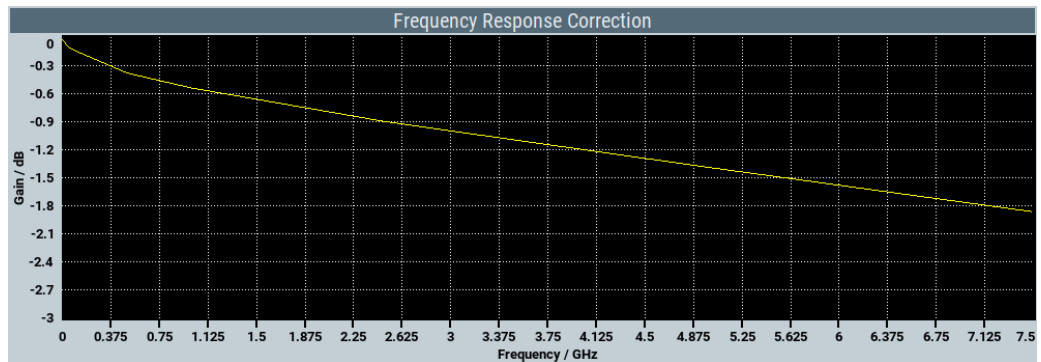
If a correction file with a file extension *.s2p is loaded, the button also displays the filename.

By default, the file if_default_cable_1347_7552_00.s2p is loaded. This file contains correction data for the standard R&S IF cable with order number 1347.7552.00. Also, the correction data uses the S-parameter S21.

Example: Displaying file correction data

The example for the *.s2p file below comprises correction data for frequencies from 0 GHz to 7.5 GHz.

```
# HZ S DB R 50.00
! Date: 2020-06-12;11:48:28
! freq[Hz] db:S11 ang:S11 db:S21 ang:S21 db:S12 ang:S12 db:S22 ang:S22
100000.0 0.001 0 -0.018267469344920073 0 -0.018267469344920073 0 0.001 0
50000000.0 0.001 0 -0.10438567392872056 0 -0.10438567392872056 0 0.001 0
100000000.0 0.001 0 -0.1402532552881901 0 -0.1402532552881901 0 0.001 0
500000000.0 0.001 0 -0.37850173705964973 0 -0.37850173705964973 0 0.001 0
1000000000.0 0.001 0 -0.5387899823157998 0 -0.5387899823157998 0 0.001 0
2500000000.0 0.001 0 -0.8994010660064706 0 -0.8994010660064706 0 0.001 0
5000000000.0 0.001 0 -1.3888357992535698 0 -1.3888357992535698 0 0.001 0
7500000000.0 0.001 0 -1.8624967962088599 0 -1.8624967962088599 0 0.001 0
```



Remote command:

`[:SOURce<hw>] :EFRontend:ALIGNment:FILE:CATalog?` on page 518

`[:SOURce<hw>] :EFRontend:ALIGNment:FILE[:SElect]` on page 518

Recommended Frequency Range

Displays the recommended frequency range of the IF signal that the external frontend requires.

We recommend that you cover this range in the cable correction file. See [Example "Displaying file correction data"](#) on page 192.

Remote command:

`[:SOURce<hw>] :EFRontend:ALIGNment:FILE:FREQuency:RANGe:LOWer?`
on page 518

`[:SOURce<hw>] :EFRontend:ALIGNment:FILE:FREQuency:RANGe:UPPer?`
on page 518

7.1.3.5 Network settings

Access:

1. Select "RF Out" > "RF Frontend" > "Frontend Device".

2. Select the "Network" tab.

Settings	Versions / Options	Attenuator	Cable Correction	Network
Address Mode				
				Auto (DHCP)
IP Address				192.168.0.1
Subnet Mask				255.255.255.0
<input checked="" type="checkbox"/> Apply				

The tab provides settings to configure network settings of the external frontend.

Settings:

Address Mode.....	193
IP Address.....	193
Subnet Mask.....	193
Apply.....	194

Address Mode

Selects the mode for assigning the IP address of the external frontend.

"Auto (DHCP)"

Assigns the IP address automatically, provided the network supports DHCP (Dynamic Host Configuration Protocol).

"Static"

Enables you to assign the IP address manually.

Remote command:

n.a.

IP Address

Displays the IP address of the external frontend in the network.

To assign an IP address manually, select "Address Mode" > "Static".

By default, the external frontend is configured to use dynamic TCP/IP configuration and to obtain the whole address information automatically.

If the network does not support DHCP or the attempt does not succeed, the external frontend tries to obtain the IP address via Zeroconf (APIPA) protocol. IP addresses assigned via Zeroconf start with the number blocks 169.254.*.*.

Note: An IP address that is assigned via the Zeroconf protocol although the network requires an IP address assigned via the DHCP server can cause network connection failures.

Remote command:

[:SOURce<hw>] :EFRontend:IPADdress? on page 523

Subnet Mask

Displays the bit group of the subnet in the host identifier.

To assign the subnet mask manually, select "Address Mode" > "Static".

Remote command:
n.a.

Apply

Applies any changes to the network configuration of the external frontend.

Beware that if you change the network configuration, the connection is aborted and you must re-establish a connection to the frontend.

See "To configure the R&S SF1100A for frontend control" on page 37.

Remote command:

[:SOURce<hw>] :EFRontend:NETWork on page 524

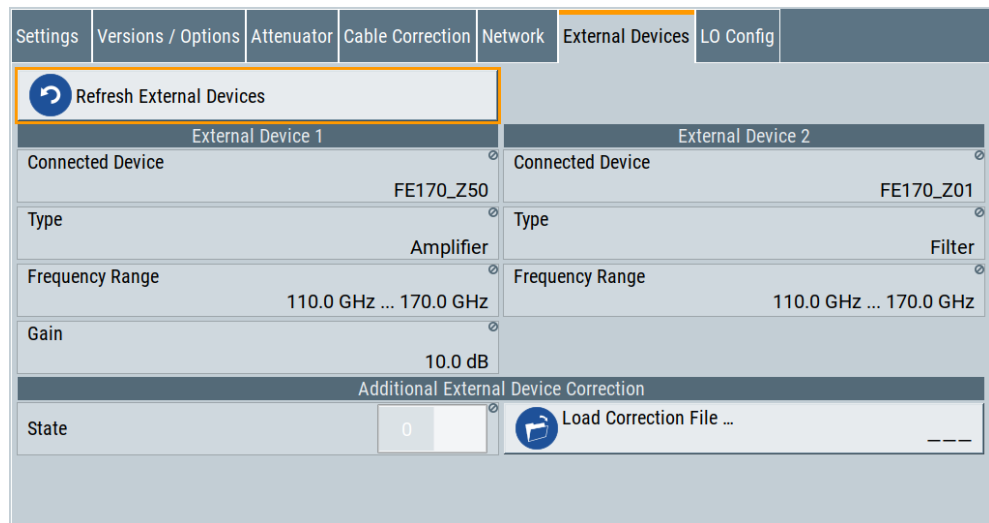
7.1.3.6 External devices settings

External devices are available for the following external frontends:

- R&S FE170ST
- R&S FE110ST

Access:

1. Select "RF Out" > "RF Frontend" > "Frontend Device".
2. Select "External Devices".



The tab provides information about connected external devices.

Refresh External Devices..... 195

External Device 1 / External Device 2..... 195

 L Connected Device..... 195

 L Type..... 195

 L Frequency Range..... 195

 L Gain..... 195

Additional External Device Correction.....	195
L State.....	196
L Load Correction File.....	196

Refresh External Devices

Updates the display of external devices connected to the external frontend.

Remote command:

`[:SOURce<hw>] :EFRontend:EXTDevice:REFresh` on page 525

External Device 1 / External Device 2

You can connect up to two external devices to the external frontend.

Connected Device ← External Device 1 / External Device 2

Queries the name of the connected external device.

Remote command:

`[:SOURce<hw>] :EFRontend:EXTDevice<id>:NAME?` on page 526

Type ← External Device 1 / External Device 2

Queries the type of the connected external device.

FILTer A filter is connected to the frontend as an external device.

AMPLifier An amplifier is connected to the frontend as an external device.

ATTenuator An attenuator is connected to the frontend as an external device.

NONE No external device is connected to the frontend.

Remote command:

`[:SOURce<hw>] :EFRontend:EXTDevice<id>:TYPE?` on page 526

`[:SOURce<hw>] :EFRontend:EXTDevice:LIST?` on page 526

Frequency Range ← External Device 1 / External Device 2

Queries the minimum and maximum value of the frequency of the connected external device.

Remote command:

`[:SOURce<hw>] :EFRontend:EXTDevice<id>:FREQuency:MINimum?`

on page 527

`[:SOURce<hw>] :EFRontend:EXTDevice<id>:FREQuency:MAXimum?`

on page 527

Gain ← External Device 1 / External Device 2

Queries the gain of the amplifier connected as external device.

Remote command:

`[:SOURce<hw>] :EFRontend:EXTDevice<id>:GAIN?` on page 527

Additional External Device Correction

You can load user-defined correction files for the connected external devices, e.g. to compensate for signal losses.

State ← Additional External Device Correction

Activates correction of the RF signal for different RF signal frequencies for the connected external devices.

Activation requires loading of a valid correction file, see "[Load Correction File](#)" on page 196.

Remote command:

`[:SOURCE<hw>] :EFRontend:EXTDevice:CORrection:STate` on page 527

Load Correction File ← Additional External Device Correction

Accesses a standard file-select dialog to load correction data, e.g. to compensate for signal losses in the external device occurring at different RF signal frequencies.

If a correction file with a file extension *.s2p is loaded, the button also displays the filename.

Remote command:

`[:SOURCE<hw>] :EFRontend:EXTDevice:CORrection:FILE` on page 527

7.1.3.7 LO config settings

Access:

1. Select "RF Out" > "RF Frontend" > "Frontend Device".
2. Select "LO Config".

Settings	Versions / Options	Attenuator	Cable Correction	Network	External Devices	LO Config
Mode					External	Mandatory LO IN Frequency 8 812.500 000 00 MHz
Out State					On	LO OUT Frequency 8 812.500 000 00 MHz

The tab provides settings for configuring the local oscillator when using more than one external frontend in a test setup.

Settings:

Mode	196
Out State	197
Mandatory LO IN Frequency	197
LO OUT Frequency	197

Mode

Selects the LO input source for the connected external frontend.

INTERNAL	Uses the internally generated LO signal.
EXTERNAL	Uses an externally supplied LO signal.

Remote command:

`[:SOURCE<hw>] :EFRontend:LOSCillator:MODE` on page 528

Out State

Activates or deactivates the LO output of the connected external frontend.

Remote command:

`[:SOURCE<hw>] :EFRontend:LOSCillator:OUTPut:STATe` on page 528

Mandatory LO IN Frequency

Requires "Mode > External".

Displays the required frequency on the "LO In" connector of the connected external frontend.

Set the displayed frequency value for the externally supplied LO signal correctly on the external frequency source.

Remote command:

`[:SOURCE<hw>] :EFRontend:LOSCillator:INPut:FREQuency?` on page 528

LO OUT Frequency

Requires "Out State > On".

Displays the current frequency on the "LO Out" connector of the connected external frontend.

Remote command:

`[:SOURCE<hw>] :EFRontend:LOSCillator:OUTPut:FREQuency?` on page 528

7.1.4 Troubleshooting external frontends

If problems arise during external frontend control, try the following measures to optimize the connection.

Resolving network connection errors

If you cannot connect to the external frontend, check the status bar or error queue of the R&S SF1100A for error messages. See [Table 7-1](#).

If no messages are available, check the "LAN" and "Power" status LEDs on the external frontend. Permanent red lights indicate an error, usually hardware problems, e.g. if the fans are off. In this case, the instrument is automatically put in a safe (error) state to avoid damage. A LAN connection is no longer possible. Try switching the external frontend off and on again.

Handling touchstone file errors

Some errors concerning `.s2p` correction files do not cause warnings in the status bar. Also, they do not provide results in the system error queue, but do display messages or return errors in remote control.

Error messages

If errors occur, status messages in the external frontend configuration dialog box and in the status bar of the display inform you about them.

Query the error message queue using the remote command `SYST:ERR?` to determine if any or which errors occurred during operation.

If any errors occur that are not described here, contact the Rohde & Schwarz customer support.

Table 7-1: Status and error messages

Status bar message	Dialog status	SYST:ERR? result	Description/Remedy
External Frontend [x]: Connecting...	Connecting...		Connection to the external frontend is being established. It can take up to 10 seconds to determine that LAN connection failed.
Connected	Connected		Connection established, ready for operation.
No External Frontend Connected	Not connected		No external frontend detected. Connect an external frontend to the R&S SF1100A.
External Frontend [x]: Invalid Host IP	Invalid Host IP	300, "Invalid Host IP"	Verify the specified IP address of the external frontend.
External Frontend [x]: LAN Connection Failed	Not connected	301, "LAN Connection Failed"	Verify if the external frontend is connected to the same network as the R&S SF1100A. Verify the specified IP address of the external frontend. Make sure that no other instrument is accessing the external frontend at the moment.
External Frontend [x]: Incompatible Signal Generator Firmware	Incompatible Signal Generator Firmware	302, "Incompatible Signal Generator Firmware"	The frontend hardware is not compatible with the installed signal generator firmware. Update the signal generator firmware, see the R&S SF1100A service manual.
External Frontend [x]: Incompatible Frontend Firmware	Incompatible Frontend Firmware	303, "Incompatible Frontend Firmware"	The firmware of the external frontend is not up to date. Perform a firmware update of the external frontend.
External Frontend [x]: Device Locked	Device Locked	304, "Device Locked"	The external frontend is accessible via ping, but no SSL-connection could be established. Disconnect all other devices that are currently accessing the external frontend and try reconnecting.
External Frontend [x]: Wrong Device Type	Wrong Device Type	306, "Wrong Device Type"	The connected external frontend is not of the specified type. Disconnect the device, select the correct external frontend type in the configuration dialog box, and reconnect.
External Frontend [x]: LAN Connection Lost	LAN Connection Lost	314, "LAN Connection Lost"	The connection to the external frontend has been lost. The signal generator attempts to reconnect periodically. Wait for the "Connecting..." message.
External Frontend [x]: Firmware Update Failed	Firmware Update Failed	315, "Firmware Update Failed"	The firmware of the external frontend was not updated successfully.
	<filename>.s2p has wrong file format	-150, "String data error"	The .s2p file does not have the correct syntax. Correct the file.

Status bar message	Dialog status	SYST:ERR? result	Description/Remedy
		-256, "File name not found"	The specified .s2p file does not exist. Correct the path and filename and make sure that the file is stored on the instrument under /var/user//external_frontends/<frontend_type>/touchstonefiles.
External Frontend [x]: Touchstone file insufficient frequency range		350, "Touchstone file frequency range insufficient"	The .s2p file does not cover the used frequency. Correct the file or select a different correction file.

If you still have connection problems, contact Rohde & Schwarz, see [Chapter 14.10, "Contacting customer support"](#), on page 626.

7.2 Configuring RF signals

This chapter provides information on how to define the settings for your RF signal.

See also [Chapter 7.3, "RF settings"](#), on page 200.

To access the RF settings

1. In the block diagram, select the block "RF > RF".
2. Select the required function from the list.
The RF block comprises all functions and settings concerning the RF signal. The settings include the RF frequency and level settings, enhanced functions for improving the signal characteristics, frontend device settings, connector assignments and measurement functions of the RF signal.

To set the frequency and level

The simplest form of the RF signal is a continuous wave (CW) of constant frequency and amplitude. The RF signal is defined by its frequency and level.

1. In the status bar, enter the "Frequency" value.
2. If you want to add a frequency offset:
 - a) Select "RF > RF Frequency > Frequency".
 - b) Enter the "Offset" value.
3. In the status bar, enter the "Level" value.
4. If you want to add a level offset:
 - a) Select "RF > RF Level > Level".
 - b) Enter the "Offset" value.

To activate the RF output

By default, the RF output signal is disabled. When you activate the RF output, the instrument restores the previously set signal configuration.

► Activate the RF output in one of the following ways:

- a) Select "Level > RF ON > On".
- b) At the front panel, press the [RF on/off] key.

The blue color of the "RF On" icon and the RF block indicate that the RF signal output is enabled.

RF State/RF ON.....	200
PEP.....	200
RF output impedance.....	200

RF State/RF ON

Activates or deactivates the RF output.

Acts as the [RF On/Off] key.

Remote command:

`:OUTPut<hw>[:STATe]` on page 443

PEP

Displays the PEP (Peak Envelope Power) in the status bar. This value corresponds to the level specification of a digital modulation or of a digital standard signal at the RF output.

Remote command:

`[:SOURce<hw>]:POWer:PEP?` on page 508

RF output impedance

You can query the impedance of the RF output.

Remote command:

`:OUTPut<hw>:IMPedance?` on page 444

7.3 RF settings

7.3.1 RF frequency settings

Access:

- Select "RF" > "RF Frequency" > "Frequency".

In the "RF Frequency" dialog, you can configure the RF frequency and an offset. The remote commands required to define the settings are described in [Chapter 13.15.4, "SOURCE:FREQUENCY subsystem"](#), on page 491.

Settings:

Frequency.....	201
Offset.....	201

Frequency

Sets the RF frequency.

This frequency is output at the RF Out connector.

It does not consider any parameter that affect the frequency, as e.g., a frequency offset.

Note: Suppressed values in the status bar

For security concerns or certain operating modes, you can hide the frequency and level display in the status bar.

- *********

The display has been disabled for security reasons.

See:

- [Annotation Frequency](#)

- 

Remote command:

[\[:SOURCE<hw>\]:FREQUENCY\[:CW|FIXed\]](#) on page 491

Offset

Sets the frequency offset.

This value represents the frequency shift of a downstream instrument, like for example a mixer.

The "Frequency" value displayed in the status bar is the resulting frequency, as it is at the output of the downstream instrument. The frequency at the R&S SF1100A RF output is not changed.

Remote command:

[\[:SOURCE<hw>\]:FREQUENCY:OFFSET](#) on page 492

7.3.2 RF level settings

Access:

1. Select "RF" > "RF Level" > "Level".

RF Level		Attenuator	UCOR None	Power-On/EMF	Settings
RF State	<input checked="" type="checkbox"/>				
Amplitude	-69.90 dBm	Limit	20.00 dBm		User Variation
Offset	0.00 dB				
Setting Characteristics	Auto				
Level Range	-90.11 ... -52.97dBm				

In the "RF Level" dialog, you can configure the offset-free level, the level limit, and the step width for varying the level with the rotary knob.

2. Select "User Variation" to set the step width to be used when setting the RF level using the rotary knob.

RF Level		Attenuator	UCOR None	Power-On/EMF	Settings
Variation Active	<input type="checkbox"/>	Variation Step	1.00 dB		User Variation

The remote commands required to define the settings are described in [Chapter 13.15.9, "SOURCE:POWER subsystem"](#), on page 505.

Settings:

RF State/RF ON.....	203
Amplitude.....	203
Limit.....	203
Offset.....	203
Setting Characteristics.....	204
Level Range.....	204
User Variation.....	204
L Variation Active.....	204
L Variation Step.....	204

RF State/RF ON

Activates or deactivates the RF output.

Acts as the [RF On/Off] key.

Remote command:

`:OUTPut<hw>[:STATe]` on page 443

Amplitude

Sets the level of the RF signal.

The value is offset-free and corresponds to the level at the RF Out connector.

Note: Suppressed values in the status bar

For security concerns or certain operating modes, you can hide the frequency and level display in the status bar.

- *********

The display has been disabled for security reasons.

See:

- [Annotation Frequency](#)

- 

Remote command:

`[:SOURce<hw>]:POWer:POWer` on page 508

Note: The SCPI command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the "Level" display.

This means, the level containing offset.

Limit

Sets an upper limit for the output power.

Note: The parameter "RF level" > "**Limit**" and "NRP power control" > "**RF Amplitude Limit**" are identical.

You can use this value to protect your DUT from damage due to high input power. If you enter an RF level above this value, the instrument limits the output power to this specified value, and generates the warning message:

"Pep value greater than the defined limit." However, the level indication in the status bar is not affected.

The setting is not affected by an instrument preset ([Preset] key or *RST) and the "Save/Recall" function. It is reset only by factory preset.

Remote command:

`[:SOURce<hw>]:POWer:LIMit[:AMPLitude]` on page 507

Offset

Sets a level offset.

This value represents the level shift of a downstream instrument, like, for example, an attenuator or an amplifier.

The "Level" value displayed in the status bar is the resulting level, as it is at the output of the downstream instrument. The level at the R&S SF1100A RF output is not changed.

Remote command:

`[:SOURce<hw>] :POWER [:LEVel] [:IMMediate] :OFFSet` on page 512

Setting Characteristics

Selects additional quality characteristics to optimize the behavior of the RF signal level for the specific application.

"Auto" Sets the RF output level automatically according to the selected mode.
In this mode, the instrument provides the highest dynamic range and fastest setting times.
The RF signal is shortly blanked when the step attenuator is switching.
For more information, refer to the specifications document.

"Uninterrupted" Suppresses blanking at level transitions. Frequency transitions can lead to an RF level blanking due to hardware-specific switching points.
This mode reduces the dynamic range of the instrument. The step attenuator is fixed.

Remote command:

`[:SOURce<hw>] :POWER:LBEHaviour` on page 507

Level Range

Shows the interruption-free range of the level that you can use in the currently selected mode.

Remote command:

`[:SOURce<hw>] :POWER:RANGe:LOWer?` on page 514

`[:SOURce<hw>] :POWER:RANGe:UPPer?` on page 514

User Variation

Defines and activates a user-defined step width for varying the RF frequency or RF level with the rotary knob.

If disabled, the step width varies in steps of one unit at the cursor position.

Variation Active ← User Variation

Activates the set user-defined step width.

Remote command:

`[:SOURce<hw>] :FREQuency:STEP:MODE` on page 492

`[:SOURce<hw>] :POWER:STEP:MODE` on page 511

Variation Step ← User Variation

Sets the user-defined step width.

Remote command:

`[:SOURce<hw>] :FREQuency:STEP [:INCRement]` on page 493

`[:SOURce<hw>] :POWER:STEP [:INCRement]` on page 512

7.4 Generating reference signals

This chapter provides information on reference input signals and reference output signals. It covers the following topics:

- [Required options](#).....205
- [RF connector settings](#).....205
- [Reference frequency settings](#).....206
- [Reference output settings](#).....209
- [Adjustment settings](#).....211

7.4.1 Required options

R&S SF100A base unit equipped with the following options:

- 100 MHz, 1 GHz ultra-low-noise reference input and output (R&S SFI-K703)
- 1 MHz to 100 MHz flexible reference input (R&S SFI-K704)
- 8 GHz ultra-low-noise reference input and output (R&S SFI-K708)

For more information, refer to the specifications document.

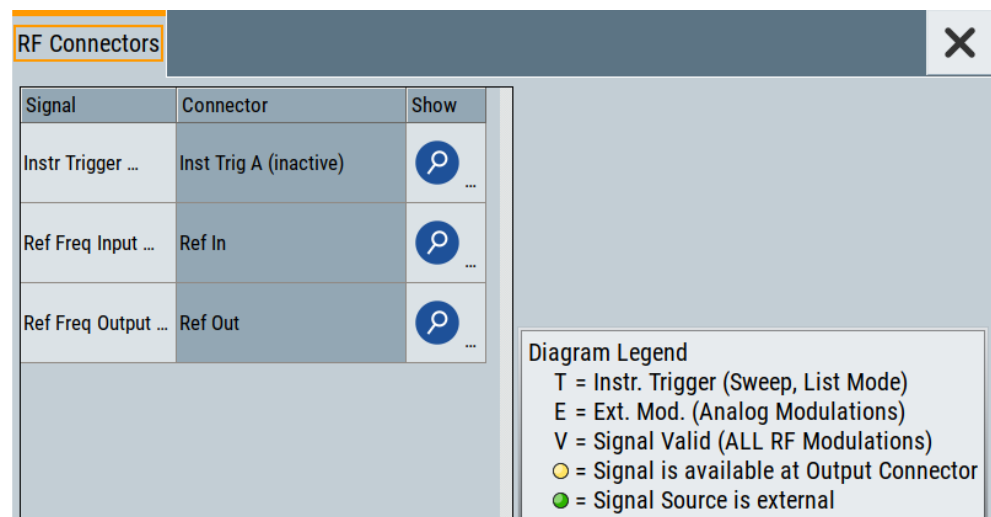
7.4.2 RF connector settings

The "RF Connectors" dialog gives an overview of the mapping of the logical signals to the connectors. The displayed connectors depend on the installed options.

Selecting a signal name accesses directly the related connector settings.

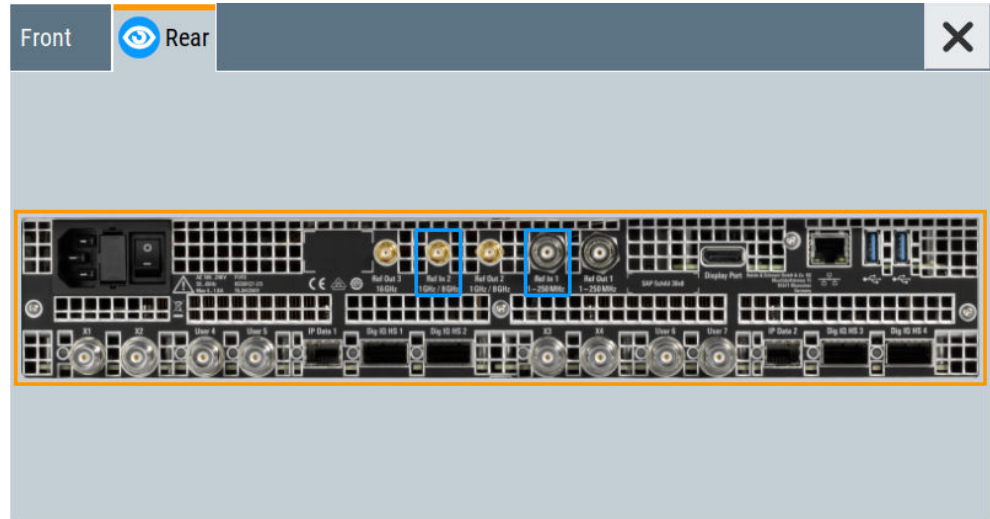
Access:


1. Select "RF" > "RF Frequency" > "RF Connectors".



The dialog shows the assignment of the logical signals to the connectors.

2. Select a "Signal" to open the corresponding settings dialog.
3. Use the built-in [Show Connector](#) function to display the physical location of the selected connector.



The eye icon  in the tab header indicates the panel (front, rear or both) the selected connector is at.

Settings:

[Signal](#)..... 206

[Connector](#).....206

[Show Connector](#).....206

Signal

Opens the dialog for configuring the selected signal.

Connector

Displays the assigned connector.



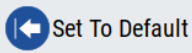
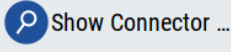
Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

7.4.3 Reference frequency settings

Access:

- ▶ Select "RF" > "RF Frequency" > "Reference Frequency".

Reference Frequency	Reference Output	Adjustment	
			
Source External			
Deactivate RF Output <i>(if external reference is missing)</i> <input type="checkbox"/>			
External Reference Frequency 10 MHz			
Synchronization Bandwidth Wide			
Nominal Synchronization Bandwidth 100 Hz		Minimum Locking Range +/- 25 ppm	

In the "Reference Frequency" tab, you can select the reference frequency signal source and the frequency and synchronization bandwidth mode of an external reference signal.

The symbol in the status bar indicates the current oscillator configuration.



The remote commands required to define these settings are described in [Chapter 13.15.8, "SOURCE:ROSCillator subsystem"](#), on page 499.

Settings:

Set to Default.....	207
Source.....	207
Show Connector.....	208
Deactivate RF Output (if external reference is missing).....	208
External Reference Frequency.....	208
Variable Reference Frequency.....	208
Synchronization Bandwidth.....	209
Nominal Synchronization Bandwidth.....	209
Minimum Locking Range.....	209

Set to Default


Resets the reference oscillator settings to default.

Remote command:

`[:SOURCE] :ROSCillator :PRESet` on page 503

Source

Selects the reference frequency source.

- "Internal" Uses the internal reference oscillator, either with calibrated or a user-defined [Adjustment Value](#).
- Note:** The internal reference frequency automatically uses [Synchronization Bandwidth > Narrow](#). Thus, if you preset this parameter, or set the reference source from "External" to "Internal" manually, the R&S SFI100A sets the bandwidth to "Narrow".
- "External" Uses an external reference signal.
- Note:** If the external reference is missing, the R&S SFI100A issues a warning message and indicates the icon  (external reference missing).
- To set the frequency of the external reference, see "External Reference Frequency".

Remote command:

[\[:SOURce\]:ROSCillator:SOURce](#) on page 504



Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

Deactivate RF Output (if external reference is missing)

Turns off the RF output when the external reference signal is selected, but no signal is supplied.

This function prevents that no improper RF signal due to the missing external reference signal is used for measurements. A message indicates that the RF output is deactivated.

Remote command:

[\[:SOURce\]:ROSCillator:EXTernal:RFOff\[:STATe\]](#) on page 502

External Reference Frequency

Selects the frequency of the external reference input signal.

- "10 MHz" Selects an external reference frequency of 10 MHz.
- "100 MHz"/"640 MHz"/"1 GHz"
Requires R&S SFI-K703.
Selects an external reference frequency of 100 MHz, 640 MHz or 1 GHz.
- "Variable" Requires R&S SFI-K704.
The external reference signal has an arbitrary frequency, within the range from 1 MHz to 250 MHz.
- "8 GHz" Requires R&S SFI-K708.
Selects an external reference frequency of 8 GHz.

Remote command:

[\[:SOURce\]:ROSCillator:EXTernal:FREQuency](#) on page 500

Variable Reference Frequency

Option: R&S SFI-K704

Sets the variably settable external reference frequency.

Remote command:

[\[:SOURCE\]:ROSCillator:EXTernal:FREQuency:VARiable](#) on page 501

Synchronization Bandwidth

Selects the synchronization bandwidth for an external reference signal, set with "Source > External".

The resulting bandwidth is indicated by the parameter [Nominal Synchronization Bandwidth](#).

Note: If you preset or set the reference source from "External" to "Internal", the R&S SFI100A resets the synchronization bandwidth to "Narrow".

"Narrow" The internal reference oscillator is synchronized to the external signal with narrow bandwidth.

This setting is recommended if the phase noise of the external signal is worse than the phase noise of the internal OCXO.

"Wide" Synchronizes the internal oscillator to the external signal with the maximum possible bandwidth.

This mode is the recommended standard mode and for precise reference sources of high spectral purity.

Note: If the frequency of the external reference signal is outside the locking range of the internal reference oscillator, spurs due to the difference of the internal and external reference frequency are generated in the reference PLL.

The R&S SFI100A issues an error message.

For more information, refer to the specifications document.

Remote command:

[\[:SOURCE\]:ROSCillator:EXTernal:SBANdwidth](#) on page 502

Nominal Synchronization Bandwidth

Indicates the nominal synchronization bandwidth for the selected external reference frequency and the synchronization bandwidth.

Remote command:

[\[:SOURCE\]:ROSCillator:EXTernal:NSBandwidth?](#) on page 501

Minimum Locking Range

Indicates the minimum locking range for the selected external reference frequency and the synchronization bandwidth.

Remote command:

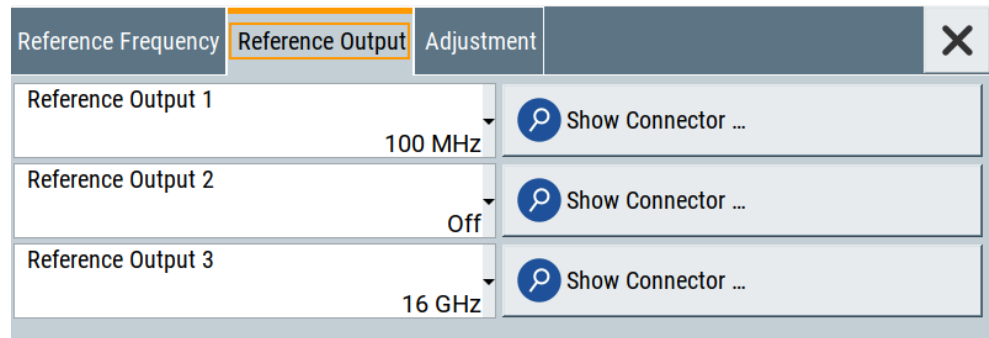
[\[:SOURCE\]:ROSCillator:EXTernal:MLRange?](#) on page 501

7.4.4 Reference output settings

Access:

1. Select "RF" > "RF Frequency" > "Reference Frequency".

2. Select "Reference Output".



In the "Reference Output" tab, you can set the reference frequency value at the output connectors.

As a result of parameter dependencies, "Preset This Parameter" sometimes does not affect output dialogs.

The remote commands required to define these settings are described in [Chapter 13.15.8, "SOURce:ROSCillator subsystem"](#), on page 499.

Settings:

Reference Output	210
Show Connector	211

Reference Output

Selects the frequency of the reference output signal for downstream instruments.

The R&S SF100A derives a reference signal from the internal reference oscillator, or loops through an externally applied reference signal for output. The R&S SF100A provides three output connectors for a reference signal.

The settings at "Reference Output 1" and "Reference Output 2" also depend on the set external reference frequency.

The reference input and output signals require the corresponding frequency options, see [Chapter 7.4.1, "Required options"](#), on page 205.

"Off" Disables the reference signal output.

"10 MHz"/"100 MHz"

Derives the selected frequency from the internal reference oscillator and provides this signal at reference output 1.

"1 GHz"/"8 GHz"

Derives the selected frequency from the internal reference oscillator and provides this signal at reference output 2.

"16 GHz"

Provides 16 GHz reference frequency at reference output 3.

"Signal from Ref Input <n> (loop through)"

<n> = 1 to 2

Passes the external reference frequency to the output directly. You can pass through frequencies of 10 MHz or 100 MHz.

Remote command:

`[:SOURce] :ROSCillator :OUTPut :FREQuency :MODE` on page 502

`[:SOURce] :ROSCillator :OUTPut2 :FREQuency :MODE` on page 503

`[:SOURce] :ROSCillator :OUTPut3 :FREQuency :MODE` on page 503



Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

7.4.5 Adjustment settings

Access:

1. Select "RF" > "RF Frequency" > "Reference Frequency".
2. Select "Adjustment".

Adjustment Active <input checked="" type="checkbox"/>	Adjustment Value 0
---	---

Settings:

Adjustment Active	211
Adjustment Value	211

Adjustment Active

Selects the adjustment mode.

- | | |
|-------|--|
| "Off" | Uses the calibrated internal reference frequency. |
| "On" | Allows you to apply a deviation to the internal reference frequency, according to your requirements.
Enter the value in the Adjustment Value field. |

Remote command:

`[:SOURce] :ROSCillator [:INTernal] :ADJust [:STATe]` on page 504

Adjustment Value

Sets a user-defined adjustment value for the internal reference frequency. This value takes effect when it is activated with [Adjustment Active](#).

- "0" represents the calibrated state.
- The setting range depends on the reference oscillator type and its factory calibration value.

Note:

The setting is not affected by an instrument preset ([Preset] key or *RST) and the "Save/Recall" function. It is reset only by factory preset.

Remote command:

`[:SOURce] :ROSCillator [:INTernal] :ADJust :VALue` on page 504

7.5 Using power sensors

The R&S SFI100A works with any of the R&S NRP power sensors and thus supports various application tasks. Using power sensors, you can for example determine attenuation characteristics of downstream equipment or cables. You can use the measured values to compensate the losses with internal control functions or with an external control circuit in real time.

For information on the various possibilities of interoperability between Rohde & Schwarz power sensors and Rohde & Schwarz signal generators, see the application note [1GP141](#).

R&S NRP power sensors are highly accurate standalone measuring devices, suitable for a wide range of applications. The power sensors communicate directly with the signal generator, calculate the average or peak power internally, include S-parameter correction and return the measurement results to the generator.

The R&S SFI100A supports up to four power sensors, allowing up to four power measurements simultaneously.



Check the firmware version of the R&S NRP sensors regularly. Update the firmware, if necessary.

For updates, see the Rohde & Schwarz website www.rohde-schwarz.com in section "Power Meters & Voltmeters".

For information on working with power sensors, see the following topics:

- [Chapter 7.5.2, "Connecting R&S NRP power sensors to the R&S SFI100A"](#), on page 214
Overview on the supported connectors, connection options and the required accessories.
- [Chapter 7.5.3, "NRP power viewer settings"](#), on page 215
A function for measuring and monitoring the RF output power or a user-defined signal source.
- [Chapter 7.5.4, "NRP power control"](#), on page 216
Controls a downstream closed loop power control circuit, to compensate frequency response characteristics.
- [Chapter 7.5.5, "NRP sensor configuration"](#), on page 221
Parameter settings of the specific R&S NRP power sensor.
- [Chapter 7.5.6, "NRP sensor mapping"](#), on page 225
Shows all R&S NRP sensors connected to the instrument, or in the LAN.

7.5.1 About

The R&S SFI100A can perform up to four power measurements simultaneously.

Depending on the signal characteristic (CW, AM, pulsed, etc.) or the parameter to be measured (average, peak, etc.) a suitable R&S power sensor must be used.

About the measuring principle, averaging filter, filter length, and achieving stable results

A sensor measures the average or peak RF power of the source continuously. The measurement results are displayed in the "NRP Power Viewer" dialog.

The power viewer function uses **averaging filters** for getting a stable readout.

Measurement results could be interfered, for instance, by too much noise in your setup, by a bad suppression of harmonics or non-harmonics or when you reach the sensitivity level of your power sensor.

Measurements are continuously repeated in a predefined time window. The measurement result is obtained by averaging the measured values for the last $2N$ time windows. This approach is referred as a **two-step averaging process**.

The factor of 2 in the formula arises because the output signals from the microwave detector are chopped at the same rate as the time windows to suppress low-frequency noise. An independent measured value can only be obtained from two consecutive values.

The variable N in the formula indicates the **filter length**. The filter length then directly influences the measurement time. The filter length can be selected automatically or it can be manually set to a fixed value.

Follow the following general recommendation to find out the **optimum filter length**:

- Always start a measurement in auto mode ("Filter > Auto").
Check if the measurement results are sufficient.
- If the power is not constant, select the filter length manually ("Filter > User").
Trigger the "Auto Once" function to search for the optimum filter length for the current measurement conditions.
The estimated value is indicated as filter length.
- If the target measurement accuracy value is known, select "Filter > Fixed Noise".
The averaging factor is selected automatically and so that the sensor's intrinsic noise (two standard deviations) does not exceed the specified noise content.
- Depending on the R&S NRP power sensor type, the manual setting of the filter length varies in resolution.
- Different sensor types achieve the same filtering result with different filter and time window lengths.
For most sensors, the time window length is fixed to 20 ms, whereas, e.g., for the R&S NRP-Z81 sensor, the time window length is 10 μ s.

For more information, refer to the specifications document.

About zeroing

Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor. If a Rohde & Schwarz power sensor receives an input power during the zeroing process, it aborts zeroing and generates an error message. Zeroing takes a few seconds, depending on the sensor model. Refer to the documentation of your power sensor for more information.

Tips for zeroing

When to perform zeroing:

- During warm up after switching on or connecting the instrument
- After a substantial change of the ambient temperature
- After fastening the power sensor module to an RF connector at high temperature
- After several hours of operation
- When low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
- Switch off the RF power source for zeroing, but do not disconnect it from the power sensor. This proceeding keeps the thermal equilibrium, and the zeroing process also compensates the noise that superimposes the measured signal (e.g. from a broadband amplifier).

Related settings and functions

- Measurements-related settings, like results, filter, filter length:
[Chapter 7.5.5, "NRP sensor configuration"](#), on page 221
- Closed loop power control of the output level:
[Chapter 7.5.4, "NRP power control"](#), on page 216.
- Software version of the connected power sensor:
`:SENSe<ch>[:POWer]:TYPE?` on page 459
- Acquisition of level correction data:
[Chapter 7.6, "Applying user correction"](#), on page 228

Additional information

See the Rohde & Schwarz website www.rohde-schwarz.com, section "Power Meters & Voltmeters" for:

- R&S NRP power sensor manual.
- Information on the R&S NRP-Z5 sensor hub and the available accessories.
- Sensor software updates.

7.5.2 Connecting R&S NRP power sensors to the R&S SFI100A

Connection	Sensor type (incl. USB hub)	Cables/Accessories	Characteristics
USB type A	R&S NRPxx	R&S NRP-ZKU	USB interface cable
	R&S NRP-Zxx	R&S NRP-Z3 R&S NRP-Z4	USB adapter cables

Connection	Sensor type (incl. USB hub)	Cables/Accessories	Characteristics
	R&S NRP-Z5 USB sensor hub (high-speed USB 2.0)	Standard USB cable (USB type A to USB type B)	This connection does not support external triggering.
	Standard USB hub with external power supply unit R&S NRPxx	R&S NRP-ZKU	USB interface cable
	Standard USB hub with external power supply unit R&S NRP-Zxx	R&S NRP-Z3 R&S NRP-Z4	USB adapter cables
LAN	R&S NRPxxxSN/xxxTN/ xxxAN	<ul style="list-style-type: none"> A PoE Ethernet switch, e.g. R&S NRP-ZAP1 and an RJ-45 Ethernet cable. A PoE injector and an RJ-45 Ethernet cable. 	Using the Ethernet interface requires PoE (Power over Ethernet) to provide the electrical power.

For details, see the description R&S®NRP Power Sensors getting started.

Detection and mapping

The R&S SF1100A either detects a R&S NRP power sensor automatically or you can scan for available power sensors manually. The "NRP Sensor Mapping" dialog lists all detected R&S NRP power sensors, see [Chapter 7.5.6, "NRP sensor mapping"](#), on page 225. The dialog enables you to add, remove and map the sensors manually.

Depending on the connection interface, the R&S SF1100A detects and maps connected R&S NRP power sensors differently:

- USB interface
Detects a sensor automatically and maps it with index "1" to index "4" according to the sequence of connection.
- LAN interface
To detect sensors that are connected in the LAN, the instrument provides a scan function. When you start the function, scan searches in the LAN for available R&S NRP power sensors and adds all detected sensors to list. Assigning a mapping index activates the sensor for the measurement.



On connection, the R&S SF1100A immediately starts the measurement of the R&S NRP power sensor. If you preset the instrument ([Preset] key or *RST), the R&S SF1100A stops the measurement. The connection and the mapping of the power sensors remain.

7.5.3 NRP power viewer settings

The R&S SF1100A features the power viewer function for measuring or monitoring signals with R&S NRP power sensors.

Access:

- ▶ Select "RF" > "RF Measurement" > "NRP Power Viewer".

Power Viewer	Sensor Configuration	Sensor Mapping				✕
1: NRP-Z81 900008	Average	-52.42	dBm	Config ...		
2: NRP18SN 101748	Average	-1.03	dBm	Config ...		
3: NRP67TN 101015	Average	-38.20	dBm	Config ...		

The "Power Viewer" tab lists the mapped R&S NRP power sensors with the measured parameter mode and the current readings. The "Config" button leads you to the configuration dialog to set the parameters for each sensor.

The remote commands required to define these settings are described in [Chapter 13.13, "SENSE, READ, INITiate and SLISt subsystems"](#), on page 445, including the triggering of the measurement and the retrieval of measurement results.

Settings:

[Config](#).....216

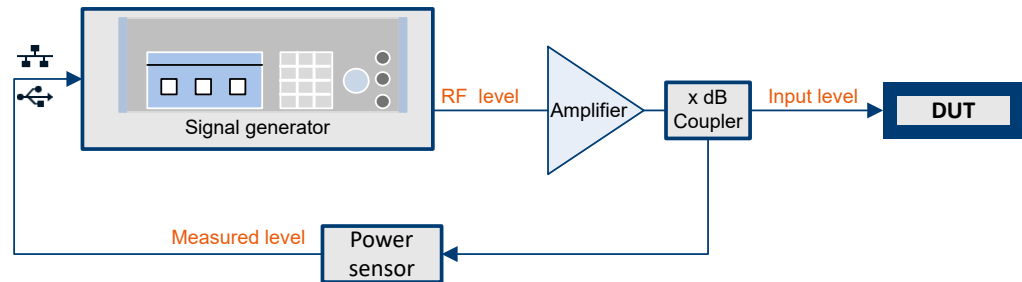
Config

Opens the "Sensor Configuration" dialog.

See also [Chapter 7.5.5, "NRP sensor configuration"](#), on page 221.

7.5.4 NRP power control

The NRP power control function enables you to apply stable and accurate RF power to the DUT. For example, you can set up a downstream closed loop power control circuit to compensate spurious effects or losses caused by power amplifiers or cables.

Example: How to set up a closed loop power control**Figure 7-5: Example of a test setup with NRP power control**

The signal generator applies the RF output signal to an amplifier and to the DUT. An intermediately connected coupler derives the output power from the output signal and forwards it to the power sensor. Thus, the power sensor measures a proportional power in defined time intervals, and returns the results to the signal generator. If supported, the power sensor also includes given S-parameters. The signal generator compares the measured power with the set level value and adjusts the level of the output signal accordingly.

This closed loop power control enables you to control the external signal level continuously and reliably achieve a constant input power at the DUT in real time.

**Impact of NRP power control and operating modes**

Since the frequency and level of the RF output signal are continuously adjusted during "NRP Power Control", this operating mode interferes signal generation modes with varying frequency and level values. In addition, the setting time increases. The reason is the interaction between the signal generator and the R&S NRP power sensor in the control loop.

The operating modes impact each other as follows:

- Enabling the RF frequency sweep, RF level sweep or the list mode disables a running "NRP Power Control".
- A running list or RF sweep mode blocks "NRP Power Control".
- Modulated signals can deviate from the CW signal in mean power and peak power, and thus affect the "NRP Power Control".

7.5.4.1 NRP power control settings

Access:

- ▶ Select "RF" > "RF Measurement" > "NRP Power Control".

Power Viewer	Power Control	Sensor Configuration	Sensor Mapping
State		<input type="checkbox"/>	
Sensor		2: NRP18SN 101748	
Target Level		Average -1.52 dBm Config ...	
Mode		Take Measurement as Target Level	
Catch Range +/-		Execute Single	
RF Amplitude Limit		Delay Time 0 ms	
		RF Setting Characteristics Auto	

In this dialog you can configure the parameters of the power control setup for the selected power sensor.

The remote commands required to define these settings are described in [Chapter 13.15.9, "SOURCE:POWER subsystem"](#), on page 505.

Settings

State.....	218
Sensor.....	218
Measured Level.....	219
Target Level.....	219
Take Measurement as Target Level.....	219
Mode.....	219
Execute Single.....	219
Catch Range +/-.....	219
Delay Time.....	220
Limit.....	220
Setting Characteristics.....	220

State

Enables power control with the selected sensor.

The control loop periodically adjusts the generator output. After switching off, the running loop is completed.

Note: If you want to use another sensor, you must disable power control before. It is not possible to switch between sensors when power control is active.

Remote command:

`[:SOURCE<hw>] :POWER:SPC:STATE` on page 510

Sensor

Indicates the R&S NRP power sensor that is selected for power control.

To configure the power sensor parameters, see [Chapter 7.5.5, "NRP sensor configuration"](#), on page 221.

Remote command:

`[:SOURCE<hw>] :POWER:SPC:SElect` on page 510

Measured Level

Indicates the current reading of the selected power sensor.

Remote command:

`:READ<ch>[:POWER]?` on page 451

`:SENSe<ch>:UNIT[:POWER]` on page 452

Target Level

Specifies the nominal level expected at the input of the sensor. The signal generator adjusts the output power accordingly, to meet the target value at the sensor input, and thus the power required at the DUT.

Remote command:

`[:SOURce<hw>]:POWER:SPC:TARGet` on page 511

Take Measurement as Target Level

Uses the currently measured level as reference and applies the value as target level, see "[Target Level](#)" on page 219.

This feature simplifies setting up the control loop after manual adjustment of the measurement configuration. To assign the measured level as reference level, you must switch off "NRP Power Control". It is not possible when the control loop is running.

Remote command:

`[:SOURce<hw>]:POWER:SPC:MEASure` on page 509

Mode

Selects the measurement mode for acquiring the power values measured by the sensor.

"Auto" Immediately starts and measures the power continuously.

"Single" Starts when you manually select [Execute Single](#), and executes one power measurement cycle.
Note, that you can achieve the expected target power level at the DUT only with linear test setups. Non-linear test setups, for example, setups including an amplifier do not work.

Remote command:

`[:SOURce<hw>]:POWER:SPC:MODE` on page 509

Execute Single

In mode "Single", starts one measurement cycle manually.

Remote command:

`[:SOURce<hw>]:POWER:SPC:SINGLE` on page 510

Catch Range +/-

Sets the capture range of the control system.

Within the range:

Target Level +/- Catch Range

the power control locks and tries to achieve the target level. Readings outside the range are not considered.

Remote command:

`[:SOURce<hw>] :POWer:SPC:CRANge` on page 509

Delay Time

Sets a waiting period between the level adjustment of the generator and the next measurement of the power sensor.

With this parameter, you can bypass idle times in the controlled system.

Remote command:

`[:SOURce<hw>] :POWer:SPC:DELay` on page 509

Limit

Sets an upper limit for the output power.

Note: The parameter "RF level" > "**Limit**" and "NRP power control" > "**RF Amplitude Limit**" are identical.

You can use this value to protect your DUT from damage due to high input power. If you enter an RF level above this value, the instrument limits the output power to this specified value, and generates the warning message:

"Pep value greater than the defined limit." However, the level indication in the status bar is not affected.

The setting is not affected by an instrument preset ([Preset] key or *RST) and the "Save/Recall" function. It is reset only by factory preset.

Remote command:

`[:SOURce<hw>] :POWer:LIMit [:AMPLitude]` on page 507

Setting Characteristics

Selects additional quality characteristics to optimize the behavior of the RF signal level for the specific application.

"Auto" Sets the RF output level automatically according to the selected mode.
In this mode, the instrument provides the highest dynamic range and fastest setting times.
The RF signal is shortly blanked when the step attenuator is switching.
For more information, refer to the specifications document.

"Uninterrupted" Suppresses blanking at level transitions. Frequency transitions can lead to an RF level blanking due to hardware-specific switching points.
This mode reduces the dynamic range of the instrument. The step attenuator is fixed.

Remote command:

`[:SOURce<hw>] :POWer:LBEHaviour` on page 507

7.5.5 NRP sensor configuration

Access:

- ▶ Select "RF" > "RF Measurement" > "NRP Sensor Configuration".

Power Viewer	Sensor Configuration	Sensor Mapping	
Average		-19.98	dBm
State	<input checked="" type="checkbox"/>	Zero	
Display Permanent	<input checked="" type="checkbox"/>	Display	Average
Use Frequency Of	User	Frequency	1.000 000 000 GHz
Level Offset State	Off	Level Offset	0.000 dB
Filter	Auto	Filter Length	---
		Timeout	4.00 s
Default Aperture Time	<input checked="" type="checkbox"/>	Aperture Time	20.0 ms
S-Parameter	Unused	Enable Logging	<input type="checkbox"/>

In this dialog you can configure the parameters for each mapped R&S NRP power sensor in separate tabs.

The remote commands required to define these settings are described in [Chapter 13.13, "SENSe, READ, INITiate and SLISt subsystems"](#), on page 445, including the triggering of the measurement and the retrieval of measurement results.

Settings:

Sensor type and serial number.....	222
Level (Peak) / Level (Average).....	222
State.....	222
Zero.....	222
Display.....	222
Display Permanent.....	222
Use Frequency Of.....	223
Frequency.....	223
Level Offset State,Level Offset.....	223

Filter.....	223
Filter Length.....	224
Auto Once.....	224
Noise/Signal Ratio.....	224
Timeout.....	224
Default Aperture Time.....	224
Aperture Time.....	225
S-Parameter.....	225
Enable Logging.....	225

Sensor type and serial number

The side tab label indicates type and serial number of an R&S NRP power sensor and its mapping index.

The **Level (Peak) / Level (Average)** values display the current readings of the sensor.

Remote command:

`:SENSe<ch>[:POWer]:TYPE?` on page 459

`:SENSe<ch>[:POWer]:SNUMber?` on page 458

Level (Peak) / Level (Average)

Indicates the measured peak or average level value.

You can also change the unit for the results display: Watt, dBm or dBµV.

Note: Peak level measurements are provided if the power sensor supports this feature.

Remote command:

`:READ<ch>[:POWer]?` on page 451

`:SENSe<ch>:UNIT[:POWer]` on page 452

State

Enables level measurement of the R&S NRP power sensor.

Remote command:

`:INITiate<hw>[:POWer]:CONTinuous` on page 450

To query the availability of a sensor at a given connector, use the command :

`SENSe<ch>[:POWer]:STATus[:DEVice]?` on page 458.

Zero

Activates the auto zeroing.

For details, see "About zeroing" on page 213.

Remote command:

`:SENSe<ch>[:POWer]:ZERO` on page 459

Display

Sets the display of results on mean or peak power.

Remote command:

`:SENSe<ch>[:POWer]:DISPlay:PERMANent:PRIority` on page 453

Display Permanent

Enables the display of the power sensor with the currently measured value in the task bar.

You can activate the permanent display for several sensors.

Remote command:

`:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe` on page 454

Use Frequency Of

Selects the source for measurement.

- | | |
|--------|--|
| "RF" | The R&S SF100A transfers the RF frequency and level settings to the R&S power sensor automatically. Thus you achieve power readings of high accuracy, irrespective from the connected sensor type. |
| "User" | Sets a user defined frequency. |

Example:

If you have a frequency converting device between the generator and the DUT. If the frequency converter doubles the frequency, you can set twice the frequency in the R&S SF100A. The R&S power sensor considers this RF frequency setting.

Set the parameter [Frequency](#) to the measurement's frequency.

Remote command:

`:SENSe<ch>[:POWer]:SOURce` on page 458

Frequency

Defines the frequency value if "Source > User" is used.

Remote command:

`:SENSe<ch>[:POWer]:FREQuency` on page 456

Level Offset State,Level Offset

Activates and defines a level offset which is considered in the power measurement result. The level offset value is always expressed in dB, irrespective of the display of the measurement result.

This function allows you to consider, for example, an attenuator in the signal path.

Remote command:

`:SENSe<ch>[:POWer]:OFFSet` on page 457

`:SENSe<ch>[:POWer]:OFFSet:STATe` on page 457

Filter

Selects the way the length of the used filter is defined.

See also "[About the measuring principle, averaging filter, filter length, and achieving stable results](#)" on page 213.

- | | |
|--------|---|
| "Auto" | <p>Selects the filter length automatically and adjusts it to the measured value. The value is indicated with the parameter Filter Length.</p> <p>When high output power is applied, the filter length and therefore the measurement time can be short.</p> <p>When low output power is applied, the filter length and therefore the measurement time is increased which reduces the considered noise content in your measurement.</p> |
|--------|---|

- "User" The filter length is defined manually, with the parameter [Filter Length](#). As the filter length works as a multiplier for the time window, constant filter length results in a constant measurement time. Values 1 and 2N are allowed.
- "Fixed Noise" The averaging factor is taken automatically in accordance to the value [Noise/Signal Ratio](#). Thus, the sensor's intrinsic noise (2 standard deviations) does not exceed the specified noise content. To avoid long measurement times when the power is too low, set a [Timeout](#).
Timeout is the maximum acceptable measurement time which limits the averaging factor and therefore leads to a more unstable readout.

Remote command:

`:SENSe<ch>[:POWER]:FILTer:TYPE` on page 456

Filter Length

Sets or indicates the filter length, depending on the selected filter mode.

- "Filter > Auto" indicates the automatically adjusted filter length.
- "Filter > User" enables you to set the filter length manually.
- "Filter > Fixed Noise" hides the setting parameter.

Remote command:

`:SENSe<ch>[:POWER]:FILTer:LENGth:AUTO?` on page 454

`:SENSe<ch>[:POWER]:FILTer:LENGth[:USER]` on page 454

Auto Once

Searches the optimum filter length for the current measurement conditions. The result is indicated with the parameter [Filter Length](#).

See also "[About the measuring principle, averaging filter, filter length, and achieving stable results](#)" on page 213.

Remote command:

`:SENSe<ch>[:POWER]:FILTer:SONCe` on page 455

Noise/Signal Ratio

For [Filter > Fixed Noise](#), sets the noise content.

Remote command:

`:SENSe<ch>[:POWER]:FILTer:NSRatio` on page 455

Timeout

Sets a time limit for the averaging process.

The setting is bound to the timeout of the connected sensor.

Remote command:

`:SENSe<ch>[:POWER]:FILTer:NSRatio:MTIME` on page 455

Default Aperture Time

The sensor default setting is sufficient. Disable this parameter to specify a user-defined aperture time per sensor, if, for example, the readings vary.

To obtain stable readings, set the [Aperture Time](#) exactly to one modulation period.

Remote command:

`:SENSe<ch>[:POWer]:APERTure:DEFault:STATe` on page 452

Aperture Time

If "Use Default Aperture Time > Off", defines the acquisition time per sensor.

For example, to obtain a sufficient low average value, set the aperture time exactly to one modulation period.

Remote command:

`:SENSe<ch>[:POWer]:APERTure:TIME` on page 452

S-Parameter

S-Parameter correction is used to mathematically shift the reference plane to the DUT by considering the S-parameters for any components connected upstream of the sensor.

The S-Parameter table can be changed with the S-Parameters tool, provided as part of the free R&S NRP Toolkit software. For more information, refer to the manual of the connected R&S NRP power sensor.

Remote command:

`:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe` on page 453

`:SENSe<ch>[:POWer]:CORRection:SPDevice:LIST?` on page 453

`:SENSe<ch>[:POWer]:CORRection:SPDevice:SELeCt` on page 453

Enable Logging

Activates recording of R&S NRP power sensor readings in a log file.

There is 1 log file per sensor. The log files are created automatically and filled in continuously. They are text files with predefined filename `SensLog<n>.txt`, where `<n>` indicates the connected sensor. Log files are stored on the internal memory, in the directory `/var/user/SensorLogging`.

Each log file contains the measured value (2 readings when you work with peak sensors), the sensor type, and the measurement time (timestamp). Logged data is not overwritten. When a new measurement is started, the collected logging data is appended in the log file.

Check the used disc space regularly and remove log files to maintain storage capacity.

Note: The logging function is intended for measurements with long time intervals. It is suitable source for data reconstructions if the connection to the sensor was interrupted.

Remote command:

`:SENSe<ch>[:POWer]:LOGGing:STATe` on page 457

7.5.6 NRP sensor mapping









The "NRP Sensor Mapping" lists the sensors detected by the instrument.

Any R&S NRP sensor that supports the USB legacy protocol and is connected to one of the USB interfaces, is detected automatically and added to the list. When you disconnect a power sensor, the R&S SF100A removes it from the list accordingly.

R&S NRP power sensors that are connected in the LAN or use the USBTMC protocol are only detected by the scan search function.

Access:

- ▶ Select "RF" > "RF Measurement" > "NRP Sensor Mapping".

Power Viewer	Sensor Configuration	Sensor Mapping				
	Sensor	Peak	Revision	Protocol	Connector	Mapping
1	NRP-Z11 900003	<input type="checkbox"/>	04.16	Legacy		1
2	NRP18SN 101699	<input checked="" type="checkbox"/>	02.40.22081101	Visa		3
3	NRP18SN 101748	<input checked="" type="checkbox"/>	02.40.22081101	Legacy		2
4	NRP18SN 101748	<input checked="" type="checkbox"/>	02.40.22081101	Visa		
5	NRP18TN 100952	<input type="checkbox"/>	03.00.23050801 .beta	Visa		
6	NRP67TN 101015	<input type="checkbox"/>	02.30.21062301	Visa		
7	NRP67TN 101016	<input type="checkbox"/>	02.30.21062301	Visa		
8	NRP6AN 101118	<input checked="" type="checkbox"/>	17.11.27.03	Visa		

Scan

The dialog lists all detected R&S NRP sensors for selection and mapping. You can also browse the network for sensors.

For each sensor, you find the used protocol and the connector icon of the interface. In the "Mapping" column, you can assign a mapping index to enable the sensor for use. The list can contain several entries but the R&S SFI100A can only use up to four sensors simultaneously.

Settings

Sensor Mapping List	226
Scan	227
Clear	227
Add Sensor	227
Add LAN Sensor	227
Add USBTMC Sensor	227

Sensor Mapping List

Shows the sensors that are connected to the R&S SFI100A.

The table informs on the sensor type, specific features and the installed sensor firmware. It also shows the interface the sensor is connected to, including the communication protocol and the mapping index.

Remote command:

`:SLIST[:LIST]?` on page 448

`:SLIST:ELEMent<ch>:MAPPING` on page 450

`:SLIST:SENSor:MAP` on page 450

Scan

Scans the network and the USB connections for sensors connected using the VISA communication protocol, i.e. sensors that are addressed over LAN or USBTMC.

The instrument detects sensors communicating over the USB legacy protocol automatically.

Remote command:

`:SLISt:SCAN[:STATe]` on page 448

Clear

Removes the selected sensor from the sensor mapping list.

Remote command:

`:SLISt:CLEAr:LAN` on page 449

`:SLISt:CLEAr:USB` on page 449

`:SLISt:CLEAr[:ALL]` on page 450

Add Sensor

Shows or hides the "Add Sensor" dialog to configure power sensors connected to the R&S SF100A over USB or LAN.

Add LAN Sensor

Configures settings to add sensors connected to the R&S SF100A over LAN.

"IP Address or Host Name"

Displays the host name or the IP address of a R&S NRP power sensor.

If the R&S SF100A does not detect a connected R&S NRP sensor, you can assign the address information manually.

"Add LAN Sensor"

Adds a detected R&S NRP sensor connected in the LAN to the list of sensors, including its device ID or name and its serial number.

Remote command:

`:SLISt:SCAN:LSENsor` on page 448

Add USBTMC Sensor

Configures settings to add sensors connected to the R&S SF100A over USB.

If the R&S SF100A does not detect a connected R&S NRP sensor, you can assign the device ID manually.

"Sensor"

Selects the name of the R&S NRP power sensor.
If the R&S SF100A does not contain the R&S NRP power sensor you use, select "<from Device ID". The "Device ID" entry field switches in edit mode where you can enter the ID of your product manually.

"Device ID"

Displays the device identifier of a selected R&S NRP power sensor.
If you want to assign the device ID manually, get the information in the user documentation of your power sensor.

"Serial Number"

Displays the serial number of the R&S NRP power sensor.
If the R&S SF100A does not detect a connected R&S NRP sensor, you can assign the serial number manually.

"Add USBTMC Sensor"

Adds a detected R&S NRP sensor connected at the USB interface to the list of sensors, including its device ID or name and its serial number.

Remote command:

`:SLISt:SCAN:USENSor` on page 449

7.6 Applying user correction

The R&S SF100A supports a correction function to compensate external losses, caused, for example, by the RF cable, to achieve a precise target input level at the DUT.

The signal at the RF outputs of the R&S SF100A is flat. However, the DUT is usually not connected directly to the outputs of the instrument but rather via connecting cables. Components like cables, power combiners, switches or mixers can affect the signal flatness at the DUT input.

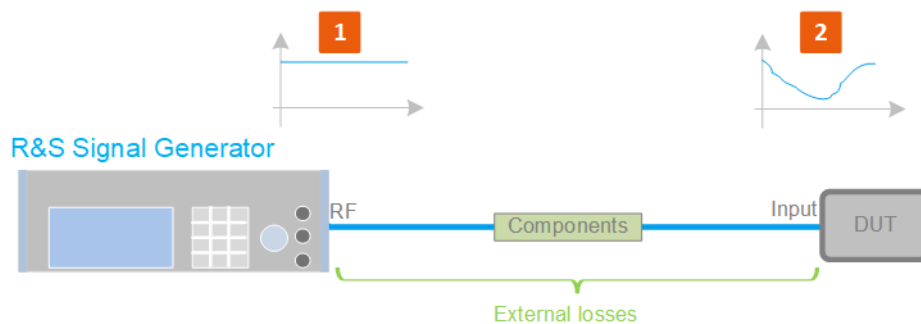


Figure 7-6: Effect of external losses on the signal flatness at the DUT input

- DUT = Device under test
 Components = Designation of all components between the measurement equipment and the DUT, e.g. cables
 1 = Flat signal at the outputs of the R&S SF1100A
 2 = Signal received at the DUT, incl. the external losses

About UCOR

User correction (UCOR) is a method that determines the external level loss of the RF output signal over a frequency range in advance, see [Figure 7-7](#).



User correction relates to the RF center frequency only. It does not affect the baseband bandwidth.

The difference between the generator output level and the level at the DUT determines the correction value at the respective frequency. Alternatively, the attenuation characteristics over a certain frequency range of, for example, RF cables are also specified in the associated specifications document.

For more information, refer to the specifications document.

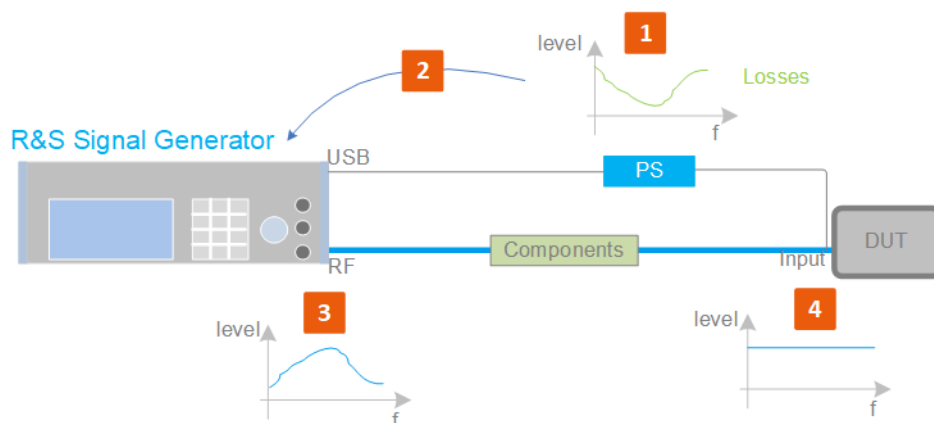


Figure 7-7: Understanding the principle of user correction

- DUT = Device under test
 Components = Designation of all components between the measurement equipment and the DUT, e.g. cables
 PS = Power sensor, e.g. R&S NRP, connected at the DUT's input and the USB connector of the R&S SF1100A
 1 = Power sensor measures the level over a frequency range, where the collected values correspond to the losses caused by the components between the R&S SF1100A and the DUT
 2 = Obtain the correction data by inverting the collected data; load the correction parameters in the R&S SF1100A
 3 = In the R&S SF1100A, the RF signal is pre-processed with the correction values so that the signal at the outputs is the inverted version of the external losses
 4 = Received at the DUT input, the pre-processed signal is flat

With active **UCOR**, the generator adds the correction value internally and thus increases the output level by exactly the amount of the loss between its output and the DUT. For frequencies which are not contained in the list, the level correction is calculated by interpolation of the closest correction values.

Possible ways for configuring the user correction values

You can configure correction values in the following ways:

- **Internally**

- Use the built-in table editor in the "UCOR > Edit User Correction Data" dialog. Once defined, user correction values can be saved in a file. Files with correction data can be exported, for example, to exchange configuration between instruments or to modify the file content with an external program and reload them again.
- Using the corresponding remote-control commands. Note that you have to create a user correction file first.

- **Externally**

Create a file with correction values as a CSV file with Microsoft Excel, with a Notepad or a similar tool and save it with the predefined extension. Transfer the file to and load it into the instrument.

UCOR file format

Files containing correction data are simple files in text or comma-separated value (CSV) file format. The filename is user-definable; the file extension is *.ucor.

The file contains a list of correction values, one row per frequency and correction value pair; a new line indicator separates the correction values.

For file handling, use the standard functions in the "File Manager", see [Chapter 10.7, "Using the file manager"](#), on page 284.

Collecting correction data

To fill the frequency and power values in the correction table, use one of the following options:

- **Manually**, row by row.
- Fill the table **automatically** with linearly interpolated values, calculated from value range and step size.
- Acquire the real frequency response characteristics of the used component with the **R&S NRP power sensor**, see [Understanding the principle of user correction](#).

Using a power sensor for frequency response measurements

Consider the following when using R&S NRP power sensors to measure the correction values:

- Measure the level directly at the input of the DUT.
- Use the internal correction functions of an R&S NRP power sensor to increase the measurement accuracy.
- Use S-parameter to consider the impact of any two-port device like an adapter between the signal generator and the sensor input.

For information on the various possibilities of interoperability between Rohde & Schwarz power sensors and Rohde & Schwarz signal generators, see the application note [1GP141](#).



Interactions and characteristics

You can enable user correction in all operating modes.

The RF output level ($Level_{RF}$) is the sum of the level value and the correction for the particular frequency:

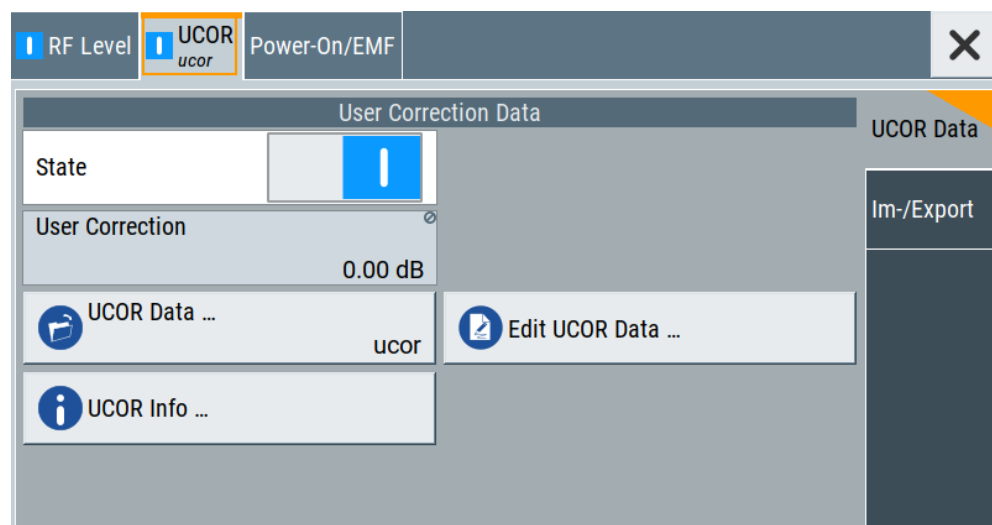
$$Level_{RF} = \text{"Status bar > Level"} + \text{"UCOR"}$$

If enabled, the R&S SF100A indicates user correction by the "Lev Ucor" icon in the status bar.

7.6.1 User correction data settings

Access:

1. Select "RF" > "RF Level" > "User Correction".
2. If you already have created a file with user correction data:
 - a) Select "UCOR Data" > navigate to the file "*.uco" > "Select".
 - b) Proceed with [step 4](#).
3. If you need to create a file:
 - a) Select "UCOR Data" > "New".
 - b) Enter the filename `UCOR_Data` and confirm with "Ok".
 - c) Choose the file and confirm with "Select".
 - d) Select "Edit UCOR Data".
 - e) To fill the user correction data table, see [Chapter 7.6.3, "UCOR data editor"](#), on page 235.
4. Select "UCOR" > "State" > "On".
5. Select block diagram > RF > "On".



The "UCOR" dialog contains all settings for creating and handling files with user-defined level correction values.

The remote commands required to define these settings are described in [Chapter 13.15.2, "SOURCE:CORREction subsystem"](#), on page 472.

Settings:

State.....	232
User Correction.....	232
UCOR Data.....	232
Edit UCOR Data.....	232
UCOR Info	232

State

Activates user correction.

See the user manual "R&S SFI-K544 User-Defined Frequency Response Correction".

Remote command:

`[:SOURCE<hw>] :CORREction [:STATe]` on page 477

User Correction

Indicates the corrected level value for a specific frequency point.

Remote command:

`[:SOURCE<hw>] :CORREction:VALue?` on page 476

UCOR Data

Accesses the standard "File Select" function of the instrument. The provided navigation possibilities in the dialog are self-explanatory.

Files with user correction values are files with predefined file extension `*.uco`. When a file is selected, the dialog indicates the filename.

You can create the file internally in the table editor or externally.

- To select an existing file, select "Select List > navigate to the file *.uco > Select"
- Use the general editor function to create a file or to edit an existing one.
- Use the standard file manager function to load externally created files to the instrument.

Remote command:

`[:SOURCE] :CORREction:CSET:CATalog?` on page 477

`[:SOURCE<hw>] :CORREction:CSET [:SElect]` on page 476

`[:SOURCE] :CORREction:CSET:DElete` on page 477

Edit UCOR Data

Opens the build-in table editor to define a new correction table or edit an existing one.

See also:

- "Fill..." on page 236
- [Chapter 7.6.4, "Fill with sensor"](#), on page 237

UCOR Info ...

Opens a window with information on the user correction file.

The window shows the metadata of the file and the output level parameters that are relevant for user correction.

Remote command:
n.a.

7.6.2 Im-/Export settings

Access:

1. Select "RF" > "RF Level" > "User Correction".
2. Select "Import/Export".

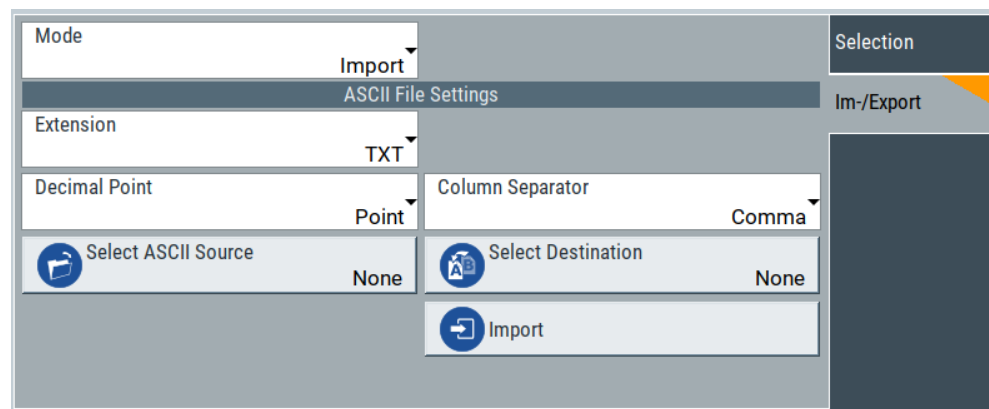


Figure 7-8: Im-/Export dialog (example with UCOR settings)

The "Import/Export" dialog contains all functions and settings to import externally created user correction data or to export it accordingly. You can process and store a list in the formats *.txt (ASCII), or *.csv (plain text with identical sequence of fields). The table separators and the decimal floating point numbers are customizable.

The remote commands required to define these settings are described in [Chapter 13.15.2, "SOURCE:CORREction subsystem"](#), on page 472.

Settings:

Mode.....	233
ASCII File Settings.....	234
Select ASCII Source/Select Destination.....	234
Select Source/Select ASCII Destination.....	234
Import / Export.....	234

Mode

Selects import or export of a data list file. The provided parameters vary according to the selected mode.

Remote command:

[\[:SOURCE<hw>\]:CORREction:DEXChange:MODE](#) on page 480

ASCII File Settings

Defines the format and the separators of the associated data file.

- "Extension" Selects *.csv or *.txt format.
- "Decimal Sets "Point" (dot) or "Comma" as the decimal separator used in the
Point" ASCII data with floating-point numerals.
- "Column Separator"
 Sets the separator between the columns in an ASCII table.
 Available are: "Tab", "Semicolon", "Comma" or "Space".

Remote command:

[\[:SOURCE<hw>\]:CORREction:DEXChange:AFIle:EXTension](#) on page 478

[\[:SOURCE<hw>\]:CORREction:DEXChange:AFIle:SEParator:DECimal](#)
on page 479

[\[:SOURCE<hw>\]:CORREction:DEXChange:AFIle:SEParator:COLumn](#)
on page 479

Select ASCII Source/Select Destination

In "Mode > Import", opens the common file dialog with standard file handling functions.

- "Select ASCII Source"
 Opens the "Select ASCII Source" tab of the file dialog for file import.
- "Select Destination"
 Opens the "Select ASCII Source" file dialog to select the file path and
filename.

Remote command:

[\[:SOURCE<hw>\]:CORREction:DEXChange:AFIle:CATalog?](#) on page 478

[\[:SOURCE<hw>\]:CORREction:DEXChange:AFIle:SElect](#) on page 479

Select Source/Select ASCII Destination

In "Mode > Export", opens the common file dialog with standard file handling functions.

- "Select Source"
 Opens the "Select Source" tab of the file dialog for file export.
- "Select ASCII Destination"
 Opens the "Select ASCII Source" file dialog to define the filename
and the file path.

Remote command:

[\[:SOURCE<hw>\]:CORREction:DEXChange:SElect](#) on page 480

Import / Export

Imports or exports the selected user correction file.

Remote command:

[\[:SOURCE<hw>\]:CORREction:DEXChange:EXECute](#) on page 479

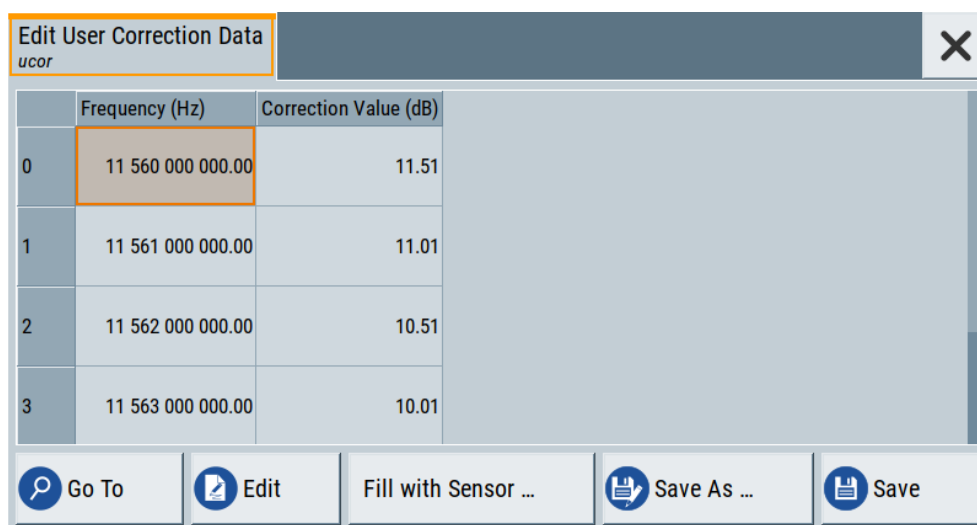
7.6.3 UCOR data editor

The "User Correction" dialog provides a build-in list editor for defining the corresponding value pairs. Prerequisite to define correction values, is that you have selected a file.

How to: see [Chapter 7.6.1, "User correction data settings"](#), on page 231, [step 1](#) to [step 3](#).

Access:

1. "RF" > "RF Level" > "User Correction" > "Edit User Cor. Data".
2. Select "Edit".



	Frequency (Hz)	Correction Value (dB)
0	11 560 000 000.00	11.51
1	11 561 000 000.00	11.01
2	11 562 000 000.00	10.51
3	11 563 000 000.00	10.01

The editor provides a table with RF frequency and level correction values and standard navigation functions.

The remote commands required to define the user correction data are described in [Chapter 13.15.2, "SOURCE:CORrection subsystem"](#), on page 472.



All columns in a row must contain values. Cells with missing values are therefore filled with preset values automatically.

Since the table and navigation functions can be assumed to be known, the following description contains a brief overview, shown by the example of the "Edit List Mode Data" dialog. If a function relates to a particular dialog, it is explicitly stated.

Settings

Edit UCOR Data.....	236
Frequency (Hz).....	236
Correction Value (dB).....	236
Data handling keys.....	236
L Go To.....	236
L Edit.....	236

L Fill with Sensor.....	236
L Save As/Save.....	236
Fill.....	236

Edit UCOR Data

Opens the build-in table editor to define a new correction table or edit an existing one.

See also:

- "Fill..." on page 236
- Chapter 7.6.4, "Fill with sensor", on page 237

Frequency (Hz)

Sets the frequency for level correction.

Remote command:

`[:SOURce<hw>] :CORRection:CSET:DATA:FREQuency` on page 475

Correction Value (dB)

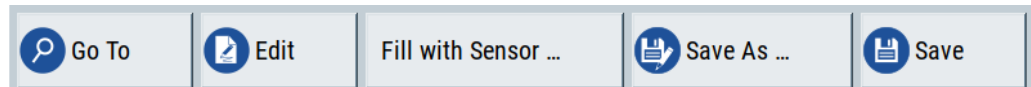
Sets the level value.

Remote command:

`[:SOURce<hw>] :CORRection:CSET:DATA:POWer` on page 475

Data handling keys

Standard functions for file and data handling.



Go To ← Data handling keys

Selects a row for editing.

Edit ← Data handling keys

Enables you to insert, or delete a row or ranges within the table, and provides access to a dialog for automatic filling, see "Fill..." on page 236.

Fill with Sensor ← Data handling keys

Opens a dialog to configure the automatic filling of user correction data with an R&S NRP power sensor.

See Chapter 7.6.4, "Fill with sensor", on page 237

Save As/Save ← Data handling keys

Saves the table in a file with a user-defined name and predefined file extension. To save a copy or create a file, use the "Save as" function.

Fill...

Provides parameters for filling a table automatically with user-defined values.

Fill User Correction Data <i>ucor</i>		✕	
From	0	Range	5
Column To Fill	Frequency (Hz)		
Start Value	11.560 000 000 00 GHz	End Value	11.564 000 000 00 GHz
Increment Value	1.000 000 00 MHz		
<input checked="" type="checkbox"/> Fill			

To fill the table, select "Fill".

Note: Once you fill one column only, the editor automatically adds preset values in the other columns. This functionality protects against data loss, otherwise incomplete rows are when saving. You can simply overwrite these values.

"From / Range"

Defines the start line and number of lines to be filled.

"Column To Fill"

Selects, if the column is filled up with frequencies in Hz or correction values in dB.

"Start Value / End Value"

Sets the start value for frequency or correction values. The end value is read only and depends on the increment value and the range.

"Increment Value"

Determines the step size.

"Fill"

Fills the column specified in "Column To fill".

7.6.4 Fill with sensor

The fill with sensor function requires that you have connected a power sensor and also selected a file for user correction data before.

See:

- [Chapter 7.5, "Using power sensors"](#), on page 212
- ["To create user correction data with an R&S NRP and the R&S SF100A"](#) on page 241

Access:

1. Select "RF" > "RF Level" > "User Correction".
2. Select "UCOR Data > navigate to the file *.ucor > Select".

3. Select "Edit UCOR Data > Fill With Sensor...".

This dialog contains parameters for filling a table automatically with sensor readings.



To fill the table, select "Execute".

For information on power sensors and how to use them, see [Chapter 7.7, "Improving the RF signal performance"](#), on page 239.

Settings:

Fill User Correction Data with Sensor	238
Generator Settings used for Measurement	239

Fill User Correction Data with Sensor

The "Execute" button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

"Sensor"	Displays connected sensors for selection.
"List To Fill"	Indicates the used list.
"Config"	Opens the sensor configuration dialog to set the parameters for the selected power sensor.

"Include Zeroing"

Performs a zeroing procedure before acquiring the user correction data to improve precision.

No signal is applied to the sensor during zeroing. RF output is temporarily switched off during that time.

When unchecked, the zeroing procedure is skipped. However, the RF signal level can be blanked shortly. This setting is useful if blanking of RF is undesirable or the absence of power at the sensor cannot be guaranteed.

Remote command:

`[:SOURce<hw>] :CORRection:ZERoing:STATe` on page 476

"Execute"

Triggers the sensor to measure and to return the data for user correction.

The "Execute" button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

Remote command:

`[:SOURce<hw>] :CORRection:CSET:DATA [:SENSor<ch>] [:POWER] :SONCe` on page 475

Generator Settings used for Measurement

Displays the settings relevant for the measurement.

"Modulation"

Indicates that modulation is off.

The R&S SFI100A disables modulation for the "Fill with sensor" process, even if you have enabled a modulation and if you have started "Fill with sensor".

"Amplitude"

Displays the currently set level.

Remote command:

`[:SOURce<hw>] :POWER:POWER` on page 508

"Offset"

Displays the level offset, set with **"Offset"** on page 203.

Remote command:

`[:SOURce<hw>] :POWER[:LEVel] [:IMMediate]:OFFSet` on page 512

"UCOR Reference Level"

Displays the reference value for user correction.

The user correction reference level is the set **Amplitude** plus the set **Offset**.

Remote command:

`[:SOURce<hw>] :POWER[:LEVel] [:IMMediate]:REFLevel` on page 514

7.7 Improving the RF signal performance

To achieve an accurate input level at the DUT, you can compensate losses, e.g. caused by cables between the RF output and the DUT over a frequency range.

Using the user correction function and e.g., a R&S NRP power sensor, the R&S SF100A utilizes the readings of the power sensor and creates a correction value table for controlling the output level during operation.

See also [Chapter 7, "Generating RF signals"](#), on page 178.

To connect the R&S NRP to the R&S SF100A

1. Connect the power sensor.
See [Chapter 7.5.2, "Connecting R&S NRP power sensors to the R&S SF100A"](#), on page 214.
2. Select "RF" > "RF Measurement" > "NRP Sensor Mapping".
3. If the sensor is not detected automatically, select "Scan > Start".
The instrument scans the network and the USB connections for connected sensors and lists all detected R&S NRP sensors in the mapping table.
4. In the "Mapping" column, assign the sensor to a sensor channel, see [Chapter 7.5.6, "NRP sensor mapping"](#), on page 225.
5. Close the dialog.

To configure and calibrate the R&S NRP in the R&S SF100A

Provided the power sensor is connected to the R&S SF100A and is assigned to a sensor channel, we recommend that you calibrate and configure the power sensor.

1. In the block diagram > RF, turn off the RF output signal.
2. Select "RF" > "RF Measurement" > "NRP Power Viewer".

Power Viewer	Sensor Configuration	Sensor Mapping			
1: NRP-Z81 900008	Average	-52.42	dBm	Config ...	
2: NRP18SN 101748	Average	-1.03	dBm	Config ...	
3: NRP67TN 101015	Average	-38.20	dBm	Config ...	

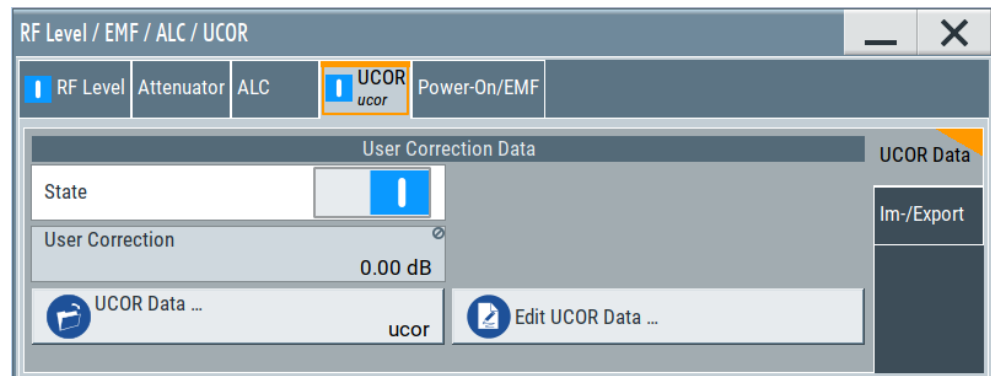
3. To configure a sensor, select "Config".
4. Select "Zero" to start zeroing of the sensor.
Note: Always turn the RF power off or disconnect the sensor from RF before zeroing, since the function calibrates the power sensor at zero signal power.
The zeroing process takes a few seconds, depending on the power sensor type.
5. Configure additional parameters for the selected sensor as required.

6. Select "State > On".
7. Close the dialog.

To create user correction data with an R&S NRP and the R&S SFI100A

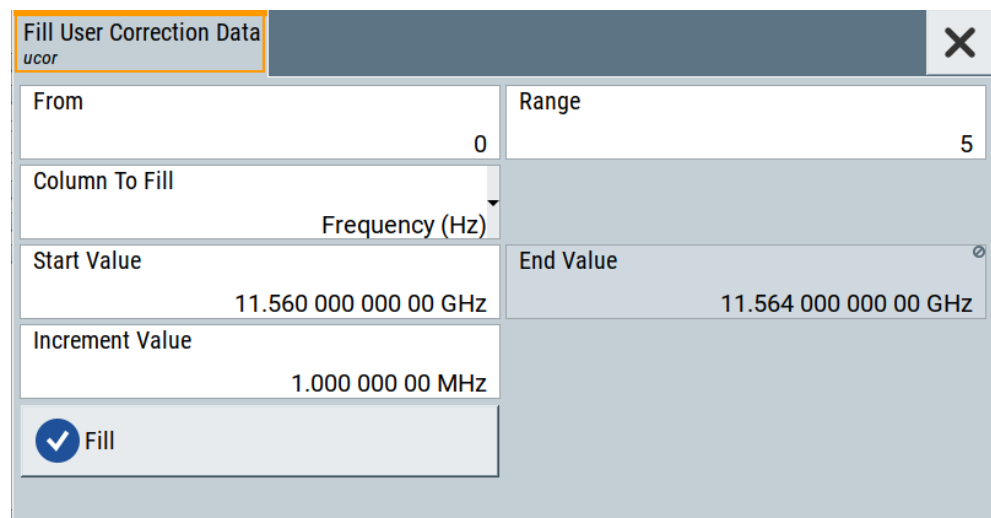
We assume, that the power sensor is connected, assigned and ready for operation.

1. Select "RF" > "RF Level" > "User Correction".



2. Select "UCOR Data" > "UCOR Data...."
3. Create a file: "New" > Filename and confirm with "OK".
4. Select the new file with "Select".
5. Select "Edit UCOR Data...".
6. Select "Edit" > "Fill".

The "Fill Table" dialog enables you to fill in the values of the columns automatically.
7. To fill in the frequency column:



- a) Select "Select Column To Fill > Frequency / Hz".
- b) Select "Range > e.g. 15" to determine the number of values.
- c) Select "Start Value > e.g. 1.56 GHz".

- d) Select "Increment Value > e.g. 1 MHz", to determine the frequency steps.
- e) Select "Fill", to insert the frequency values.

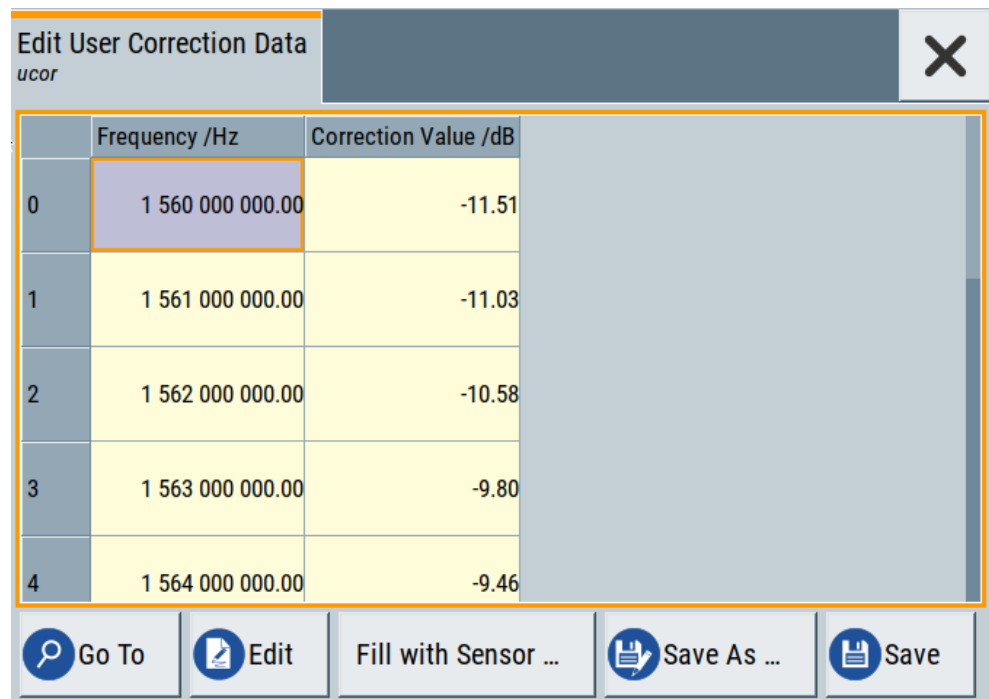
The "Fill" function also fills the column of the "Correction Value / dB" values with a predefined value, since empty cells lead to the data loss of the entire line. If you need different values, you can change them manually, or you can use the automatic function "Fill with Sensor" as described in the next steps.

8. Select "Fill with Sensor".

The "Fill User Correction Data With Sensor" dialog provides an overview of the sensor configuration.

9. Select "Execute".

The R&S SF100A successively sets each frequency point, reads the measured power of the sensor and fills in the value in the correction table.



	Frequency /Hz	Correction Value /dB
0	1 560 000 000.00	-11.51
1	1 561 000 000.00	-11.03
2	1 562 000 000.00	-10.58
3	1 563 000 000.00	-9.80
4	1 564 000 000.00	-9.46

10. Select "Save" to save the data in the file.
11. Close the dialog.

To perform power leveling calibration with user correction data

We assume that a user correction file is available in the user directory of the R&S SF100A or on a memory stick or in a shared directory.

If you have created and saved the file immediately before this step, the file is loaded in the "User Correction" dialog automatically. Otherwise you can load a previously saved file.

1. Select "RF" > "RF Level" > "User Correction".

2. Select "UCOR Data" > "UCOR Data...", if there is no file loaded already.
3. Select the directory and file you want to use.
4. Load the file with "Select".
5. To view the file content, select "Edit UCOR Data...".
6. Select "UCOR Data" > "State" > "On" to apply the user correction values.

When you activate the RF output, the R&S SF100A considers the user correction data and adjusts the signal level accordingly to compensate external frequency responses.

8 Generating I/Q output signals

Option: R&S SFI-K17

- [About I/Q analog output signals](#).....244
- [Generating I/Q analog output signals](#).....245
- [I/Q analog output settings](#).....251

8.1 About I/Q analog output signals

Required options

The equipment layout for output of analog I/Q signal includes:

- Base unit
Sufficient for direct DAC output of the baseband signal at the DAC connectors.
- Option R&S SFI-K17 single-ended/differential analog I/Q outputs
Required for singled-ended and amplified differential output of the baseband signal at the Single and Diff connectors.
- Optional RF modulation bandwidth extension to 8 GHz (R&S SFI-K529) or 10 GHz (R&S SFI-K530)
Required for wideband analog I/Q output of up to 5 GHz.

For more information, refer to the specifications document.

I/Q analog output interface and states

The block diagram displays the "I/Q OUT" connector in a folded state. The analog output connectors are inactive (gray LEDs).

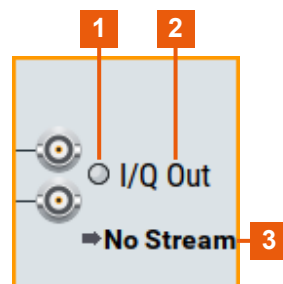


Figure 8-1: Representation of the analog output interface

- 1 = Analog output interface state: gray = inactive; blue = active
- 2 = Analog output interface name
- 3 = "No Stream" indicating no mapped I/Q stream

Maximum overall output voltage

The voltage of the analog output signals is defined as a combination of the output voltage of the I and Q signal components and an optional bias voltage. If you use the differential output, you can also set an offset.

The values of these parameters are interdependent so that the sum of output voltage and bias voltage has an upper limit V_{\max} as follows:

- Single-ended signal: $V_p + V_{\text{bias}} \leq V_{\max}$
- Differential signal: $0.5 \cdot V_p + |V_{\text{bias}}| + 0.5 \cdot V_{\text{offset}} \leq V_{\max}$
- DAC signal: $0.5 \cdot V_p + |V_{\text{bias}}| + 0.5 \cdot V_{\text{offset}} \leq V_{\max}$

Where:

- V_p is the output voltage, see "[I/Q Level Vp \(EMF\)](#)" on page 253.
- V_{bias} is the bias voltage, see "[Bias \(EMF\)](#)" on page 253.
- V_{offset} is the offset between inverting and non-inverting output, see "[Offset \(EMF\)](#)" on page 254.

For more information, refer to the specifications document.

8.2 Generating I/Q analog output signals

This section provides information on how to generate analog I/Q output signals. It covers the following topics:

- "[To connect to the analog I/Q output interfaces](#)" on page 245
- "[To open general analog I/Q output settings](#)" on page 246
- "[To generate single-ended analog I/Q signals](#)" on page 247
- "[To generate differential analog I/Q signals](#)" on page 248
- "[To generate DAC analog I/Q signals](#)" on page 249

To connect to the analog I/Q output interfaces

1. Use the analog I/Q connectors on the front panel:
 - "DAC" for differential I/Q signal output directly from the D/A converter (DAC) board.
 - "Diff" for amplified differential I/Q signal output.
 - "Single" for single-ended I/Q signal output.
2. Connect to the analog I/Q connectors. See "[To connect to screwable connectors](#)" on page 24.

[Table 8-1](#), [Figure 8-2](#) and [Figure 8-3](#) provide an overview on connections and a test setup.

Table 8-1: Analog I/Q signals and R&S SF1100A connections

Signal	Signal type	R&S SF1100A
I/Q	Single-ended	"Single"
I/Q	Positive differential	"DAC" or "Diff"
I/Q bar	Negative differential	"DAC" or "Diff"

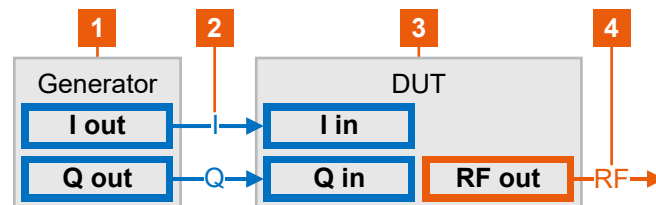


Figure 8-2: Test setup single-ended I/Q output

- 1 = R&S SF1100A with "Single" I/Q connectors
- 2 = Single-ended I/Q output signal components I and Q
- 3 = DUT as I/Q sink, for example a transmitter chipset
- 4 = RF output signal of the DUT

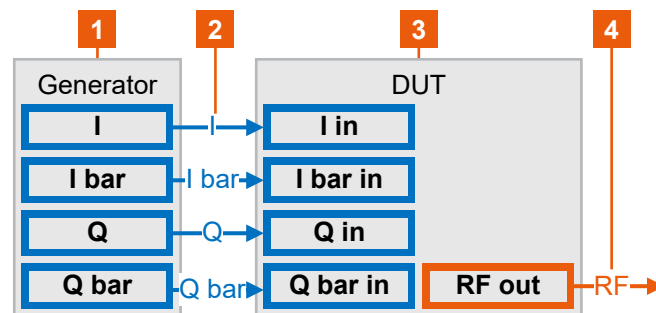
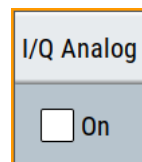


Figure 8-3: Test setup differential I/Q output

- 1 = R&S SF1100A with "DAC" or "Diff" I/Q connectors
- 2 = Positive and negative differential I/Q output signal components I and Q
- 3 = DUT as I/Q sink, for example a transmitter chipset
- 4 = RF output signal of the DUT

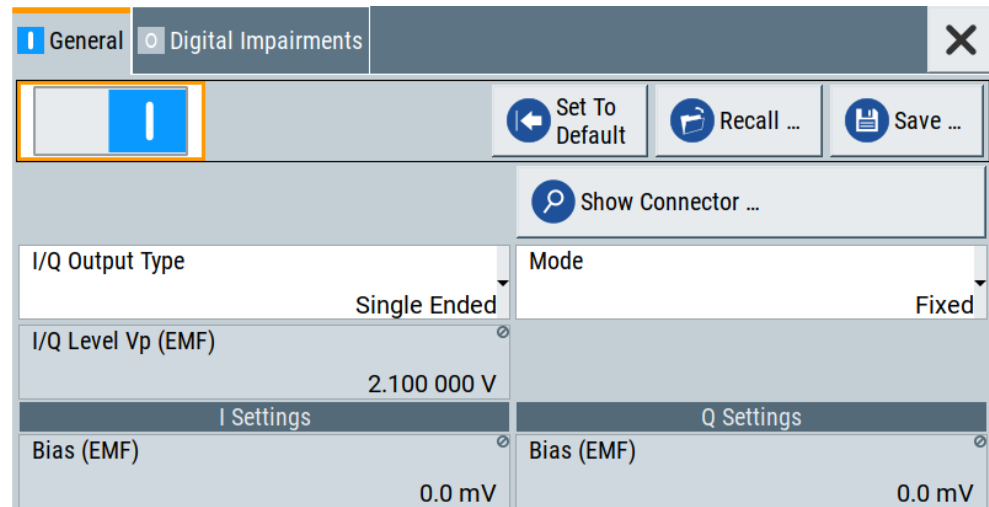
To open general analog I/Q output settings

1. In the block diagram, select the "I/Q OUT" symbol to unfold the "I/Q Analog" block.



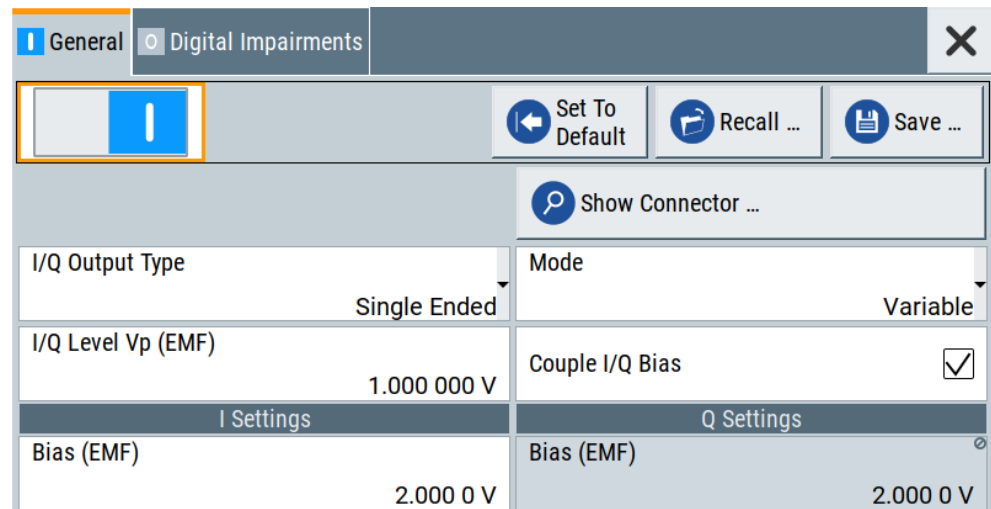
2. To open analog I/Q output settings, proceed as follows:
 - a) Select "I/Q Analog" bar of the block.
 - b) In the opening menu, select "I/Q Analog" > "I/Q Analog Outputs".

The general settings tab opens of the I/Q analog output configuration dialog.

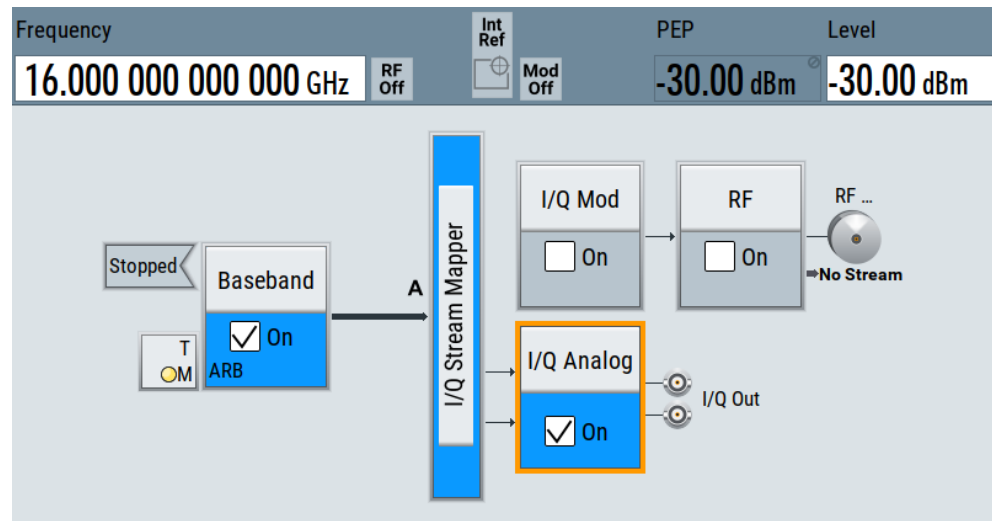


To generate single-ended analog I/Q signals

1. Connect to the single-ended I/Q analog output connectors of the R&S SF100A. See ["To connect to the analog I/Q output interfaces"](#) on page 245.
2. Open general settings of the I/Q analog output signal. See ["To open general analog I/Q output settings"](#) on page 246.
3. Select "Output Type" > "Single Ended".
4. Select "Mode" > "Fixed" for fixed power levels of I/Q output signals. See also [Table 8-2](#).
5. For individual level settings, proceed for example as follows:
 - a) Select "Mode" > "Variable".
 - b) Set "I/Q Level Vp (EMF)" = 1 V.
 - c) Enable "Couple I/Q Bias" to use the same "Bias (EMF)" value for the I-component and the Q-component.
 - d) Set "Bias (EMF)" = 2 V.
6. To enable single-ended analog I/Q signal output, set "State" > "On".



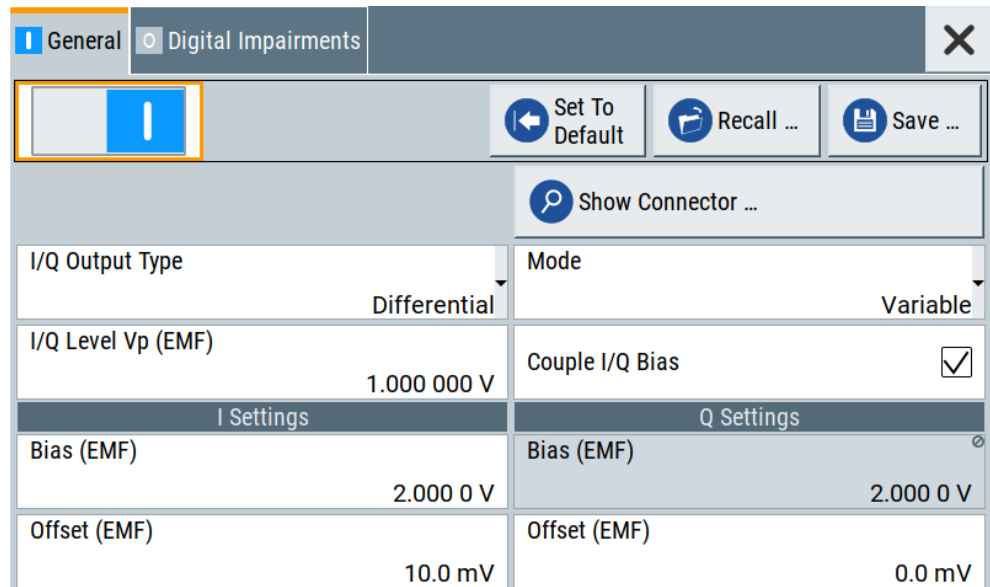
The block diagram automatically adjusts the signal routing to the single-ended analog I/Q outputs "I/Q Out".



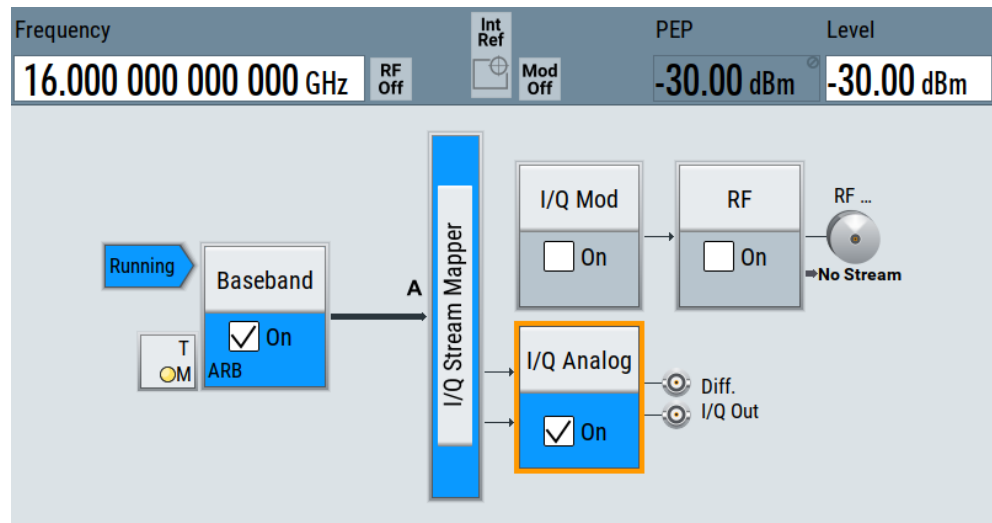
To generate differential analog I/Q signals

1. Follow steps (1) and (2) as in section "To generate single-ended analog I/Q signals" on page 247.
2. Select "Output Type" > "Differential".
3. Select "Mode" > "Fixed" for fixed power levels of I/Q output signals. See also [Table 8-2](#).
4. For individual level settings, proceed for example as follows:
 - a) Select "Mode" > "Variable".
 - b) Set "I/Q Level Vp (EMF)" = 1 V
 - c) Enable "Couple I/Q Bias" to use the same "Bias (EMF)" value for the I-component and the Q-component.
 - d) Set "Bias (EMF)" = 2 V.

- e) Set "Offset (EMF)" = 10 mV.
5. To enable differential analog I/Q signal output, set "State" > "On".



The block diagram automatically adjusts the signal routing to the single-ended analog I/Q outputs "I/Q Out".



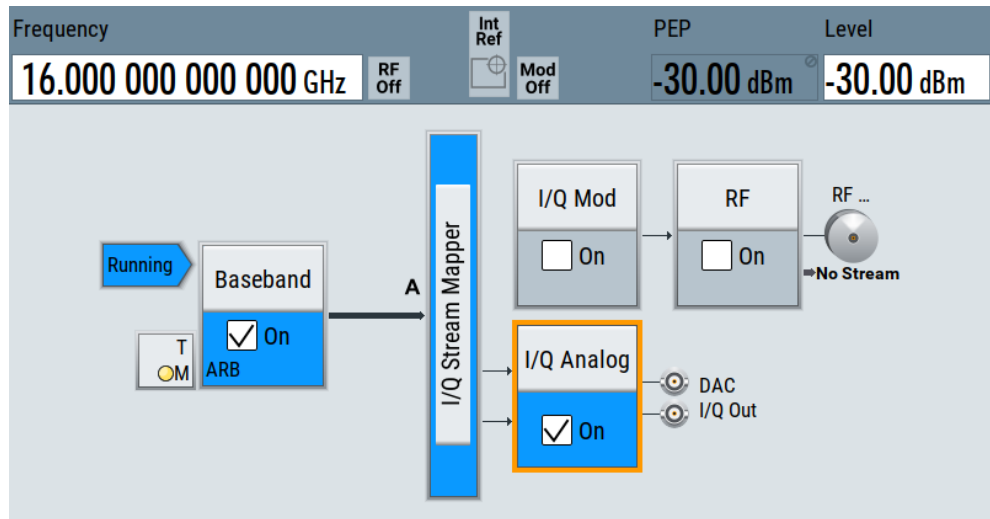
To generate DAC analog I/Q signals

1. Follow steps (1) and (2) as in section "To generate single-ended analog I/Q signals" on page 247.
2. Select "Output Type" > "DAC".
3. Select "Mode" > "Fixed" for fixed power levels of I/Q output signals. See also [Table 8-2](#).
4. For individual level settings, proceed for example as follows:

- a) Select "Mode" > "Variable".
 - b) Set "I/Q Level Vp (EMF)" = 850 mV
 - c) Enable "Couple I/Q Bias" to use the same "Bias (EMF)" value for the I-component and the Q-component.
 - d) Set "Bias (EMF)" = 10 mV.
 - e) Set "Offset (EMF)" = 10 mV.
5. To enable DAC analog I/Q signal output, set "State" > "On".

General		Digital Impairments	
<input checked="" type="checkbox"/>		<input type="checkbox"/>	
		<input type="button" value="Set To Default"/>	<input type="button" value="Recall ..."/>
		<input type="button" value="Save ..."/>	
<input type="button" value="Show Connector ..."/>			
I/Q Output Type	DAC	Mode	Variable
I/Q Level Vp (EMF)	850.000 mV	Couple I/Q Bias	<input checked="" type="checkbox"/>
I Settings		Q Settings	
Bias (EMF)	10.0 mV	Bias (EMF)	10.0 mV
Offset (EMF)	10.0 mV	Offset (EMF)	0.0 mV

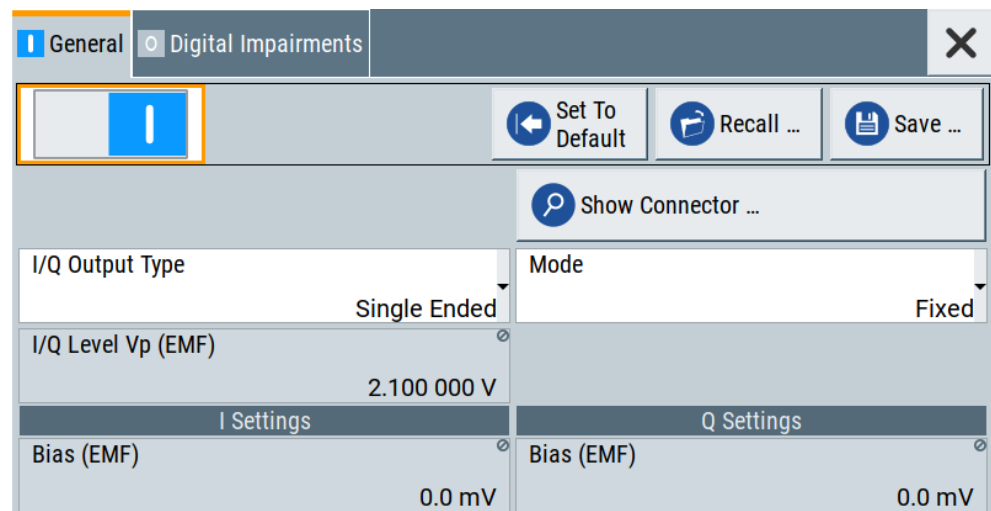
The block diagram automatically adjusts the signal routing to the single-ended analog I/Q outputs "I/Q Out".



8.3 I/Q analog output settings

Access:

- ▶ Open general settings of the I/Q analog output signal.
See "To connect to the analog I/Q output interfaces" on page 245.



The dialog provides the I/Q analog settings to select and configure the analog output signal type and to add digital impairments to the signal.

Settings:

State.....	251
Set To Default.....	251
Save/Recall.....	252
Show Connector.....	252
I/Q Output Type.....	252
Mode.....	252
I/Q Level Vp (EMF).....	253
Couple I/Q Bias.....	253
Bias (EMF).....	253
Offset (EMF).....	254

State

Enables the analog I/Q signal output at the "I/Q" or "I/Q bar" connectors. By default, these output connectors are disabled.

Remote command:

[:SOURce<hw>] : IQ:OUTPut:ANALog:STATe on page 496

Set To Default

Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Value
"State"	Not affected by a preset
"I/Q Output Type"	Single Ended Not affected by a preset, if you have connected external instruments and "Preset behavior: Keep connections to external instruments" > "On".
"I/Q Level Vp (EMF)"	1 V
"Bias (EMF)"	0 mV

Remote command:

`[:SOURce<hw>] : IQ:OUTPut [:ANALog] :PRESet` on page 496

Save/Recall

Opens the "Save/Recall" dialog that is the standard instrument function for saving and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The settings are saved in a file with a predefined extension. You can define the file-name and the directory, in that you want to save the file.

See also [Chapter 10.4, "Saving and recalling settings"](#), on page 278.

Remote command:

`[:SOURce<hw>] : IQ:OUTPut [:ANALog] :SETTing:CATalog?` on page 496



Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

I/Q Output Type

Selects the type of output signal.

The parameters in the "I/Q Analog Out" dialog depend on the selected output mode.

- "Single Ended" Requires R&S SFI-K17.
Single-ended output at the "Single" I/Q connectors.
You can define a bias between the output signal and the ground.
- "Differential" Requires R&S SFI-K17.
Differential output at the "Diff" I/Q connectors and I/Q bar connectors.
- "DAC" Direct D/A converter (DAC) output at the "DAC" I/Q connectors and I/Q bar connectors.

Remote command:

`[:SOURce<hw>] : IQ:OUTPut [:ANALog] :TYPE` on page 497

Mode

Selects fixed mode or variable mode for the power levels at the I/Q outputs.

"Fixed" The power levels of the I/Q signal components are fixed, see table [Table 8-2](#).

Table 8-2: Fixed mode I/Q output power levels

"I/Q Output Type"	"I/Q Level Vp (EMF)"	"Bias (EMF)"	"Offset (EMF)"
Single ended	2.1 V	I: 0.0 mV Q: 0.0 mV	-
Differential	2.9 V	I: 0.0 mV Q: 0.0 mV	I: 0.0 mV Q: 0.0 mV
DAC	900 mV	I: 0.0 mV Q: 0.0 mV	I: 0.0 mV Q: 0.0 mV

"Variable" Enables individual power level settings of the I/Q signal components. For more information, refer to the specifications document.

Remote command:

`[:SOURce<hw>] :IQ:OUTPut [:ANALog] :MODE` on page 497

I/Q Level Vp (EMF)

Displays or sets the output voltage for the I and Q signal components. Setting requires "Mode" > "Variable".

To keep the I/Q analog output power levels below the maximum input power level at your DUT, see ["Maximum overall output voltage"](#) on page 245.

Remote command:

`[:SOURce<hw>] :IQ:OUTPut:LEVel` on page 497

Couple I/Q Bias

Requires "Mode" > "Variable".

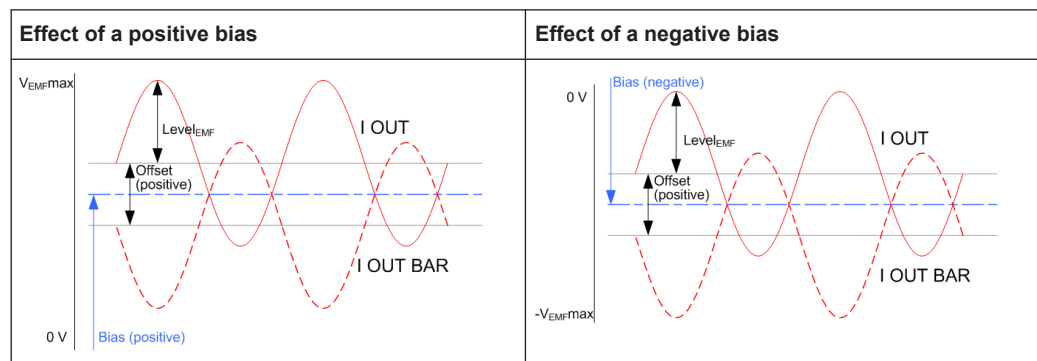
If enabled, couples the bias setting of the I signal and the Q signal component. The bias of the I signal component is configurable, the bias of the Q signal component updates automatically to the same value.

Remote command:

`[:SOURce<hw>] :IQ:OUTPut [:ANALog] :BIAS:COUPling [:STATe]` on page 498

Bias (EMF)

Displays or sets the bias DC voltage. This bias is superimposed upon the I or Q signal. Setting requires "Mode" > "Variable".



In "Single Ended" mode, this parameter is the bias between the I/Q output signal and the ground. Use this bias, for example, to define the operating point of a DUT.

To keep the I/Q analog output power levels below the maximum input power level at your DUT, see ["Maximum overall output voltage"](#) on page 245.

Remote command:

`[:SOURce<hw>] :IQ:OUTPut [:ANALog] :BIAS:I` on page 498

`[:SOURce<hw>] :IQ:OUTPut [:ANALog] :BIAS:Q` on page 498

Offset (EMF)

Requires "I/Q Output Type" > "Differential"/"DAC".

Displays or sets the offset between the inverting and the non-inverting output. Setting requires "Mode" > "Variable".

Sets an offset between the inverting and the non-inverting output.

To keep the I/Q analog output power levels below the maximum input power level at your DUT, see ["Maximum overall output voltage"](#) on page 245.

The selected offset is set half in the positive and half in the negative direction.

Effect of a positive offset	Effect of a negative offset
<p>A positive offset is set with half of the value in the positive direction at the non-inverting outputs, in the negative direction at the inverting outputs.</p>	<p>A negative offset is set with half of the value in the negative direction at the non-inverting outputs, in the positive direction at the inverting outputs.</p>

Example: Effect of a positive offset on the I signal component

"I Offset" = 100.0 mV

The offsets applied on the two output connectors are as follows:

- +50.0 mV at the positive signal output
- -50.0 mV at the inverted signal output

Remote command:

`[:SOURce<hw>] :IQ:OUTPut [:ANALog] :OFFSet:I` on page 499

`[:SOURce<hw>] :IQ:OUTPut [:ANALog] :OFFSet:Q` on page 499

9 Monitoring baseband signal characteristics

Instead of analyzing the baseband signal characteristics with an external instrument, the R&S SF100A can also visualize a subset of these signal characteristics with the built-in graphical signal display function. Also, this function evaluates signal measurement quantities and displays signal characteristics graphically in real-time.

9.1 Required options

The minimum equipment layout for using this function includes the base unit.

9.2 About the graphical signal display

To ease the setting and routing of baseband signals, R&S SF100A is able to capture these signals and display them graphically in different ways: as I/Q, vector, eye or constellation diagram, as power spectrum or as statistical evaluations.

In the digital domain, the measurements are based on recorded I/Q samples. The sources of these samples are selectable points (acquisition points) in the signal flow. You can configure and display the signal characteristics simultaneously in up to diagrams.

9.2.1 Available diagrams

This section focuses on graphical signal displays, their content and application. See [Table 9-1](#) for an overview of the signal characteristics that you can monitor.

Table 9-1: Graphics modes overview

Graphics modes	Domain	Measurement instrument
I/Q diagram	Time	Oscilloscope (standard mode)
Vector diagram	Time	Oscilloscope (XY mode)
Constellation diagram	Time	Oscilloscope (XY mode)
Eye diagram	Time	Oscilloscope (triggered to symbol clock and showing repetitive traces)
CCDF display	Statistical representation of peaks	Peak power analyzer
Power spectrum	Frequency	Spectrum analyzer

9.2.1.1 I/Q diagram

The I/Q diagram displays the in-phase component ($i[t]$) and quadrature component ($q[t]$) of the I/Q signal over time.

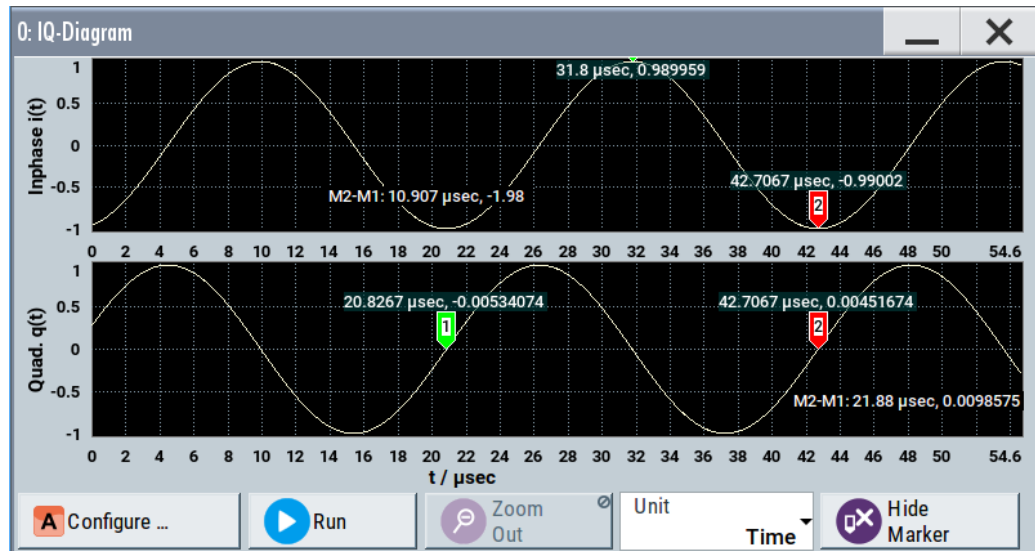


Figure 9-1: I/Q diagram with markers

= window with two separate coordinate systems with identical x-axis and y-axis
 x-axis = time in units number of symbols, chips, samples or seconds depending on the signal
 y-axis = amplitude, scaled to the peak envelope power; where minimum scaled amplitude = -1, maximum scaled amplitude = +1

Application: To analyze impairments, added noise and signals (e.g. from external baseband input) in the time domain. This mode shows the signal like an oscilloscope.

Signal acquisition points: See [Table 9-2](#).

9.2.1.2 Vector diagram

The vector diagram displays the Q component over the I component. All points in the complex domain are connected by lines.

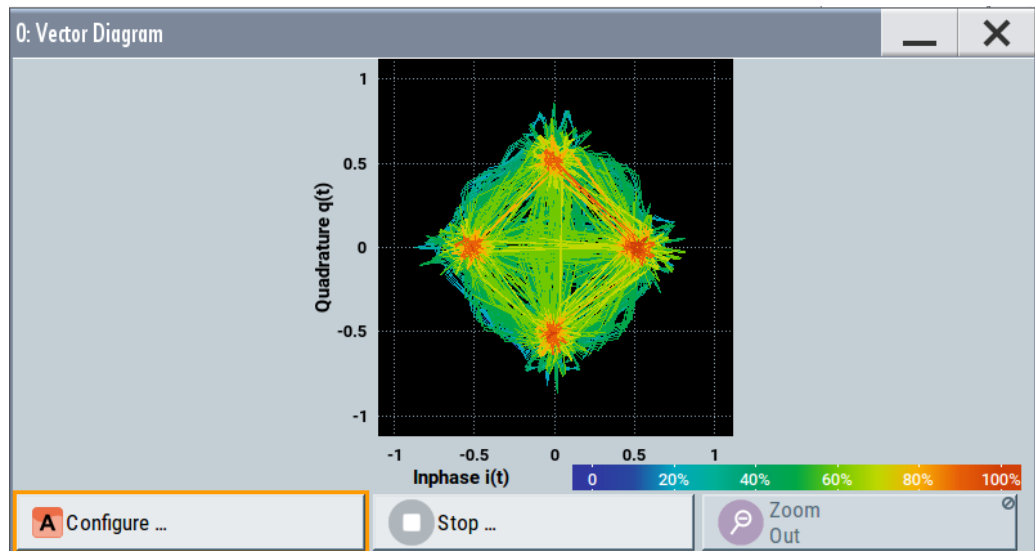


Figure 9-2: Vector diagram (64QAM)

X-axis, Y-axis = amplitudes of the signal components, scaled to the peak envelope power; where minimum scaled amplitude = -1, maximum scaled amplitude = +1

Application: To analyze the transition between the various states of modulation mapping, especially with linear modulations like MSK, QPSK or QAM. This mode shows the signal like an oscilloscope (X/Y-mode).

Signal acquisition points: See [Table 9-2](#).

9.2.1.3 Constellation diagram

Constellation diagrams display the modulation symbols as discrete points in the I/Q plane. Unlike the vector diagram, the constellation diagram displays only one sample per symbol. This sample represents the symbol.

Constellation diagrams are helpful when generating signals using the "Custom Digital Modulation" settings. Compare the displayed constellation diagram with the diagram displayed in the "Custom Digital Modulation > Modulation" dialog.

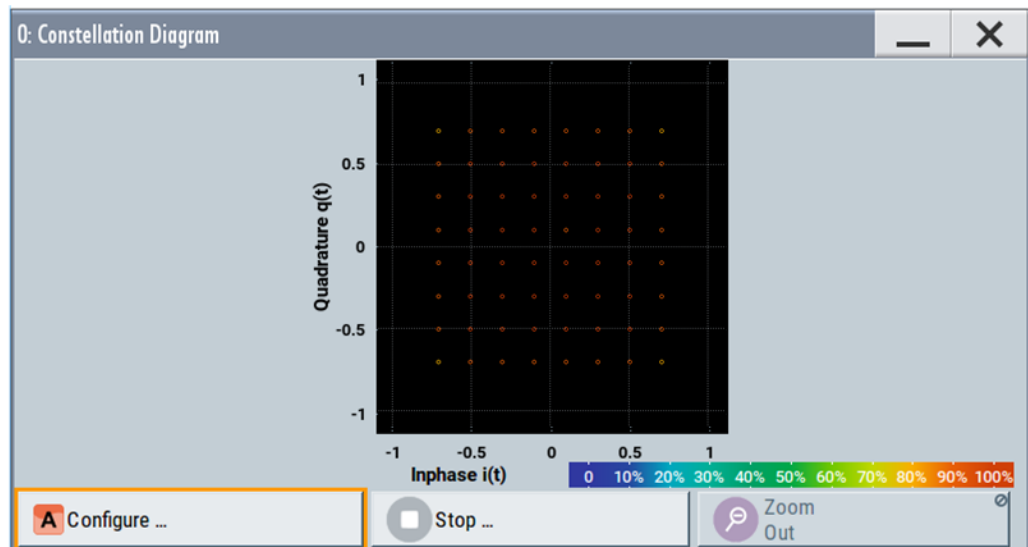


Figure 9-3: Constellation diagram (64QAM)

X-axis, Y-axis = amplitudes of the signal components, scaled to the peak envelope power; where minimum scaled amplitude = -1, maximum scaled amplitude = +1

Application: To classify modulation.

Signal acquisition points: See [Table 9-2](#).

9.2.1.4 Eye diagram

The eye diagram displays synchronized and superimposed sections of either the in-phase or the quadrature components of the signal.

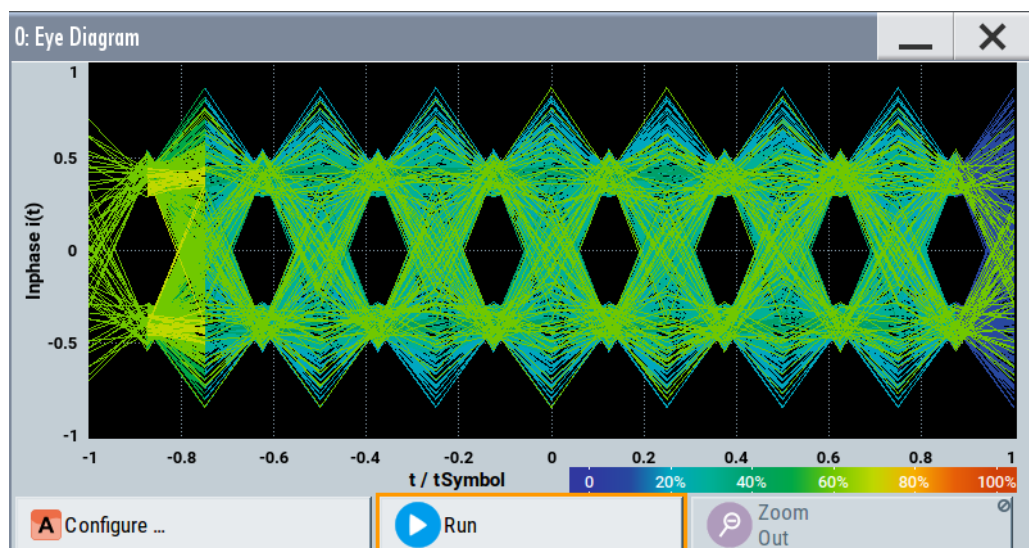


Figure 9-4: Eye diagram with partially closed eye (QPSK)

X-axis = time in the range of ± 1 symbol

Y-axis = amplitude, scaled to the peak envelope power; where minimum scaled amplitude = -1, maximum scaled amplitude = +1

The display width is normalized for 2 symbols. It uses one-symbol "eye opening" in the center of the display and 1/2-symbols to the left and right of the center eye for capturing time transitions. Several hundred curve segments are superimposed. The beginning of the recording is synchronous to the symbol and chip clock pulse.

Application: To analyze amplitude and time distortion elements (e.g. jitter) at high-speed digital data systems. A high quality, unimpaired signal shows a clearly open eye (horizontally and vertically).

Signal acquisition points: See [Table 9-2](#).

9.2.1.5 CCDF display

The complementary cumulative distribution function (CCDF) displays the probability with which the output signal exceeds the average power.

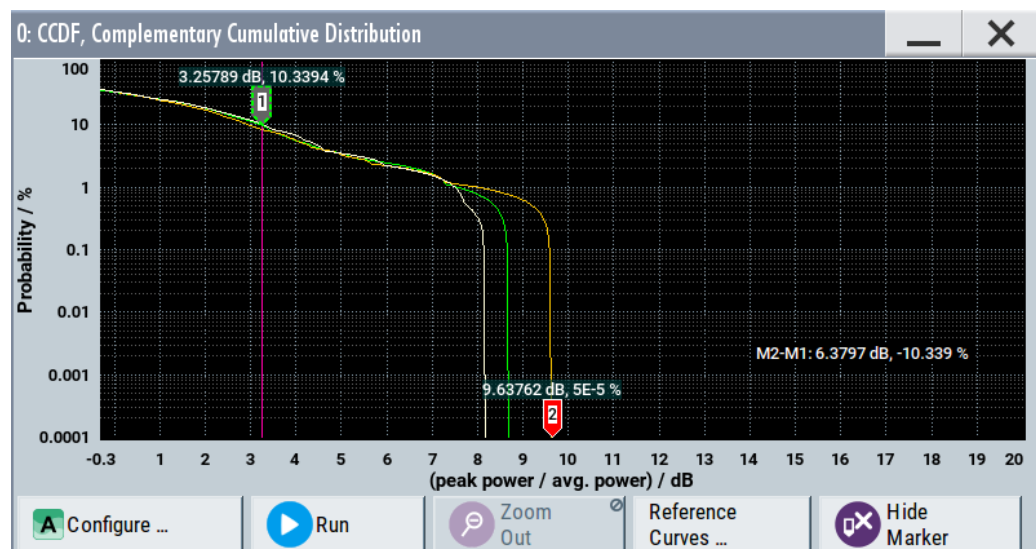


Figure 9-5: CCDF diagram of a 5 MHz LTE signal (Level -30 dBm) and two reference curves

X-axis = Level over the average signal power, where the average power (RMS) corresponds to the origin
 Y-axis = Probability of exceeding the average power that is the percentage of time the signal spends at or above the power level specified by the X-axis

Marker 1 = Interpolation: 10.3% of the samples exceed 3.3 dB above average; 1% of the samples exceed 7.5 dB above average (not shown with a marker)

Marker 2 = The point where the trace crosses the x-axis; indicates the highest peak that is found in the sample block and is 9.6 dB higher than average.

Signal acquisition points: See [Table 9-2](#).

9.2.1.6 Power spectrum

The power spectrum displays the signal spectrum which is calculated from the I/Q signal with fast Fourier transform (FFT). The power density over frequency is displayed.

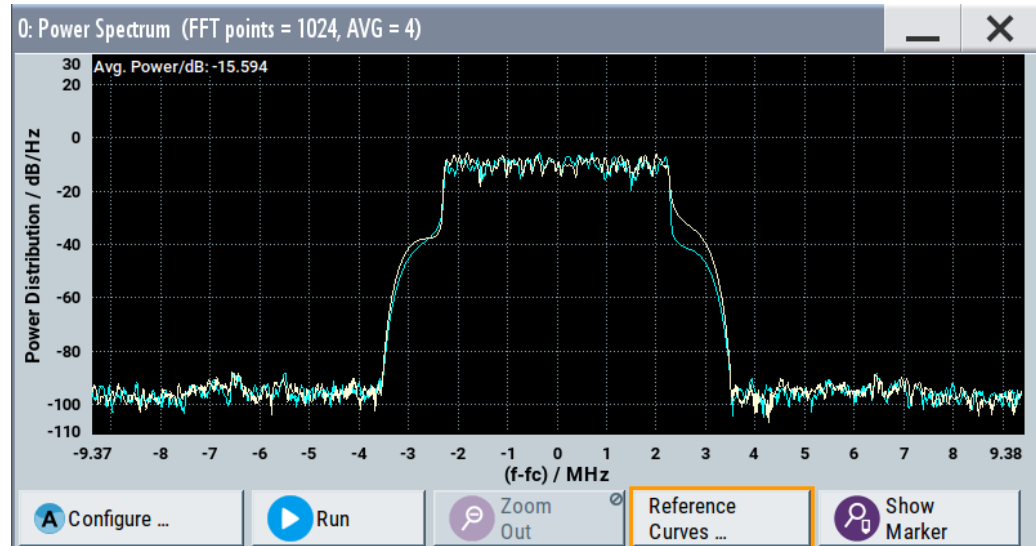


Figure 9-6: Power spectrum diagram of a 5 MHz LTE signal with enabled reference curve (blue)

"FFT points" = indicates the number of I/Q value pairs that are used for calculating a (part-)FFT

"AVG" = indicates the number of subspectra used for averaging

X-axis = frequency plotted symmetrically (- Sampling Rate/2 to +Sampling Rate/2)

Y-axis = power density

Signal acquisition points: See [Table 9-2](#).

9.2.2 Signal acquisition points

Signal characteristics can be displayed using different methods and different acquisition points, also at the same time. [Table 9-2](#) shows which signal acquisition point is suitable for which kind of graphics mode. Also, it provides associated graphics sources and the designation of the access points in the block diagram.

Table 9-2: Signal acquisition points, modes and sources

Signal acquisition points	Graphics modes	Graphics source	Designation
Baseband signals	Constellation diagram, eye diagram	"Baseband"	A
Input streams	I/Q diagram, vector diagram, CCDF diagram, power spectrum diagram	"Stream"	A
Analog outputs	I/Q diagram, vector diagram, CCDF diagram, power spectrum diagram	"IQ Out" "RF"	1 A

Figure 9-7 shows an example for locations of signal acquisition points.

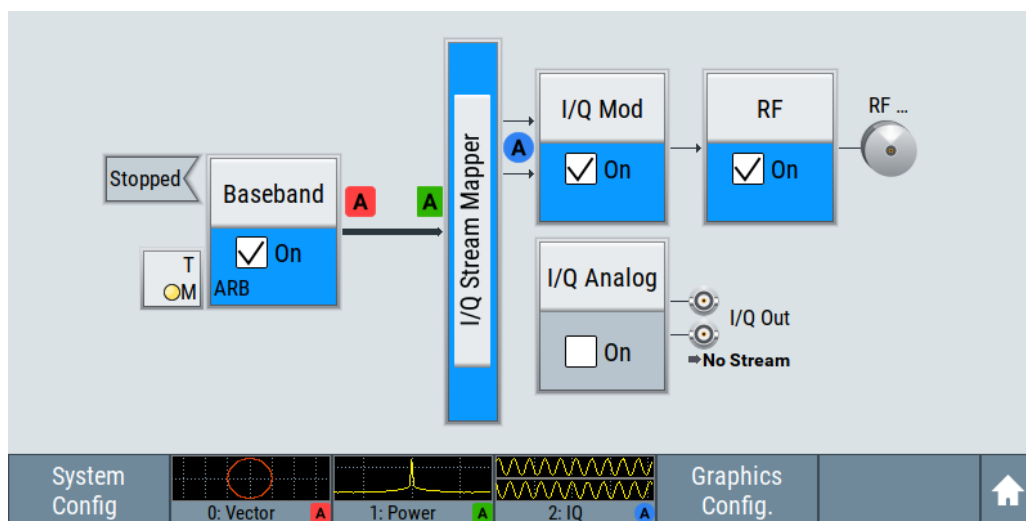


Figure 9-7: Block diagram with graphical signal display and signal acquisition points

9.2.3 Display functions

The graphical display provides general display functions known from other measurement instruments and offers zoom and markers.

Zooming

You can zoom into the diagram to visualize the measurement results in greater detail. Using the touchscreen or a mouse pointer you can easily define the area to be enlarged.

Zooming is merely a visual tool, it does not change the number of samples used for the calculation. You can increase the number of samples before zooming.

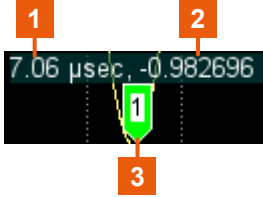

See also ["To zoom into a diagram"](#) on page 269.

Using markers

Markers are tools for numerical readout of measured data in diagrams. They help you analyze the displayed signal characteristics by determining particular values in the diagram.

Often you can use markers to measure the frequency distance of two peaks or to measure the power decrease of an oscillator at a given frequency offset, dBc value. Note that markers in the diagram are not related to the markers in the digital standards.

In the graphical display, the markers and their values (for example time or frequency) are displayed as usual.

Single marker indication	Delta marker indication
 <ul style="list-style-type: none"> 1 = marker position on the x-axis in the current units 2 = marker value on the y-axis 3 = marker number 	 <ul style="list-style-type: none"> 1 = delta marker 2 = result of the marker function, i.e. the delta values in the current units

See also "[To enable markers to read-out measured data](#)" on page 269.

Persistence and color maps

In addition to the standard representation, the vector, the constellation, and the power spectrum diagrams use a color map.

The color encodes the relative amplitude (in percent) of the probability distribution of the data points in the diagram. A detailed breakdown of the colors is below diagrams the colors are relevant for. Data points in areas with high probability are marked in red, data points in areas with low probability in blue. Thus, for example, you can observe not only the "level versus frequency" trace but also a third dimension, the probability of the power level.

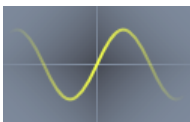
Reference trace

Reference traces help you analyze a displayed characteristic, as do the markers. Reference traces are used to define amplitude curves or spectral distribution boundaries in the result diagram which are not to be exceeded. They indicate, for example, the upper power limits which are allowed from a device under test (DUT).

The R&S SF100A supports up to five reference traces. You can load reference traces and activate them simultaneously.

9.3 Graphics configuration settings

This section focuses on the graphics configuration dialog, which determines the number and kind of the graphical signal displays.



Access:

1. Select the sine wave icon.

The "Graphics Configuration" dialog opens.

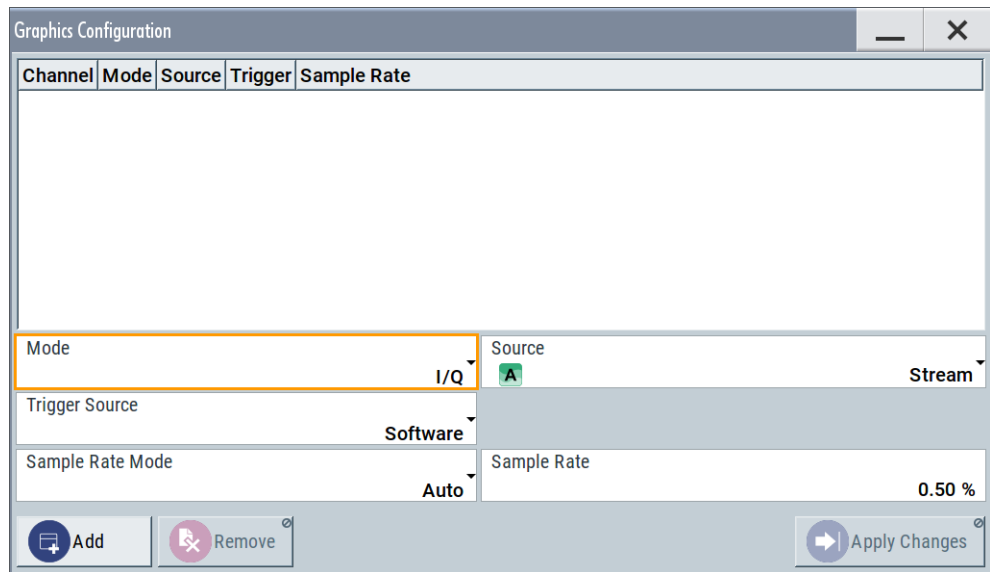


Figure 9-8: Graphics configuration dialog

2. To display a certain characteristic of the signal, use the parameter "Mode".
3. To select suitable signal acquisition points, use the parameter "Source".
4. To enable the graphical signal display, select "Add".

A thumbnail of the graphical signal display is shown in the taskbar.

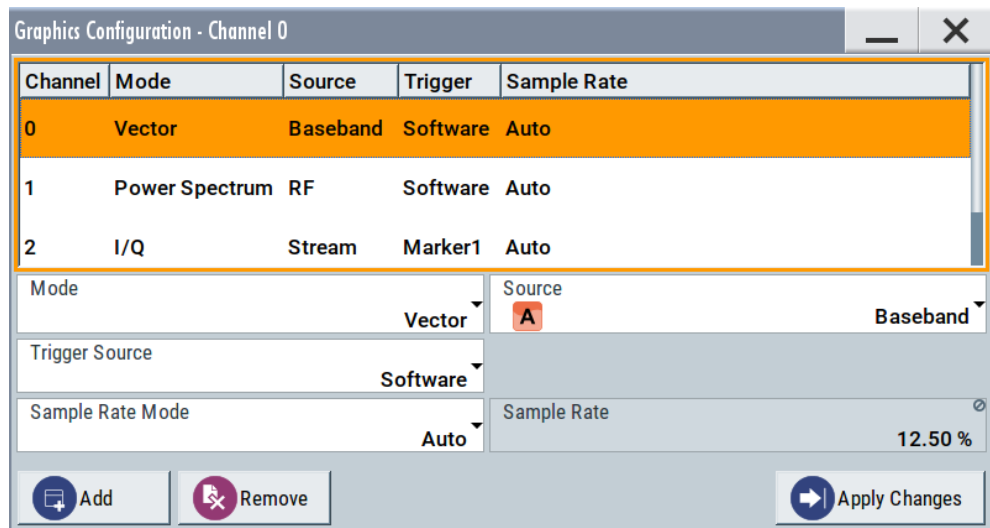


Figure 9-9: Graphics configuration dialog with active graphical signal displays

5. To enlarge the thumbnail, select it.

Settings:

Graphical Diagrams Table.....264

Mode.....264

Source.....264

FFT Length.....	264
Full Scale (dBFS).....	264
Trigger Source.....	264
Sample Rate Mode.....	265
Sample Rate.....	265
Add.....	265
Apply Changes.....	265
Remove.....	266

Graphical Diagrams Table

The active graphical signal displays are listed in the table at the top of the dialog.

Mode

Sets the graphics mode, see [Chapter 9, "Monitoring baseband signal characteristics"](#), on page 255.

Remote command:

`[:SOURce<hw>] :BB:GRAPhics:MODE` on page 570

Source

Sets the source for the signal acquisition point.

See [Chapter 9.2.2, "Signal acquisition points"](#), on page 260.

Remote command:

`[:SOURce] :BB:GRAPhics:SOURce` on page 571

FFT Length

In "Mode > Power Spectrum", selects the number of samples to be included in the graph of the power spectrum.

Remote command:

`[:SOURce] :BB:GRAPhics:FFTLen` on page 572

Full Scale (dBFS)

In "Mode > Power Spectrum", determines the normalization of the power values in the diagram.

Observe the change in the units on the y-axis.

"On" The maximal digital power $|I|=|Q|=max$ is mapped to 0 dB in the power spectrum diagram.

The y-axis shows the normalized power in dBFS.

"Off" The frequency average of the displayed power (frequency domain) agrees with the average power in the time domain.

The y-axis shows the power distribution in dB/Hz.

Remote command:

`[:SOURce] :BB:GRAPhics:FFTFscale` on page 572

Trigger Source

Defines the trigger for signal recording.

"Software"	Recording of signals starts automatically in predefined intervals. This asynchronous method is suitable if a representative display of the complete signal is required.
"Marker 1"	The starting point for recording of signals is determined by the marker 1 setting of the activated digital standard ("Trigger/Marker" dialog). This synchronous method is suitable if specific signal segments are to be shown in greater detail. With periodic signals, a static image is obtained by selecting a period length of marker 1 that is equal to the signal period. The displayed signal segment can be shifted by entering a marker delay in the "Trigger/Marker" dialog of the activated digital standard.

Remote command:

[\[:SOURce<hw>\]:BB:GRAPhics:TRIGger:SOURce](#) on page 572

Sample Rate Mode

Sets how the time resolution of the signal is determined. Maximum resolution corresponds to a display covering the entire signal bandwidth. The higher the resolution, the shorter the length of the displayed signal segment.

"Auto"	The resolution is set to an optimum value in terms of signal and display type.
"Full Bandwidth"	The resolution is set so that the display covers the entire signal bandwidth.
"User"	Activates the "Sample Rate" input field, where you can manually set the resolution.

Remote command:

[\[:SOURce<hw>\]:BB:GRAPhics:SRATe:MODE](#) on page 570

Sample Rate

- If "Sample Rate Mode = Auto/Full Bandwidth"
Displays the percentage of the entire signal bandwidth which is used for the graphical signal display.
- If "Sample Rate Mode = User"
Input for the percentage of signal bandwidth which is used for the graphical signal display.

Remote command:

[\[:SOURce<hw>\]:BB:GRAPhics:SRATe:USER](#) on page 570

Add

Adds a graphical signal display (as set in the "Graphics Configuration" dialog) to the taskbar/graphical diagrams table.

Remote command:

[\[:SOURce\]:BB:GRAPhics:ADD](#) on page 571

Apply Changes

Enables the current settings for the selected graphical signal display.

Remove

Removes the selected graphical signal display from the taskbar/graphical diagrams table.

Remote command:

[\[:SOURce\]:BB:GRAPhics:CLOSe](#) on page 571.

The command closes all graphical signal displays.

9.4 Graphical signal display settings

Access:

1. Select "Taskbar > System Config > Graphics > Add".
2. Double-click the thumbnail in the taskbar.

This section focuses on the functions of the enlarged graphical signal displays.

Settings:

Configure	266
Stop/Run	266
Zoom Out	266
Reference Curves	266
Display Units	266
Show / Hide marker	267
Reference Curve	267

Configure

Opens the "Graphics Configuration" dialog, see [Chapter 9.3, "Graphics configuration settings"](#), on page 262.

Note: This function is available for enlarged graphical signal displays and in the context menus of the thumbnails.

Stop/Run

Stops the processing of the displayed signal and freezes it.

"Run" continues a stopped displayed signal.

Zoom Out

Resets a previous zoom, see also ["To zoom into a diagram"](#) on page 269.

Reference Curves

Accesses the dialog for defining reference curves, see ["Reference Curve"](#) on page 267.

Display Units

Changes the units of the X-axis. The available values depend on the generated signal.

Show / Hide marker

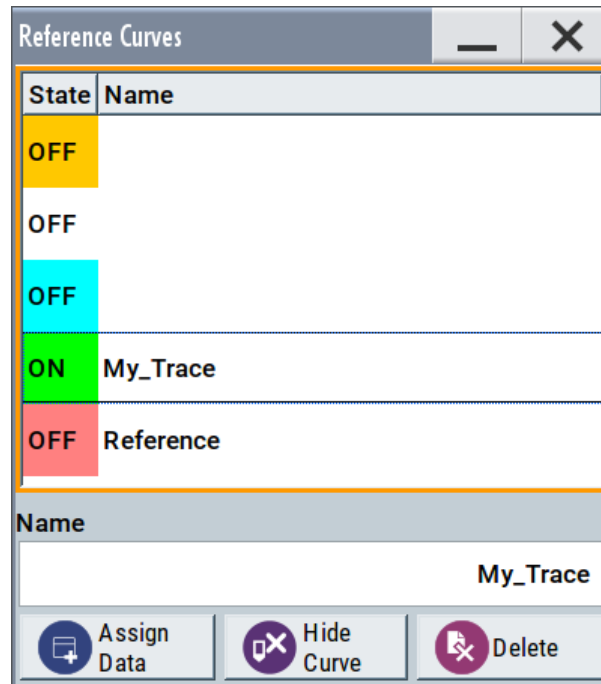
Sets two markers to the displayed signal or hides them.

See also:

- ["Using markers"](#) on page 261
- ["To enable markers to read-out measured data"](#) on page 269

Reference Curve

Enable the indication of up to five configurable reference curves (traces).



See ["Reference trace"](#) on page 262.

"Reference Curves Table"

Lists the configured reference curves and their current state.
To change a curve, select it.

"Name" Enters the name of a new reference curve

"Assign Data" Opens the standard "File Select" function to load a file describing a reference curve.

"Show Curve" Toggles the show/hide state of the selected curve

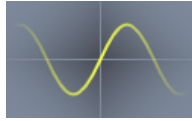
"Delete" Removes the curve

9.5 Checking the generated signal graphically

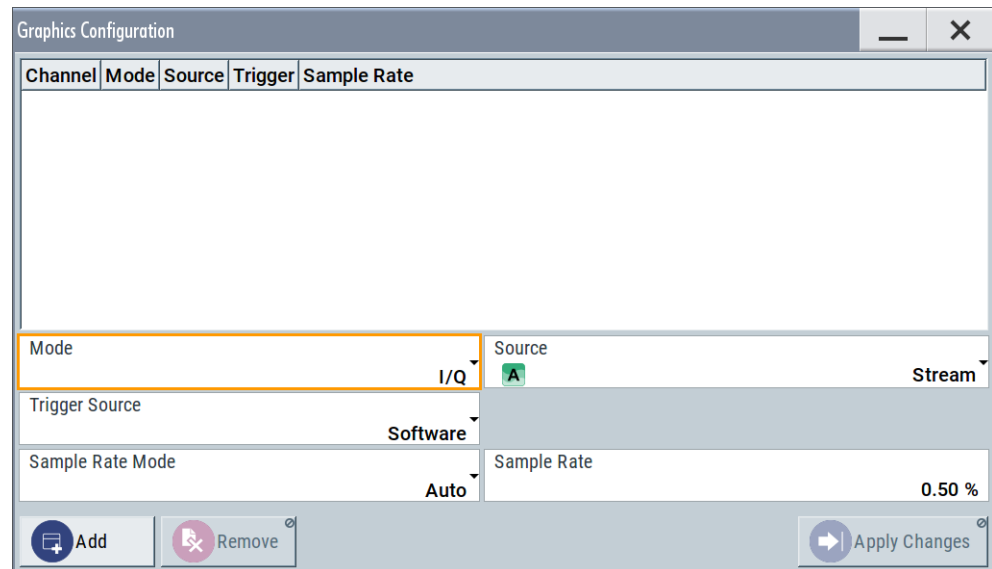
This section shows you how to use the different graphic modes to visualize the signal characteristics of the generated signal. It also shows how to observe the effect of standard settings, like an applied filter, an enabled fading or AWGN. The examples use a simple custom digital modulated signal.

Configure the graphical signal display

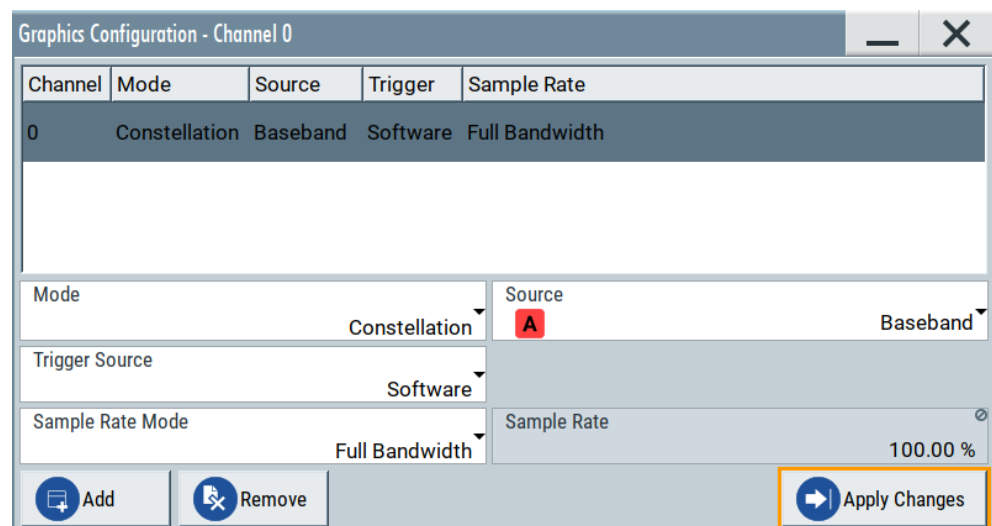
1. Select the wave icon:



The "Graphics Configuration" dialog opens.



2. Select "Mode > Constellation".
3. Select "Source > Baseband".
4. To view the signal, select "Add".



A new thumbnail (minimized view) indicating the constellation diagram appears in the "Taskbar".

- To enlarge the constellation diagram, select it.

The displayed constellation diagram confirms the a QPSK offset modulation.

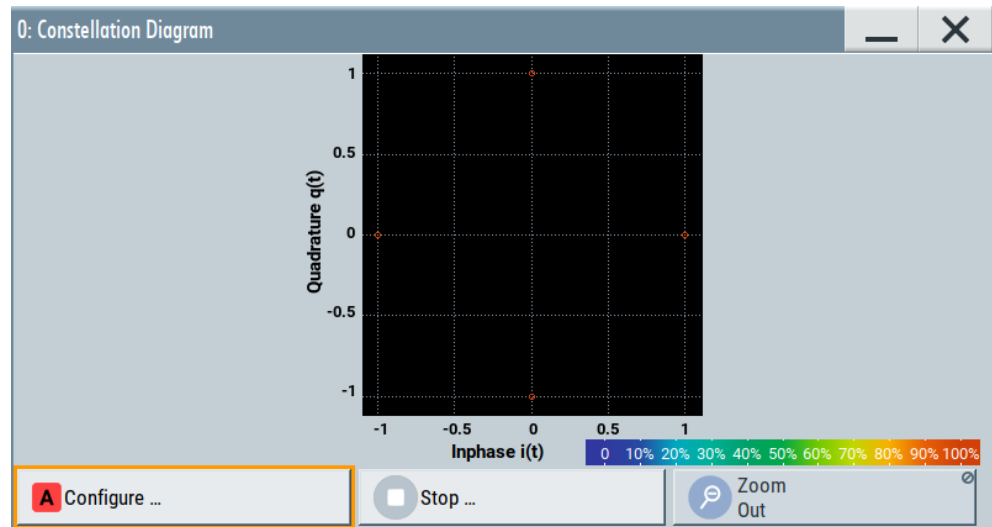


Figure 9-10: Constellation diagram of a WCDMA-3GPP (QPSK 45° offset) signal

To zoom into a diagram

In an enlarged diagram:

- Use the one-finger zoom to zoom with a fixed zoom factor.
- Use the two-finger zoom to do a custom zoom.
This zoom works like the two-finger pinching for magnifying images on your mobile phone.
If the diagram is zoomed, an overview window appears.
- Move the visible area in the graphics or in the overview window.
- For the reverse operation, select "Zoom out".

To enable markers to read-out measured data

In an enlarged diagram:

- Select "Show Marker".
Two markers appear, one over the other.
- To position the markers, select and shift them.
"M2-M1" indicates the distance of marker 1 and marker 2 on the x-axis (left value) and on the y-axis (right value).
- To hide the markers, select "Hide Marker".

To print the current power spectrum

- Select "System Config" > "Setup" > "User Interface" > "Hardcopy".

2. Use the default settings.

3. Select "Save".

The instrument creates a screenshot of the current screen and stores it in a file with a predefined filename in the default user directory `/var/user/`.

See [Chapter 10.9, "Creating screenshots of current settings"](#), on page 295.

4. Use one of the standard file transfer methods to access the user directory of the instrument. Transfer the file to a PC.

See [Chapter 10.8, "Transferring files from and to the instrument"](#), on page 289.

5. Print the file content.

10 Managing files and data

The R&S SF100A uses files to save all instrument data. The instrument allows you to save and to load instrument settings, and to import and to export user data for processing in another instrument or later. Finally, you can create a screenshot of the current settings displayed on the screen and save it as a file.

This section focuses on the functions provided for managing of user data files and covers the topics listed below.

For information on the related remote control commands, refer to [Chapter 13.5, "Memory subsystem"](#), on page 412.

For information on how to save the displayed setting in a file, refer to [Chapter 10.9, "Creating screenshots of current settings"](#), on page 295.

• About the file system	271
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10.1 About the file system

Depending on their content, this description distinguishes between system files and user files. System files and the system directory are protected and not accessible. User files contain user-defined configurations or data.

This section focuses on user files. It provides an overview of the R&S SF100A file system and covers the following topics:

- ["Types of user data"](#) on page 271
- ["File storage location"](#) on page 272
- ["File handling"](#) on page 272
- ["File naming conventions"](#) on page 273
- ["File contents"](#) on page 273

Types of user data

The following data types contain user data:

- Settings or configuration files, for example, you save the current instrument settings and load these settings on another instrument.
See [Chapter 10.4, "Saving and recalling settings"](#), on page 278.
- SCPI scripts that contain a series of commands. You can run the script to perform a task.

See [Chapter 10.6, "Exporting and importing remote command lists"](#), on page 284.

- Externally generated waveforms. You can load the waveform files at the ARB application on the instrument.
See [Chapter 4.3, "Using the arbitrary waveform generator \(ARB\)"](#), on page 64.

Depending on the **data storage method**, user data can be:

- *Persistent*, i.e. user files that are recorded on the data storage.
Data is preserved when instrument is powered off and can be accessed and modified subsequently.
- *Temporary*, i.e. volatile data that the instrument retains while it is powered on.
Volatile data is immediately lost when the R&S SF100A is switched off.

File storage location

Both, the user directory `/var/user/` on the internal memory or the `/usb/` directory on the memory stick, can be used to **preserve** user-defined data. Any directory structure can be created.

The `/var/volatile` directory serves as a RAM drive and can be used to protect sensitive information. The data is available **temporarily**.

Default storage location

The R&S SF100A stores user data in the user directory.

In the file system, user directory is always indicated as `/var/user/`.

In manual control, you access this directory via the "File Manager", see [Chapter 10.7, "Using the file manager"](#), on page 284. In remote control, you can query it with the command `:SYSTEM:MMEMory:PATH:USER?`.

To query and change the default directory used for mass storage, use the command `:MMEMory:CDIRectory`.

File handling

To *access files* and the file system of the instrument or to use the general file management functions such as copying and moving data, use the standard "File Manager" dialog.

See [Chapter 10.7, "Using the file manager"](#), on page 284.

To *transfer files* from and to the instruments or to exchange files, use one of the following alternatives:

- Connect a memory stick to one of the USB interfaces.
The instrument automatically recognizes a connected memory stick and assigns the `/usb/` drive to it.
- Connect the instrument to a LAN.
An instrument connected to a LAN supports two standard file transfer methods from a remote client:
 - FTP (file transfer protocol)
 - File sharing according to the SAMBA/SMB (server message block) protocol.

Both file transfer methods open the folder `/user` that is the `/var/user/` folder on the instrument.

For a step-by-step description, see [Chapter 10.8, "Transferring files from and to the instrument"](#), on page 289.

- Map a network folder or a computer to an instrument connected to a LAN. A mapped network folder is indicated as `/shares/<"Local Folder">`. For a step-by-step description, see [Chapter 10.7.4, "Mapping a network folder"](#), on page 288.

File naming conventions

To enable files to be used in different file systems, consider the following file naming conventions:

- The *filename* can be of any length and *is case-sensitive*, i.e it is distinguished between uppercase and lowercase letters.
- All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the filename).
- Avoid using special characters.
- Do not use slashes "`\`" and "`/`". These symbols are used in file paths.
- Avoid using the following filenames: `CLOCK$`, `CON`, `COM1` to `COM4`, `LPT1` to `LPT3`, `NUL` or `PRN`. They are reserved by the operating system.

File contents

To maintain the file size and to accelerate processing times, the instrument saves settings that deviate from their default values. Considered is also configuration data for the operating elements and lists with user data, e.g. dialog positions and a list of user correction data. However, if a list data is part of the instrument settings, a reference to this list is saved, not the list itself.

This approach ensures that the created files contain only relevant information and allows you to transfer instrument settings even between different equipped signal generators. During the recall process, the instrument interprets only the relevant settings; all non-referenced parameters are set to their preset values. Error messages indicate the settings which cannot be implemented, like referencing non-existing lists or the attempt to activate settings which are not supported by the instrument.

10.2 Restoring an instrument configuration

The R&S SF100A has various options to set default settings. You can preset the R&S SF100A to an initial state at any time as a known starting point for configurations. It is often useful as a first step during troubleshooting when unusual results arise.

Overview of the characteristics of the preset functions

Select the preset option that most fits to your particular application:



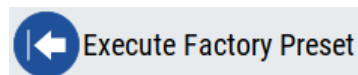
- [Preset]
It is the most frequent function. A preset executes a defined instrument setup to provide an initial instrument state as a basis for a new configuration. It resets all parameters and switching states including the states of inactive operating modes. Also, it resets external instruments connected to the R&S SFI100A. A preset does not change network settings, remote access settings or system settings.
- To execute a preset, press the [Preset] key at the front panel.



- "Set to Default"
This function relates to individual dialogs or tabs and resets the associated settings of the corresponding dialog. All other settings are retained.
- To reset the settings, click "Set To Default".



- "Preset this parameter"
Sets a single parameter to its default value.
1. To reset an individual parameter, open its context-sensitive menu.
 2. Select "Preset This Parameter".



- "Factory Preset"
A factory preset is the most profound preset function that resets almost all instrument settings, including reference oscillator, network and remote access settings. A factory preset does not change the following settings:
 - Security, password, and settings protected by these passwords
 - User-defined data, like setups or data lists
 - Settings that relate to an integration of the instrument in a measurement setup.
- **NOTICE!** Execute a "Factory Preset" only if it is necessary. After a "Factory Preset", the network connection to the instrument no longer exists. To restore the factory defaults, select "System Config" > "Setup" > "Settings" > "Factory Preset". See ["Execute Factory Preset"](#) on page 276.

Presetting the instrument to a user-defined state

The reset functions set the parameters and operating modes to default values predefined by the factory. Alternatively to these default settings, you can:

Alternatively to recalling the instrument default settings, you can preset the instrument to a user-defined state as follows:

- Restore user-specific settings after a preset, see [Chapter 10.2.3, "Presetting the instrument to a user-defined state"](#), on page 276.
- Save and reload user-defined instrument states, see [Chapter 10.4.2, "Saving and recalling instrument settings"](#), on page 281.

Marking parameters with non-default values

To check the current state of the settings concerning default values, the R&S SF100A offers a feature that visually identifies deviations from the default values.

For more information, see [Chapter 10.2.2, "Identifying parameters with non-default values"](#), on page 276.

10.2.1 Preset, set to default and factory preset settings

Preset	275
Set To Default	275
Preset this Parameter	275
Execute Factory Preset	276

Preset

Resets all parameters and switching states, and closes all opened dialogs.

Note:

In contrast to the [Preset] key, the SCPI commands `*RST` and `:SYSTEM:PRESet` do not close open dialogs in the GUI.

Consider also the following possibilities:

- You can define the settings that are restored when you preset the instrument (see [Chapter 10.2.3, "Presetting the instrument to a user-defined state"](#), on page 276)
- You can reset the instrument to the factory state (see ["Execute Factory Preset"](#) on page 276)

See also [Table 10-1](#) that contains the key parameters that are reset by the corresponding preset functions.

Remote command:

`*RST` on page 409

Set To Default

Resets the associated settings of the corresponding dialog or tab.

Preset this Parameter

Restores the default value of a single parameter.

Execute Factory Preset

Resets the instrument to its factory settings.

Note: "Factory Preset" retains all security settings and does not delete any user files like setups or user data.

See also [Table 10-1](#) that contains the key parameters that are reset by the corresponding preset functions.

Remote command:

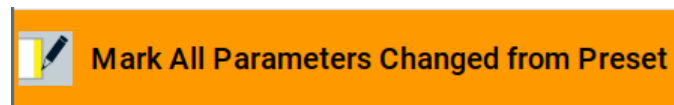
:SYSTem:FPReset on page 412

10.2.2 Identifying parameters with non-default values

To recognize the current state of the settings related to their default values at the first glance, enable a function that visually identifies parameters in states different than preset.

To enable this display:

1. To open the context-sensitive menu, touch and hold the screen anywhere in the GUI of the R&S SF1100A.
2. Select "Mark All Parameters Changed from Preset".



If enabled, marks the parameters that deviate from their default values.

Example:

Frequency	19.500 000 000 000 GHz
Offset	0.000 Hz

Figure 10-1: Marked parameters show that the value deviates from its default

Frequency	= changed (default = 1 GHz)
Offset	= changed (default = 0 kHz)
Multiplier	= unchanged
Variation active	= changed (default = disabled)
Variation step	= unchanged

10.2.3 Presetting the instrument to a user-defined state

You can define the settings that are restored when you preset the instrument.

1. Configure the settings as required.

2. Save them as described in [Chapter 10.4.2, "Saving and recalling instrument settings"](#), on page 281:

- a) Save the settings as a file with the predefined filename

`UserPreset.savrcltxt.`

- b) Save this file in the directory `/var/user/`.

The filename `UserPreset.savrcltxt` and the directory `/var/user/` are mandatory.

3. Press the [Preset] key.

When operating the instrument remotely, send the `*RST` command.

The instrument restores these user-defined settings. An "Info" message appears and confirms loading of a file with user-defined preset settings.

10.2.4 Reference

See [Table 10-1](#) for an overview of the main generator settings that are affected by the corresponding preset functions. While the regular [Preset] key primarily resets the signal relevant parameters of the instrument, the "Factory Preset" affects almost all instrument settings.

For information on the default values of further parameters, see the description of the corresponding remote commands.

Table 10-1: Key parameters affected by preset and factory preset

Parameter	Preset value	Preset	Factory Preset
RF frequency	1 GHz	x	x
RF level (RF output)	off	x	x
Offsets	0	x	x
Modulation state	off	x	x
Reference frequency settings	-	-	x
Network settings	-	-	x
Hostname	-	-	x
Start or stop display update	-	-	x
Display and keyboard settings	-	-	x
Password and password-protected settings	-	-	-
Security settings	-	-	-
User files (setups, user correction, etc.)	-	-	-

10.3 Protecting data

During operation, the R&S SF100A saves user data permanently in the user directory, see ["File storage location"](#) on page 272.

To protect any classified data and to avoid saving any sensitive data on the R&S SF100A permanently, you have the following options:

- Activate the **volatile mode**. This mode redirects user data to the volatile memory, see ["Volatile Mode"](#) on page 323.
The internal memory is write-protected.
Once you power off the instrument for at least five minutes, all volatile memory modules lose their contents.
To avoid losing this data, connect an **external memory device**, for example, a USB flash drive.
See also:
 - ["Default storage location"](#) on page 272
 - ["Volatile Mode"](#) on page 323
 - [Chapter 10.8.4, "Using a USB storage device for file transfer"](#), on page 293
- Save user files **temporarily in the `/var/volatile` directory**, which remains available only until the instrument is turned off.
You can access data in the volatile memory just as data that is saved permanently in the `/var/user/`.
See also [Chapter 10.7.3, "Displaying all saved files"](#), on page 287.

For detailed information on how to protect the instrument and to protect sensitive data from unauthorized access, refer to the document Instrument Security Procedures.

10.4 Saving and recalling settings

You can save and recall instrument settings, user settings and other related data for the following use cases:

- Reload or repeat a specific signal generation task on the instrument.
- Transfer a specific configuration of your instrument to another instrument, for example in multi-instrument setups.
- Save or load complete instrument settings to or from a file.

Save or recall the complete instrument settings

Two different methods are available for managing *complete instrument settings*:

- Immediate (quick) Save/Recall
A defined set of instrument settings are saved or recalled quickly in just one step, without defining a filename or storage location. This function enables a fast switching between different instrument settings.
- Save/Recall in files with user-defined names
The defined set of instrument settings are saved to a definable storage location. The file extension is `*.savrc1txt`.

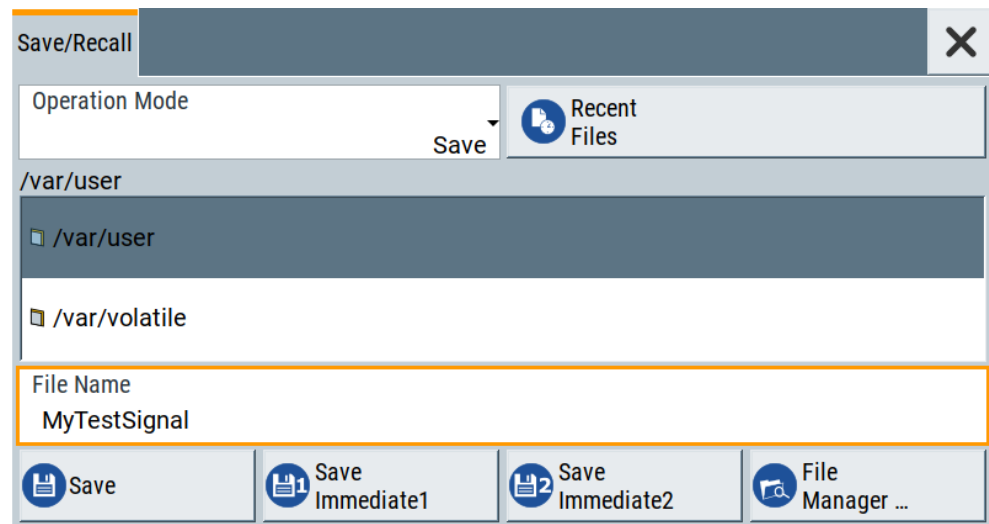
Settings files created in this way are visible in the file system and accessible with the supported methods for file handling.

In the general case, a recall process replaces the instruments settings with the saved values. An exception is the frequency and level settings. During recall of the instrument settings, it is possible to retain the current settings or to overwrite them with the saved values.

10.4.1 Save/Recall settings

Access:

1. Press the [Save/Recall] key.
2. Select "Operation Mode" > "Save" or "Recall" to open the corresponding settings.



The settings for both operation modes are similar and related.

Settings:

Operation Mode.....	280
Directory, File List and Filename.....	280
Recent files.....	280
Show SCPI List.....	280
SCPI List.....	280
Save.....	280
Save Immediate x.....	280
Exclude Frequency.....	281
Exclude Level.....	281
Recall.....	281
Recall Immediate x.....	281
File Manager.....	281

Operation Mode

Accesses the settings for storing ("Save") and loading ("Recall") of the instrument settings. Also, you can import SCPI-Files ("SCPI-Import") or export SCPI files ("SCPI-Export").

See [Chapter 10.6, "Exporting and importing remote command lists"](#), on page 284.

Directory, File List and Filename**Note:**

You access this generic standard function each time you perform one of the following:

- Save or load (settings) files
- Define a folder in that these files are saved
- Navigate through the file system.

The dialog name changes depending on the context. The provided functions are self-explanatory and similar.

Use the settings for example as follows:

- To navigate through the file system, use the directory tree.
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see [Chapter 10.7, "Using the file manager"](#), on page 284).

Remote command:

To list all files in a directory:

`:MMEMory:CDIRectory` on page 417

`:MMEMory:CATalog?` on page 417

Recent files

Displays the files last used.

Show SCPI List

Opens the "SCPI List", which lists the current settings of the R&S SF100A as SCPI commands.

The R&S SF100A provides this function for [Operation Mode > SCPI-Export](#).

SCPI List

Provides a list of all SCPI commands corresponding to the current instrument settings.

Save

Saves the current instrument settings under the defined filename.

Remote command:

`:MMEMory:STORe:STATe` on page 423

Save Immediate x

Stores the current instrument setting in one of the intermediate memories.

These instrument settings are retained until a different instrument setting is stored in the intermediate memory. When the instrument is switched off, the contents of the intermediate memories are retained.

Remote command:

*`SAV` on page 410

Exclude Frequency

The current frequency is retained when a stored instrument setting is loaded.

Remote command:

[\[:SOURce<hw>\]:FREQuency\[:CW|FIXed\]:RCL](#) on page 492

Exclude Level

The current level is retained when a stored instrument setting is loaded.

Remote command:

[\[:SOURce<hw>\]:POWer\[:LEVel\]\[:IMMediate\]:RCL](#) on page 512

Recall

Restores the selected configuration.

During recall, the instrument considers all related settings, for example sweeps in active state or lists. An error message indicates the settings which cannot be implemented.

Remote command:

[:MMEMory:LOAD:STATe](#) on page 421

Recall Immediate x

Loads the selected configuration from one of the intermediate memories. A message appears if no instrument configuration is stored in this memory.

Remote command:

[*RCL](#) on page 409

File Manager

Accesses the "File Manager" dialog, see [Chapter 10.7, "Using the file manager"](#), on page 284.

10.4.2 Saving and recalling instrument settings

Instrument settings can be saved to a file and loaded again later, so that you can repeat the tests with the same settings.

To access and recall instrument setups quickly

- ▶ Assign the appropriate action to the [**★**] key.
See [Chapter 11.2.4, "How to assign actions to the \[**★**\] key"](#), on page 309.

To save and recall instrument settings

1. Select "System Config" > "Setup" > "Settings" > "Save / Recall" > "Operation Mode" > "Save".
2. Select "Save Immediate 1".
The instrument saves its settings in the intermediate memory 1. The filename and the storage location cannot be changed.
3. Adapt the instrument settings as required. Select "Save Immediate 2"

4. To restore the settings, select the "Operation Mode > Recall"
5. Select "Recall Immediate 1"
The instrument is restored to the previous state.
6. Select "Recall Immediate 2" to switch to the settings saved in the second file.

To save complete instrument settings

1. Select "System Config" > "Setup" > "Settings" > "Save / Recall" > "Operation Mode" > "Save".
2. In the file selection dialog, select a filename and storage location for the settings file.
3. Select "Save".
A file with the defined name and path and the extension *.savrc1.txt is created.

To restore an instrument configuration

Save the configuration as described in ["To save complete instrument settings"](#) on page 282.

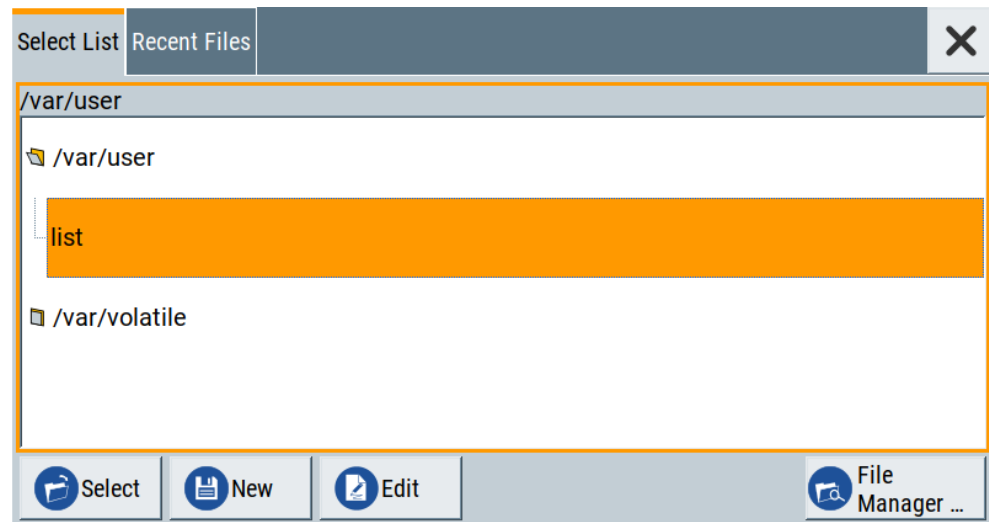
1. To restore settings, select "System Config" > "Setup" > "Settings" > "Save / Recall" > "Operation Mode > Recall".
2. To retain the current frequency and level settings, enable "Save"/"Recall" > "Exclude Frequency"/"Exclude Level",
3. In the file select dialog, select the filename and storage location of the settings file.
The settings are restored, but the frequency and level settings are retained. You can repeat the signal generation with the same settings.
See also [Chapter 10.2.3, "Presetting the instrument to a user-defined state"](#), on page 276.

10.5 Managing files with user data

For loading waveform files or applying user correction values, use dedicated files. Whenever your setup requires these files, use the standard "File Select" function. This function enables you to select, create and edit these files.

To use the file-select settings

1. For example, select "Baseband" > "ARB" > "General" > "Load Waveform ...".
A file select dialog opens for loading, creating and modifying a file.



The name of the dialog can be different but the provided functions are equal. See also [Chapter 4.3.4.2, "Loading and playing waveform files"](#), on page 84.

2. To load a file, proceed as follows:
 - a) Navigate through the file system.
 - b) Select the file.
 - c) Confirm with "Select".
3. To create a file, proceed as follows:
 - a) Navigate through the file system.
 - b) Select "New".
 - c) Enter the filename.

The instrument saves the created file into the selected folder.

4. To edit a file, proceed as follows:
 - a) Navigate through the file system.
 - b) Select the file.
 - c) Select "Edit".
 - d) Edit the file content.
 - e) Confirm with "Save".

Settings:

Directory, File List and Filename	283
Recent files	284
File Manager	284

Directory, File List and Filename

Note:

You access this generic standard function each time you perform one of the following:

- Save or load (settings) files
- Define a folder in that these files are saved
- Navigate through the file system.

The dialog name changes depending on the context. The provided functions are self-explanatory and similar.

Use the settings for example as follows:

- To navigate through the file system, use the directory tree.
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see [Chapter 10.7, "Using the file manager"](#), on page 284).

Remote command:

To list all files in a directory:

`:MMEMory:CDIRectory` on page 417

`:MMEMory:CATalog?` on page 417

Recent files

Displays the files last used.

File Manager

Accesses the "File Manager" dialog, see [Chapter 10.7, "Using the file manager"](#), on page 284.

10.6 Exporting and importing remote command lists

To set specific instrument settings or perform tasks automatically, you can create scripts or import scripts that contain the settings in the form of remote control command sequences.

The R&S SF100A also offers a SCPI macro recorder with code generator to record manual settings and create an executable script.

Completed scripts are saved in files and possibly converted to different formats, depending on the language of the source code.

The R&S SF100A supports the following commonly used languages:

- Plain SCPI: *.txt
- MATLAB: *.m
- NICVI: *.c
- Python: *.py

It is also possible to convert the SCPI command list to a user-specific language.

How to: [Chapter 12.9, "Using remote command scripts"](#), on page 385.

10.7 Using the file manager

The "File Manager" is a tool similar to a standard Windows Explorer. It helps you manage mass storage media and files saved on the R&S SF100A.

You can perform the following tasks:

- Copying multiple files from disk to other media
See [Chapter 10.8, "Transferring files from and to the instrument"](#), on page 289
- Copying files into another directory
See [Cut, Copy&Paste and Delete](#)
- Renaming and deleting files
- Creating directories
See [Create New Directory](#)
- Mapping shared network folders
See [Chapter 10.7.4, "Mapping a network folder"](#), on page 288
- Displaying saved files
See [Chapter 10.7.3, "Displaying all saved files"](#), on page 287

10.7.1 File manager settings

Access:

- ▶ Select "System Config" > "Setup" > "Settings" > "Save / Recall" > "File Manager".

Tip: Each "Save/Recall" dialog and each "File Select" dialog provides a quick access to the "File Manger".

The "File Manager" dialog provides all standard functions required for file management. It displays the contents of the selected folder on the R&S SFI100A and provides functions to rename, delete, copy, or move individual files.

Settings:

Map Network Share	285
File Type	285
Directory and Filename	285
Cut, Copy&Paste and Delete	286
Rename	286
Create New Directory	286

Map Network Share

Opens a dialog where you can map one or more network folders. See [Chapter 10.7.2, "Map network share settings"](#), on page 286.

See also [Chapter 10.7.4, "Mapping a network folder"](#), on page 288.

File Type

Selects the file type to be listed. If a file type with a specific file extension is selected, only files with this extension are listed.

Directory and Filename

Selects the directory in which the file to be deleted or copied is located. The dialog lists all files in this directory. Selected files are highlighted. The path is indicated above the directory tree.

Unlike the "Save/Recall" and "File Select" dialogs, the "File Manager" displays the full filenames including extensions.

Remote command:

[:MMEMory:CDIRectory](#) on page 417

Cut, Copy&Paste and Delete

Standard file management functions.

Before a file is deleted, you have to confirm the delete operation.

Remote command:

[:MMEMory:DELeTe](#) on page 421

[:MMEMory:COpy](#) on page 417

Rename

Renames the selected file or directory.

Remote command:

[:MMEMory:MOVE](#) on page 422

Create New Directory

Creates a folder and opens an edit dialog box to enter name and path (absolute or relative to the current directory) of the new folder.

Remote command:

[:MMEMory:MDIRectory](#) on page 421

10.7.2 Map network share settings

Access:

- ▶ Select "System Config" > "Setup" > "Settings" > "Save / Recall" > "File Manager" > "Map Network Share".

The "Map Network Share" dialog provides settings that are similar to the standard Windows Explorer function "Map network drive". These settings help you to create up to 10 "shortcuts" to shared folders or computers in the network.

The dialog displays a list of current mapped network folders. The directory tree of the "File Manager", "Save/Recall", and "File Select" dialogs indicate a mapped network folder as /shares/<"Local Folder">.

See also [Chapter 10.7.4, "Mapping a network folder"](#), on page 288.

Settings:

Network Folder	287
Local Folder	287
User Name	287
Password	287
Reconnect at Startup	287

Connect.....	287
Change.....	287
Disconnect.....	287

Network Folder

Enter the path of the folder or computer, e.g. `//<IP Address>/user` or `//<server name>/user`.

Local Folder

Enter a letter or an alias name to describe the folder.

In the directory tree, a mapped network folder is indicated as `/shares/<"Local Folder">`.

User Name

Enter a user name of a user that has the permission to access the selected network folder.

Password

Enter the user password of the selected user.

Reconnect at Startup

Enables reconnecting every time you start up the instrument.

Connect

Triggers the instrument to prove the credential and to map (i.e. connect) the selected network folder or computer to the instrument.

You can map up to 10 network folders.

Change

Applies the changes.

Disconnect

Disconnects the network drive.

10.7.3 Displaying all saved files**To display all files on the internal memory**

1. Select "System Config" > "Setup" > "Settings" > "Save / Recall" > "File Manager".
2. Navigate to `/var/user/`.

To display all files on a connected USB flash drive

1. Select "System Config" > "Setup" > "Settings" > "Save / Recall" > "File Manager".
2. Navigate to `/usb/`.

To display all files in the volatile memory

1. Select "System Config" > "Setup" > "Settings" > "Save / Recall" > "File Manager".
2. Navigate to `/var/volatile/`.

10.7.4 Mapping a network folder

Possibly you would like to transfer instrument or user settings to another R&S SF100A, distribute waveform files to several instruments or you have to access frequently the same network drive. In these cases, on a R&S SF100A connected to a LAN you can create a shortcut to this network folder or this computer.

How to: [Chapter 3.1.7, "Connecting to LAN"](#), on page 19

To map a network folder, proceed as follows:

1. On the computer or the network folder you want to map, enable remote access. You can specify a list of users allowed for remote access.
Note: The remote access settings depend on the operating system the remote computer is using. For step-by-step instructions, refer to the documentation of the particular operating system.
2. On the R&S SF100A, [enable file transfer via SMB \(samba\)](#).
3. Select "System Config" > "Setup" > "Remote Access" > "Network" to configure the following network settings:
 - a) Select "Address Mode" > "Auto (DHCP)".
 - b) Check that the "DNS Suffix" and "DNS Server" are correct.
4. In the "Save/Recall" dialog, select "File Manager" > "Map Network Share".
5. In the "Map Network Share" dialog, select:
 - a) In the "Network Folder" field, enter `//<IP Address>/user` or `//<Server Name>/user`.
 - b) In the "Local Folder" field, enter an alias name, e.g. *setups*.
 - c) Enter the "User Name" and "Password" of a user with a remote access permission to the selected network folder.
 - d) If necessary, enable "Reconnect at Startup".
 - e) Select "Connect".

The selected network folder is mapped to your instrument. The list of mapped network folders is updated.

6. Close the "Map Network Share" dialog.

The navigation tree in the "File Manager" dialog displays the mapped network folder as `/shares/Setups`.



If the connection does not succeed, consider to check the following:

- Is the network folder or computer you try to map turned on?
- Is the network folder or computer enabled for remote access?
- Does the selected user name have the necessary permissions?

See also [Chapter 10.8.5, "Using a file server for test files exchange"](#), on page 294.

10.8 Transferring files from and to the instrument

As explained in ["File handling"](#) on page 272, you access the file system of the R&S SF1100A via one of the following ways:

- Via the built-in "File Manager"
See [Chapter 10.7, "Using the file manager"](#), on page 284.
- On an instrument connected to a LAN:
 - Via one of the standard functions FTP or SMB (samba)
See [Chapter 10.8.2, "Accessing the file system using FTP"](#), on page 291 and [Chapter 10.8.3, "Accessing the R&S SF1100A file system using SMB \(Samba\)"](#), on page 292
 - Via mapped network drives
See [Chapter 10.7.4, "Mapping a network folder"](#), on page 288.
- Via a connected USB storage device
See [Chapter 10.8.4, "Using a USB storage device for file transfer"](#), on page 293

Mainly because of security reasons, the access to the file system of your R&S SF1100A can be denied, because one or all these access methods are deliberately disabled. Access to the file system via LAN and/or USB requires that the corresponding service is enabled and a write access to the file system is enabled. Refer to [Chapter 10.8.1, "Removing file system protection"](#), on page 289 for description of the required steps.

This section provides an introduction to the topic. For comprehensive information, refer to the application note [1GP72: Connectivity of Rohde&Schwarz Signal Generators](#).

- [Removing file system protection](#)..... 289
- [Accessing the file system using FTP](#)..... 291
- [Accessing the R&S SF1100A file system using SMB \(Samba\)](#)..... 292
- [Using a USB storage device for file transfer](#)..... 293
- [Using a file server for test files exchange](#)..... 294

10.8.1 Removing file system protection

Before you try to access the file system via FTP, SMB (samba) or USB, fulfill the following:

- Disable write protection on the file system
- Enable the corresponding service or interface

To enable write permission on the file system

1. Select "System Config" > "Setup" > "Security" > "Security".
2. Select "General" > "Disk & Memory".
3. Enable "Volatile Mode".
4. Enter the "Security Password".
The default password is 123456. For more information, see [Chapter 11.4, "Using the security settings"](#), on page 319.
The R&S SFI100A requests a reboot.
5. Confirm the request.
The system reboots. The enabled settings are active.

To enable file transfer over FTP

1. Select "System Config" > "Setup" > "Security" > "Security".
2. Select "LAN Services" > "Common Services" > "LAN" > "On".
3. Enable "FTP"
4. Enter the "Security Password".
The default password is 123456. For more information, refer to [Chapter 11.4, "Using the security settings"](#), on page 319.
5. Select "Accept".

To enable file transfer over SMB (samba)

1. Select "System Config > Setup > Security > Security > LAN Services"
2. Enable "LAN Interface"
3. Select "Samba Services".
4. Enable the "SMB 1.0/2.0 Client".
5. Enable the "SMB 1.0/2.0 Server".
6. Enter the "Security Password".
The default password is 123456. For more information, see [Chapter 11.4, "Using the security settings"](#), on page 319.
7. Select "Accept".

To enable file transfer over USB

1. Select "System Config > Setup > Security > Security > General"
2. Select "Disk & Memory".
3. Enable "USB Storage"
4. Enter the "Security Password".

The default password is `123456`. For more information, see [Chapter 11.4, "Using the security settings"](#), on page 319.

5. Select "Accept".

10.8.2 Accessing the file system using FTP

If the R&S SF100A is connected to a LAN, you can use file transfer protocol (FTP) to access the file system and to transfer files from and to the instrument.

How to: [Chapter 3.1.7, "Connecting to LAN"](#), on page 19

To access the file system over FTP

We assume that the instrument and the remote PC are connected to a LAN.

1. [Enable file transfer via FTP](#)
2. [Enable write permission on the file system](#)
3. On the remote PC, start the Windows Explorer.
4. In the address field, enter `ftp://<"IP Address" of the Instrument>`, e.g. `ftp://10.124.0.166`.

Tip: The R&S SF100A indicates its IP address on the block diagram.

A log-on dialog opens and requests a password.

The default user name and password is *instrument*.

Tip:

Default password

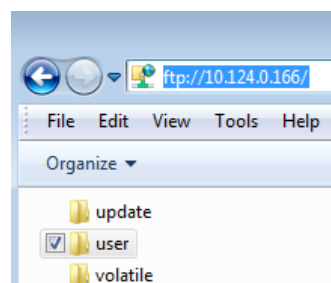
The FTP and SAMBA file access use the user "instrument" with default password "instrument".

We recommend that you change this password in the "Setup > Security > Password Management > Change User Password" dialog before connecting the instrument to the network.

See [Chapter 11.4.4, "Password management"](#), on page 330.

5. Enter the password to access the `user` directory.

The `user` directory corresponds to the `/var/user/` directory of the instrument.

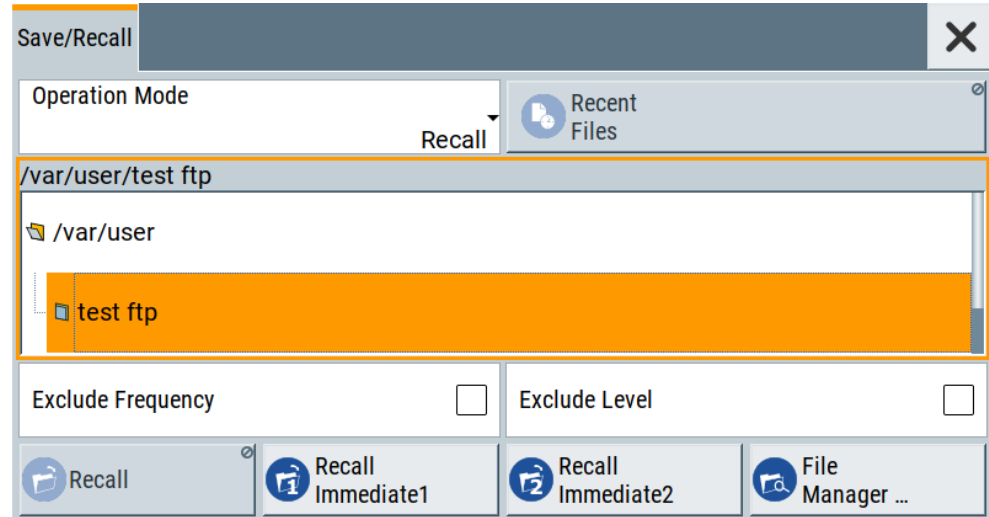


There, you can perform standard functions like creating directory, or saving files.

6. In the `user` directory, create a directory, e.g. `test ftp`.

7. Select "System Config" > "Setup" > "Settings" > "Save / Recall".
Open the `/var/user/` directory.

The dialog displays the `/var/user/test ftp` directory.



10.8.3 Accessing the R&S SFI100A file system using SMB (Samba)

The SMB (Samba) protocol is an alternative way to access the file system of the instrument from a remote PC. This protocol works if both the instrument and the PC are connected to a LAN.

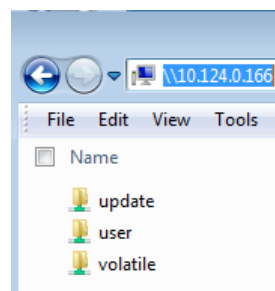
How to: [Chapter 3.1.7, "Connecting to LAN"](#), on page 19

To access the file system over SMB

We assume that the instrument and the remote PC are connected to a LAN.

1. [Enable file transfer via FTP](#)
2. [Enable write permission on the file system](#)
3. On the remote PC, start the Windows Explorer.
4. In the address field, enter `\\<"IP Address" of the Instrument>`, e.g. `ftp://10.124.0.166`.

Tip: The R&S SFI100A indicates its IP address on the block diagram.



The `user` directory corresponds to the `/var/user/` directory of the instrument; the `volatile` directory - to the `/var/volatile` directory.

To map the R&S SFI100A as a network drive to the remote PC

We assume that the instrument and the remote PC are connected to a LAN.

1. [Enable file transfer via SMB \(Samba\)](#)
2. [Enable write permission on the file system](#)
3. On the remote PC, start the Windows Explorer.
Open the "Map Network Drive" dialog.
 - a) Select a valid "Drive", e.g. *W*.
 - b) In the "Folder" field, enter `//<"IP Address" of the Instrument>/user` or `//<"Hostname" of the Instrument>/user`
For example: `//10.124.0.166/user` or `//SFI100A-102030/user`.
Tip: The R&S SFI100A indicates its IP address on the screen.
 - c) Select "Finish".

A log-on dialog opens and requests a user name and a password.

Tip:

Default password

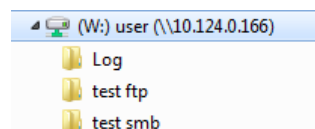
The FTP and SAMBA file access use the user "instrument" with default password "instrument".

We recommend that you change this password in the "Setup > Security > Password Management > Change User Password" dialog before connecting the instrument to the network.

See [Chapter 11.4.4, "Password management"](#), on page 330.

4. Enter the user name and the password of your instrument.

The `/var/user/` directory of the instrument is mapped to and displayed as a network drive of the remote PC.



You can access the files in the `/var/user/` directory, perform standard function like creating directory, or saving files.

10.8.4 Using a USB storage device for file transfer

Alternatively to the file transfer possibility via LAN, you can use a USB storage device for direct file transfer from and to the instrument.

We recommend that you transfer files with user data (like lists or instrument setup files) to the instrument, rather than load and play them from a connected USB storage device.

To transfer a file with user data to the instrument

1. Connect a USB storage device, for example a USB memory stick to one of the USB interfaces of the instrument.
The R&S SF100A recognizes the connected USB storage device automatically.
2. [Enable file transfer via USB](#)
3. [Enable write permission on the file system](#)
4. Select "System Config" > "Setup" > "Settings" > "Save / Recall".
The dialog displays the `/var/user/` directory and the `/usb/` drive.
5. In the "Save/Recall" dialog, select "File Manager".
6. In the directory tree, navigate to the `/usb/` drive.
Select the required file with user data.
7. Select "Copy".
8. In the directory tree, navigate to the `/var/user/` directory.
Select "Paste".
The file with user data is transferred to the instrument.

10.8.5 Using a file server for test files exchange

You can use a central file storage location like a file server in your company network to save setup files, SCPI scripts, application programs, or waveform files on it. Usually, you would like to distribute the files to several instruments. If the R&S SF100As are connected to a LAN, you can create a shortcut on the instruments to the file server.

To access the file server

1. On each R&S SF100A, map the required directory of the file server to the instrument.
Perform the steps described in [Chapter 10.7.4, "Mapping a network folder"](#), on page 288.
2. On each R&S SF100A, use the same alias name for the directory of the file server, i.e. enter the same "Local Folder" (in this example `Setups`).

On any of the R&S SF100A, you access the file server directly from the "File Manager" and under the same name, e.g. `/shares/Setups`.

An extra advantage in remote control is that the same application program would control the instruments.

For example, use the remote control command `MMEORY:CDIRECTORY "/shares/Setups"` to set the default directory for mass storage.

10.9 Creating screenshots of current settings

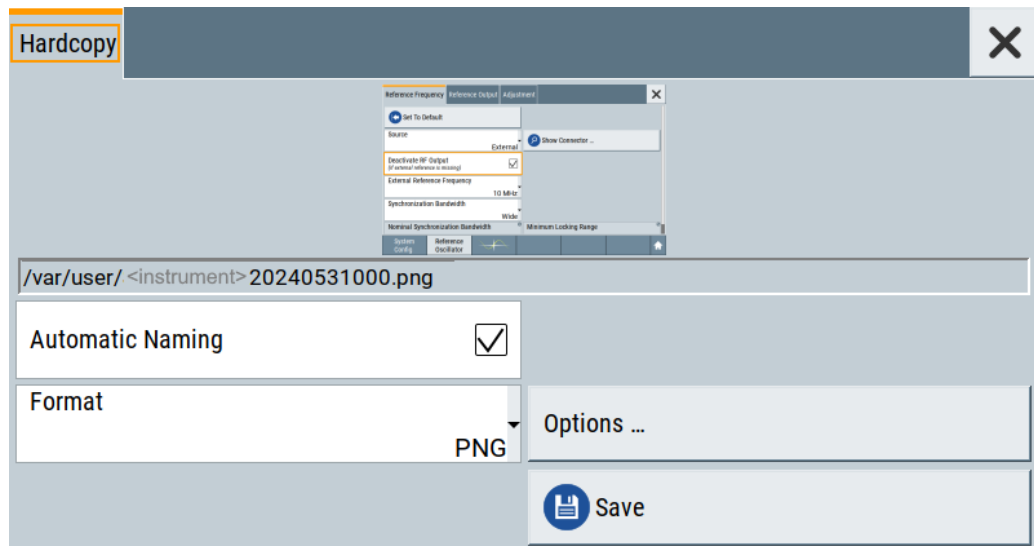
The save/recall function enables you to save current settings in a file. To document the most important settings for a performed signal generation, you can also save a hardcopy of the current display.

- [Hardcopy settings](#)..... 295
- [Creating a hardcopy of the display](#).....298

10.9.1 Hardcopy settings

Access:

- ▶ Select "System Config" > "Setup" > "User Interface" > "Hardcopy".



The remote commands required to define these settings are described in [Chapter 13.10, "HCOPY subsystem"](#), on page 436.

Settings:

Automatic Naming	296
File	296
Format	296
Options	296
Save	296
Hardcopy Options > Common	296
L Automatic Naming	297
L Format	297
L Region	297
Hardcopy Options > Automatic Naming	297
L Path	297

L Clear Path.....	298
L Prefix, Year, Month, Day.....	298
L Current Auto Number.....	298

Automatic Naming

If enabled, creates the output filenames automatically according to the rules set with the [Hardcopy Options > Automatic Naming](#) settings.

Remote command:

:HCOPY:FILE[:NAME]:AUTO:STATE on page 440

File...

In "Automatic Naming > Off" mode, accesses the standard file select dialog for selecting the filename and folder the hardcopy is stored in.

If you have enabled "Automatic Naming", the instrument displays the automatically generated filename.

Remote command:

:HCOPY:FILE[:NAME] on page 438

Format

Selects the output file format, for example *.bmp, *.jpg*.xpm and *.png.

Remote command:

:HCOPY:IMAGE:FORMAT on page 438

:HCOPY:DEVICE:LANGUAGE on page 438

Options...

Accesses [Hardcopy Options](#) dialog.

Save

Saves a hardcopy of the current display as a file.

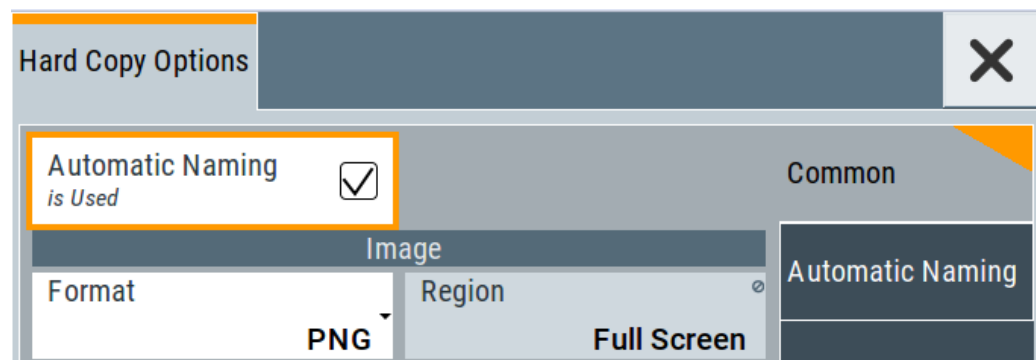
Remote command:

:HCOPY[:EXECute] on page 439

Hardcopy Options > Common

Access: select "Hardcopy > Options... > Common".

With the provided settings, you can customize the file format and the syntax of the automatically assigned filename.



Automatic Naming ← **Hardcopy Options** > **Common**

If enabled, creates the output filenames automatically according to the rules set with the [Hardcopy Options > Automatic Naming](#) settings.

Remote command:

[:HCOPY:FILE\[:NAME\]:AUTO:STATE](#) on page 440

Format ← **Hardcopy Options** > **Common**

Selects the output file format, for example *.bmp, *.jpg*.xpm and *.png.

Remote command:

[:HCOPY:IMAGE:FORMAT](#) on page 438

[:HCOPY:DEVICE:LANGUAGE](#) on page 438

Region ← **Hardcopy Options** > **Common**

Displays the snapshot area.

Remote command:

[:HCOPY:REGION](#) on page 438

Hardcopy Options > Automatic Naming

Access: select "Hardcopy > Options... > Automatic Naming".

Hardcopy Options

Common Automatic Naming

Path ... /var/user

Delete All Image Files In Path Clear Path

Prefix <instrument>

Year Month Day

Current Auto Number 000

Resulting File Name <instrument>20240611000.png

Provided are the following settings:

Path... ← **Hardcopy Options** > **Automatic Naming**

Selects the directory.

Note: To select the destination path, specify also a filename. Otherwise an error message is displayed and selection is canceled.

Remote command:

[:HCOPY:FILE\[:NAME\]:AUTO:DIRectory](#) on page 439

Clear Path ← Hardcopy Options > Automatic Naming

Deletes all image files with extensions *.bmp, *.jpg, *.png and *.xmp in the directory set for automatic naming.

Before the command is executed, a warning message prompts you to confirm the deletion of the files.

Remote command:

`:HCOPY:FILE[:NAME]:AUTO:DIRectory:CLEar` on page 440

Prefix, Year, Month, Day ← Hardcopy Options > Automatic Naming

Determines the rules for "Automatic Naming".

Per default, the automatically generated filename is composed of:

`<Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`, where Y, M and D mean year, month, Day; Number is the [Current Auto Number](#).

You can activate or deactivate each component separately.

The "Resulting filename" indicates the current filename syntax.

Remote command:

`:HCOPY:FILE[:NAME]:AUTO[:FILE]:PREFIX` on page 441

`:HCOPY:FILE[:NAME]:AUTO[:FILE]:PREFIX:STATE` on page 441

`:HCOPY:FILE[:NAME]:AUTO[:FILE]:YEAR:STATE` on page 441

`:HCOPY:FILE[:NAME]:AUTO[:FILE]:MONTH:STATE` on page 441

`:HCOPY:FILE[:NAME]:AUTO[:FILE]:DAY:STATE` on page 441

Current Auto Number ← Hardcopy Options > Automatic Naming

Indicates the number which is used in the automatically generated filename.

Note: When initially switching on the instrument, the number is reset to the lowest possible value. Starting with number 0 the output directory is scanned for existing files. As long as files with the same name are existing, the number is increased by 1. The number is automatically set so that the resulting filename is unique within the selected path. The current number is not in the save/recall file but is temporarily stored within the database. At the following save operation, the number is increased.

Remote command:


`:HCOPY:FILE[:NAME]:AUTO[:FILE]:NUMBER?` on page 441

10.9.2 Creating a hardcopy of the display

To create a hardcopy

- ▶ Select "System Config" > "Setup" > "User Interface" > "Hardcopy".

Alternatively, you can use the following controls to create a hardcopy quickly:

- On the screen, select context-sensitive menu >  (print).
- On an external keyboard, press the [Print] key.
- Assign the hardcopy function to the [User] key.

See [Chapter 11.2.4, "How to assign actions to the \[★\] key"](#), on page 309.

The R&S SF100A creates a snapshot of the screen and opens the "Hardcopy" dialog for saving it in a file.

To configure and save the hardcopy

1. To define the output format, select "Format" > "JPG".
2. To enable the instrument to create output filenames, select "Automatic Naming" > "On".
3. Select "Options ...".
4. In the "Hardcopy Options" dialog:
 - a) To change the default storage directory, select "Automatic Naming Settings" > "Path".
 - b) Define a path and a filename.
For example, select the default directory `/var/user`.
 - c) If necessary, modify the parameters in the "Automatic Naming Settings".
 - d) Close the "Hardcopy Options" dialog.
5. In the "Hardcopy" dialog, select "Save".

The instrument saves a hardcopy of the current instrument display as a `*.jpg` file. Also, creates the filename automatically.

To export a hardcopy

1. Connect the instrument to the LAN.
2. Transfer the file to a remote computer
See [Chapter 10.8, "Transferring files from and to the instrument"](#), on page 289.
3. On the remote computer, select the file.

11 General instrument functions

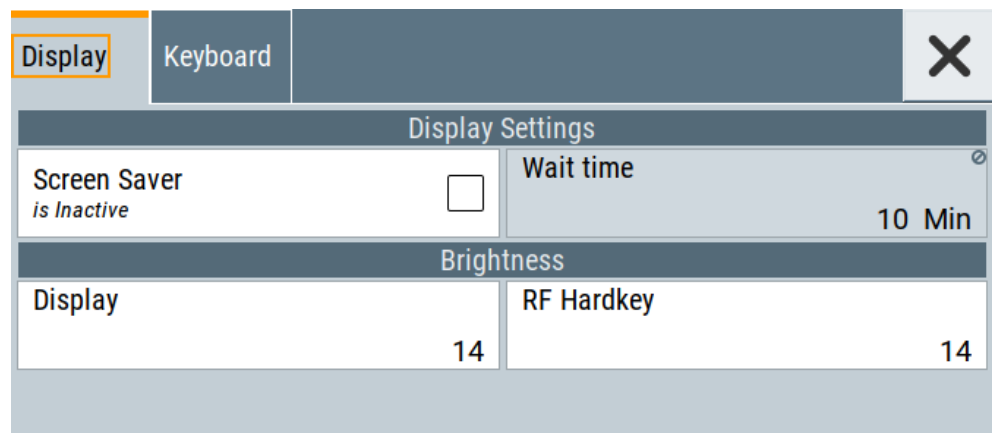
The general instrument functions include basic instrument settings, regardless of the selected operating mode and measurement. Some of these settings like screen display and peripherals are initially configured at the setup of the instrument, according to personal preferences and requirements. However, you can individually adjust the settings at any time, for example, for specific applications.

11.1 Customizing the user interface

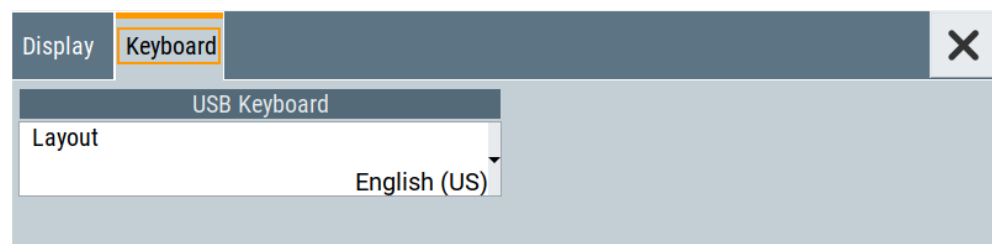
11.1.1 Display and keyboard settings

Access:

1. Select "System Config > Setup > User Interface > Display".



2. Select "Keyboard".



In the "Display" and "Keyboard" dialogs, you can enable the screen saver function and configure the language for the key assignment of an external keyboard and the keypad.

The remote commands required to configure the display and keyboard are described in [Chapter 13.8, "DISPlay subsystem"](#), on page 430 and [Chapter 13.11, "KBOard subsystem"](#), on page 442.

Screen Saver	301
Wait Time	301
Display	301
RF Hardkey	301
Layout	301

Screen Saver

Activates the screensaver.

If activated, the display including backlight is switched off after the selected [Wait Time](#) elapses and if no entries via touch panel, front panel, external mouse, or external keyboard are made

Remote command:

[:DISPlay:PSAVe\[:STATe\]](#) on page 432

Wait Time

Enters the idle time that must elapse before the display lamp is shut off when no entries are made.

Remote command:

[:DISPlay:PSAVe:HOLDoff](#) on page 431

Display

Adjusts the brightness of the display.

Increase the value to turn up the display brightness.

Remote command:

[:DISPlay:BRIGhtness](#) on page 432

RF Hardkey

Adjusts the brightness of the [RF On/Off] key.

Increase the value to change the contrast between the key and the front panel background color.

Remote command:

[:DISPlay:BUtTon:BRIGhtness](#) on page 432

Layout

Selects the language of an external keyboard connected over USB. The function assigns the corresponding keys automatically.

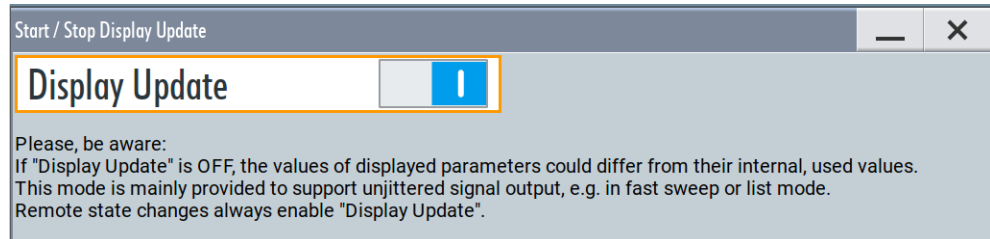
Remote command:

[:KBOard:LAYout](#) on page 442

11.1.2 Display update settings

Access:

- ▶ Select "System Config > Setup > User Interface > Start/Stop Display Update".



This dialog enables you, to deactivate updating the display.

The remote command to switch off the display update is described in [Chapter 13.8, "DISPlay subsystem"](#), on page 430.

Display Update is

Disables the automatic refreshing of the displayed values.

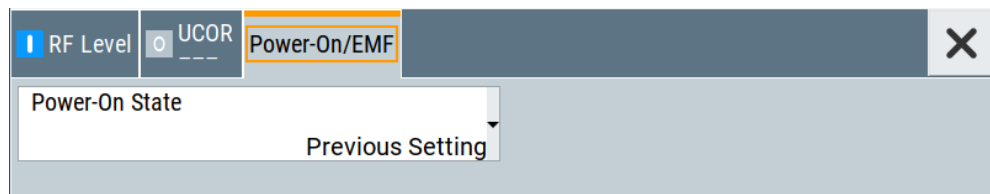
Remote command:

:DISPlay:UPDate[:STATe] on page 432

11.1.3 Power-On/EMF settings

Access:

- ▶ Select "RF" > "RF Level" > "Power-On/EMF".



The "Power-On/EMF" dialog contains the setting for configuring the power-on behavior.

[Power-On State](#).....302

Power-On State

Determines the RF signal output state when the instrument is switched on.

You can disable the RF output signal in general, or start it in the same state as it had been when it was switched off.

Remote command:

:OUTPut<hw>[:STATe]:PON on page 443

11.2 Organizing frequently used settings as favorites

The R&S SF100A provides two possibilities to define frequently used settings and procedures for later retrieval individually.

User menu and [★] key

These two functions work similar to the favorites function of a browser or other programs. They allow you to create a list of frequently used actions or to group frequently used settings in one dialog.

You can collect the parameters of your configuration in a favorites list, i.e. in the "User Menu", or define settings and actions with the [★] key:

- "User Menu" to group settings of specific tasks.
Similar to a favorites function, you can use this menu for:
 - Grouping the settings required for a task in one dialog.
 - Saving and recalling the settings of a task.
 - Transferring the settings for use on multiple instruments.
- [★] key, with customizable function.
You can perform the following steps using this key:
 - Open the "User Menu" (default functionality).
 - Add or remove settings and functions.
 - Execute actions and access functions.

Possible applications

The ★ key and the "User Menu" are useful for the following situations:

- There are functions or tasks you have to perform in a defined order but the setting parameters are distributed across several dialogs.
- There are functions or tasks you have to perform frequently but they are not accessible via the front panel keys.
- The required functions are grouped in a dialog that is not directly accessible from the block diagram.
- Your task involves loading and executing of SCPI scripts.
See [Chapter 12.9, "Using remote command scripts"](#), on page 385.
- A quick access to saved setups is required.
- There are functions and tasks you have to perform on several instruments.

Dialog identification

To identify each dialog, the instrument uses a dedicated dialog ID. The dialog ID contains the dialog position on the display and the current active tab. The action that triggers the instrument to open a dialog uses this identification.

Save/Recall vs. recall setup

If you need to restore a specific signal generation setup and perform further configurations based on this particular instrument state, the R&S SF1100A provides two options:

- "Save/Recall" function
For a detailed description, refer to [Chapter 10.4, "Saving and recalling settings"](#), on page 278.
- "Recall Setup" function
If the "Recall Setup" is the only user action assigned to the [★] key, pressing this key triggers the R&S SF1100A to load the user-defined preset file immediately.

11.2.1 User menu settings

The "User Menu" dialog contains function keys to organize, save and load a favorites list. You can also modify, add or delete list entries directly in the dialog.

Clear User Menu

Removes all entries from the "User Menu" at once.

Save User Menu

Saves the current "User Menu" under the defined filename.

Recall User Menu

Loads the selected "User Menu" file.

This function enables you to use the user specific favorites file on another instrument. However, if functions or parameters are not provided due to varying configuration of the instrument, the settings of these particular parameters take no effect.

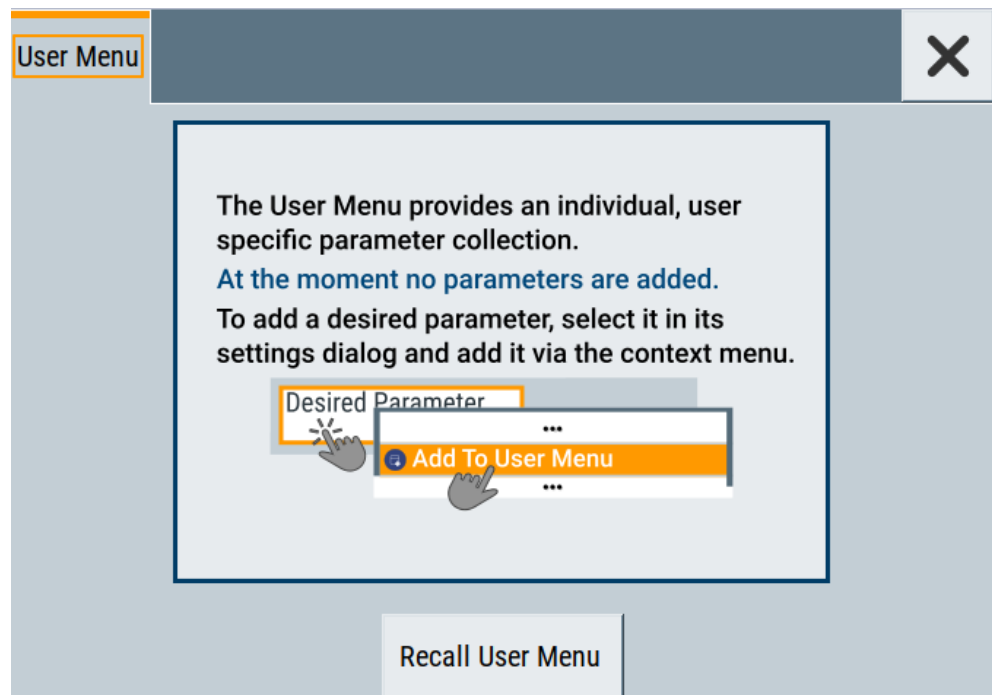
11.2.2 How to use the user menu for fast adjustments

Access:



1. Press the [★] key.

The "User Menu" dialog opens.



If you execute this action for the first time, the dialog displays instructions on how to use the "User Menu".

2. If you already have a saved user menu file on the instrument, you can load with "Recall User Menu".

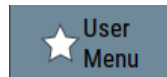
Creating a user menu

To create your own user dialog with settings:

1. Open a dialog with settings you frequently use.
2. Select a parameter.
3. Open the context menu and select "Add to User Menu".



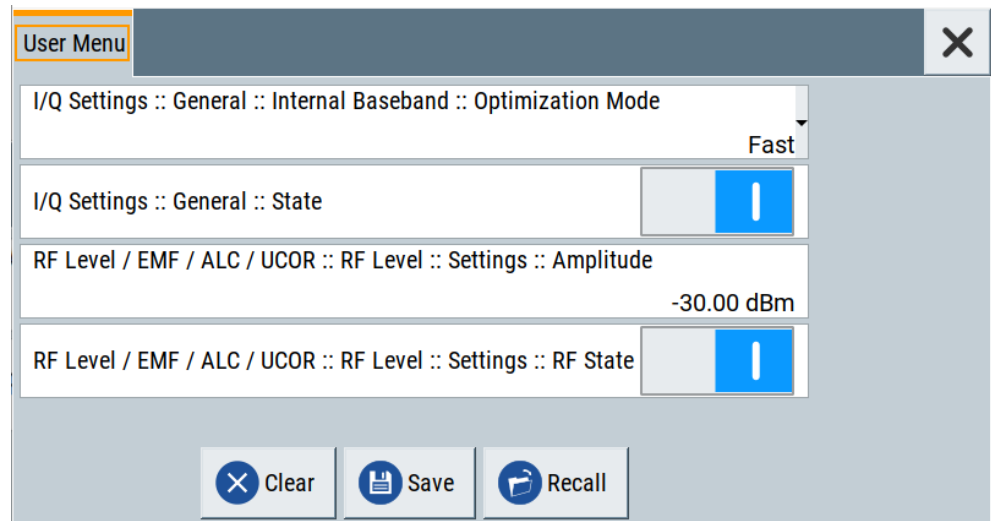
A favorites icon ★ indicates that the parameter is used in the "User Menu".



The "User Menu" button in the taskbar confirms that you have created a "User Menu" with at least one entry.

4. Press the [★] key.

The "User Menu" dialog shows all parameters that you have added to the list.



You can modify the parameter settings directly in this dialog, e.g. change a state or set values, as you do in the particular dialog the parameter originally belongs to.

5. To remove an entry, select the parameter either in the "User Menu" or in the dialog where it originally belongs to.
 - a) Open the context menu and select "Remove from User Menu".



6. To remove all entries at once, select "Clear User Menu".
7. To save your individual favorites list, select "Save User Menu", and follow the file managing instructions.
The file system automatically assigns the file extension *.user_menu.
8. To recall a previously saved user menu, select "Recall User Menu" and proceed accordingly.

Providing a user menu favorites list for several instruments

To transfer files from or to an instrument:

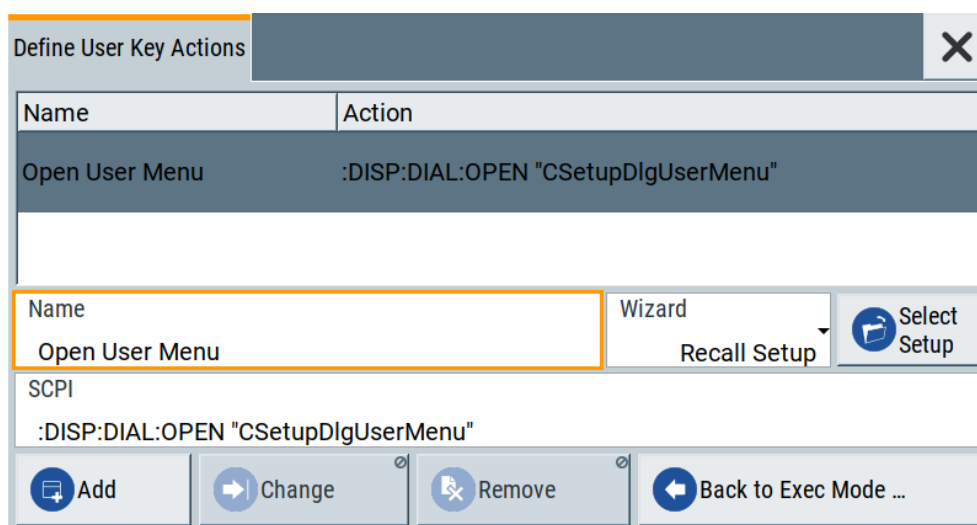
1. Create the favorites list, as described in ["Creating a user menu"](#) on page 305.
2. Save the favorites list.

- To transfer a file from or to an instrument, the R&S SF100A provides several options, see ["File handling"](#) on page 272.

11.2.3 Define user key actions settings

Access:

- ▶ Select "System Configuration > Setup > User Interface > Define User Key".



The dialog displays a list of the currently enabled actions and provides functions to define new, edit or remove existing actions. If no actions have been defined, the list is empty.

See [Chapter 11.2.4, "How to assign actions to the \[★\] key"](#), on page 309.

The remote commands required to define these settings are described in [Chapter 13.8, "DISPlay subsystem"](#), on page 430.

Name

Enters a user-defined name for the action.

Wizard

Defines the action to be executed.

"Load SCPI Script"

Selects and executes the SCPI script.

"Recall Setup"

Opens the file dialog for selecting a saved setup with user-defined settings.

"Open Dialog"

Selects an open settings dialog or menu.

Select

Depending on the selected "Wizard", provides access to:

- the standard "File Select" function for loading an SCPI script or setup file
- a list of all currently opened dialogs.
See [SCPI](#).

SCPI

For the currently selected action, displays the corresponding SCPI command with the associated parameter for dialog identification (dialog ID). The automatically displayed SCPIs are enabled for subsequent modification.

Remote command:

:DISPlay:DIALog:OPEN on page 434

See also :DISPlay:DIALog:ID? on page 434

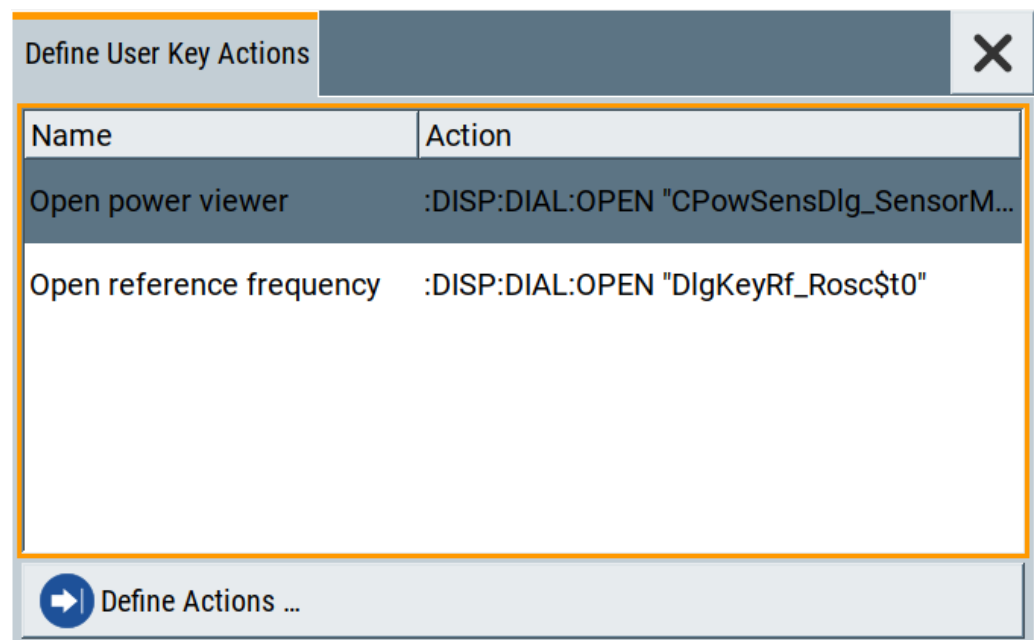
Add, Change, Remove

Standard functions for managing of the actions.

Back to Execute Mode

Opens the "Select Action to Execute" dialog. Select an Action form the list to execute it.

To return to the "Define User Key Actions" dialogs, select [Select Action to Execute > Define Actions](#).

Select Action to Execute > Define Actions

Opens the "Define User Key Actions" settings dialog.

11.2.4 How to assign actions to the [★] key

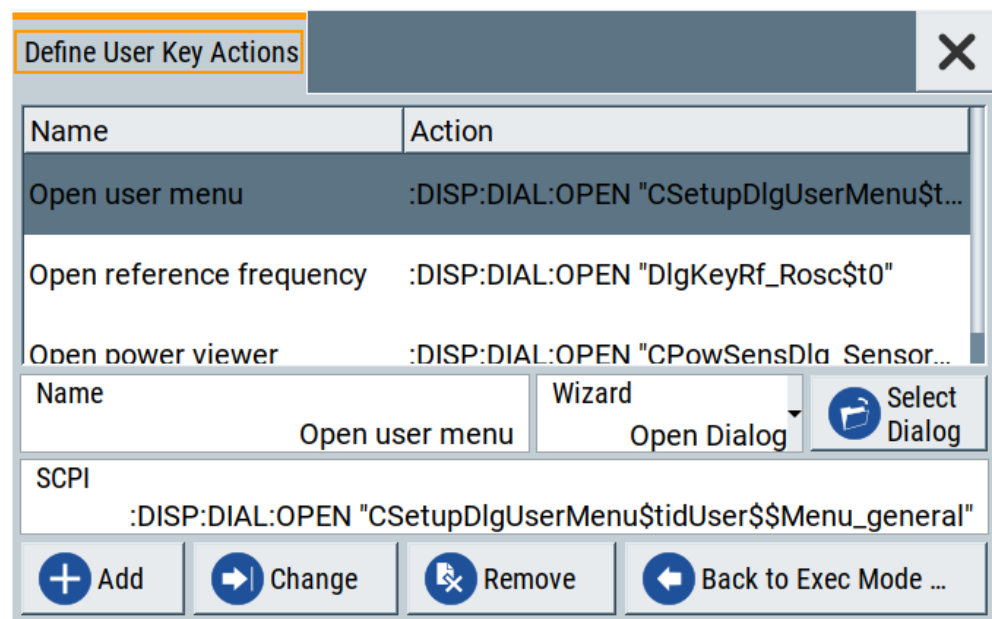
The customizable [★] key has no predefined function assigned. You can individually define actions to be executed or functions to be accessed when pressing this key.

To assign a frequently used dialog to the [★] key:

1. Open the dialog you want to quickly access.
2. Select "System Configuration > Setup > User Interface > Define User Key".
3. To create an action:
 - a) Specify the "Name".
E.g. *Open reference frequency*.
 - b) Select "Wizard > Open Dialog"
 - c) Select "Select Dialog" and select a settings dialog from the list

The corresponding SCPI command is automatically displayed and can be modified.

4. Select "Add" to save the new action in the list of user key actions.



5. To execute the created action, press ★.
In the list of actions ("Select Action to Execute" dialog), navigate to the required action.

Define User Key Actions	
Name	Action
Open user menu	:DISP:DIAL:OPEN "CSetupDlgUserMenu\$ti...
Open reference frequency	:DISP:DIAL:OPEN "DlgKeyRf_Rosc\$0"
Open power viewer	:DISP:DIAL:OPEN "CPowSensDlg_SensorM...

The R&S SF100A executes the action and opens the dialog.

11.3 Managing licenses and license keys

An option is ready to operate after it is enabled with a license keycode supplied with the option. The license key is delivered as a file or on paper. Unregistered licenses must be registered for a particular instrument before the corresponding option can be enabled for operation.



For reliable operation, a software option usually requires the latest firmware version. The required version is specified in the delivery. If your instrument works with a former firmware version, update the firmware before enabling the software option.

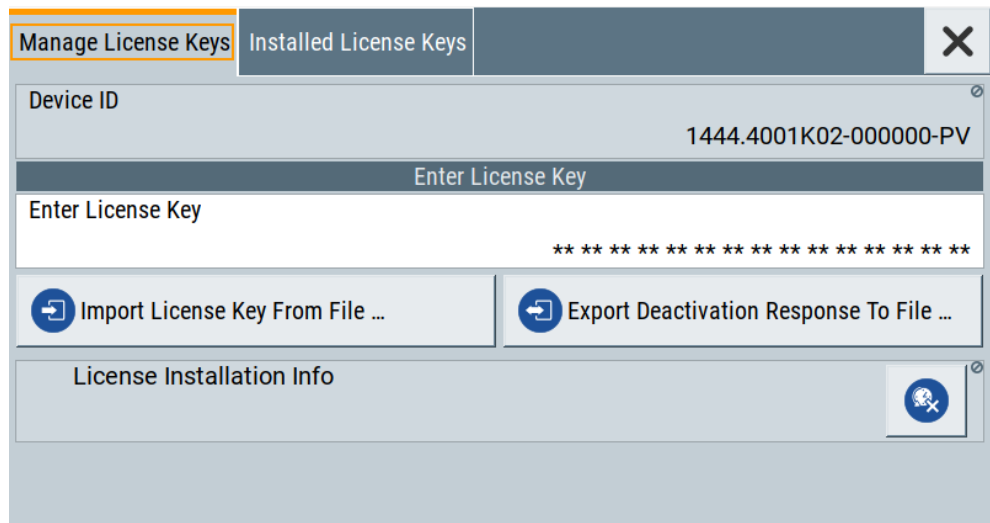
The firmware update is described in the release notes provided on the product page of the R&S SF100A.

11.3.1 Manage license keys settings

The "Manage Licnese Keys" dialog provides all information on the available licenses. Instrument-related steps guide you through the process of registering or deactivating licenses.

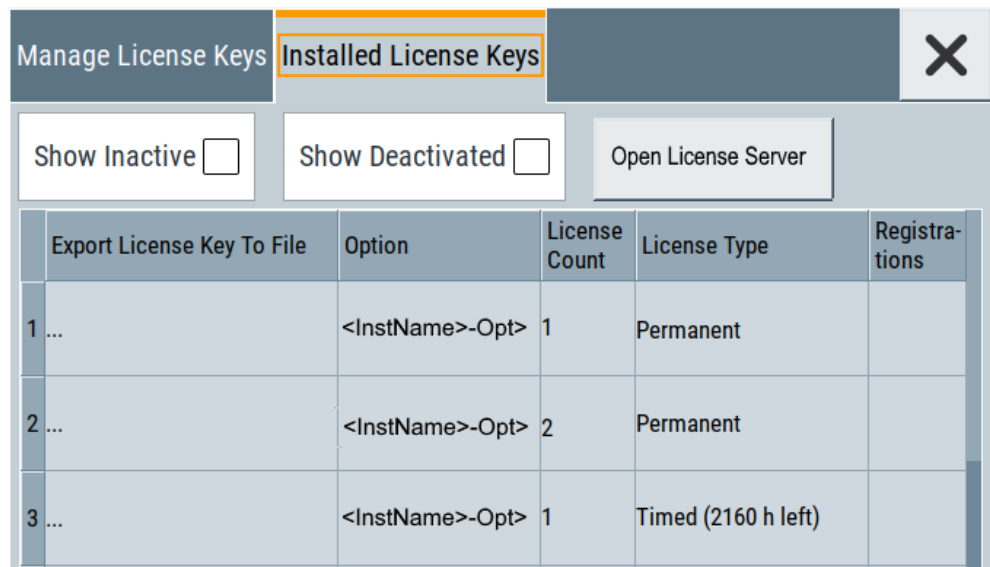
Access:

1. Select "System Config > Setup > Instrument Assembly > Manage License Keys > Manage License Keys".



In this tab, you can activate licenses for newly purchased or newly registered options.

2. Select "Installed License Keys".



This tab lists all active options, with information on the available number of an option, the license type and registration. You can query inactive or disabled options also.

3. Select "Open License Server".

The "Manage License Keys" dialog covers all required parameters for activating or deactivating newly purchased or newly registered options, and provides access to the onboard license server, see [Chapter 11.3.2, "Using the license server"](#), on page 313.

Settings

Device ID.....	312
Enter License Key.....	312
Import License Key from File.....	312
Export Deactivation Response to File.....	312
License Installation Info.....	312
Installed License Keys.....	312
L Show Inactive.....	312
L Show Deactivated.....	312
L Installed License Keys Table.....	313
Open License Server.....	313

Device ID

Displays the instrument-specific identification number. The device ID is a unique string with the following structure:

```
<stock number>-<serial number>-<checksum>
```

Enter License Key

Type here the license key provided with the option.

For license keys delivered as a file, use [Import License Key from File...](#)

Import License Key from File...

Opens a dialog for selecting the file with the license key.

Use this function also to import the deactivation key file generated by the R&S License Manager online tool (see [How to move a portable license](#)).

Export Deactivation Response to File...

Exports the generated deactivation response key to a file and opens a file management dialog to save the file.

This key is required during the unregistration process, e.g. when you want to deinstall an option or have a portable option, which you want to register later on another instrument (see [How to move a portable license](#)).

License Installation Info

Indicates status information on the performed actions.

Installed License Keys

Access: select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys".

Comprises information on the installed options.

Show Inactive ← Installed License Keys

Enables the display of the inactive (expired) licenses in the [Installed License Keys Table](#).

Show Deactivated ← Installed License Keys

Enables the display of the deactivated licenses in the [Installed License Keys Table](#).

See [How to move a portable license](#) for information on how to activate deactivated licenses.

Installed License Keys Table ← Installed License Keys

Shows information on the currently installed options.

"Export License Key to File"

Opens a dialog to save the generated license key file. This file is required during the unregistration process.

If you have a portable unregistered option, you can register it later on another instrument (see [How to move a portable license](#)).

"Option"

Displays the short designation of the option.

"License Count"

Displays the number of the licenses for the selected option key.

"License Type"

Displays the type of license.

A license type determines the common qualification application duration and the portability of a license. The following license types are provided: evaluation, permanent, portable, quantified, time-controlled with a duration of 1, 3, 6 or 12 months. A license can also be deactivated or expired.

For time limited licenses, the left time of applicability is displayed too.

"Registrations" (reserved for future use)

Open License Server

Opens the R&S License Server of the R&S SF100A, see [Chapter 11.3.2, "Using the license server"](#), on page 313.

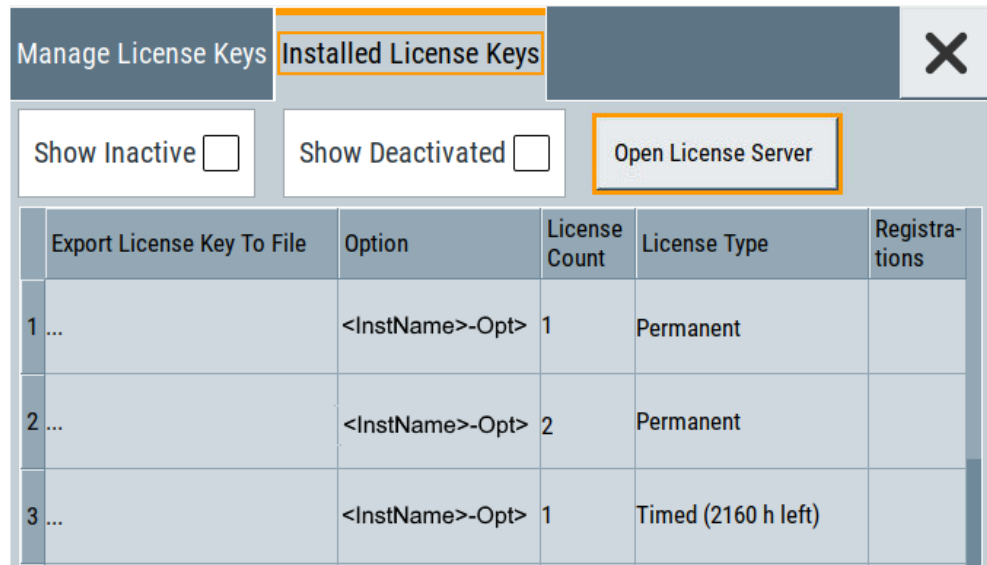
11.3.2 Using the license server

The R&S SF100A now supports handling of software licenses using the license server from Rohde & Schwarz.

To open the license server

Access:

1. Select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys".



2. Select "Open License Server".

The license server browser opens in a browser window and starts initially in the "Configuration" view.

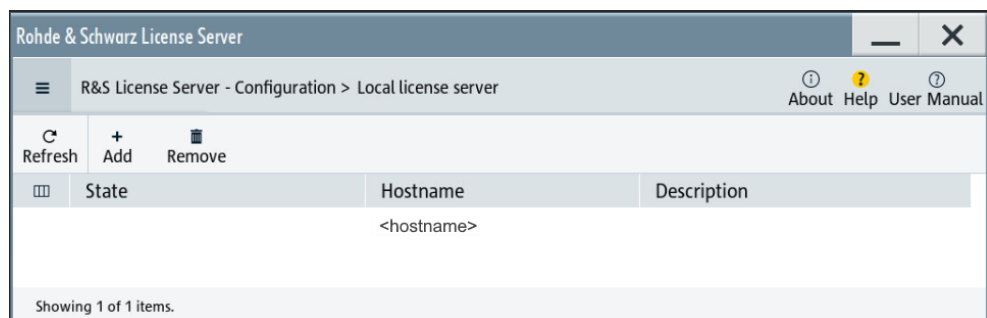


Figure 11-1: R&S license server dialog

The icons in the status bar on the right lead you to information on the license server:

- "About": shows the software version.
- "User Manual": opens the embedded license server user manual.
- "Help": provides the functional description on a specific dialog and its settings.

Short glance at the main views

The section provides a brief insight into the main windows of the license server. For details and handling of the application, refer to the embedded user documentation.



1. To access a view, select the menu button.
2. Select "Configuration".

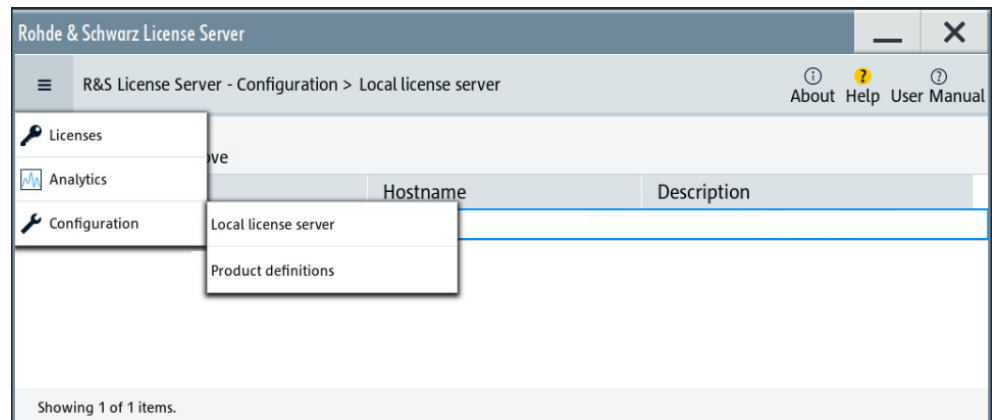


Figure 11-2: Configuration menu

Accesses the license server, access lists and installed product definitions.

- a) Select "Local license server".

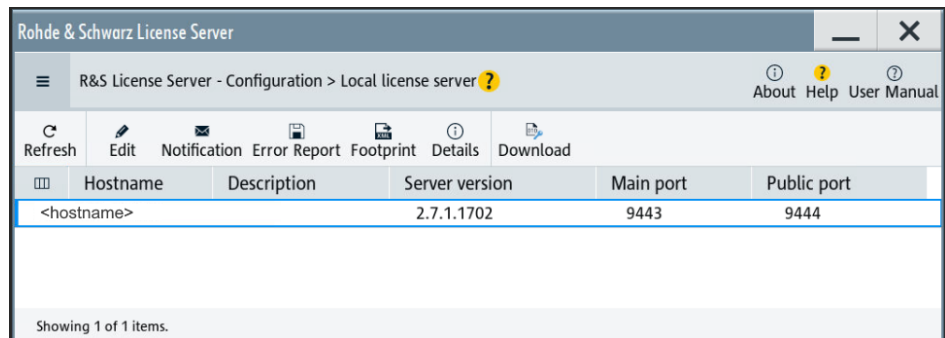


Figure 11-3: Example of a local license server view

Shows the onboard license server of the instrument. With the column selection, you can indicate or unhide characteristics of the available server. The task bar buttons provide access to the corresponding functions and access lists.

- b) Select "Product definitions".

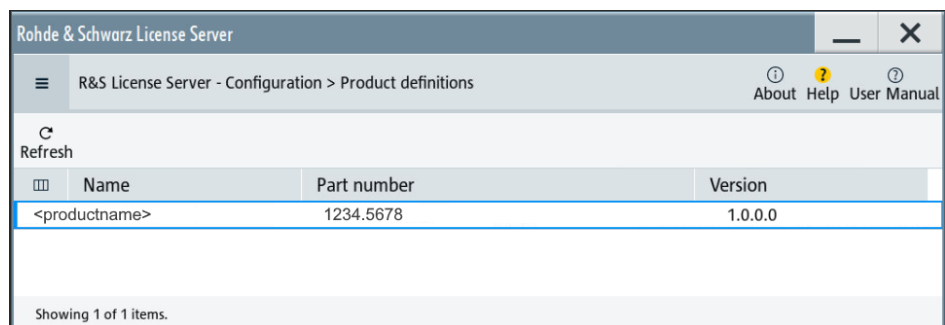


Figure 11-4: Example of a product definition view

Shows installed product definitions. To view the available characteristics, use the column selection.

3. Select "Licenses".

Provides access to the available license servers.

The "License keys" view lists the license key options that are available on the selected server. To show additional information, use the column selection.

The task bar functions enable you to activate or deactivate a license, to get details on an option and export license keys or information on the selected product.

4. Select "Analytics".

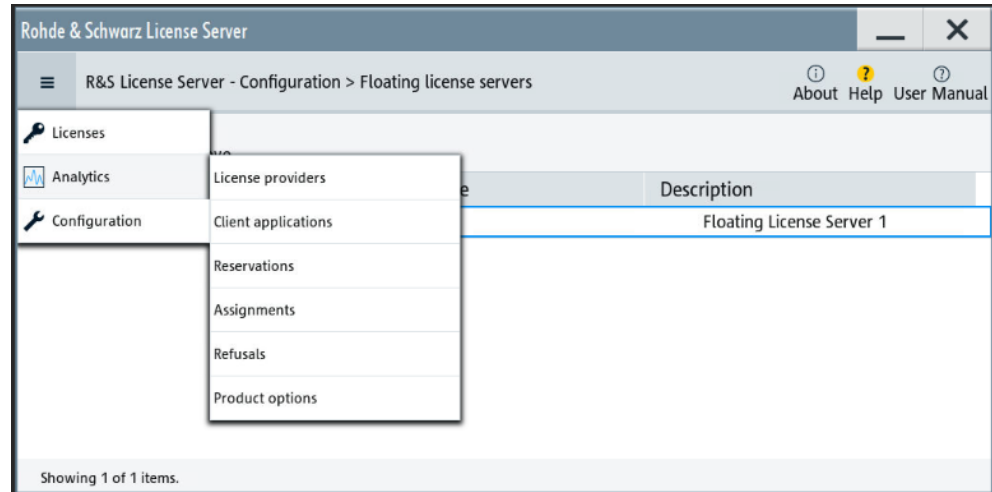


Figure 11-5: Analytics menu

Provides access to the license providers, client applications and enables you to export statistics data for evaluation in external applications.

Shows information on configured client applications, license providers and license types. To show additional information, use the column selection.

To manage licenses on the R&S SF100A

To request or return a license, proceed as follows:

1. Access: see ["To open the license server"](#) on page 313.

The browser application opens.

2. Select "Licenses"

3. Select a license server in the menu list, e.g. "R&S SF100A".

The "License keys" view lists the enabled options available on the selected server.

4. Select "Status" > "Select all" to list also options that are currently deactivated.

The "Licenses" view shows all active, inactive and time limited options.

5. To get detailed information on a specific option:

a) Select the option in the list.

- b) In the task bar, select "Details".

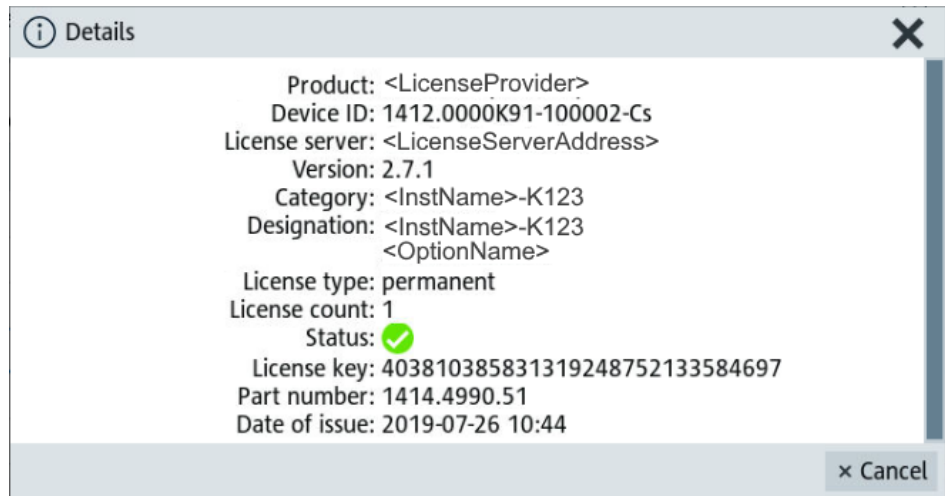





Figure 11-6: Example of the license characteristics of an option

6. To enable a discontinued license: , select  in the taskbar.
 - a) Select the license you want to activate.
 - b) In the task bar, select .
7. To return a license, proceed the same way:
 - a) Select the license.
 - b) Deactivate the license with .
8. Follow the instructions on the screen.

11.3.3 How to move a portable license

This example is intended to explain how to perform the required steps at the instrument.

Use a USB flash drive to transfer the license key files between the instruments and the browser.



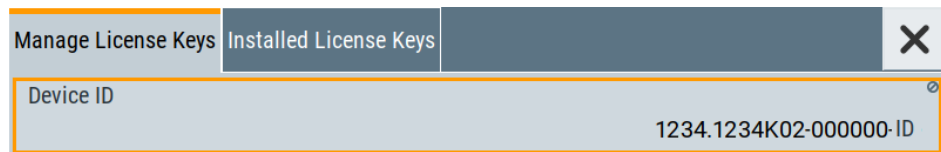
We assume knowledge about the handling of the R&S License Manager online tool and the description of the whole process.

1. Open your browser. Enter <https://extranet.rohde-schwarz.com/service>.
Select "Manage Licenses > Move Portable License".

The first step requires the Device IDs of the source and target instruments.

2. To find out the Device IDs, proceed as follows:

- a) On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Manage License Keys > Device ID".



- b) On the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys".
- c) In the "Mange License Keys" tab, select "Device ID".
- d) In the browser, select "Manage Licenses > Move Portable License > Select Devices".
- e) Enter the Device IDs.
3. On the source instrument, select "System Config > Setup > Instrument Assembly > Installed License Keys > License Keys Table".
- a) Navigate to the portable license that you want to move.
- b) Select the "Export License to File" column.
- A standard file manager dialog opens.
4. Enter a filename.
5. Save the exported license key, e.g. `k123_portable_key_to_move.xml`.
6. In the browser, select "Manage Licenses > Move Portable License > Select License (from file)":
- a) Select the exported license key.
- b) Check the selection.
- c) Create the deactivation key.
- d) Save it to file.
7. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Import License Keys from File".
Select the transferred deactivation key.
8. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Export Deactivation Response to File".
9. In the browser, go to "Manage Licenses > Move Portable License > Install Deactivation Key (from file)".
10. Enter the deactivation response of the instrument.
The license is deactivated for the source instrument.
11. In the "Manage Licenses > Move Portable License", go to step "Create License" to generate a license key for this portable option and the selected target instrument.
- a) Download the license key as a file.
- b) Transfer it to the target instrument.

12. In the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New License > Import License Keys from File".

13. Select the created license key file.

The portable option is installed on the target instrument.

11.4 Using the security settings

The protection function of the R&S SFI100A provides several levels to activate particular functions like self-test or tests for service purposes specifically.

Protection

The five protection levels are automatically active on startup that means all protected functions are locked.

To unlock a protection level:

- ▶ In the "System Config > Setup > Security > Protection" dialog, enter the correct password.

To lock a protection level:

- ▶ Clear the corresponding checkbox.

Protection levels

The following functions are protected in the respective levels:

- Protection level 1
Protects against accidental changes, like, for example, the clock and date, several internal adjustments functions and the self-test, as well as network settings or the instrument hostname.
You can access this level with the password 123456.
- Protection level 2
Unlocks protected service functions. It is accessible to authorized personnel of Rohde & Schwarz service department only.
- Protection level 3 to 5
Are reserved for internal use.

Security

The security concept of the R&S SFI100A helps you to protect your instrument against uncontrolled access and changes. All provided security services require that you enter the security password.

Provided security services are:

- **General** security parameters, such as:
 - **USB storage** that secures controlled access to the mass memory of the instrument

- **Volatile mode** that prevents information to be written to the internal memory permanently.
- **Sanitizing** that prevents the instrument from leaving a secure environment with stored user information.
- **Annotation** frequency and amplitude prevent reading the display.
- **Secure Update Policy** check that verifies the integrity and origin of the firm-ware package to be installed.
To access the settings of these topics, see [Setting security parameters](#) > "[Secure Update Policy](#)" on page 322.
- **Password** management secures controlled user access to the instrument
With the two-step password concept, you can assign a user-defined password for the operating system, and a security password for accessing the mass storage of the instrument.
See [Chapter 11.4.4, "Password management"](#), on page 330.
- **LAN services** secure controlled network access
You can individually lock and unlock supported LAN interface services, including the SMB client and SMB server that use versions 1.0 and 2.0 of the SMB protocol. Remote control over LAN requires you have enabled the interface, but you can disable not needed LAN services individually.
Note: Disabling LAN services needed for remote control over LAN locks the instrument access persistently. You cannot address the instrument any longer.
See [Chapter 11.4.3, "Configuring LAN services"](#), on page 326.
- **User interface** prevents front panel operation and/or reading the display.

For more information, see the document R&S SF100A Instrument Security Procedures.

11.4.1 Protection level settings

Access:

- ▶ Select "System Config > Setup > Security > Protection".

Protection Level 1	<input checked="" type="checkbox"/>	Password	*****
Protection Level 2	<input checked="" type="checkbox"/>	Password	*****
Protection Level 3	<input checked="" type="checkbox"/>	Password	*****
Protection Level 4	<input checked="" type="checkbox"/>	Password	*****
Protection Level 5	<input checked="" type="checkbox"/>	Password	*****

The "Protection" dialog provides access to the unlocking of different protection levels.

Several functions in the instrument are password-protected to prevent for example accidental changes, "[Protection](#)" on page 319.

The remote commands required to unlock a protected stage are described in [Chapter 13.18, "SYSTem subsystem"](#), on page 581.

Protection Level/Password

Unlocks the selected level of protection, if you enter the correct password.

The default protection level 1 password is 123456.

To lock the protection level again, clear the checkbox.

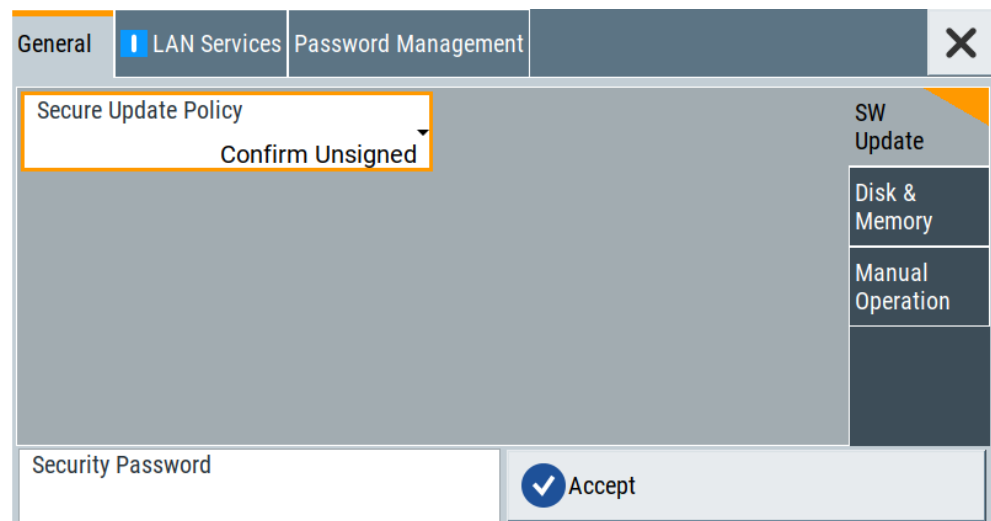
Remote command:

:SYSTem:PROTect<ch>[:STATe] on page 592

11.4.2 Setting security parameters

Access:

- ▶ Select "System Config > Setup > Security > Security > General".



In the "General" tab, you can determine the security level for firmware updates, and configure the security settings for the mass memory and manual operation.



All modified settings in this dialog are not applied until you enter the [Security Password](#) and confirm with [Accept](#).

11.4.2.1 Update policy security settings

Access:

1. Select "System Config > Setup > Security > Security".

2. Select "General > SW Update".



The "SW Update" tab enables you to select the security mode for firmware updates.

The remote commands available to control security settings are described in [Chapter 13.18, "SYSTem subsystem"](#), on page 581.

Secure Update Policy

Allows you to configure the automatic signature verification for firmware installation.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See also:

- [Chapter 11.4, "Using the security settings"](#), on page 319 for more information on the security concept.
- The release notes for details on signature verification when installing new or former firmware versions, available at www.rohde-schwarz.com/firmware/sfi100a.
The release notes for details on signature verification when installing new or former firmware versions, available at www.rohde-schwarz.com/firmware/sma100b.

"Confirm Unsigned"

Performs the signature verification.

If the check detects any discrepancies, the instrument issues a warning message. You can still update the firmware or reject updating.

This setting also enables you to downgrade the firmware version.

"All Packages" Accepts all packages without signature verification.

"R&S Signed Packages"

Performs the signature check.

If the check detects any discrepancies, the instrument issues a warning message and locks the update to this firmware.

Remote command:

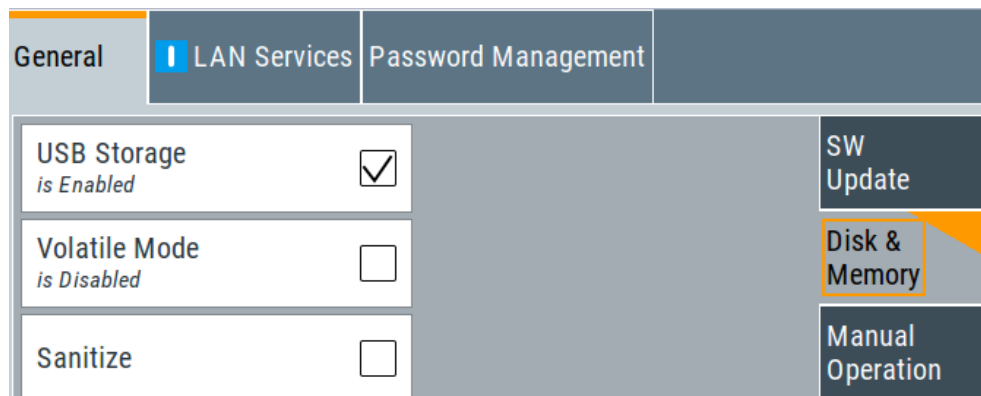
`:SYSTem:SECurity:SUPolicy` on page 602

11.4.2.2 Disk & memory security settings

Access:

1. Select "System Config > Setup > Security > Security".

2. Select "General > Disk & Memory".



The "Disk & Memory" tab secures controlled access to the mass memory and prevents information from leaving a secure environment.

The remote commands available to control security settings are described in [Chapter 13.18, "SYSTem subsystem"](#), on page 581.

USB Storage

Activates the access to external USB storage media.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See [Chapter 10.8.4, "Using a USB storage device for file transfer"](#), on page 293.

Note: Remove all USB memory devices before disabling the USB storage. If any USB memory device remains connected, disabling is blocked, and the instrument returns a warning message.


Volatile Mode

Activates volatile mode, so that no user data can be written on the internal memory permanently.

In volatile mode:

- Data that the instrument normally stores on the internal memory is redirected to volatile memory.
- The user directory is mapped to the volatile memory. You access the temporary data just as data stored in the `/var/user/`, see [Chapter 10.3, "Protecting data"](#), on page 278.
- Data on the internal memory cannot be changed. It is protected against modification or erasure.
- You can only save data:
 - Temporarily in the volatile memory
 - On a connected external storage device, such as a memory stick

To activate volatile mode: enter the security password, confirm with "Accept" and reboot the instrument. Otherwise the change has no effect.

Activated volatile mode is indicated by the icon .

Remote command:

`:SYSTem:SECurity:VOLMode[:STATe]` on page 602

Sanitize

Executes the erase procedure that sanitizes the internal memory.

The sanitizing function makes sure that no user information is stored on the instrument when it leaves the secure environment.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

Note: If the instrument is subject to high security, and you have disabled volatile mode, the internal memory holds user-data, and thus poses a security risk.

See also [Chapter 11.4, "Using the security settings"](#), on page 319 for more information on the security concept.

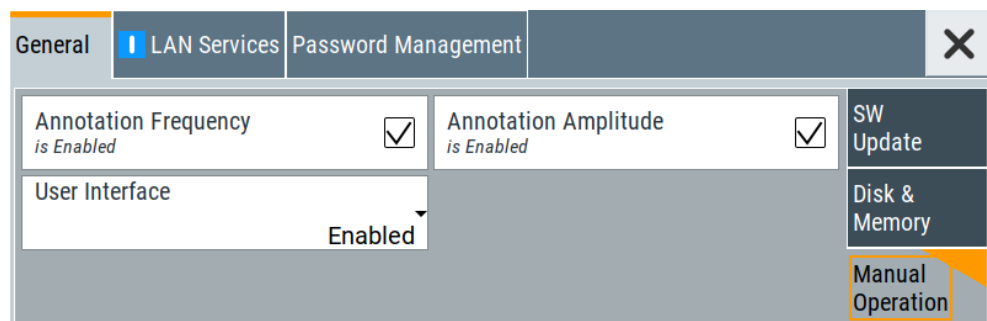
Remote command:

`:SYSTEM:SECURITY:SANITIZE[:STATE]` on page 601

11.4.2.3 Manual operation security settings

Access:

1. Select "System Config > Setup > Security > Security".
2. Select "General > Manual Operation".



The "SW Update" tab enables you to lock front panel operation and/or reading the display.

The remote commands available to control security settings are described in:

- [Chapter 13.8, "DISPlay subsystem"](#), on page 430
- [Chapter 13.18, "SYSTEM subsystem"](#), on page 581.

Annotation Frequency

Enables the display of the currently used frequency in the status bar.

How to: see ["To disable frequency and level indication in the status bar"](#) on page 335.

Remote command:

`:DISPlay:ANNotation:FREQuency` on page 433

Annotation Amplitude

Enables the display of the currently selected level in the status bar.

How to: see ["To disable frequency and level indication in the status bar"](#) on page 335.

Remote command:




`:DISPlay:ANNotation:AMPLitude` on page 433

User Interface

Allows you to lock the controls for manual operation and the display individually.


How to: see ["To disable the user interface"](#) on page 336.

See also [Chapter 11.4, "Using the security settings"](#), on page 319.

"Enabled"	Enables the display and all controls for the manual operation of the instrument.
"Touchscreen Off"	<p>Locks the touch sensitivity of the screen. This security feature protects the instrument against unintentional change of settings by accidentally touching of the screen.</p> <p>Still available controls for manual operation are:</p> <ul style="list-style-type: none"> • The keys at the front panel, including the rotary knob • The external mouse and keyboard • Remote operation over VNC <p>The instrument indicates the locked touchscreen by an icon . Unlocking is possible via VNC, external controls or remote control.</p>
"VNC Only"	<p>Locks the keys at the front panel, the touchscreen and externally connected keyboard and mouse. The display on the screen remains and shows the current settings and changes. The instrument indicates the activated "VNC only" feature by the icon . Unlocking is possible via VNC or turning off and on again.</p>
"Display Only"	<p>Locks the manual operation of the instrument. The display on the screen remains and shows the current settings and changes. This security feature protects the instrument against unauthorized access, but still shows the current settings and processes, for example when you operate the instrument via remote control.</p> <p>The function disables:</p> <ul style="list-style-type: none"> • The touchscreen functionality of the display • The keys at the front panel of the instrument • The external mouse and keyboard <p>The instrument indicates the locked controls by a padlock  softkey. How to unlock: see "Unlocking (reactivating) the user interface for manual operation" on page 336.</p>

"Disabled" Locks the display and all controls for the manual operation of the instrument.
This security feature protects the instrument against unauthorized reading and access, for example when you operate the instrument via remote control.
The function disables:

- The display
- The touchscreen
- The keys at the front panel of the instrument
- The external mouse and keyboard

The screen shuts off and displays a padlock symbol  instead.
How to unlock: see ["Unlocking \(reactivating\) the user interface for manual operation"](#) on page 336.

Remote command:

:SYSTem:ULOCK on page 590

:SYSTem:DLOCK on page 589

:SYSTem:KLOCK on page 589

Enabling a locked user interface for manual operation

Follow the instructions listed in ["Unlocking \(reactivating\) the user interface for manual operation"](#) on page 336.

Remote command:

:SYSTem:ULOCK on page 590

:SYSTem:DLOCK on page 589

:SYSTem:KLOCK on page 589

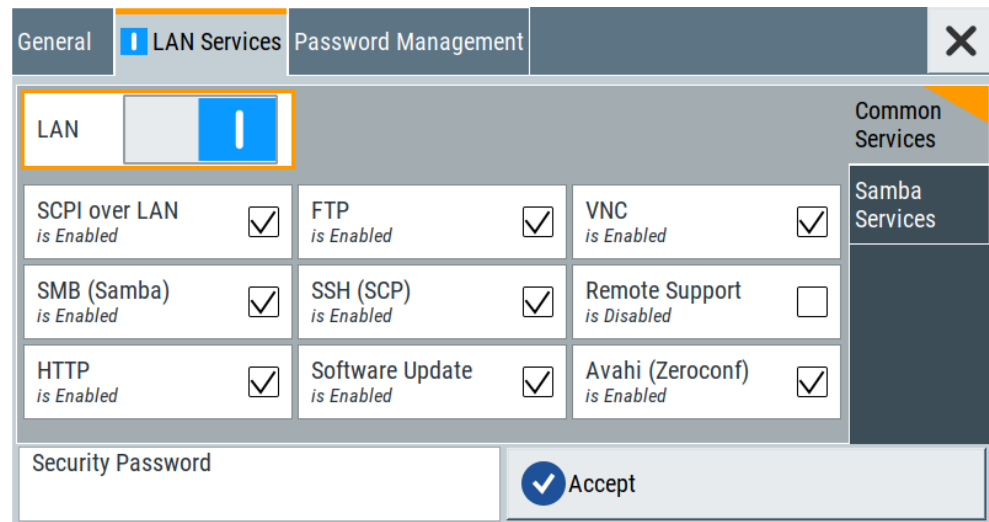
11.4.3 Configuring LAN services

Access:

1. Select "System Config > Setup > Security > Security > LAN Services > Common Services".
2. **NOTICE!** Risk of losing access over LAN. Disabling the LAN interface or the common services "SCPI over LAN", "VNC" and "HTTP" locks the remote access to the instrument.

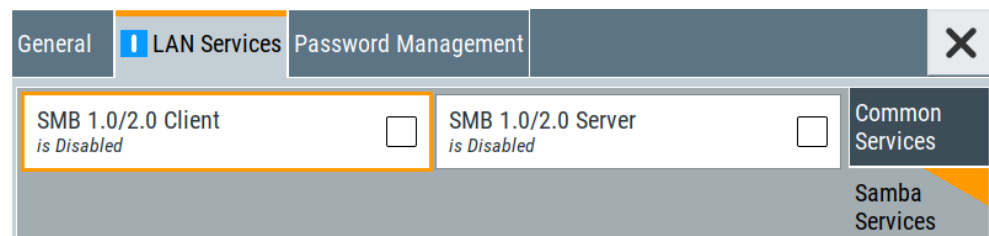
Do not disable the LAN interface or LAN services needed for remote control while you operate the instrument remotely.

Proceed with step [step 4](#) for troubleshooting disabled services.



In the "Common Services" side tab, you can individually disable the supported services of the LAN interface.

3. Disable LAN services as needed.
 - a) Disable the service.
 - b) To confirm disabling, enter the security password.
 - c) Select "Accept".
4. If you have locked the access accidentally, you have the following options:
 - Update the instrument firmware using ISO image (`<instrument>_<version-number>.iso`).
Note: A firmware update with the ISO image resets the instrument. The instrument reset dismisses user-specific configurations and deletes user data. Contact the Rohde & Schwarz (<https://www.rohde-schwarz.com/support>) to get the ISO image.
 - Ship the instrument to your local service department. The service center experts can enable the remote access over LAN without losing user-specific settings and data.
 See www.services.rohde-schwarz.com.
5. Select "System Config > Setup > Security > Security > LAN Services > Samba Services".



In the "Samba Services" side tab, you can activate former versions of the SMB client and SMB server.

The remote commands available to control security settings are described in [Chapter 13.18, "SYSTEM subsystem"](#), on page 581.

How to:

- ["To disable LAN access in general"](#) on page 333
- ["To disable LAN services individually"](#) on page 334
- ["To enable SMB version 1.0/2.0 client and server"](#) on page 335

Common Services.....	328
L LAN.....	328
L LAN Services.....	328
Samba Services.....	329
L SMB 1.0/2.0 Client.....	329
L SMB 1.0/2.0 Server.....	330
Security Password.....	330
Accept.....	330

Common Services

Enables the LAN interface and supported LAN interface services.

LAN ← Common Services

Enables the LAN interface in general, and thus provides remote access over all unlocked services.

Remote command:

`:SYSTEM:SECURITY:NETWORK[:STATe]` on page 601

LAN Services ← Common Services

Enables the supported LAN interface services individually.

"SCPI over LAN"

Access over LAN to control the instrument remotely, by using SCPI (Standard Commands for Programmable Instruments) commands. See also ["To set up the controller with R&S VISA"](#) on page 378 and ["To start remote control with R&S VISA"](#) on page 381

Remote command:

`:SYSTEM:SECURITY:NETWORK:SOE[:STATe]` on page 600

"VNC"

Access over VNC (Virtual Network Computing) interface, a graphical desktop sharing system that uses RFB protocol to control the instrument remotely.

See also [Chapter 12.10, "Setting up remote operation over VNC"](#), on page 394.

Remote command:

`:SYSTEM:SECURITY:NETWORK:VNC[:STATe]` on page 601

- "SSH (SCP)" Access over SSH (Secure Shell), a network protocol for secure data communication.
Remote command:
`:SYSTem:SECurity:NETWork:SSH[:STATe]` on page 600
- "Remote Support"
Remote support over SSH (SCP).
The service provides communication for service purposes only.
Remote command:
`:SYSTem:SECurity:NETWork:REMSupport[:STATe]`
on page 599
- "HTTP" Access with HTTP (Hyper Text Transfer Protocol), the application protocol for hypermedia information systems.
Remote command:
`:SYSTem:SECurity:NETWork:HTTP[:STATe]` on page 599
- "FTP" Access with FTP (File Transfer Protocol), used to transfer files from a host to the instrument and vice versa.
See also [Chapter 10.8.2, "Accessing the file system using FTP"](#), on page 291.
Remote command:
`:SYSTem:SECurity:NETWork:FTP[:STATe]` on page 598
- "SMB (Samba)"
Access to SMB (Server Message Block), used for providing shared access to files, printers and serial ports of a network.
See also [Chapter 10.8.3, "Accessing the R&S SFI100A file system using SMB \(Samba\)"](#), on page 292.
Remote command:
`:SYSTem:SECurity:NETWork:SMB[:STATe]` on page 600
- "Avahi (Zeroconf)"
Avahi, a service for automatic configuration of the instrument in a network environment.
Remote command:
`:SYSTem:SECurity:NETWork:AVAHi[:STATe]` on page 598
- "Software Update"
Allows updating the software.
Remote command:
`:SYSTem:SECurity:NETWork:SWUPdate[:STATe]` on page 601

Samba Services

Enables support of SMB client and SMB server version 1.0 and 2.0 of the SMB protocol.

Support of version 1.0 and 2.0 is additional to the current SMB protocol version supported in the firmware. This firmware supports SMB protocol up to version 3.1.1.

SMB 1.0/2.0 Client ← Samba Services

Enables support of the SMB client compatible with SMB protocol versions 1.0 and 2.0.

SMB 1.0/2.0 Server ← Samba Services

Enables support of the SMB server compatible with SMB protocol versions 1.0 and 2.0.

Security Password

Enters the password that is required to enable or to disable the settings protected by a security password. Default is 123456.

How to: ["To change the security password"](#) on page 333

Accept

Applies the modified settings, provided the security password is entered and correct.

11.4.4 Password management


Access:

1. Select "System Config > Setup > Security > Security > Password Management > User Password".

General	LAN Services	Password Management
Valid for VNC, FTP and SMB (Samba) access		User Password
User Name		Security Password
instrument		
Old Password		
New Password		
Confirm Password		
Change Password		

In this tab, you can assign the security and a user-defined password.

2. Select "System Config > Setup > Security > Security > Password Management > Security Password".

General	LAN Services	Password Management	
Old Password		User Password	
New Password		Security Password	
Confirm Password			
			

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

User Name

Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SMB (Samba) access.

User Password

Access: select "System Config > Setup > Security > Security > Password Management > User Password".

Allows you to change and confirm the user password.

Old Password ← User Password

Enters the current user password. The default password is "instrument".

Note: We recommend that you change the default password before connecting the instrument to a network.

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

Note: Note that you cannot reset the password to factory state.

If you encounter problems with the password, contact the Rohde & Schwarz customer support, see [Chapter 14.10, "Contacting customer support"](#), on page 626.

New Password ← User Password

Enters the new user password.

The security password can contain decimal characters only.

Confirm Password ← User Password

Confirms the new user password by repeating.

How to:

- ["To change the user password of the instrument"](#) on page 333.

- ["To change the security password"](#) on page 333.

Change Password ← User Password

Changes the user password accordingly.

Security Password

Access: select "System Config > Setup > Security > Security > Password Management > Security Password".

Enables you to change and confirm the security password.

Old Password ← Security Password

Enters the currently used security password. The default password is '123456'.

Note: We recommend that you change the default password before connecting the instrument to a network.

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

The security password is required when changing the status of the USB and LAN interface or other security settings.

Note: Note that you cannot reset the password to factory state.

If you encounter problems with the password, contact the Rohde & Schwarz customer support, see [Chapter 14.10, "Contacting customer support"](#), on page 626.

New Password ← Security Password

Enters the new security password.

The security password can contain decimal characters only.

Confirm Password ← Security Password

Confirms the new security password by repeating.

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

Change Password ← Security Password

Changes the password accordingly.

11.4.5 Preventing unauthorized access

The default computer name and user password are *instrument*. The user password is the password required for VNC, FTP and SMB (samba) connections. If for example, the VNC service or FTP are enabled, anyone in the network who knows the computer name and user password of the instrument can access it.

The default security password is 123456. The security password is required when changing the status of the USB and LAN interfaces.

To prevent unauthorized access, use the following configurations exclusively or complementary:

- ["To change the user password of the instrument"](#) on page 333
- ["To change the security password"](#) on page 333
- ["To disable LAN access in general"](#) on page 333
- ["To disable LAN services individually"](#) on page 334
- ["To enable SMB version 1.0/2.0 client and server"](#) on page 335
- ["To disable frequency and level indication in the status bar"](#) on page 335
- ["To disable the user interface"](#) on page 336

If security is a concern, see the document instrument security procedures for comprehensive description.

To change the user password of the instrument

- **Note:** We recommend that you change the default password before connecting the instrument to a network.

How to:

- ["To change the user password of the instrument"](#) on page 333.
 - ["To change the security password"](#) on page 333.
- a) Select "System Config > Setup > Security > Security > Password Management > User Password".
 - b) Enter the current password in the "Old Password" field.
 - c) Enter the new password in the "New Password" and "Confirm Password" fields.
 - d) Select "Change Password".

The user password is changed; the user name is displayed ("Security > Password Management > User Password > User Name").

To change the security password

- **Note:** We recommend that you change the default password before connecting the instrument to a network.

How to:

- ["To change the user password of the instrument"](#) on page 333.
 - ["To change the security password"](#) on page 333.
- a) Select "System Config > Setup > Security > Security > Password Management > Security Password".
 - b) Enter the current password in the "Old Password" field.
The default password is *123456*.
 - c) Enter the new password in the "New Password" and "Confirm Password" fields.
 - d) Select "Change Password".

To disable LAN access in general

1. **NOTICE!** Risk of loosing access over LAN. Disabling the LAN interface or certain services lock the remote access to the instrument.

The following services lock the remote access when disabled: "LAN", "SCPI over LAN", "VNC" and "HTTP".

If you have locked the access accidentally, you have the following options:

- Update the instrument firmware using ISO image (`<instrument>_<version-number>.iso`).
Note: A firmware update with the ISO image resets the instrument. The instrument reset dismisses user-specific configurations and deletes user data. Contact the Rohde & Schwarz (<https://www.rohde-schwarz.com/support>) to get the ISO image.
- Ship the instrument to your local service department. The service center experts can enable the remote access over LAN without losing user-specific settings and data.
 See www.services.rohde-schwarz.com.

2. Select "System Config > Setup > Security > Security".
3. Select "LAN Services > Common Services".
4. Disable "LAN" state.
5. Enter the [Security Password](#).
6. Select "Accept".

All LAN connections are blocked, including the LAN services. Communication over LAN is not possible.

To disable LAN services individually

1. Select "System Config > Setup > Security > Security".
2. Select "LAN Services > Common Services".
3. Uncheck all services you want to block, for example "FTP > Off" or "VNC > Off".

General		LAN Services	Password Management	X	
LAN	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
SCPI over LAN <i>is Enabled</i>	<input checked="" type="checkbox"/>	FTP <i>is Disabled</i>	<input type="checkbox"/>	VNC <i>is Disabled</i>	<input type="checkbox"/>
SMB (Samba) <i>is Enabled</i>	<input checked="" type="checkbox"/>	SSH (SCP) <i>is Disabled</i>	<input type="checkbox"/>	Remote Support <i>is Disabled</i>	<input type="checkbox"/>
HTTP <i>is Disabled</i>	<input type="checkbox"/>	Software Update <i>is Enabled</i>	<input checked="" type="checkbox"/>	Avahi (Zeroconf) <i>is Enabled</i>	<input checked="" type="checkbox"/>
Security Password		<input checked="" type="checkbox"/> Accept			

4. Uncheck the services you want to block, for example "FTP" and "VNC".

5. Enable "LAN" state, if disabled.
6. Enter the [Security Password](#).
7. Select "Accept".

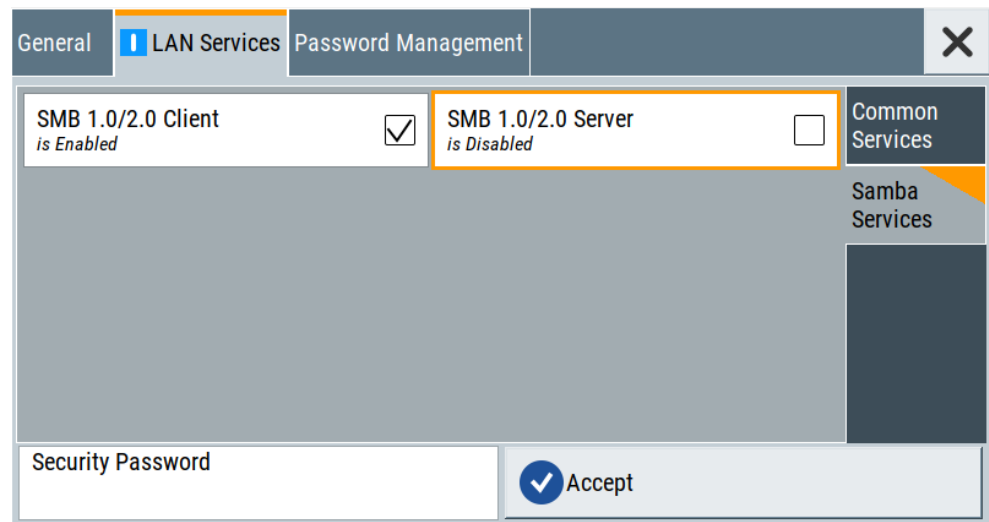
Communication over LAN is possible for the enabled services only.

To enable SMB version 1.0/2.0 client and server

By default, support of SMB client and SMB server of the SMB protocol versions 1.0 and 2.0 is disabled.

Activate support only, if needed:

1. Select "System Config > Setup > Security > Security".
2. Select "LAN Services > Samba Services".



3. For example, check "SMB 1.0/2.0 Client".
4. Select "SMB 1.0/2.0 Client > On" and "SMB 1.0/2.0 Server > On".
5. Enter the [Security Password](#).
6. Select "Accept".

Enables the access for the SMB Samba client, the access for the SMB Samba server remains blocked.

To disable frequency and level indication in the status bar

These settings are useful to prevent unauthorized personnel from reading the display, when you remotely control the instrument from a different location.

1. Select "System Config > Setup > Security > General > Manual Operation".
2. Select "Annotation Frequency > Off" or "Annotation Amplitude > Off".
3. Enter the [Security Password](#).

4. Select "Accept".

To disable the user interface

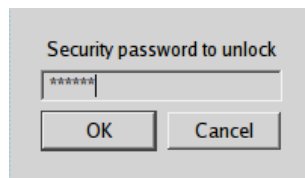
1. Select "System Config > Setup > Security > General > Manual Operation".
2. Select "User Interface > Disabled".
3. Enter the [Security Password](#).
4. Select "Accept".

The screen shuts off and displays a padlock symbol  instead.

There are further possible configurations. For details, see "[User Interface](#)" on page 325.

Unlocking (reactivating) the user interface for manual operation

1. In manual operation:
 - a) On the instrument's keypad or external keyboard, press any key.
The instrument prompts you to enter the security password for unlocking.



If you press the character of the first key, the input field accepts the character immediately.


- b) Delete the entry before inserting the password.
Enter the security password `123456`.
2. In remote control mode:
 - a) Send the command `SYST:ULOC ENABled` to release all locks at once.
 - b) Send the command `SYST:KLOC OFF` to unlock the keyboard and touchscreen.
 - c) Send the command `SYST:DLOC OFF` to release all locks.

Via remote control, there is no password required.

11.5 Password management


Access:

1. Select "System Config > Setup > Security > Security > Password Management > User Password".

General	LAN Services	Password Management	
Valid for VNC, FTP and SMB (Samba) access			User Password
User Name		instrument	Security Password
Old Password			
New Password			
Confirm Password			
		 Change Password	

In this tab, you can assign the security and a user-defined password.

2. Select "System Config > Setup > Security > Security > Password Management > Security Password".

General	LAN Services	Password Management	
Old Password			User Password
New Password			Security Password
Confirm Password			
		 Change Password	

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

User Name

Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SMB (Samba) access.

User Password

Access: select "System Config > Setup > Security > Security > Password Management > User Password".

Allows you to change and confirm the user password.

Old Password ← User Password

Enters the current user password. The default password is "instrument".

Note: We recommend that you change the default password before connecting the instrument to a network.

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

Note: Note that you cannot reset the password to factory state.

If you encounter problems with the password, contact the Rohde & Schwarz customer support, see [Chapter 14.10, "Contacting customer support"](#), on page 626.

New Password ← User Password

Enters the new user password.

The security password can contain decimal characters only.

Confirm Password ← User Password

Confirms the new user password by repeating.

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

Change Password ← User Password

Changes the user password accordingly.

Security Password

Access: select "System Config > Setup > Security > Security > Password Management > Security Password".

Enables you to change and confirm the security password.

Old Password ← Security Password

Enters the currently used security password. The default password is '123456'.

Note: We recommend that you change the default password before connecting the instrument to a network.

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

The security password is required when changing the status of the USB and LAN interface or other security settings.

Note: Note that you cannot reset the password to factory state.

If you encounter problems with the password, contact the Rohde & Schwarz customer support, see [Chapter 14.10, "Contacting customer support"](#), on page 626.

New Password ← Security Password

Enters the new security password.

The security password can contain decimal characters only.

Confirm Password ← Security Password

Confirms the new security password by repeating.

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

Change Password ← Security Password

Changes the password accordingly.

11.6 Undoing or restoring actions

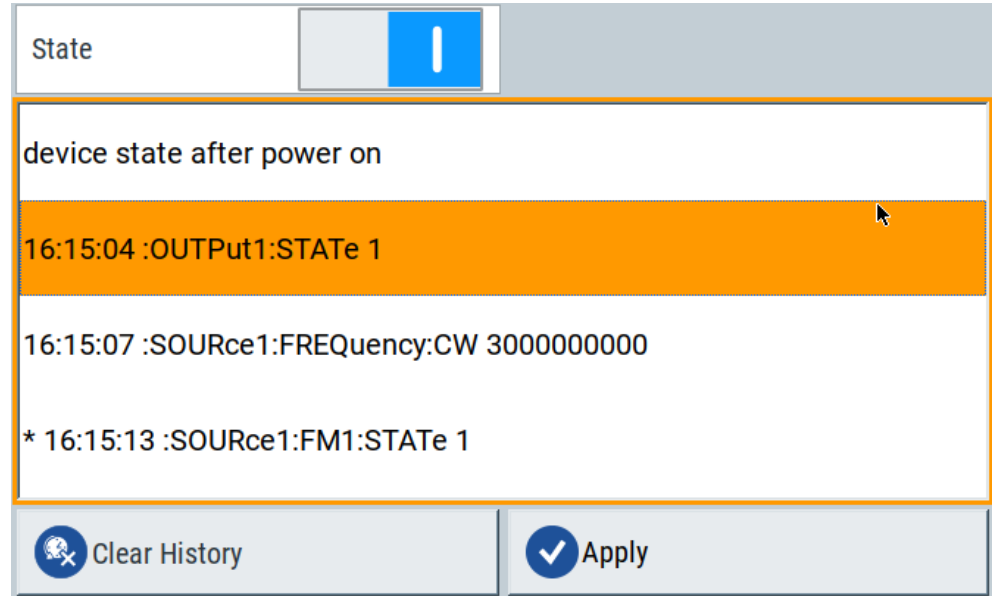
"Undo" is a function that removes the effect of the last action on the instrument and reverts it to an older state. Conversely, "Redo" restores a previously undone action.

You can "Undo/Redo" actions according to two criteria:

- Step by step
Gradually undo/redo the actions in reverse order as previously performed.
Depending on the available memory the "Undo/Redo" steps may restore all actions.
- Multiple steps at once
Select any specific action in the history list to "Undo/Redo" multiple actions in a single step.
Note: This mode requires a system restoration file on the instrument.

Access:

- ▶ Select "Setup > Settings > Undo/Redo".



The dialog contains all functions for enabling the "Undo/Redo" functionality.

Settings:

State.....	340
History List.....	340
Clear History.....	340
Apply.....	340

State

Enables the recording of the performed actions.

History List

Lists the performed actions, provided "Undo/Redo" state is "On".

Clear History

Deletes the recorded list of the performed steps.

Apply

Performs the "Undo/Redo".

If you select a previously performed action of the list, all subsequent actions are undone. The list entries remain.

If you select a subsequently executed action, you can restore all the actions undone up to this state.

11.7 Shutting down and rebooting the instrument

On the front panel, the [On/Standby] key switches the instrument from the standby to the ready state or vice versa. In remote operation from a remote computer or in manual control, there is another possibility to shut down the instrument or to reboot the system.

Access:

- ▶ Select "System Config > Setup > Maintenance > Shut down".



Remote control commands:

- `:SYSTEM:REBoot` on page 609
- `:SYSTEM:SHUTdown` on page 609

11.8 Using the on-screen keypad

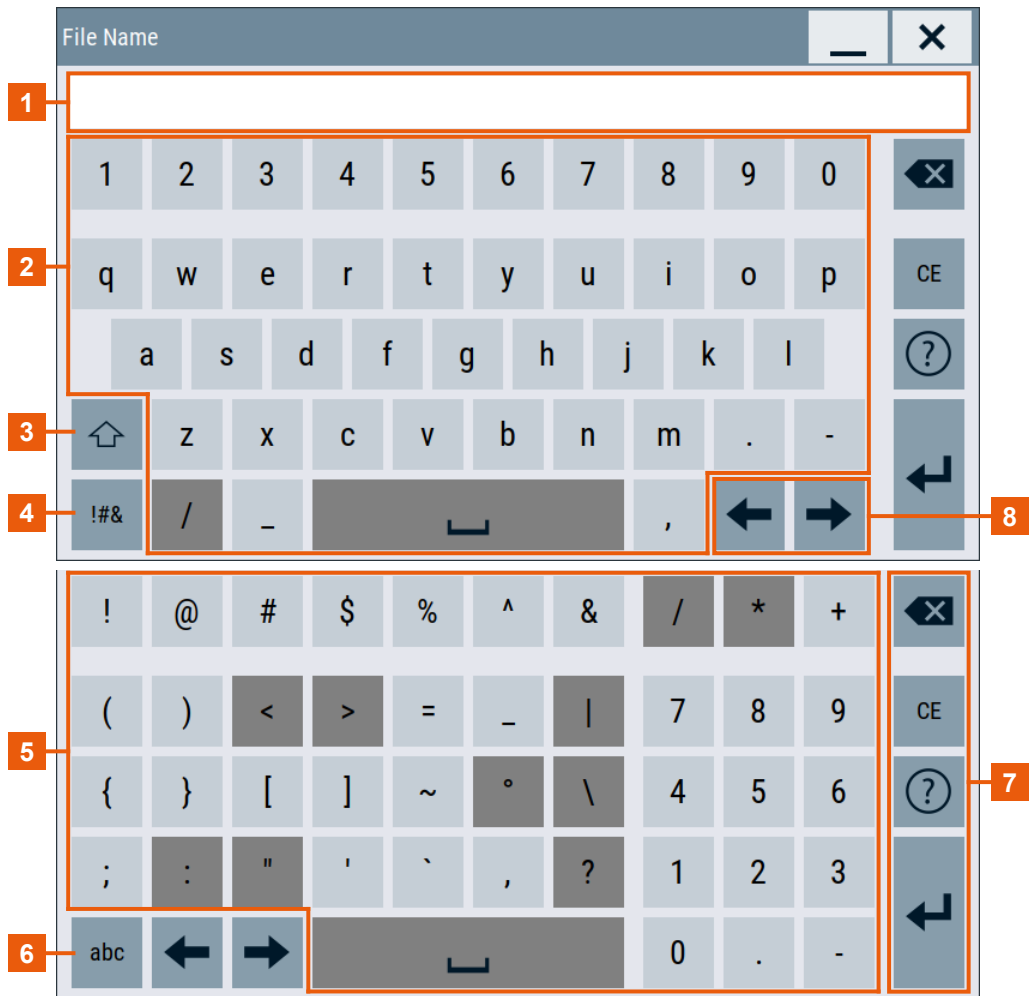


Figure 11-7: Alphanumeric entry

- 1 = Input field
- 2, 3, 10, 11 = Function keys
- 4, 9 = Alphanumeric keys
- 5, 8 = Non-walkable keys

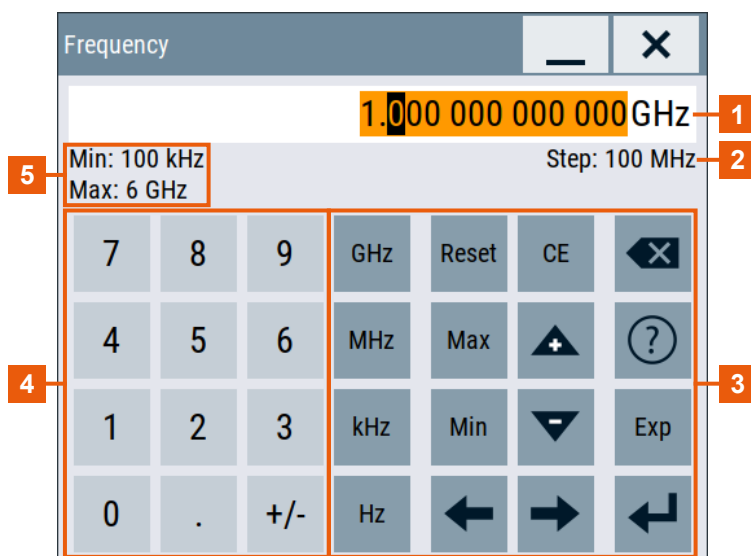


Figure 11-8: Numerical entry

- 1 = Input field
- 2, 6 = Min/Max limit
- 3 = Function keys
- 4 = Non-walkable keys
- 5 = Special characters and number keys

Table 11-1: Keys on the keypad

Type of key	Description
[Question mark]	Displays context-sensitive help text.
[Special characters/abc TOGGLE]	Switches between number keys and special character/alphanumeric keys.
Sign key	Changes the sign of a numeric parameter.
Unit keys (GHz, MHz, kHz, Hz)	Adds the selected unit to the entered numeric value and completes the entry.
[Backspace] key	Deletes the character to the left of the cursor, if an alphanumeric entry has already been started.
[Enter]	Concludes the entry of dimensionless entries. The new value is accepted.
[Up/Down] key	In a numeric edit dialog box, increase or decrease the instrument parameter.
[Left/Right] key	Moves the cursor.
[CE] key	Clears the current entry.
[Max/Min] key	Limits the maximal/minimal value.
[Exp] key	Enters the exponential representation.
Decimal point	Inserts a decimal point "." at the cursor position.
Alphanumeric keys	Enter numbers, letters and (special) characters in edit dialog boxes.

To open the editor

1. To open directly the large On-Screen-Keyboard with mouse/keyborad operation, press [Ctrl+Click].
2. To make the On-Screen-Keyboard configurable, open the configuration dialogue through the [Setting] button.

To overwrite an entry

1. Open the editor.
The whole numeric value is selected.
2. To cancel the selection, move the cursor.
3. Variate the numeric value with the block cursor. The value is transferred with each variation.
4. To change the selected unit, click the unit key. The numeric value is not converted into the other unit.

To use the rotary knob

1. Use the rotary knob for one of the following situations:
 - For navigation purposes, e.g. cursor movement
 - For scalar values
 - For the determination of the numeric values through interactive search during a measurementOtherwise lock the encoder.
2. Serve the rotary knob to increment or decrement the numeric value at a defined step width.
3. The numeric value is immediately set, not only after completion with <ENTER> or similar.
4. By default, the variation for number parameters is always on. To switch off the variation per parameter, start with e.g. "Save -> Filename" in edit mode.

Behavior in the open editor

1. To change between insert and overwrite mode, press the [INSERT] hardkey or [EINFG]. The numeric value is transferred after completion with <ENTER> and variation is not possible. With insert modus, the line cursor appears.
2. Click the [Up/Down] key to increase/decrease the numeric value by 100 [unit].
3. Entering values outside the valid value range, is signaled to the user. The entered value is automatically set to min/max and corrected.
4. If you click [ESC] or next to the key or input field, the input is discarded.

Tips for quick usage

1. Tolltip/move-over: Get hints on using the keypad efficiently by moving over the key.
2. Exponential representation: Simplify the representation of numeric values with exponents, e.g. "1e6 ENTER" instead of 1 000 000 Hz independent of the current unit. Take always the basis unit.

12 Network operation and remote control

As an alternative to the interactive operation directly at the instrument, you can operate the R&S SF1100A also from a remote location.

The LAN interface provides flexible access to the instrument, for example *remote control*, *remote operation* or *remote file access*. These remote access modes are fundamentally different, although they are often considered interchangeable, as described in [Chapter 12.1, "Overview of remote access modes"](#), on page 346.

[Figure 12-1](#) shows the physical connection (interface) for remote access.

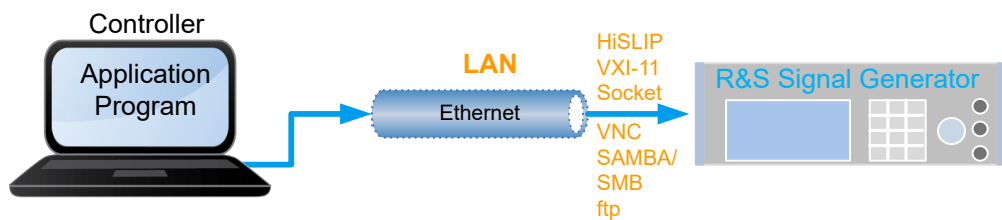


Figure 12-1: Supported remote connections



The following descriptions provide information required for operating the R&S SF1100A remotely. The information applies to all applications and operating modes supported by the instrument. Definitions specified in the SCPI standard are not provided.

For basic knowledge on remote control operation and additional information, see the following documents, available on the Rohde & Schwarz website:

- [Remote control via SCPI](#)
- [1GP72: Connectivity of Rohde&Schwarz Signal Generators](#)
- [1MA208: Fast Remote Instrument Control with HiSLIP](#)
- [1GP98: SCPI Recorder Test Automation on a Fingertip](#)

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• Status reporting system	354
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12.1 Overview of remote access modes

This section outlines the possible access modes and their major characteristics.

Remote control (SCPI)

- A remote PC controls the instrument, usually via VISA (Virtual Instrument Software Architecture) interfaces.
- Remote control disables the manual operation of the instrument; you can set different lock states.
- The GUI is not visible.
- Remote control commands (SCPI) perform the settings, either individually or in sequences (SCPI programs).
- Using SCPI programs is faster than the manual operation, since they automate repeating applications.

Remote operation (VNC)

- A remote device accesses the instrument via the common platform technology VNC (Virtual Network Computing).
- The protocol allows simultaneous operation from several remote devices and the instrument nevertheless remains locally operable.
- The GUI is visible.
- To perform the settings, you can operate the instrument as with the manual control.
- During remote operation via VNC, the direct control of the instrument is not disabled.
You can control the instrument from the front panel and via the remote computer alternately.
- Clients supporting remote operation depend on the used remote device, see [Table 12-1](#).
- How To: see [Chapter 12.10, "Setting up remote operation over VNC"](#), on page 394

Table 12-1: Supported VNC operation modes

Remote device	VNC client	Requirements	Characteristics
Desktop (Windows, Linux, Mac™OS)	<ul style="list-style-type: none"> • Ultr@VNC • Other dedicated client software 	<i>Ultr@VNC or Client Software</i> must be installed.	Fast, supports several options like full screen mode or auto-login.
	<ul style="list-style-type: none"> • Any web browser 	<i>Java Runtime</i> must be installed and activated in the browser settings.	Fast and convenient - only the instrument address required. Java runtime is sometimes considered as security concern.
	<ul style="list-style-type: none"> • Web browser with HTML5 	<i>Web sockets</i> must be supported.	Slower than the other modes. No additional installation or activation required. No security concern.
Smart device (Tablet/ smartphone)	<ul style="list-style-type: none"> • Dedicated client App 	<i>App</i> must be installed.	Fast, supports several options like full screen mode or auto-login.
	<ul style="list-style-type: none"> • Web browser with HTML5 	<i>Web sockets</i> must be supported.	Support of QR code scanning Slower than a dedicated App.

Remote file access (FTP, SAMBA/SMB)

- A remote client accesses the instrument's file system, using the protocols FTP (file transfer protocol) and SAMBA/SMB (server message block).
- The protocols enable you to transfer files from or to the instrument and to get direct access to its file sharing directory `share`.

How to:

[Chapter 10.8.2, "Accessing the file system using FTP"](#), on page 291.

[Chapter 10.8.3, "Accessing the R&S SFI100A file system using SMB \(Samba\)"](#), on page 292

["To enable SMB version 1.0/2.0 client and server"](#) on page 335

12.2 Remote control interfaces and protocols

The LAN interface supports various protocols for remote control. [Table 12-2](#) gives an overview on the connectivity:

Table 12-2: Remote control interfaces and protocols

Interface	Protocols, VISA ^{*)} address string and library	Remarks
Local area network (LAN)	<ul style="list-style-type: none"> • HiSLIP High-Speed LAN Instrument Protocol (IVI-6.1) TCP/IP::host address::hislip0[::INSTR] VISA • VXI-11 TCP/IP::host address[:: LAN device name][::INSTR] VISA • Socket communication (Raw Ethernet, simple Telnet) TCP/IP::host address[:: LAN device name]::<port>::SOCKET VISA or socket controller 	<p>The LAN connector is at the rear panel of the instrument.</p> <p>The interface is based on TCP/IP, see Chapter 12.2.1, "LAN interface", on page 349 for details on the address information.</p>

^{*)} VISA (Virtual Instrument Software Architecture) is a standardized software interface library providing input and output functions to communicate with instruments. A VISA installation on the controller is prerequisite for remote control over LAN (when using VXI-11 or HiSLIP protocol). With socket communication, VISA installation is optional. For basic information, see [Remote control via SCPI](#).



<http://www.rohde-schwarz.com/rsvisa> provides the standardized I/O software library R&S VISA for download at the Rohde & Schwarz website <http://www.rohde-schwarz.com/rsvisa>.

How to: [Chapter 12.8, "Setting up remote control"](#), on page 374

- [LAN interface](#)..... 349
- [LXI browser interface](#)..... 350

12.2.1 LAN interface

The LAN interface of the instrument consists of a connector, a network interface card and protocols.

For remote control, the instrument and the controller PC must be connected to a common network with TCP/IP network protocol.

There are two methods to establish a LAN connection to the instrument:

- A non-dedicated network (Ethernet) connection from the instrument to an existing network.
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer.

How to: [Chapter 3.1.7, "Connecting to LAN"](#), on page 19



Identifying instruments in a network

If several instruments are connected to the network, each instrument has its own IP address and associated resource string. The controller identifies these instruments by the resource string.

VISA resource strings

The VISA resource string is required to establish a communication session between the controller and the instrument in the LAN. The resource string is a unique identifier, composed of the specific IP address of the instrument and some network and VISA-specific keywords.

TCPIP::<host address>[:<LAN device name>][:INSTR]

TCPIP	= designates the network protocol
host address	= designates the IP address or hostname of the instrument
[<LAN device name>]	= defines the protocol and the instance number of a subinstrument
[INSTR]	= indicates the instrument resource class (optional)

The **IP address** (host address/computer name) is used by the programs to identify and control the instrument. It is automatically assigned by the DHCP server the first time the device is registered in the network. Optionally, you can also assign its **LAN device name**.

If assigned, the IP address is displayed in the block diagram.

The following section lists the characteristics of the VISA resource strings for the corresponding interface protocols. The emphasized characters determine the protocol.



For description of the interface protocols, control commands and messages, refer to [Remote control via SCPI](#).

HiSLIP

TCPIP::[<host address>::hislip0\[:INSTR\]](#)

hislip0 = HiSLIP device name, designates that the interface protocol HiSLIP is used (mandatory)

hislip0 is composed of `[::HiSLIP device name[,HiSLIP port]]` and must be assigned.

Example:

```
TCPIP::192.1.1.2.3::hislip0
```

VXI-11

TCPIP::[<host address>\[:inst0\]\[:INSTR\]](#)

[:inst0] = LAN device name, indicates that the VXI-11 protocol is used (optional)

inst0 currently selects the VXI-11 protocol by default and can be omitted.

Example:

```
TCPIP::192.1.1.2.3::INSTR
```

Socket communication

TCPIP::[<host address>::<port>::SOCKET](#)

port = determines the used port number
SOCKET = indicates the raw network socket resource class

Socket communication requires the specification of the port (commonly referred to as port number) and of "SOCKET" to complete the resource string.

Basically, instruments from Rohde & Schwarz use port number 5025 for socket communication.

Example:

```
TCPIP::192.1.1.2.3::5025::SOCKET
```

12.2.2 LXI browser interface

The LXI browser interface allows easy configuration of the LAN and remote control of the R&S SF100A without additional installation requirements. The instrument's LXI browser interface works correctly with all W3C compliant browsers.

See [Chapter 12.11.1, "LXI functionality"](#), on page 401 for more about LXI.

The LAN settings are configured using the instrument's LXI browser interface described in [Chapter 12.7.1, "LAN configuration"](#), on page 369.

For LXI status information in the R&S SF100A, see [Chapter 12.6, "LXI status settings"](#), on page 366.

12.3 Remote control programs and libraries

This section shows how the remote-control programs access the instrument, and the libraries they require for the corresponding interface protocols.

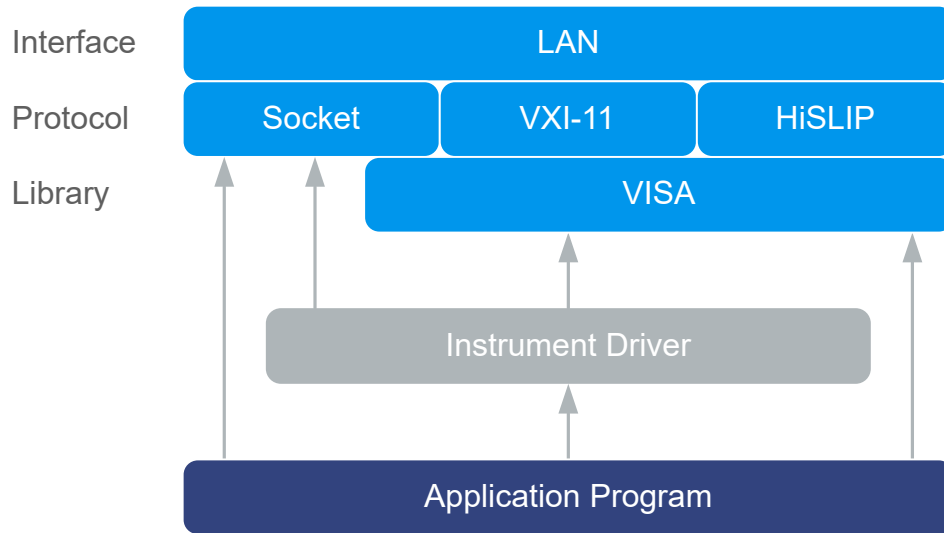
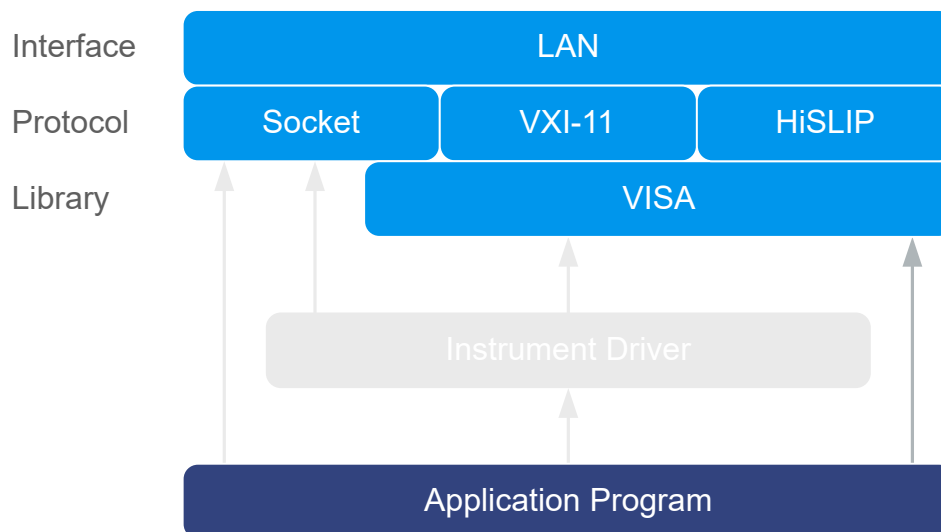


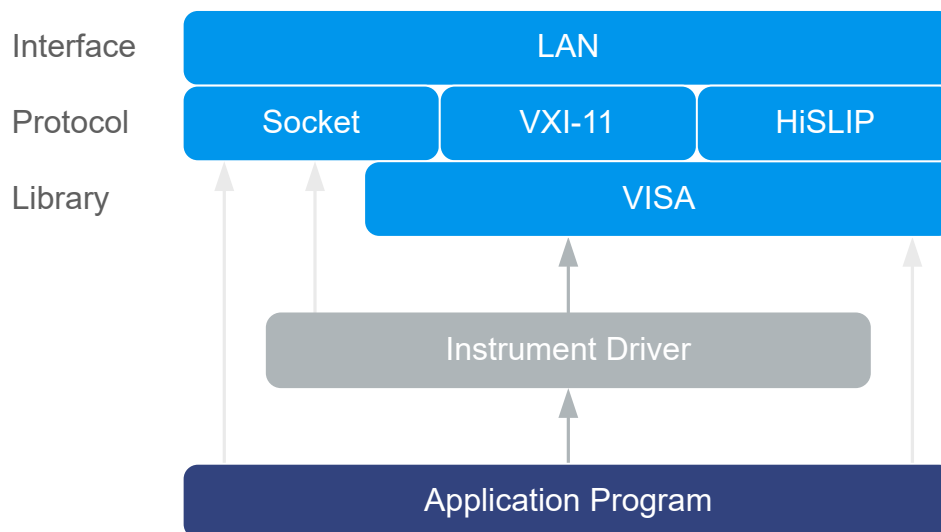
Figure 12-2: Overview of remote control interfaces, protocols and libraries

Possible setups and access functions

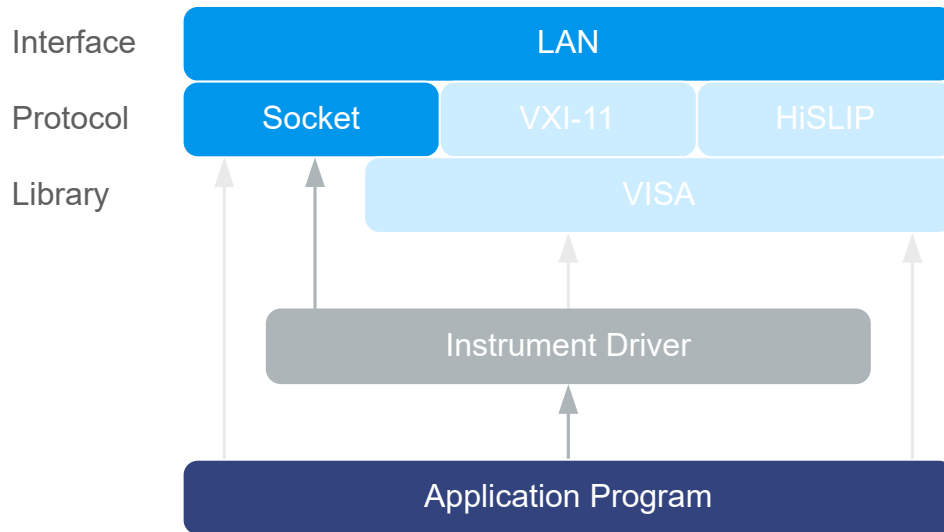
The following examples give an overview of dependencies between the available libraries, the possible interfaces and protocols, and whether an instrument driver is provided. For detailed information, see the application note [1GP72](#).

Example: Remote control (application) program using VISA**Figure 12-3: Application program using VISA**

Protocol	Remote control program
Socket	<pre>viOpen (... , "TCPIP:SF100A-102030::5025::SOCKET", ...) viPrintf (... , "SOUR:FREQ 2GHz\n")</pre>
VXI-11	<pre>viOpen (... , "TCPIP:SF100A-102030::inst0::INSTR", ...) viPrintf (... , "SOUR:FREQ 2GHz\n")</pre>
HiSLIP	<pre>viOpen (... , "TCPIP:SF100A-102030::hislip0::INSTR", ...) viPrintf (... , "SOUR:FREQ 2GHz\n")</pre>

Example: Remote control program using instrument driver (VISA available)*Figure 12-4: Application using instrument driver (VISA available)*

Protocol	Remote control program
Socket	<pre>rssfi_init ("TCPIP:SFI100A-102030::5025::SOCKET", ...) rssfi_SetFrequency (... , 2e9)</pre>
VXI-11	<pre>rssfi_init ("TCPIP:SFI100A-102030::inst0::INSTR", ...) rssfi_SetFrequency (... , 2e9)</pre>
HiSLIP	<pre>rssfi_init ("TCPIP:SFI100A-102030::hislip0::INSTR", ...) rssfi_SetFrequency (... , 2e9)</pre>

Example: Remote control program using instrument driver (VISA not available)*Figure 12-5: Remote control program using instrument driver (VISA not available)*

Protocol	Remote control program
Socket	<pre>rssfi_init ("TCPIP:SF1100A-102030::5025::SOCKET", ...) rssfi_SetFrequency (... , 2e9)</pre>

12.4 Status reporting system

The status reporting system stores all information on the current operating state of the instrument and on errors which have occurred. This information is stored in the status registers and in the error queue. You can query the status of the registers with the remote commands of the [Chapter 13.17, "STATUS subsystem"](#), on page 577.

12.4.1 Overview of the status registers

The [Figure 12-6](#) shows the hierarchical structure of information in the status registers (ascending from left to right).

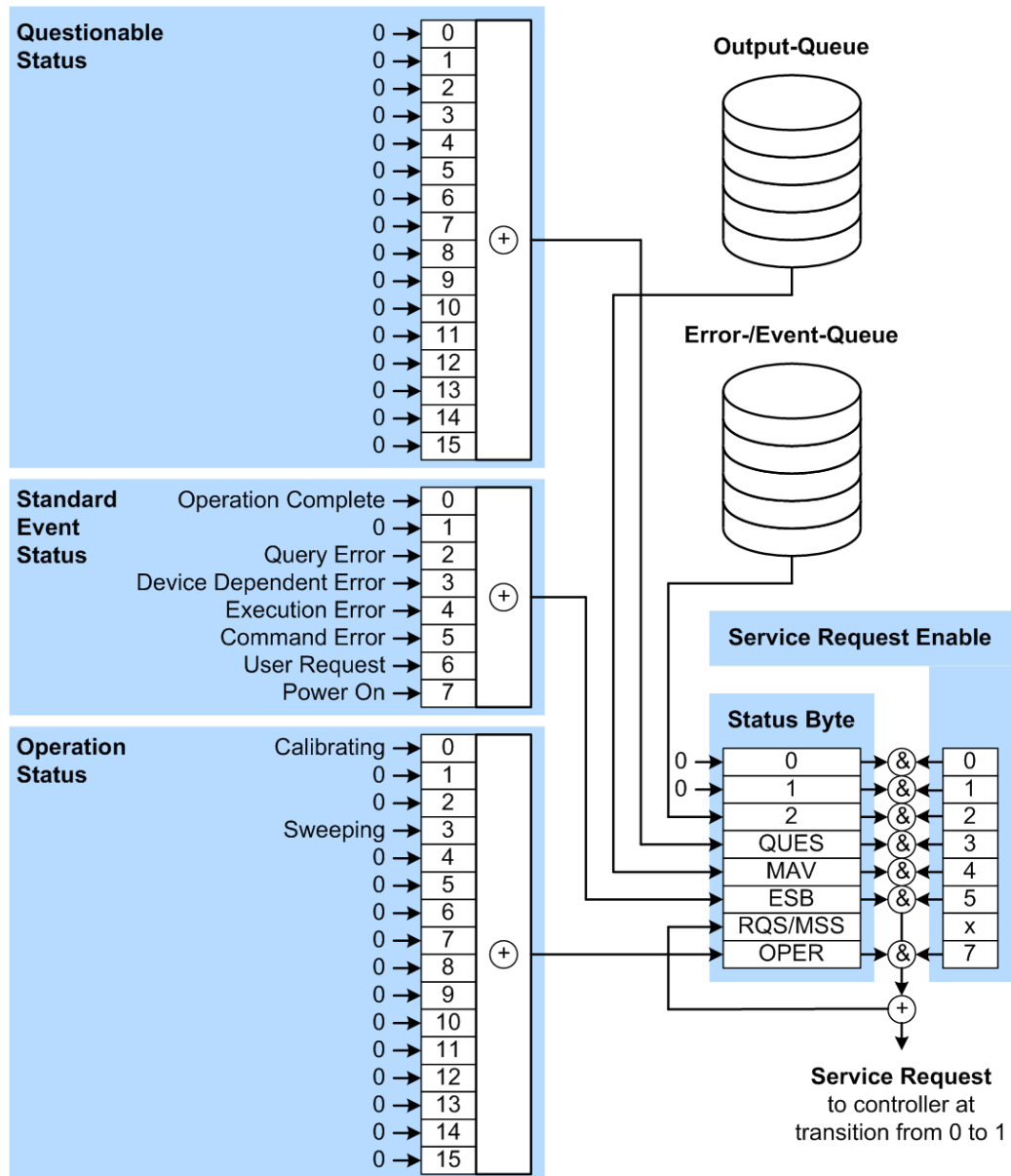


Figure 12-6: Graphical overview of the status registers hierarchy

- OPER = Operation Status Summary Bit
- RQS/MSS = Service Request Generation
- ESB = Standard Event Status Summary Bit
- MAV = Message Available in Output Queue
- QUES = Questionable Status Summary Bit
- 2 = Error- /Event-Queue
- 1, 0 = not used



The following sections describe the instrument-specific bit assignments of the operation status and the questionable status registers.

For more information, see:

- [Remote control via SCPI](#): provides general information on the status reporting system of Rohde & Schwarz instruments. This document also provides information on the standard event status register and the error queue.
- SCPI standard documentation for comprehensive information on the standard

12.4.2 Instrument-specific status operation register

The condition part contains information on currently executed actions. The event part covers information on the actions performed since the last readout of the register.

To read the register, use the query commands `:STATus:OPERation:CONDition?` on page 578 and `:STATus:OPERation[:EVENT]` on page 578.

The remote commands for the status questionable register are described in [Chapter 13.17, "STATus subsystem"](#), on page 577.

Table 12-3: Assignment of the bits used in the operation status register

Bit No.	Meaning
0	Calibrating The bit is set during the calibration phase.
1–2	Not used
3	Not Used
4–15	Not used

12.4.3 Instrument-specific status questionable register

This status register contains information on questionable instrument states. Questionable states occur when the instrument is not operated in compliance with its specifications.

To read the register, use the query commands `:STATus:QUEStionable:CONDition` on page 580 or `:STATus:QUEStionable[:EVENT]` on page 580.

The remote commands for the status questionable register are described in [Chapter 13.17, "STATus subsystem"](#), on page 577.

Table 12-4: Assignment of the bits used in the questionable status register

Bit No.	Meaning
0–15	Not used

12.4.4 Reset values of the status reporting system

The following table contains the different commands and events causing the status reporting system to be reset. None of the commands, except for *RST and SYSTem:PRESet affect the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 12-5: Resetting the status reporting system

Event	Switching on supply voltage Power-On-Status-Clear		DCL, SDC (Device Clear, Selected Device Clear)	*RST or SYSTem: PRESet	STATus: PRESet	*CLS
	0	1				
Clear STB, ESR	-	Yes	-	-	-	Yes
Clear SRE, ESE	-	Yes	-	-	-	-
Clear PPE	-	Yes	-	-	-	-
Clear error queue	Yes	Yes	-	-	-	Yes
Clear output buffer	Yes	Yes	Yes	1)	1)	1)
Clear command processing and input buffer	Yes	Yes	Yes	-	-	-

1) The first command in a command line that immediately follows a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

12.5 Remote access settings

This section describes the settings required for accessing and configuring the provided remote control interfaces. It includes network settings, access addresses, emulation settings for using the command sets of other generators, and the access with smart devices.

12.5.1 Network settings

Access:

- ▶ Select "System Config" > "Remote Access" > "Network".

Network	Visa Resource Strings	Instrument Emulations	Remote Connections	QR-Code	
Network Status					Restart Network
● Connected					
Hostname		Workgroup			
INSTRUMENT		INSTRUMENT			
Instrument Address					
Address Mode					Show Connector ...
Auto (DHCP)					
IP Address		Subnet Mask		Default Gateway	
10.111.0.133		255.255.252.0		10.111.0.1	
DNS Suffix		DNS Server		MAC Address	
rsint.net		10.0.2.166		08 00 27 0c 03 09	

The "Network" dialog provides settings of the general network environment, and specific identification parameters of the instrument in the network. If necessary, you can configure the instrument address settings manually.

How to: ["To assign the instrument address manually"](#) on page 375.

The remote commands to define these settings are described in [Chapter 13.18, "System subsystem"](#), on page 581.

Settings:

Network Status	358
Restart Network	358
Hostname	359
Workgroup	359
Address Mode	359
Show Connector	359
IP Address	359
Subnet Mask	359
Default Gateway	360
DNS Suffix	360
DNS Server	360
MAC Address	360

Network Status

Indicates that the instrument is connected to the network.

Remote command:

`:SYSTem:COMMunicate:NETWork:STATus?` on page 594

Restart Network

Terminates the network connection of the instrument and sets it up again. You can use this function to fix network problems.

Note: This function restarts only the connection of the instrument to the network. It does not impact the network itself.

Remote command:

[:SYSTem:COMMunicate:NETWork:REStart](#) on page 594

Hostname

Displays the hostname.

Each instrument is delivered with an assigned hostname, a logical name which can be used instead of the IP address. With the default network settings, the IP address is allocated by the DHCP server. This address can change each time the instrument is reconnected. Unlike the IP address, the hostname name does not change.

Note:

This function is password-protected. Unlock the protection level 1 to access it.

- We recommend that you do not change the default network settings or the hostname to avoid problems with the network connection.
If you change the hostname, be sure to use a unique name.

Remote command:

[:SYSTem:COMMunicate:NETWork\[:COMMON\]:HOSTname](#) on page 594

Workgroup

Sets the individual windows workgroup name of the R&S SF1100A. This parameter is required in case the instrument is integrated in a windows network.

This function is password-protected. Unlock the protection level 1 to access it.

Remote command:

[:SYSTem:COMMunicate:NETWork\[:COMMON\]:WORKgroup](#) on page 595

Address Mode

Selects the mode for assigning the IP address.

"Auto (DHCP)"

Assigns the IP address automatically, provided the network supports DHCP (Dynamic Host Configuration Protocol).

"Static"

Enables you to assign the IP address manually.

Remote command:

[:SYSTem:COMMunicate:NETWork:IPAdDress:MODE](#) on page 593



Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

IP Address

Displays the IP address of the instrument in the network.

To assign the IP address manually, see ["To assign the instrument address manually"](#) on page 375.

Remote command:

[:SYSTem:COMMunicate:NETWork:IPAdDress](#) on page 593

Subnet Mask

Displays the bit group of the subnet in the host identifier.

The TCP/IP protocol is preinstalled with the subnet mask 255.255.255.0. If the DHCP server is available [Address Mode A AUTO \(DHCP\)](#), the setting is read-only. The subnet mask consists of four number blocks separated by dots. Each block contains 3 numbers in maximum (e.g. 100.100.100.100), but also one or two numbers are allowed in a block (as an example see the preinstalled address).

To assign the subnet mask manually, select [Address Mode > Static](#).

Note: When assigning the subnet mask manually, make sure that the address matches with the subnet mask of the controlling host interface.

How to: "[To assign the instrument address manually](#)" on page 375.

Remote command:

`:SYSTEM:COMMunicate:NETWork[:IPAddress]:SUBNet:MASK` on page 595

Default Gateway

Displays the gateway address.

This address identifies the router on the same network as the instrument that is used to forward traffic to destinations beyond the local network.

To assign the gateway address manually, select [Address Mode > "Static"](#).

Remote command:

`:SYSTEM:COMMunicate:NETWork[:IPAddress]:GATeway` on page 595

DNS Suffix

Displays the primary DNS (Domain Name System) suffix, that means the DNS name without the hostname part.

The DNS system uses the suffix for registration and name resolution for unique identification of the instrument in the entire network.

To assign the DNS suffix manually, select [Address Mode > "Static"](#).

Remote command:

`:SYSTEM:COMMunicate:NETWork[:COMMON]:DOMain` on page 594

DNS Server

Determines the preferred server for name resolution. The DNS server contains the underlying numerical values that are required for name resolution of the hostname as part of the IP address.

To select the DNS server manually, select [Address Mode > "Static"](#).

Remote command:

`:SYSTEM:COMMunicate:NETWork[:IPAddress]:DNS` on page 595

MAC Address

Indicates the MAC (Media Access Control) address, a unique identifier of the network adapter in the R&S SF1100A.

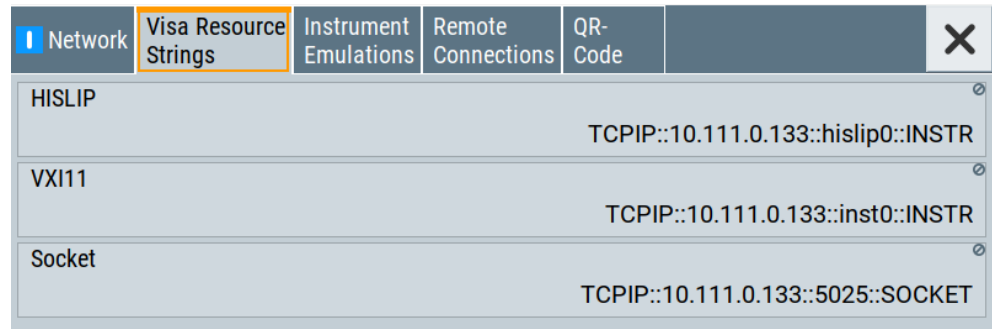
Remote command:

`:SYSTEM:COMMunicate:NETWork:MACaddress` on page 593

12.5.2 VISA resource strings settings

Access:

- ▶ Select "System Config > Remote Access > Visa Resource Strings".



The "Visa Resource String" dialog displays the VISA resource strings for accessing the instrument for remote control.

The remote commands required to query the address information remotely are described in [Chapter 13.18, "SYSTem subsystem"](#), on page 581.

Settings:

HISLIP	361
VXI11	361
Socket	361

HISLIP

Displays the visa resource string for remote control with HiSLIP protocol.

See also [Chapter 12.2.1, "LAN interface"](#), on page 349.

Remote command:

`:SYSTem:COMMunicate:HISLip:RESource?` on page 592

VXI11

Displays the visa resource string for remote control over LAN.

See also [Chapter 12.2.1, "LAN interface"](#), on page 349.

Remote command:

`:SYSTem:COMMunicate:NETWork:RESource?` on page 593

Socket

Displays the visa resource string for remote control over LAN, using the socket communication protocol.

See also [Chapter 12.2.1, "LAN interface"](#), on page 349.

Remote command:

`:SYSTem:COMMunicate:SOCKet:RESource?` on page 595

12.5.3 Instrument emulations

About instrument emulations

You can remotely control the R&S SFI100A using the command set of another signal generator. With this function you can, for example, replace a signal generator with an R&S SFI100A in an automated test setup, without adjusting the command scripts used.



The R&S SFI100A also covers command sets of Rohde & Schwarz signal generators. To achieve optimal compatibility when replacing an instrument, we recommend that you select the emulation command set for the corresponding signal generator.

You find the remote control command sets supported by the R&S SFI100A in a selection list.

The selected instrument also defines the identification string that is retrieved with query `*IDN?`. If necessary, use the parameter `Mode` and `IDN String` to change this string.

As any other parameter, the remote control command set can also be changed remotely by the command `:SYSTem:LANGuage`.

While working in an emulation mode, the R&S SFI100A specific command set is disabled and the SCPI command `:SYSTem:LANGuage` is discarded.

To return to the SCPI command set of the R&S SFI100A, use the corresponding command of the selected command set.

Access:

- ▶ Select "System Config > Remote Access > Instrument Emulations".

Network	Visa Resource Strings	Instrument Emulations	Remote Connections	QR-Code	X
Language					
SCPI					
*IDN?/*OPT? Identification					
Mode					
Automatic					
IDN String					
Rohde&Schwarz,SFI100A,1444.4001K02/0,5.30.132.04 beta (Debug)					
OPT String					
SFI-B1016,SFI-K0,SFI-K17,SFI-K261,SFI-K414,SFI-K441,SFI-K444,SFI-K448,SFI-K471,SFI-K477,SFI-K499,SFI-K510,SFI-K517,SFI-K529,SFI-K530,SFI-K544,SFI-K548,SFI-K553,SFI-K703,SFI-K704,SFI-K708					

The "Instrument Emulations" dialog enables you to emulate a remote control command set of another signal generator.

The remote commands required to configure the emulation settings are described in [Chapter 13.18, "SYSTem subsystem"](#), on page 581.

Settings:

Language	363
Mode	363
Set to Default	363
IDN String	363
OPT String	363

Language

Selects the instrument whose remote command set is emulated by the R&S SF1100A.

Remote command:

[:SYSTem:LANGUage](#) on page 598

Mode

Selects the way the instrument identification is performed.

"Automatic" Sets the "IDN String" and the "OPT String" automatically for the instrument selected with the parameter [Language](#).

"User Defined" Enables you to define the "IDN String" and the "OPT String".

Remote command:

[:SYSTem:IDENTification](#) on page 596

Set to Default

In "Mode > User Defined", resets the *IDN and *OPT strings.

Remote command:

[:SYSTem:IDENTification:PRESet](#) on page 597

IDN String

Indicates the identification string of the instrument when queried with the common command *IDN?.

In addition to the preset values, you can define your own identification string so that each generator uses an individual identification, like `My_SigGen` for instance, see [Mode](#).

Remote command:

*IDN? on page 408

[:SYSTem:IRESpone](#) on page 597

OPT String

Indicates the option string of the instrument as queried with common command *OPT?.

In [Mode](#) > "User Defined", you can define your own option string. A query responds with this option string instead of the automatically created option string.

Remote command:

*OPT? on page 408

[:SYSTem:ORESpone](#) on page 597

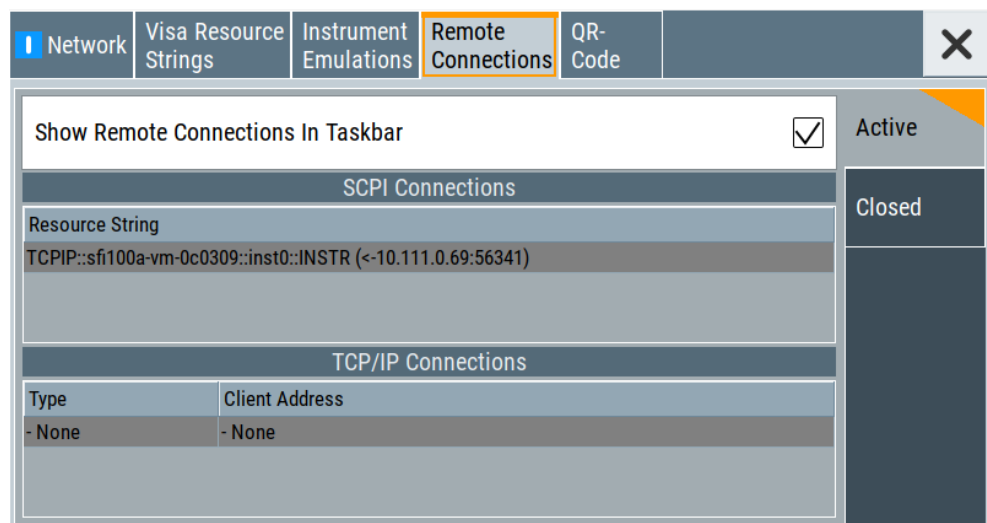
12.5.4 Remote connections

The "Remote Connections" dialog covers the active SCPI and TCP/IP connections, and a history list of the connections that have accessed the instrument before.

12.5.4.1 Active connections

Access:

- ▶ Select "System Config > Remote Access > Remote Connections > Active".



The "Active" tab shows the currently active remote connections, and you can enable the display of the active connections in the task bar.

Settings:

Show Remote Connections in Taskbar	364
SCPI Connections	364
TCP/IP Connections	364

Show Remote Connections in Taskbar

Displays the currently active connections in the taskbar.

SCPI Connections

Displays the VISA resources strings of the remote connections currently controlling the instrument via the LAN interface.

Remote command:

n.a.

TCP/IP Connections

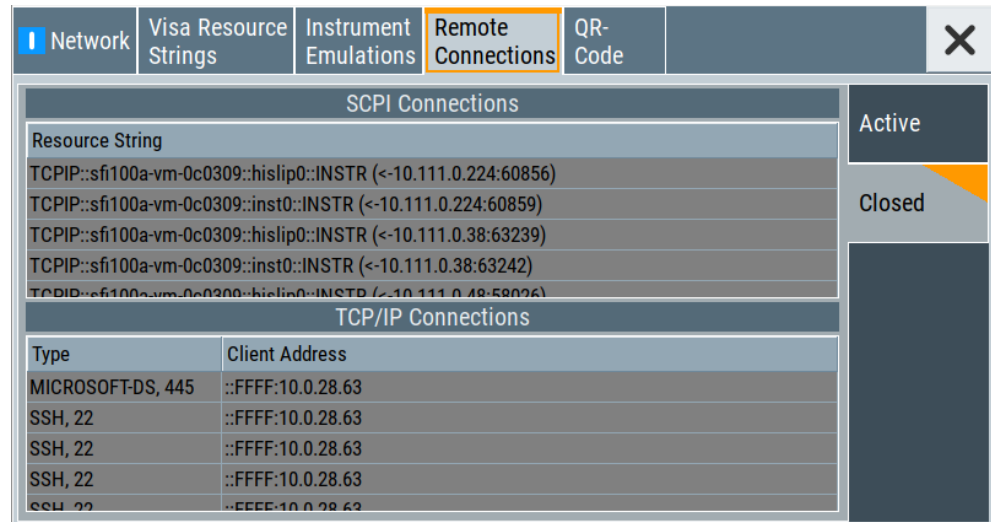
Displays the types and client addresses of the remote connections currently controlling the instrument via the LAN interface.

Remote command:
n.a.

12.5.4.2 Closed connections

Access:

- ▶ Select "System Config > Remote Access > Remote Connections > Closed".



The "Closed" tab shows the currently active remote connections, and you can enable the display of the active connections in the task bar.

Settings:

SCPI Connections	365
TCP/IP Connections	365

SCPI Connections

Lists the VISA resource strings of the last remote connections that have accessed the instrument via the LAN interface before.

Remote command:
n.a.

TCP/IP Connections

Lists the types and client addresses of the last remote connections that had accessed the instrument via the LAN interface before.

Remote command:
n.a.

12.5.5 QR code

Access:

- ▶ Select "System Config > Remote Access > QR Code".



The "QR Code" dialog shows the current instrument address (IP address) in quick response (QR) format.

This functionality provides fast access to the instrument via VNC with, for example, a smartphone or a tablet.

See [Chapter 12.10.2, "Using a smart device"](#), on page 398.

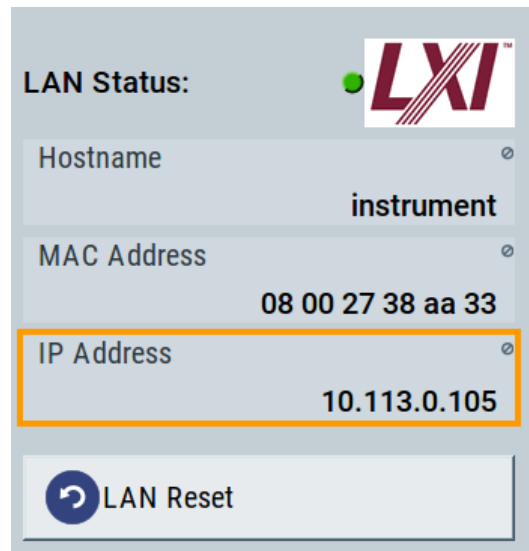
12.6 LXI status settings

On the R&S SFI100A, an LXI functionality is already installed and enabled. Thus, you can access the instrument using any web browser.

See [Chapter 12.7, "LXI browser settings"](#), on page 368.

Access:

- ▶ Select "System Config > Setup > Remote Access > LXI Status".



The LXI "LAN Status" dialog shows the parameters of the LAN connection.

Alternatively, you can change the LAN settings using the LXI web browser interface, see [Chapter 12.7.1, "LAN configuration"](#), on page 369.

LAN Status

The LED indicates the LXI status.

"green"	Normal operation
"green (flashing)"	Device identification
"red"	LAN fault

Hostname / MAC Address / IP Address

See "[Hostname](#)" on page 359.

LAN Reset

Initiates the network configuration reset mechanism for the instrument and resets the hostname, MAC address, and IP address.

According to the LXI standard, a LAN reset must set the following network parameters to a default state:

Parameter	Value
TCP/IP mode	DHCP + Auto IP address
Dynamic DNS	Enabled
ICMP ping	Enabled
Password for LAN configuration	LxiWebIfc

The LAN reset also resets the following parameters for the R&S SF100A:

Parameter	
Hostname	Instrument-specific hostname
Description	wideband IF vector signal generator
Negotiation	Auto detect
VXI-11 discovery	Enabled

12.7 LXI browser settings

Accessing the R&S SF100A over the LXI browser interface, you can perform the following tasks:

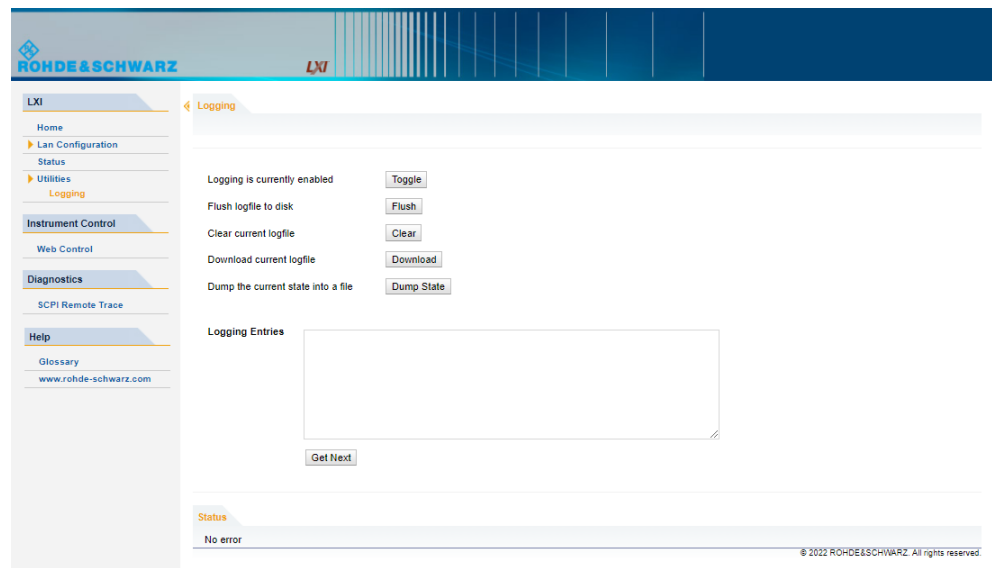
- Modifying network configurations, see [Chapter 12.7.1, "LAN configuration"](#), on page 369.
- Accessing the instrument remotely
- Analyzing SCPI remote diagnostics
- Monitoring the use and status of the instrument

Access:

- In the address field of the browser, enter the URL address, composed of the instrument's IP address or host name, for example `http://10.113.1.151`.

Note: Do not add the missing zeros in the IP address, while opening the instrument homepage.

The instrument homepage (welcome page) opens.



The navigation pane of the browser interface contains the following elements:

- "LXI"
 - "Home" opens the instrument homepage.

The homepage displays the device information required by the LXI standard, including the VISA resource string in read-only format.

- "Device Indicator" activates or deactivates the LXI status indication. When activated, the LXI LED flashes. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates that no LAN cable is connected.
- "Lan Configuration" allows you to configure LAN parameters and to initiate a ping, see [Chapter 12.7.1.3, "Ping client"](#), on page 371.
- "Status" displays information about the LXI status of the instrument.
- "Utilities" provides access to the LXI event logging functionality required by the LXI standard.
- "Instrument Control"
 - "Web Control" provides remote access to the instrument. See ["To start remote control with the LXI browser"](#) on page 377.
- "Diagnostics"
 - "SCPI Remote Trace" records messages exchanged via the remote control interface, see [Chapter 12.7.2, "SCPI remote trace"](#), on page 372.
- "Help"
 - "Glossary" explains terms related to the LXI standard.
 - www.rohde-schwarz.com opens the Rohde & Schwarz homepage.

12.7.1 LAN configuration

The "LAN Configuration" web page displays all mandatory LAN parameters and allows their modification.

It comprises the following navigation entries.

- [IP configuration](#)..... 369
- [Advanced config](#).....370
- [Ping client](#).....371

12.7.1.1 IP configuration

The "IP configuration" web page displays all mandatory LAN parameters and allows their modification.

The screenshot shows the LXI browser interface for LAN Parameters. The left sidebar contains navigation options: Home, Lan Configuration (with sub-options: IP Configuration, Advanced Config, Ping Client), Status, Utilities, Instrument Control (with sub-option: Web Control), Diagnostics (with sub-option: SCPI Remote Trace), and Help (with sub-options: Glossary, www.rohde-schwarz.com). The main content area is titled 'LAN Parameters' and contains the following fields:

- Hostname: <host name>
- DNS Hostname(s): <host name.xxx.net>
- Domain: rsint.net
- Description: <instrument>
- IP Address Mode: DHCP + Auto IP Address (dropdown menu)
- IP Address: 10.102.189.51
- Subnet Mask: 255.255.252.0
- Default Gateway: 10.102.188.1
- Obtain DNS Server Address automatically:
- DNS Server(s): 10.0.2.166 (with a secondary field containing 10.0.23.159)
- Register Device at DNS Server dynamically:
- HiSLIP Port: 4880

A 'Submit' button is located at the bottom right of the form. A note on the right side of the form reads: 'Attention! Changing the hostname reboots the device!'. A status bar at the bottom indicates 'No error' and includes the copyright notice '© 2012 ROHDE&SCHWARZ. All rights reserved.'

The "IP Address Mode" selects a configuration mode for the IP address of the instrument. With static configuration, the entered IP address, subnet mask, and default gateway are used. With dynamic configuration, DHCP or dynamic link local addressing (automatic IP) is used to obtain the instrument IP address.



Changing the LAN configuration

This function is password-protected. Unlock the protection level 1 to access it.

Note: We recommend that you change the default password before connecting the instrument to a network.

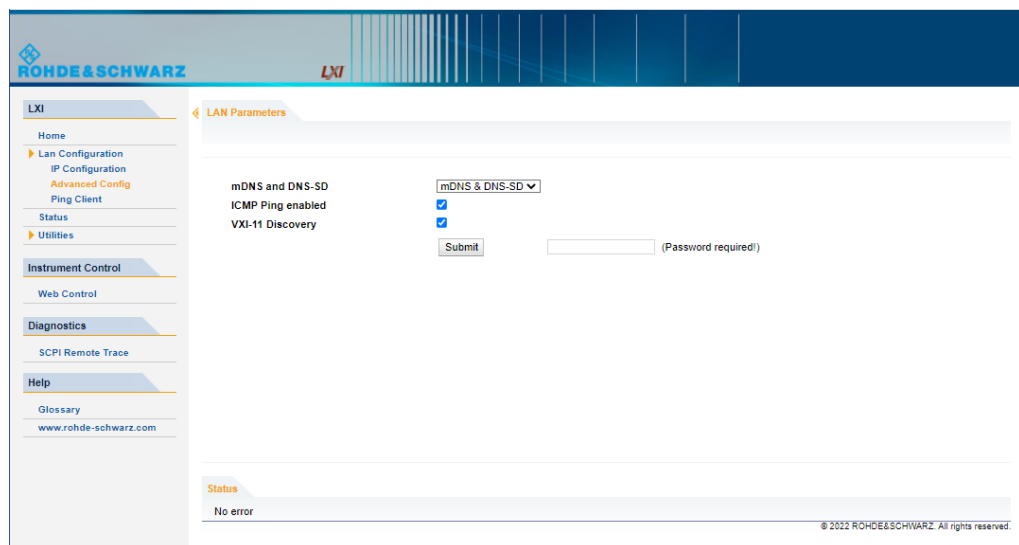
How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

See [Chapter 11.4.4, "Password management"](#), on page 330.

12.7.1.2 Advanced config

The "Advanced Config" web page provides LAN settings that are not declared mandatory by the LXI standard.



The following advanced parameters are available:

- "mDNS and DNS-SD": The additional protocols "multicast DNS" and "DNS service discovery" are used for device communication in zero configuration networks, working without DNS and DHCP.
- "ICMP Ping": Must be enabled to use the ping utility.
If you disable this setting, the instrument does not answer ping requests. The setting does not affect the LXI ping client. You can ping other hosts from the instrument, even if the setting is disabled.
- "VXI-11 Discovery": Must be enabled to detect the instrument in the LAN.
If you disable this setting, the instrument cannot be detected by the VXI-11 discovery protocol mechanism. The setting does not affect other detection mechanisms. Setting up a VXI-11 connection via the IP address or the host name is independent of this setting.



Changing the LAN configuration

This function is password-protected. Unlock the protection level 1 to access it.

Note: We recommend that you change the default password before connecting the instrument to a network.

How to:

- ["To change the user password of the instrument"](#) on page 333.
- ["To change the security password"](#) on page 333.

See [Chapter 11.4.4, "Password management"](#), on page 330.

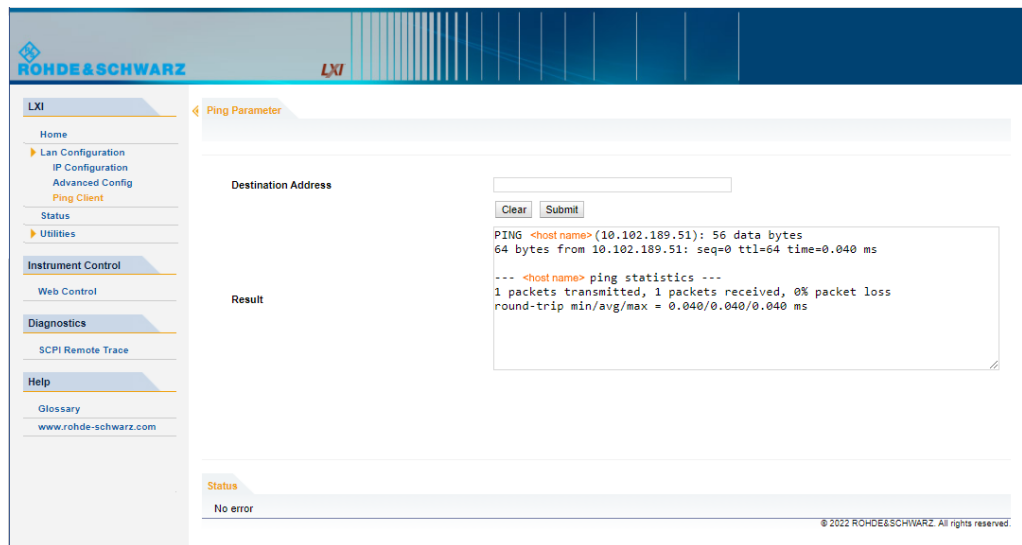
12.7.1.3 Ping client

The "Ping Client" page provides the ping utility to verify the connection between the LXI-compliant instrument and another device.

The ping is initiated from the instrument. Using the `ICMP` echo request and echo reply packets, this function checks whether the communication with a device via LAN is working. Ping is useful for the diagnosis of IP network or router failures.

To initiate a ping at the instrument:

1. On the "Ping Client" page, enter the IP address of the host in the "Destination Address" field (for example 10.113.1.151).
2. Select "Submit".



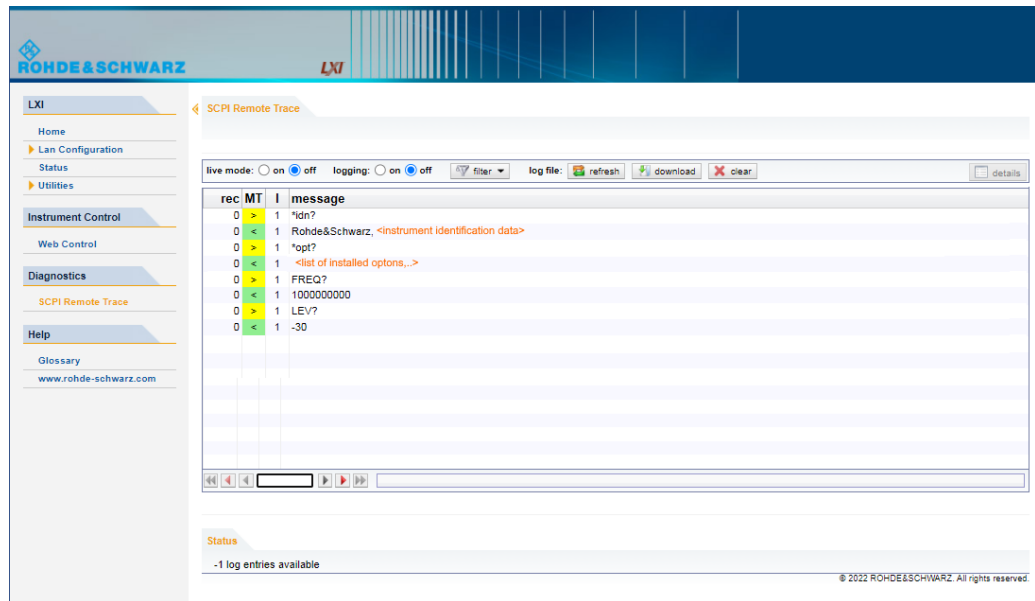
12.7.2 SCPI remote trace

The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S SF100A.

See ["To activate SCPI remote trace"](#) on page 378.

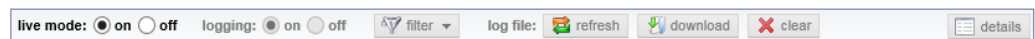
A recorded trace (message log) can be evaluated directly in the dialog. Use the highlighting and navigation functions provided by the lower toolbar to locate error messages and messages containing arbitrary search strings. You can also export the message log to a `*.csv` file and evaluate the file using a suitable program.

To trace and display messages, switch on "logging" and "live mode" in the toolbar.



Toolbars

The toolbar at the top of the dialog provides basic settings and functions.



- "Live mode" / "logging": If logging is switched on, messages are traced. They are stored in an internal database and can be displayed upon request, using the refresh button (live mode off) or they can be displayed automatically (live mode on).
- "Filter": applies a filter to columns and/or rows when working (live mode off)
- "Refresh": reads the message log from the internal database and displays it
- "Download": stores the SCPI trace log to a *.CSV file
- "Clear": deletes all message log entries in the database and at the screen
- "Details": displays details of the selected message, for example an SCPI command in hex format (also possible by double-clicking a message)

Columns

The following columns are available if no column filter is applied:

- "Rec": record number of the message within the message log
- "MT": indicates the type of the message. Possible values and related message contents are:
 - > = incoming command
 - < = outgoing response to a query
 - E = error message, highlighted by red color
 - T = execution time, i.e. time required by the instrument to process the command internally.
- I: number of the subinstrument

- "message": indicates the type of the message. Possible values and related message contents are:
 - > = incoming command
 - < = outgoing response to a query
 - E = error message, denoted in red
 - T = execution time, i.e. time required by the instrument to process the command internally

12.8 Setting up remote control

When you switch on the R&S SFI100A, it is always in manual operation state ("local" state). You can operate the instrument over the touchscreen, the front panel and an external keyboard and/or mouse.

Prerequisites

For remote control, make sure that you have fulfilled the following prerequisites:

- The instrument and the controller PC are connected in the same network. See [Chapter 3.1.7, "Connecting to LAN"](#), on page 19.
- The instrument and the controller are switched on.
- The LAN interface and SCPI over LAN are enabled. See [Chapter 11.4.3, "Configuring LAN services"](#), on page 326.
- A remote control program is running on the controller.



If security is a concern, see:

- Document Instrument Security Procedures.
- [Chapter 11.4.5, "Preventing unauthorized access"](#), on page 332.

The following sections describe how to start remote control over the available interface protocols.

- [Configuring remote access](#)..... 374
- [Starting remote control with LXI](#)..... 377
- [Starting remote control with VXI-11](#)..... 378
- [Starting remote control with socket communication](#)..... 383
- [Stopping remote control](#)..... 384

12.8.1 Configuring remote access

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.

- If the network supports dynamic TCP/IP configuration using the [DHCP](#) protocol, this service assigns all address information automatically (default setting).

- If the network does not support DHCP or if there is no server available, the instrument tries to obtain the IP address using the [Zeroconf](#)(Avahi) protocol. This protocol enables the instrument to self-configure an IP address and subnet mask. Zeroconf (Avahi) IP addresses start with the number blocks 169.254.*.*, with the subnet mask of 255.255.

The automatic address configuration establishes the physical connection to the LAN without any additional configuration.



- An IP address that is assigned with the Zeroconf protocol although the network requires an IP address assigned from the DHCP server can cause network connection failures.
- If both services fail to connect, you must set the address information manually. See ["To assign the instrument address manually"](#) on page 375.

To find the VISA resource string

- ▶ Select "System Config > Remote Access > VISA Resource Strings".

Network	Visa Resource Strings	Instrument Emulations	Remote Connections	QR-Code	
	HISLIP				TCPIP::10.111.0.133::hislip0::INSTR
	VXI11				TCPIP::10.111.0.133::inst0::INSTR
	Socket				TCPIP::10.111.0.133::5025::SOCKET

The dialog shows the VISA resource strings that enable you to access the instrument for remote control.

To assign the instrument address manually

It is assumed that you have connected the instrument in the LAN.

1. Obtain the instrument address information for the R&S SF100A and the IP address for the local default gateway from your network administrator. If necessary, also obtain the name of your DNS domain and the IP addresses of the DNS server on your network.
Obtain the IP address and subnet mask for the R&S SF100A and the IP address for the local default gateway from your network administrator. If necessary, also obtain the name of your DNS domain and the IP addresses of the DNS server on your network.
2. On the instrument, select "System Config > Remote Access > Network".
3. Select "Address Mode > Static".
4. Select the "IP Address".

5. Enter the IP address, for example *192.168.0.1*.
The IP address consists of four number blocks separated by dots. Each block contains 3 numbers in maximum.
6. Select the "Subnet Mask" and enter the subnet mask, for example *255.255.255.0*.
Note: The subnet mask must be the same for both, the R&S SF100A and the host interface, the instrument is connected to.
7. Enter the "Default Gateway", "DNS Suffix", and "DNS Server" if necessary.

Using the hostname

In a LAN that uses a [DNS](#) server, each computer or instrument connected in the LAN can be addressed with an unambiguous [Hostname](#) (also referred to as computer name) instead of the IP address. The DNS server translates the hostname to the IP address.



Using the hostname is useful in networks with dynamic TCP/IP and DHCP protocol services, that assign the address information automatically. Thus, it can be that the services assign a new IP address each time the instruments restarts, but they do not change the hostname.

Each instrument is delivered with an assigned hostname, that remains constant as long as it is not explicitly changed.

This function is password-protected. Unlock the protection level 1 to access it.

The default *hostname* name follows the syntax `<INST>-<Serial Number>`, where:

- `<INST>` is the short name of your instrument, as stated on the front panel.
- `<Serial Number>` is the individual serial number of the instrument.
You can find the serial number at the rear panel of instrument. It is the third part of the device ID printed on the barcode sticker.



To query and change the hostname

1. Select "System Config > Remote Access > Network".
Section "Instrument Name" displays the assigned "Hostname".
Note: This function is password-protected. Unlock the protection level 1 to access it.
2. Select "System Config > Setup > Security > Protection".
3. Enable the "Protection Level 1".
The default protection level 1 password is *123456*.

The parameter "Hostname" in the "Network" tab is now enabled for configuration.

4. Change the "Hostname".

Configuring LAN access and services

By default, the LAN interface and the supported LAN interface services are enabled. For security reasons, for example to protect the instrument against unauthorized access, you can block either the LAN services individually, or the access over LAN in general.

For information on how you can specify the LAN access and services individually, see [Chapter 11.4.3, "Configuring LAN services"](#), on page 326 and [Chapter 11.4.5, "Preventing unauthorized access"](#), on page 332.

For information on how you configure the remote access individually, see the following sections:

- [Chapter 11.4.3, "Configuring LAN services"](#), on page 326
- ["To disable LAN access in general"](#) on page 333
- ["To disable LAN services individually"](#) on page 334
- ["To enable SMB version 1.0/2.0 client and server"](#) on page 335

12.8.2 Starting remote control with LXI

Using the LXI browser interface you can access and control the R&S SFI100A instrument remotely from a controller PC without additional installation. Remote control over LXI supports file upload and download between the instrument and the controller PC.

It is assumed that the instrument is set up in the LAN, see ["Prerequisites"](#) on page 374.

To start remote control with the LXI browser

1. On the controller PC, start a browser that supports HTML5 (W3C compliant).
2. Enter the IP address of the R&S SFI100A in the browser's address bar.
The browser displays the R&S SFI100A's welcome page.
3. In the navigation pane, select "Instrument Control" > "Web Control".
Remote access to the instrument requires the password. The default password is *instrument*.
4. Enter the password.
5. Confirm with [Enter].
The current screen of the R&S SFI100A appears in the browser window.
6. Use the mouse cursor and keyboard to access the functionality of the instrument as if you operate the instrument directly.

To activate SCPI remote trace

The remote trace functionality allows you to trace SCPI commands and messages exchanged over the LAN of the R&S SFI100A. To communicate with the instrument over SCPI, use a suitable remote control application.

1. Set up the remote control session as described under "[To start remote control with the LXI browser](#)" on page 377.
2. In the navigation pane, select "Diagnostics > SCPI Remote Trace".
3. In the toolbar bar of the "SCPI Remote Trace" page, select "live mode > on".
4. Using the remote control program, send your SCPI commands to the R&S SFI100A.

The "SCPI Remote Trace" tab displays all sent commands and responses.

5. Select "logging > on".

(Live mode and logging exclude each other).

"logging > on" displays all commands and responses, and traces messages also.

The SCPI remote trace function records all sent commands, received responses and messages, and saves them in an internal database. If "live mode" is disabled, you can display the recent traces on request, using the "refresh" button. You can also save the log in a file.

Note: The diagnostics functionality is extended in later releases, e.g. to download or upload SCPI command files from / to the instrument.

12.8.3 Starting remote control with VXI-11

This connection uses the I/O software library R&S VISA from Rohde & Schwarz to setup a LAN remote control link to the instrument.

R&S VISA is running on a controller PC with Windows operating system. You can send commands to the instrument and receive the responses.

For information installing, operating and the utility applications the software provides, see R&S VISA product page www.rohde-schwarz.com/rsvisa.

The remote control connection requires a VISA installation but no additional hardware on the controller PC. The LAN I/O channel is selected at initialization time using the VISA resource string (also referred to as "address string"). A VISA alias (short name) replaces the complete resource string. The host address is the R&S SFI100A's host-name or its IP address.

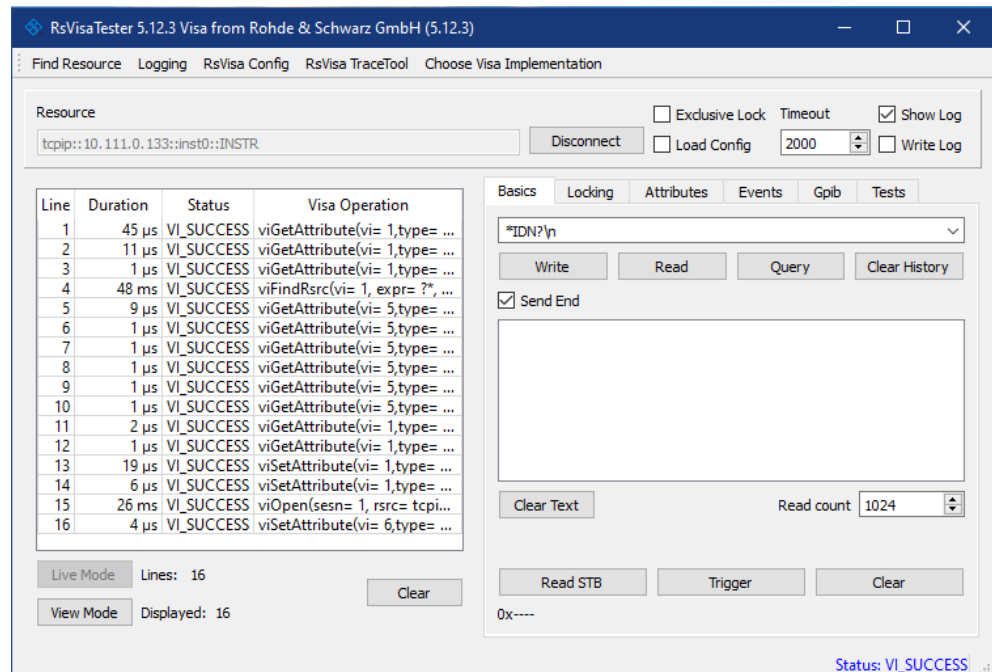
See [Chapter 12.2, "Remote control interfaces and protocols"](#), on page 348.

To set up the controller with R&S VISA

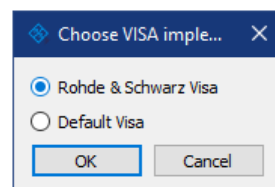
To remote control the R&S SFI100A, we use the R&S VISA Tester application. The application communicates over the TCP/IP protocol.

1. On the controller PC, install the R&S VISA program.
See www.rohde-schwarz.com/rsvisa > "RS VISA release notes".

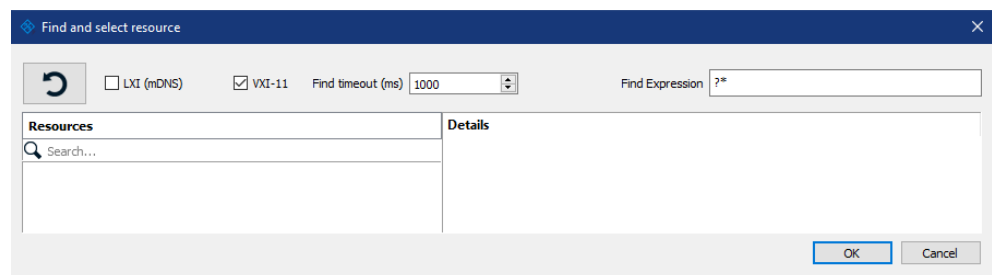
- On the instrument, enable the LAN interface and "SCPI over LAN".
- On the controller, start, e.g., "R&S VISA > Tester".



- In the menu bar, select "Choose VISA Implementation > Rohde & Schwarz Visa"
- Confirm with "OK".



- In the menu bar, select "Find Resource" to search for the instrument in the LAN.

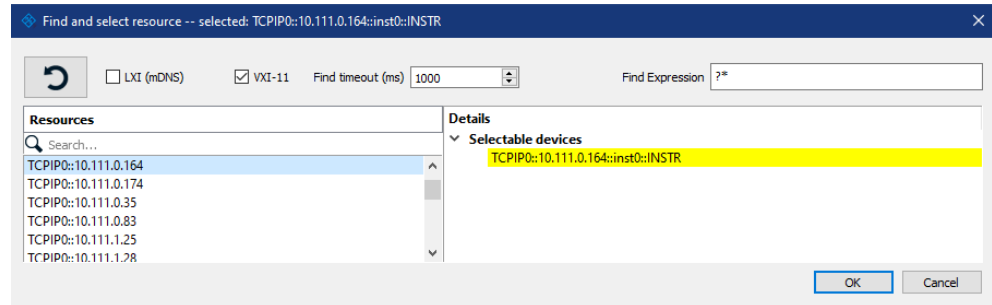


- Select "VXI-11".
- Select the "refresh" button to start the search.

R&S VISA scans the network for connected instruments and lists all detected instruments in the "Resource" list.

Note: The search can take some time, particularly in large networks.

9. Select the required instrument.

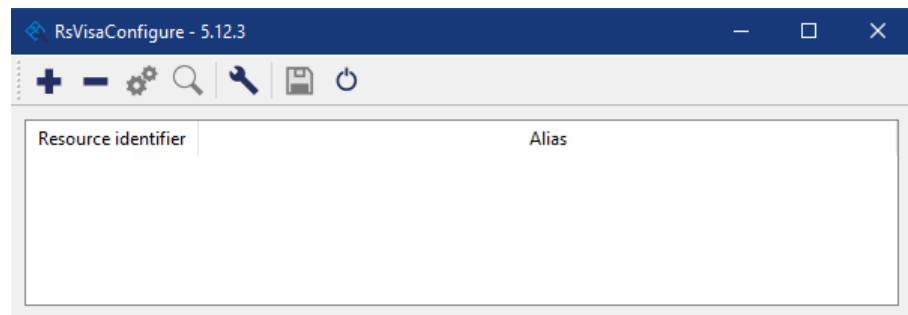


10. Confirm with "Ok".

The "Find and select resource" dialog closes and R&S VISA indicates the IP address in the "Resource" field of the main application window.

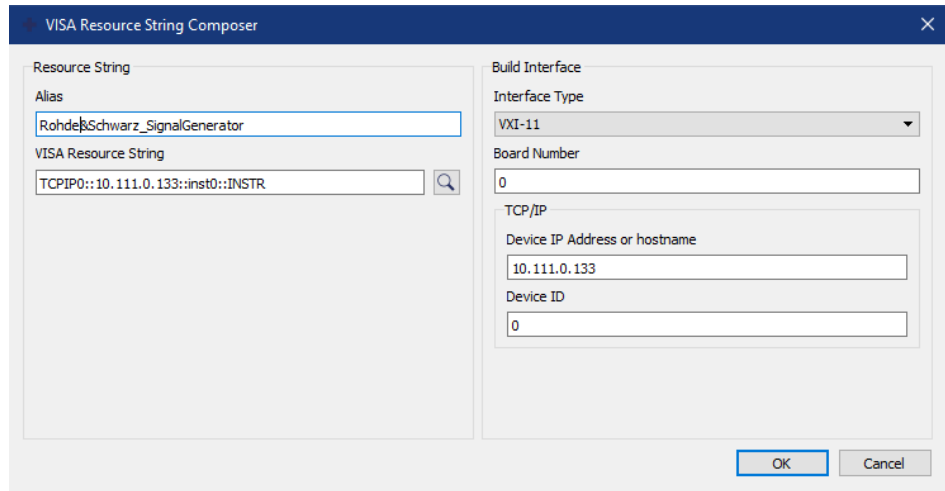
11. As an alternative to the IP address, you can assign an alias name to the R&S SF100A:

a) In the menu bar, select "RsVisaConfig".

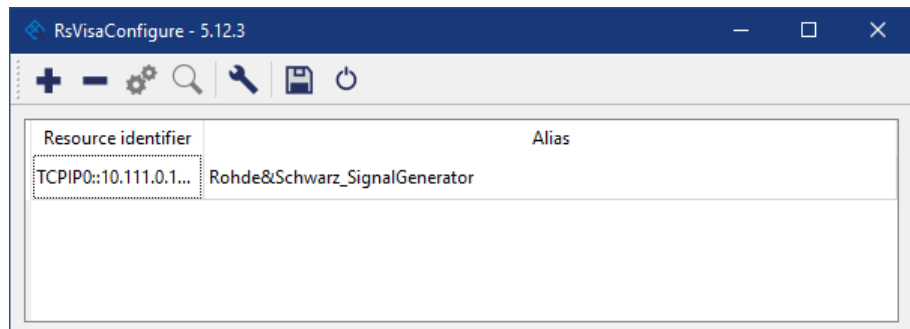


b) In the toolbar, select "+" to access the "VISA Resource String Composer".

- c) Fill in the "Alias" name, the "VISA Resource String" and the "Device IP Address or hostname" as shown in the figure.



R&S VISA indicates the assigned "Alias" name.



- d) Confirm with "OK".
R&S VISA identifies the R&S SFI100A and you can address it either with the resource string or the alias name.

12. In the main window, select "Connect".

R&S VISA establishes the connection to the R&S SFI100A.

You can send settings to configure the instrument and receive its responses.

Note: If the connection cannot be set up, R&S VISA displays an error in the log view.

See also [Chapter 14.5, "Resolving network connection failures"](#), on page 619.

To start remote control with R&S VISA

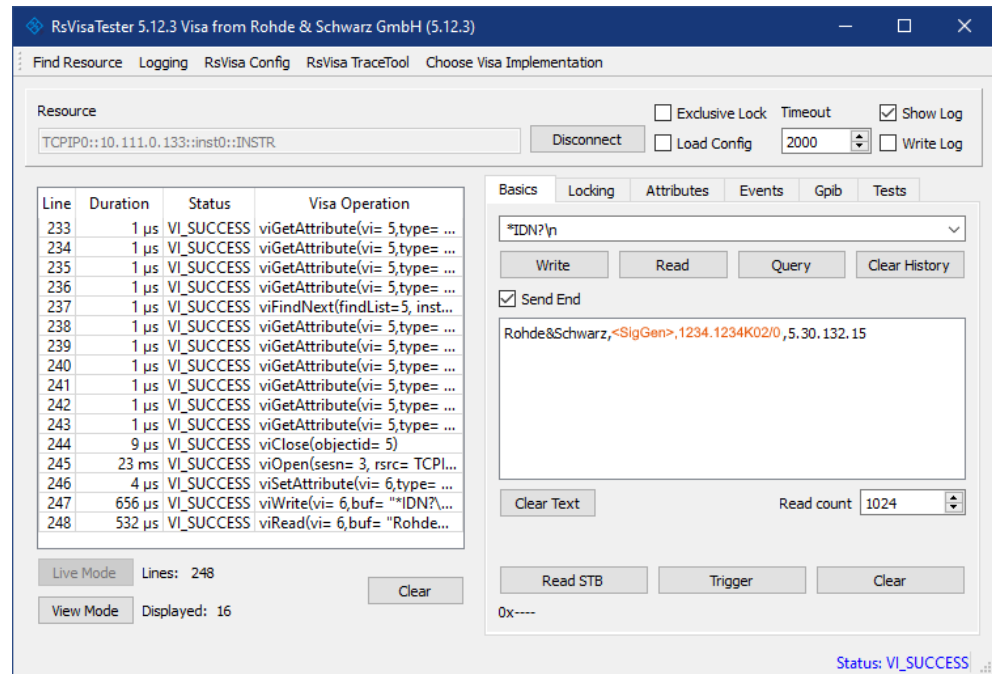
To set the instrument to remote control state, you can send any command from the controller.

1. Start the R&S VISA Tester.
Establish the connection to the R&S SFI100A.
See ["To set up the controller with R&S VISA"](#) on page 378.
2. In the R&S VISA "Basics" tab, enter a SCPI command, e.g. *IDN?.

3. Confirm with "Query".

The instrument switches to remote control when it receives a command from the controller.

4. Select "Read" to obtain the instrument response.



The instrument returns the response.
Remote control over R&S VISA is enabled.

To check remote control with VISA

You can check the communication by sending a setting command and querying the response:

1. Set, e.g. the frequency with the command:
SOUR:FREQ 19.5 GHz.
2. Select "Write".
3. Enter the command SOUR:FREQ?.
4. Select "Query".

If the R&S SF100A responds with the frequency value xyou entered, remote control works properly.

To monitor the remote control operation

1. Check the "Show Log" checkbox on the top right.
R&S VISA displays each VISA operation in the log-view on the left.
2. Check the "Write Log" checkbox.

R&S VISA saves all log-view entries to a log file.

You can operate the log-view in two modes:

- "Live Mode": shows only the most recent messages
- "View Mode" allows you to scroll the history

To return to manual operation, see [Chapter 12.8.5, "Stopping remote control"](#), on page 384.

12.8.4 Starting remote control with socket communication

This section provides an example on how to establish a remote control connection over Telnet client and a simple sockets-based program example that can be further developed.



The telnet client transmits information unencrypted. Therefore, for sensitive information we recommend that you use a client which supports secure protocols, like SSH.

To set up a Telnet connection

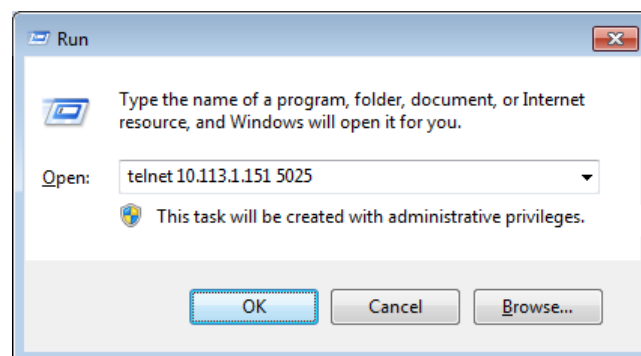
To control the software, only a Telnet program is required. The Telnet program is part of each operating system.

The controller PC and the instrument are connected in the same network.

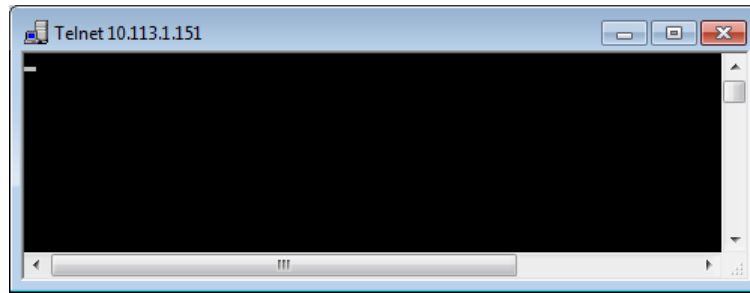
1. On the instrument, enable the LAN interface and "SCPI over LAN".
See [Chapter 11.4.3, "Configuring LAN services"](#), on page 326.
2. On the controller PC, start the Telnet program.
3. Enter the socket address.

The socket address is a combination of the IP address or the hostname of the R&S SF100A and the number of the port configured for remote-control via Telnet.

Tip: The R&S SF100A uses the port number 5025 for remote connection via Telnet.



The connection to the instrument is set up and you can send remote-control commands.



4. Telnet does not reflect your first entry.
Insert a command, e.g. *IDN and confirm with "Enter".
5. Observe the screen.
A response on the query confirms that the connection is working. The client displays all subsequent inputs and responses.
6. Even if the cursor is not visible on the screen, just enter a remote-control command. Confirm with Enter.

12.8.5 Stopping remote control



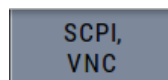
Before returning to manual control, command processing must be completed. Otherwise, the instrument switches back to remote control immediately.

You have the following options to switch from remote control to manual operation:

- Closing the remote control session
- Using remote control commands
- Selecting the remote icon in the status bar directly on the screen
- Selecting the "Local" key on the key emulation pad on the screen

To find out active remote connections

- ▶ Check the indication on the taskbar:



A softkey in the taskbar indicates if and what kind of remote connections are currently set up.




See also [Chapter 12.5.4, "Remote connections"](#), on page 364.

To return to manual operation

Depending on the used remote control state, the transition from remote control to manual operation requires different actions.

- Select the corresponding transition action as shown in the table.

Table 12-6: Remote control status icons

GUI symbol	Transition to remote control state...	Remote control state characteristics	Transition to manual operation...(local state)
	>R (controller PC)	Remote control, but usable front panel keys. The parameters are in read-only mode.	<ul style="list-style-type: none"> • &GTL (SCPI) If &NREN has been set before &GTL is locked. Use &GTR instead. • CALL IBLOC (generator%), (visual basic). • viGpibControlREN() (VISA function) • "Remote" icon in the status bar • "Local" key on the key emulation pad
		The green arrows indicate a currently performed setting.	The setting must be completed (white arrows) before you can return to manual operation.
	&LLO (controller)	Remote control with locked front panel keys to prevent user interaction. The parameters are in read-only mode. You can unlock LLO, and thus return to manual operation only over remote control commands.	<ul style="list-style-type: none"> • &LOCS • &REMS Changes from "Remote LLO" to "Remote" state. • CALL IBLOC (generator%) • viGpibControlREN()

12.9 Using remote command scripts

To configure a test setup quickly, or to make complex test setups or repeating measurements reproducible, you can automate the required settings with remote command scripts. A remote command script contains a sequence of SCPIs which configure the corresponding settings. When created, it is converted to an executable format, saved in a file and can be run whenever needed.

The graph shows the main steps required to create and execute a SCPI script.



Figure 12-7: Steps for performing SCPI Scripts

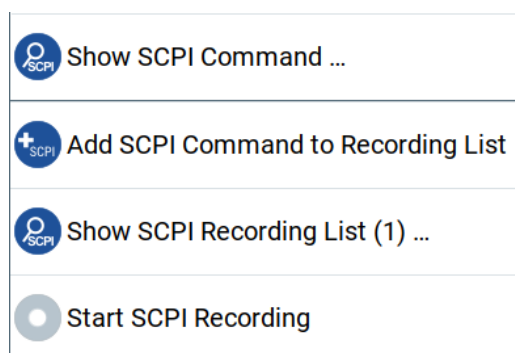
- [SCPI recording settings](#)..... 386
- [Creating remote command lists](#)..... 389
- [Checking and verifying a remote command list](#)..... 391
- [Converting a remote command list to a script](#)..... 392
- [Running a remote command script](#)..... 394

12.9.1 SCPI recording settings

The R&S SF100A provides information on the required SCPI command for the available measurement settings, functions, and results in the context-sensitive menu.

Access:

1. Select a parameter.
2. Open the context-sensitive menu (tap and hold).



The context-sensitive menu provides the SCPI recording functions to help you create your script.

- [Show SCPI command settings](#)..... 386
- [SCPI recording list settings](#)..... 387
- [SCPI recording export settings](#)..... 388

12.9.1.1 Show SCPI command settings

Access:

1. Select the parameter.
2. Open the context-sensitive menu.
3. Select "Show SCPI Command".

This function provides the syntax of the remote command with the current setting.

Settings:

Copy	387
Close	387

Copy

Copies the command and the current setting.

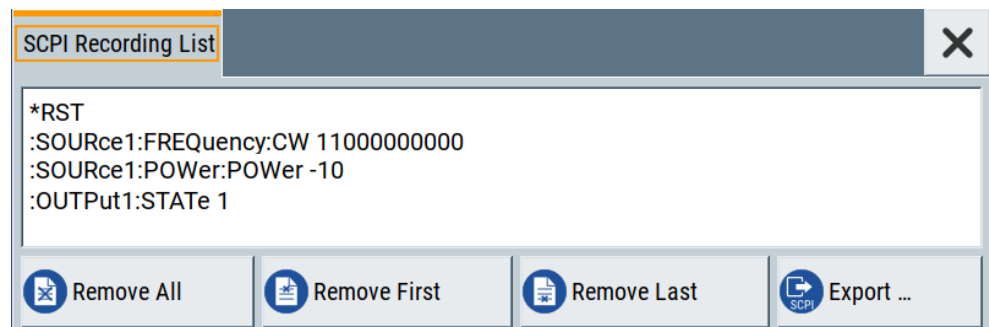
Close

Exits the "SCPI Command" dialog.

12.9.1.2 SCPI recording list settings

Access:

1. Select a parameter.
2. Open the context-sensitive menu.
3. Select "Show SCPI Recording List".



The "SCPI Recording List" shows the recorded commands.

Settings:

SCPI Recording List	387
Remove All	387
Remove First	387
Remove Last	388
Export	388

SCPI Recording List

Lists the automatically or manually recorded SCPI commands.

Remove All

Deletes all entries in the SCPI command list.

Remove First

Deletes the first entry in the SCPI command list.

Remove Last

Deletes the last entry in the SCPI command list.

Export

Opens the "SCPI Recording Export" dialog for configuring the file parameters for the SCPI command script file.

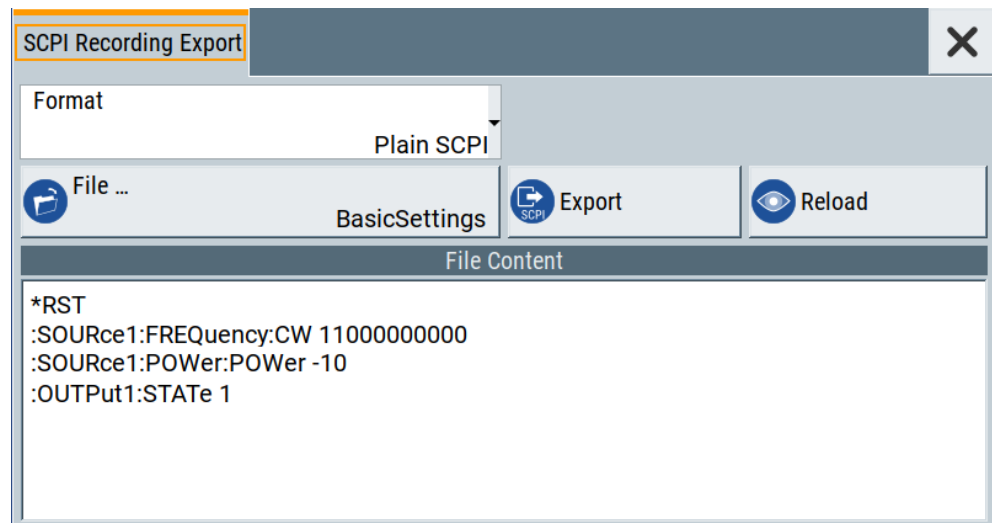
See [Chapter 12.9.1.3, "SCPI recording export settings"](#), on page 388.

12.9.1.3 SCPI recording export settings

The R&S SF100A displays recorded remote command lists in the "SCPI Recording Export" dialog. This dialog opens automatically, when you stop recording. To open the dialog manually, proceed as described.

Access:

1. Select a parameter.
2. Open the context-sensitive menu.
3. Select "Show SCPI Recording List".
4. Select "Export".



The "SCPI Recording Export" dialog contains all functions required for export of command lists to a file. It enables you to select the source code format, assign an individual filename and display the file content.

Settings:

Format	389
Code Template	389
File	389

Export	389
Reload	389
File content	389

Format

Selects the source code format for the command list.

"Plain SCPI" Uses SCPI syntax.

"Predefined Code Generator"

Accesses the predefined templates for common source code generators that convert the recorded settings in the programming languages MATLAB or NICVI or Python.

"User Code Generator"

Use this setting to convert a script by a user-specific code generator.

Code Template

Opens a standard file handling dialog for saving or loading predefined or user-defined code templates.

See "[To use the file-select settings](#)" on page 282.

File

Opens a standard file handling dialog for selecting the directory and file name for the output file.

Export

Saves the remote command list file in the selected directory.

Reload

Reloads a remote command list file.

File content

Displays the content of the remote command list in the selected format and code template.

12.9.2 Creating remote command lists

Using the SCPI recorder functions, you can create a SCPI command list directly on the instrument and then export the list for use on the controller PC. You can also edit or write a script manually, using a suitable editor on the controller. For manual creation, you can retrieve the command corresponding to a setting directly on the instrument.

You can create a SCPI list directly on the instrument at any time of operation, in the following ways:

- Recording settings automatically
The "Start SCPI Recording" function adds the SCPI command of each step that you perform to the SCPI list. You can start, stop and resume automatic recording, and also add individual commands manually.
See "[To record settings automatically](#)" on page 390.
- Recording settings manually

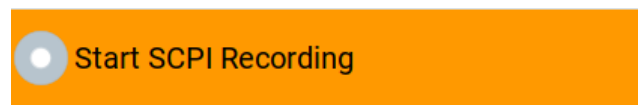
The "Add SCPI Command to Recording List" function adds the SCPI command and settings value of an individual step to the SCPI list.

See ["To record settings manually"](#) on page 390.

- Copying and pasting individual SCPI commands manually
"Show SCPI command" enables you to copy the SCPI command and the current setting and paste it into any suitable editor.
See ["To copy and paste SCPI commands"](#) on page 391.

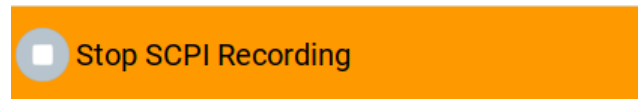
To record settings automatically

1. On the screen, open the context-sensitive menu.
2. Select "Start SCPI recording".



The R&S SFI100A now records all steps you take.

3. To stop SCPI recording, select "Stop SCPI recording" in the context-sensitive menu.

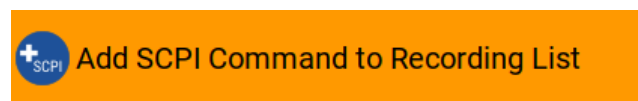


The "SCPI Recording List" dialog opens.

4. Proceed with ["To review a remote command list"](#) on page 392.

To record settings manually

1. Select the parameter or function.
2. Set the parameter.
3. Open the context-sensitive menu.
4. Select "Add SCPI Command to Recording List".



The R&S SFI100A adds the SCPI command of the setting including the value in a temporary SCPI command list.

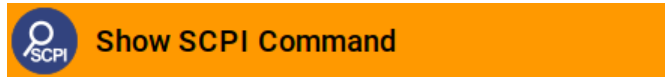
Tip: "Context-Sensitive > Show SCPI Recording List" opens the dialog with the recorded settings.



5. Continue with the next setting accordingly whenever you want to record it.
6. Proceed with ["To review a remote command list"](#) on page 392.

To copy and paste SCPI commands

1. On the instrument, select the parameter or function.
2. Set the parameter.
3. Open the context-sensitive menu.
4. Select "Show SCPI Command".



The R&S SF100A displays the syntax and the setting value of the SCPI command.

With the "Copy" function, you can copy and paste the SCPI command and setting value, e.g., in a command script on a PC.

12.9.3 Checking and verifying a remote command list

Before converting a command list to an executable script, we recommend that you check if the entries are correct and complete. It can be that ...

- a parameter has not assigned a SCPI command or an element of the user interface has not an assigned parameter. In these cases, `:SYST:INF:SCPI 'SCPI command not available'` is entered in the list instead. Such entries are also detected during execution. The instrument recognizes these incomplete commands and displays an error message.
- a preset has been executed, but several standards then perform some internal settings that are also assigned to the list with "SCPI Export".
- after a preset some settings are still defined, which are then written to the list generated with "SCPI Export."

To display a remote command list

On the instrument, you have different options to access a remote command list.

1. During automatic or manual recording:
 - a) Open the context-sensitive menu.
 - b) Select "Show SCPI Recording List".
2. At the end of automatic recording:
 - a) Open the context-sensitive menu.
 - b) Select "Stop SCPI Recording".
3. After exporting a command list to a file.
 - a) Select "SCPI Recording Export" > "Show file content".The "SCPI Recording List" opens.

To review a remote command list

To rework a remote command list, you must transfer it to a computer.

1. Export the list to a PC, using, for example, a USB flash drive.
2. Check the list, e.g. by comparing it with the modified settings in the manual mode.
Tip: To find out your settings, you can use the "Mark all parameters changed from preset" function.
See [Chapter 10.2.2, "Identifying parameters with non-default values"](#), on page 276.
3. Search for missing or incomplete command entries.
 - a) Add missing commands.
 - b) Complete missing parts of commands.
 - c) Remove superfluous entries, e.g. `:SYST:INF:SCPI 'SCPI command not available'`.
 - d) Remove unnecessary content written after a preset.
4. Rearrange the commands to a reasonable order. For example, if you set a `STATE` command to the last position in a list, you can avoid intermediate calculations of the signal.

12.9.4 Converting a remote command list to a script

For conversion of a remote command list into an executable script, a code generator translates the commands into the source code of a proprietary programming language, based on a code template. Therefore, each programming language requires a dedicated code template.

The R&S SF100A provides the following predefined code templates by default:

- Plain SCPI
Represents SCPI base format, that is ASCII format, saved as text file (*.txt).
- MATLAB
A programming environment, frequently used in signal processing and test and measurement applications (*.m).
You can directly use this format with MATLAB(c) Toolkit. For comprehensive information on this topic, refer to the application note [1GP60](#).
- NICVI
An ANSI C programming environment designed for measurements and tests (*.c).
You can directly use this format with National Instruments LabWindows CVI.
- Python3
A general-purpose and high-level programming language (*.py).

You can also convert a script to a user-specific format. In this case, you need a code template with the extension *.expcodetmpl.

When converted, you can save the script in a file with the extension corresponding to the programming language.

To configure a plain SCPI script file

1. Select "Show SCPI Recording List" in the context-sensitive menu.
2. Select "Export".
The "SCPI Recording Export" dialog opens.
3. Select the "Format" > "Plain SCPI".
4. Select "File".
A standard file handling dialog opens.
5. Configure filename and directory and confirm with "Ok".
6. In the "SCPI Recording Export" dialog, select "Export".
The R&S SFI100A saves the recorded data in *.txt format. The "File Content" section shows the SCPI commands of the script file.

To convert the command list to a predefined code template

1. Select "Show SCPI Recording List" in the context-sensitive menu.
2. Select "Export".
The "SCPI Recording Export" dialog opens.
3. In the "SCPI Recording Export" dialog, select "Format" > "Predefined Code Generator".
The "CodeTemplate" button appears.
4. Select "Code Template".
The "SCPI Recording Export - Select Predefined Code Template" dialog opens.
5. Select a predefined code template, e.g., "MATLAB".
6. Confirm with "Select".
The R&S SFI100A returns to the "SCPI Recording Export" dialog.
7. Select "File".
A standard file handling dialog opens.
8. Configure filename and directory and confirm with "Ok".
9. In the "SCPI Recording Export" dialog, select "Export".
The R&S SFI100A saves the recorded data in the corresponding format. The "File Content" section shows the content of the script file in the corresponding programming language.

To convert the command list to a user-defined code template

Before creating a script in a user-specific format, make sure that you have saved the code template with the file extension *.expcodetmpl in the instrument.

1. Select "Show SCPI Recording List" in the context-sensitive menu.
2. In the "SCPI Recording Export" dialog, select "Format" > "Use Code Generator".

The "CodeTemplate" button appears.

3. Select "Code Template".

The "SCPI Recording Export - Select User Code Template" dialog opens.

4. Select your user-defined code template.

5. Confirm with "Select".

The R&S SFI100A returns to the "SCPI Recording Export" dialog.

6. Select "File".

A standard file handling dialog opens.

7. Configure filename and directory and confirm with "Ok".

8. In the "SCPI Recording Export" dialog, select "Export".

The R&S SFI100A saves the recorded data in the corresponding format. The "File Content" section shows the content of the script file in the corresponding programming language.

12.9.5 Running a remote command script

An executable script automates measurement tasks on the instrument. Usually controlled by a remote PC, you can also save and run a script directly in the instrument by assigning the script to the [★] key.

See [Chapter 11.2.4, "How to assign actions to the \[★\] key"](#), on page 309.

12.10 Setting up remote operation over VNC

VNC accesses the R&S SFI100A over LAN from a remote device using a web browser or a VNC client. With the screen displayed on the controller, you can control the instrument as if you operate it directly. Establishing the access depends on the used remote device and VNC client software.

Prerequisites

For remote operation, make sure that you have fulfilled the following prerequisites:

- The instrument and the controller PC are connected in the same network.
See [Chapter 3.1.7, "Connecting to LAN"](#), on page 19.
- The instrument and the controller are switched on.
- The LAN interface and VNC LAN service is enabled.
See [Chapter 11.4.3, "Configuring LAN services"](#), on page 326.
- A suitable application is running on the remote device.
 - Web browser
The R&S SFI100A supports remote operation over VNC with any web browser, e.g., Windows Internet Explorer, Mozilla Firefox, or an HTML5 web browser.
 - VNC client software

Linux/Unix operating systems include a VNC client software by default. For remote devices with windows operating system a VNC client software must be installed manually. Various free-of charge programs such as Ultr@VNC or similar VNC client programs are available for download on the Internet.



VNC client software

Linux/Unix operating systems include a VNC client software by default.

For remote devices with windows operating system a VNC client software must be installed manually. Various free-of charge programs such as Ultr@VNC or similar VNC client programs are available for download on the Internet.



If security is a concern, see:

- Document Instrument Security Procedures.
- [Chapter 11.4.5, "Preventing unauthorized access"](#), on page 332.

See [Chapter 12.1, "Overview of remote access modes"](#), on page 346.

The following examples describe how to set up remote operation with remote devices:

- Using a controller PC
 - ["To operate the instrument from a web browser over VNC"](#) on page 396
 - ["To operate the instrument from a Linux/Unix client over VNC"](#) on page 396
 - ["To operate the instrument from a Windows client over VNC"](#) on page 397
- Using a smart device
 - ["To operate the instrument using a VNC App on a smart device"](#) on page 400
 - ["To operate the instrument from a web browser over VNC"](#) on page 396
 - ["To access the instrument with QR code on a smart device"](#) on page 400

To enable VNC service on the R&S SFI100A

1. **NOTICE!** Enabled VNC service can lead to unauthorized access.

Change the computer name and password of the instrument.

See [Chapter 11.4.5, "Preventing unauthorized access"](#), on page 332.

2. Select "System Config > Setup > Security > Security".
3. Select "LAN Services > Common Services".
4. Enable "VNC".
5. Enter the [Security Password](#).
6. Confirm with "Accept".

- [Using a controller PC](#)..... 396
- [Using a smart device](#).....398
- [Stopping remote operation](#).....401

12.10.1 Using a controller PC

Prerequisites

For remote operation from a controller PC, make sure that you have fulfilled the following prerequisites:

- The instrument and the controller PC are connected in the same network.
See [Chapter 3.1.7, "Connecting to LAN"](#), on page 19.
- The instrument and the controller are switched on.
- The LAN interface and VNC LAN service is enabled.
See [Chapter 11.4.3, "Configuring LAN services"](#), on page 326.
- A suitable application is running on the remote device.
 - Web browser
The R&S SF100A supports remote operation over VNC with any web browser, e.g., Windows Internet Explorer, Mozilla Firefox, or an HTML5 web browser.
 - [VNC client software](#)
Linux/Unix operating systems include a VNC client software by default.
For remote devices with windows operating system a VNC client software must be installed manually. Various free-of charge programs such as Ultr@VNC or similar VNC client programs are available for download on the Internet.



VNC client software

Linux/Unix operating systems include a VNC client software by default.

For remote devices with windows operating system a VNC client software must be installed manually. Various free-of charge programs such as Ultr@VNC or similar VNC client programs are available for download on the Internet.

To operate the instrument from a web browser over VNC

1. Install the *JRE (Java Runtime Environment)* on the remote computer.
Note: Skip this step if you are working with an HTML5 web browser.
2. Enter the IP address of the instrument in the address field of the web browser, e.g. `http://10.113.1.151`
The VNC authentication screen appears.
3. Enter the user password.
The default password is *instrument*.
4. Confirm with with "OK".

When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the remote computer.

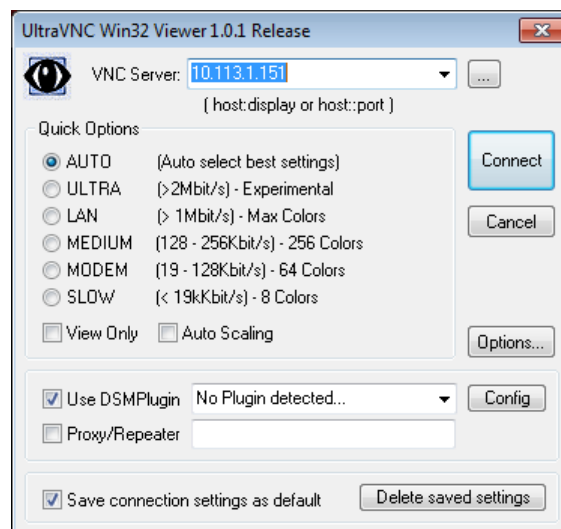
To operate the instrument from a Linux/Unix client over VNC

1. Start a web browser on the remote computer. Enter the IP address of the instrument.

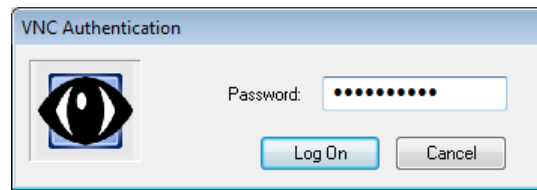
2. Enter the following address:
`vnc://<IP-address of the instrument>`, for example `vnc://10.113.1.151`.
 A dialog opens requesting the password for the remote VNC connection.
3. Enter the user password.
 The default password is *instrument*.
4. Confirm with with "OK".
 When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the remote computer.

To operate the instrument from a Windows client over VNC

1. Install the VNC viewer program component on the remote computer.
 - a) Download a VNC client program from the Internet.
 For example the free of charge software Ultr@VNC (`vncviewer.exe` is available, see <http://www.uvnc.com/download/index.html>).
 - b) Execute the VNC client installation.
 - c) Select the VNC viewer program component and follow the installation instructions.
2. Start VNC viewer program component on the PC.



3. Select "VNC Server"
4. Enter the IP address of the instrument.
5. Confirm with "Connect".
 An authentication dialog opens.



6. Enter the user password for authentication.
The default password is *instrument*.
7. Confirm with "LogOn".

When the connection is established, the screen of the signal generator appears and you can operate the instrument from the remote computer.

12.10.2 Using a smart device

The R&S SF100A supports remote operation over VNC from a smart device (remote client), like a tablet (tablet computer) or a smartphone. The smart device accesses the instrument over WLAN, either by a suitable App, or an HTML5 web browser with embedded *javascript*.

There are several possibilities to establish a WLAN connection between the smart device and the R&S SF100A. This section gives an example of how a network environment can be built up, and some essential configuration steps.

For more information, see:

- [1MA216: Remote Operation of Windows Based Instruments with Apple iPad](#)
- [7BM82: Apple iPad Remote Control of Broadcasting T&M Instruments](#)

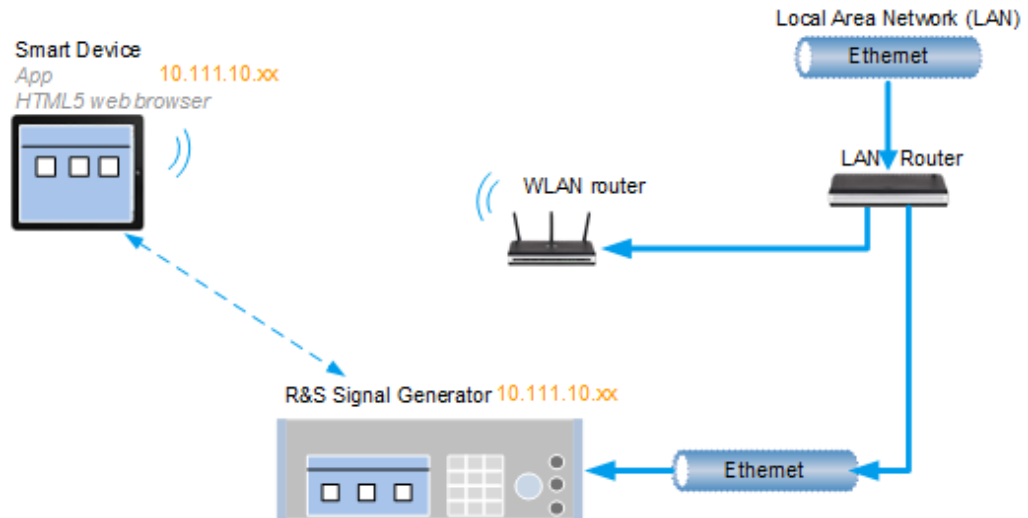
Example:

Figure 12-8: Example of a network configuration for remote operation with a smart device

As shown in the figure, the R&S SF100A and the WLAN router are connected to the LAN router. The smart device accesses the Rohde & Schwarz instrument via the WLAN router.

The WLAN router as an additional access point enables you to operate the instrument even from a great distance.

Prerequisites

For the remote operation, you need the following equipment and configuration:

- Equipment:
 - LAN router
 - WLAN router (hot spot) for accessing the instrument
 - Smart device
- The instrument and the smart device PC are connected in the same network.
- The instrument and the smart device are switched on.
- The LAN interface and VNC LAN service is enabled.
See [Chapter 11.4.3, "Configuring LAN services"](#), on page 326.
- A suitable application is running on the smart device.
 - Web browser
The R&S SF100A supports remote operation over VNC with any HTML5 compliant web browser, e.g., Internet Explorer, Firefox, Google Chrome or Safari.
 - VNC app
An application that implements the VNC functionality for remote operation. The VNC App must be suitable to the used smart device.
Refer to the manufacturer's website to find a VNC App supported for your smart device, and how it is installed.
 - QR code

If your smart device is equipped with a camera and a QR code reader, you can scan the instrument's IP address or access the instrument with the Safari web browser.

Refer to the manufacturer's website to find a QR code reader supported for your smart device, and how it is installed.

We recommend that all components in the network use DHCP, which automatically assigns the relevant address information.

To operate the instrument using a VNC App on a smart device

1. Set up the network connection as shown in [Figure 12-8](#)
2. Configure the WLAN router according to the manufacturer's instructions.
3. Install the required *VNC App* on your smart device.
4. On the smart device, start the *VNC App*.
Enter the IP address of the instrument in the address field of *VNC App*.
The VNC authentication screen appears.
5. Enter the user password.
The default password is *instrument*.
6. Enter the password to establish the remote access.
The default user name and password is *instrument*.

When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the smart device.

To operate the instrument from a web browser over VNC

1. Install the *JRE (Java Runtime Environment)* on the remote computer.
Note: Skip this step if you are working with an HTML5 web browser.
2. Enter the IP address of the instrument in the address field of the web browser, e.g. *http://10.113.1.151*
The VNC authentication screen appears.
3. Enter the user password.
The default password is *instrument*.
4. Confirm with with "OK".

When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the remote computer.

To access the instrument with QR code on a smart device

1. Set up the network connection as shown in [Figure 12-8](#)
2. Configure the WLAN router according to the manufacturer's instructions.
3. Install the required QR code reader software on your smart device.
4. On the smart device, start the QR code reader.

5. On the R&S SF100A, select "System Config > Remote Access".
6. Select the "QR-Code" tab.
7. Scan the QR code of the instrument with your smart device.
8. On the smart device, decode the scanned QR code and forward it to the web browser.
The VNC authentication screen appears.
9. Enter the user password.
The default password is *instrument*.

When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the smart device.

12.10.3 Stopping remote operation

To stop remote operation

To terminate remote operation over VNC depends on the used client:

- ▶ Select the action that applies to the used client:
 - a) On an external Unix/Linux PC, close the Internet browser or the signal generator window.
 - b) On an external Windows PC, close the VNC viewer program.
 - c) On a smart device, close the application.

The connection is terminated but not disabled. It can be established again anytime.

12.11 References

12.11.1 LXI functionality

LAN Extensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology.

The LXI implementation in the R&S SF100A allows you to change certain LAN settings, to reset the LAN connection, and to identify the instrument.



For information about the LXI standard, refer to the LXI website at <https://www.lxistandard.org>.

See also "News from Rohde & Schwarz, article 2006/II - 190".

The LXI functionality in the R&S SF100A is characterized by a common LAN implementation, including an ICMP ping responder for diagnostics. Using a web browser,

you can configure the instrument. A LAN Configuration Initialize (LCI) mechanism resets the LAN configuration. The instrument also supports automatic detection in a LAN via the VXI-11 discovery protocol and programming by IVI drivers.

In addition, the R&S SF100A provides the following LXI-related functionality:

- Integrated "LXI Status" dialog for LXI status indication and reset of the LAN configuration, see [Chapter 12.6, "LXI status settings"](#), on page 366.
- "LXI Browser Interface", as described in [Chapter 12.7.1, "LAN configuration"](#), on page 369.
- "SCPI Remote Trace" utility, see [Chapter 12.7.2, "SCPI remote trace"](#), on page 372.



Firmware update

To enable the full LXI functionality after a firmware update, shut down and restart the instrument.

12.11.2 Code generator templates

This section describes the main structure of the code generator templates, and shows the method with the NICVI template.

The code generation is controlled by templates with the following blocks:

Command	Function
#EXTENSION_START #EXTENSION_END	Defines the output file extension.
#INIT_CODE_START #INIT_CODE_END	Contains initial entries, such as included files and libraries, buffer size, commands for synchronization, or creating a VISA session. All entries between start and end are written once at the beginning of the output file.
#COMMAND_CODE_START #COMMAND_CODE_END	Frame for a SCPI command. A command is accessed with %COMMAND.
#NO_COMMAND_CODE_START #NO_COMMAND_CODE_END	Frame for a parameter with no SCPI command available. A parameter is accessed with %PARAMETER.
#EXIT_CODE_START #EXIT_CODE_END	Closes the visa session. All entries between start and end are written once at the end of the output file.

Templates are created in ASCII format with file extension `*.expcodetempl`.

Example:

Example to the code generator template `NICVI.expcodetempl`:

```

#EXTENSION_START
.c
#EXTENSION_END

#INIT_CODE_START
#include <ansi_c.h>
#include <visa.h>
#include <cvirte.h>

#define MAX_BUFFER_SIZE 200
static ViStatus status;
static ViSession defaultRM, handle;

static void write_command(char *command)
{
    char writeBuffer[MAX_BUFFER_SIZE];
    char readBuffer[MAX_BUFFER_SIZE];
    int length;
    int readCount;

    strcpy(writeBuffer, command);
    //append "*OPC?" to sync
    strcat(writeBuffer, "*OPC?");
    length = strlen (writeBuffer);
    writeBuffer[length]='\n';
    length = length+1;
    viWrite (handle, writeBuffer, length, VI_NULL);
    //read result
    viRead(handle, readBuffer, 100, &readCount);
}

int main (int argc, char *argv[])
{
    if (InitCVIRTE (0, argv, 0) == 0)
        return -1;    /* out of memory */
        //create a VISA session and return a handle to it
    viOpenDefaultRM (&defaultRM);
        //create a VISA session to the serial port and return a handle to it
    viOpen (defaultRM, (ViRsrc)"TCPIP::localhost::INSTR", VI_NULL, VI_NULL,
&handle);
#INIT_CODE_END

#COMMAND_CODE_START
    write_command("%COMMAND");
#COMMAND_CODE_END

#NO_COMMAND_CODE_START
    //no SCPI command available for parameter %PARAMETER !
#NO_COMMAND_CODE_END

#EXIT_CODE_START

```

```
    viClose (handle);
        viClose (defaultRM);
        return 0;
}
#EXIT_CODE_END
```

13 Remote control commands

In the following, all remote-control commands are presented in detail with their parameters and the ranges of numerical values.

For an introduction to remote control and the status registers, see [Chapter 12, "Network operation and remote control"](#), on page 346.

• Conventions used in SCPI command descriptions	405
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• MMEMory subsystem	412
• CALibration subsystem	423
• DIAGnostic subsystem	427
• DISPlay subsystem	430
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• HCOPy subsystem	436
• KBOard subsystem	442
• OUTPut subsystem	442
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• SOURce subsystem	468
• SOURce:BB subsystem	529
• STATus subsystem	577
• SYSTem subsystem	581
• TEST subsystem	610
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13.1 Conventions used in SCPI command descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
If not specified otherwise, commands can be used both for setting and for querying parameters.
If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
If not specified otherwise, a parameter can be used to set a value, and it is the result of a query.
Parameters required only for setting are indicated as **Setting parameters**.
Parameters required only to refine a query are indicated as **Query parameters**.
Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S SF100A follow the SCPI syntax rules.

- **Asynchronous commands**
A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
Default parameter values that are used directly after resetting the instrument (*RST command) are indicated as *RST values, if available.
- **Factory preset values**
Default parameter values that are reset only by factory preset.
- **Default unit**
The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

13.2 Programming examples

The corresponding sections of the same title provide simple programming examples for the R&S SFI100A. The purpose of these examples is to present all commands for a given task. Real applications require application-specific sets of commands and configurations.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the examples as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines start with two characters //, for example, comments.

At the beginning of the most remote control program, an instrument preset or reset is recommended to set the R&S SFI100A to a definite state. The commands *RST and SYSTem:PRESet are equivalent for this purpose. *CLS also resets the status registers and clears the output buffer.

In all the examples we assume the following:

- A remote PC is connected to the instrument.
- The remote PC and the instrument are switched on.
- A connection between them is established.
- The security setting "System Config" > "Setup" > "Security" > "SCPI over LAN" is enabled.

13.3 Common commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different devi-

ces. The headers of these commands consist of "*" followed by three letters. Many common commands are related to the Status Reporting System.

Available common commands:

*CLS.....	407
*ESE.....	407
*ESR?.....	407
*IDN?.....	408
*IST?.....	408
*OPC.....	408
*OPT?.....	408
*PRE.....	409
*PSC.....	409
*RCL.....	409
*RST.....	409
*SAV.....	410
*SRE.....	410
*STB?.....	410
*TRG.....	410
*TST?.....	410
*WAI.....	411

*CLS

Clear status

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

Usage: Setting only

*ESE <Value>

Event status enable

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

Parameters:

<Value> Range: 0 to 255

*ESR?

Event status read

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

Return values:

<Contents> Range: 0 to 255

Usage: Query only

*IDN?

Identification

Returns the instrument identification.

Return values:

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

Usage: Query only

Manual operation: See "[IDN String](#)" on page 363
See "[Hardware Options/Software Options](#)" on page 624

*IST?

Individual status query

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

Return values:

<ISTflag> 0 | 1

Usage: Query only

*OPC

Operation complete

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

*OPT?

Option identification query

Queries the options included in the instrument. For a list of all available options and their description, refer to the specifications document.

Return values:

<Options> The query returns a list of options. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.

Usage: Query only

Manual operation: See "[OPT String](#)" on page 363
See "[Hardware Options/Software Options](#)" on page 624

***PRE** <Value>

Parallel poll register enable

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

Parameters:

<Value> Range: 0 to 255

***PSC** <Action>

Power on status clear

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

Parameters:

<Action> 0 | 1
0
The contents of the status registers are preserved.
1
Resets the status registers.

***RCL** <Number>

Recall

Loads the instrument settings from an intermediate memory identified by the specified number. The instrument settings can be stored to this memory using the command `*SAV` with the associated number.

It also activates the instrument settings which are stored in a file and loaded using the `MMEMory:LOAD <number>, <file_name.extension>` command.

Manual operation: See "[Recall Immediate x](#)" on page 281

***RST**

Reset

Sets the instrument to a defined default status. The default settings are indicated in the description of commands.

The command is equivalent to `SYSTem:PRESet`.

Usage: Setting only

Manual operation: See "[Preset](#)" on page 275

***SAV** <Number>

Save

Stores the current instrument settings under the specified number in an intermediate memory. The settings can be recalled using the command ***RCL** with the associated number.

To transfer the stored instrument settings in a file, use the command **:MMEMory:STORe:STATe**.

Manual operation: See "Save Immediate x" on page 280

***SRE** <Contents>

Service request enable

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

Parameters:

<Contents> Contents of the service request enable register in decimal form.
Bit 6 (MSS mask bit) is always 0.
Range: 0 to 255

***STB?**

Status byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**

Trigger

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

***TRG** corresponds to the **INITiate:IMMEDIATE** command.

Usage: Event

***TST?**

Self-test query

Initiates self-tests of the instrument and returns an error code.

Return values:

<code><ErrorCode></code>	integer > 0 (in decimal format) An error occurred. (For details, see the Service Manual supplied with the instrument).
	0 No errors occurred.

Usage: Query only

***WAI**

Wait to continue

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

Usage: Event

13.4 Preset commands

The preset commands are not bundled in one subsystem. Therefore, they are listed separately in this section.

Four presetting actions are available:

- Activating the default state of all internal instrument functions ([*RST](#) on page 409). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. reference oscillator source settings.
- Activating the preset state of the parameters related to the selected signal path ([:SOURce<hw>:PRESet](#) on page 412)
- Activating the preset state of all parameters that are not related to the signal path ([:DEVIce:PRESet](#) on page 412)
- Activating the original state of delivery (factory reset, [:SYSTem:FPRreset](#) on page 412). Only functions that are protected by a password remain unchanged as well as the passwords themselves.



When resetting, the following deviation between remote and manual control exists:

In contrast to the [Preset] key, the SCPI commands [*RST](#) and [:SYSTem:PRESet](#) do not close open dialogs in the GUI.

:DEVIce:PRESet	412
:SOURce<hw>:PRESet	412
:SYSTem:PRESet	412
:SYSTem:FPRreset	412

:DEVIce:PRESet

Presets all parameters which are not related to the signal path, including the LF generator.

Example: `DEV: PRES`
Presets all instruments settings that are not related to the signal path.

Usage: Event

:SOURce<hw>:PRESet

Presets all parameters which are related to the selected signal path.

Example: `SOUR: PRES`
Presets all settings that are related to signal path

Usage: Event

:SYSTem:PRESet

Triggers an instrument reset. It has the same effect as:

- The `*RST` command

Example: `SYST: PRES`
All instrument settings (also the settings that are not currently active) are reset to their default values.

Usage: Setting only

:SYSTem:FPReset

Triggers an instrument reset to the original state of delivery.

Example: `SYST: FPR`
All instrument settings (also the settings that are not currently active) are reset to the factory values.

Usage: Event

Manual operation: See ["Execute Factory Preset"](#) on page 276

13.5 MMEMory subsystem

The `MMEMory` subsystem (Mass MEMory) contains the commands for managing files and directories as well as for loading and saving complete instrument settings in files.

Mass storage location

Both, the user directory `/var/user/` on the internal memory or the `/usb/` directory on the memory stick, can be used to **preserve** user-defined data. Any directory structure can be created.

The `/var/volatile` directory serves as a RAM drive and can be used to protect sensitive information. The data is available **temporarily**.

Default storage location

The R&S SF100A stores user data in the user directory.

In the file system, user directory is always indicated as `/var/user/`.

In manual control, you access this directory via the "File Manager", see [Chapter 10.7, "Using the file manager"](#), on page 284. In remote control, you can query it with the command `:SYSTEM:MMEMory:PATH:USER?`.

To query and change the default directory used for mass storage, use the command `:MMEMory:CDIRectory`.

13.5.1 File naming conventions

To enable files to be used in different file systems, consider the following file naming conventions:

- The *filename* can be of any length and *is case-sensitive*, i.e it is distinguished between uppercase and lowercase letters.
- All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the filename).
- Avoid using special characters.
- Do not use slashes "\" and "/". These symbols are used in file paths.
- Avoid using the following filenames: CLOCK\$, CON, COM1 to COM4, LPT1 to LPT3, NUL or PRN
They are reserved by the operating system.

Wildcards

The two characters "*" and "?" function as "wildcards", i.e. they are used for selecting several files. The "?" character represents exactly one character, while the "*" character represents all characters up to the end of the filename. "*.*" therefore represents all files in a directory.

Filename and file path

When used in remote control commands, the parameter `<filename>` is specified as a string parameter with quotation marks. It can contain either the complete path including the root user directory `/var/user` and filename, or only the filename. The filename must include the file extension. The same applies for the directory `/var/volatile` and for the parameters `<directory_name>` and `<path>`.

Depending on how much information is provided, the values specified in the parameter or with the command `MMEM:CDIR` are used for the path and drive setting in the commands.

13.5.2 Handling files in the default or in a specified directory

For better overview and easy file handling, you may not save all user files in the user directory `/var/user` but rather organize them into subdirectories.

The command syntax defines two general ways to access files with user data in a *specific* directory:

- **Change the current default directory** for mass memory storage and then directly access the files in this default directory, like saved list files, files with user data or save/recall files.
The subsequent commands for file handling (select, delete, read out files in the directory, etc.) require only specification of the filename. File extension can be omitted; after syntax evaluation of the used command, the R&S SF100A filters out the relevant files.
- Define the **complete file path**, including the user directory `/var/user`, created subdirectories and filename.
As a rule, whenever an complete file path is determined, it overwrites a previously specified default directory.

The following example explains this rule as a principle. Exceptions of this general rule are stated in the description of the corresponding command. The [Chapter 13.5.3, "Programming examples"](#), on page 414 explains the general working principle with the commands for mass memory storage.

The same rule applies to the `/var/volatile` directory, see [Example "Working with files in the volatile memory"](#) on page 416.

13.5.3 Programming examples

Example: Saving and loading current settings

This example shows two ways of how to save the current instrument setting in the file `settings.savrcl.txt` in the directory `/var/user/savrcl`.



Before the instrument settings can be saved in a file, they have to be saved in an intermediate memory using common command `*SAV <number>`. The specified number is then used in the `:MMEMory:STORe:STATe` command.

Also, after loading a file with instrument settings with command `:MMEMory:LOAD:STATe`, these settings have to be activated with the common command `*RCL <number>`.

```
// Save the current settings in an intermediate memory with number 4
*SAV 4
```

```
// save the settings in a file in a specific directory;
// the complete path has to be specified
MMEMory:STORe:STATe 4, "/var/user/savrcl/settings.savrcltxt"

// save the settings in a file in the default directory;
// set the default directory; specify only the file name
MMEMory:CDIRectory "/var/user/savrcl"
*SAV 4
MMEMory:STORe:STATe 4, "settings.savrcltxt"

// Load the saved settings in the intermediate memory 4 and activate them
MMEMory:LOAD:STATe 4, "/var/user/settings.savrcltxt"
*RCL 4
```

Example: Working with files and directories

This example shows how to list files in a directory, list the subdirectories, query the number of files in a directory, create directory, rename and delete files.

```
// Query the current default directory for mass storage,
// change the directory to the default user directory "/var/user"
// and read out the files in it
MMEMory:CDIRectory?
// "/var/user/temp"
MMEMory:CDIRectory
MMEMory:CDIRectory?
// "/var/user/"
MMEMory:CATalog?
// 1282630,8102817792, ".",DIR,4096", "..,DIR,4096", "Log,DIR,4096",
// "settings.savrcltxt,BIN,16949", "temp,DIR,4096", "test,DIR,4096",
// "list.lsw,BIN,1245201"
// the directory "/var/user" contains the predefined directory "Log",
// the subdirectories "test" and "temp"
// as well as the files "settings.savrcltxt" and "list.lsw"

// query only the subdirectories of the current or specified directory
MMEMory:DCATalog? "/var/user"
// ".", "..", "Log", "temp", "test"

// query only number of subdirectories in the current or specified directory
MMEMory:DCATalog:LENGth? "/var/user"
// 5

// query number of files in the current or specified directory
MMEMory:CATalog:LENGth? "/var/user"
// 7

// Create a new directory for mass memory storage in the specified directory
MMEMory:MDIRectory "/var/user/new"
```

```
// Copy the file "settings.savrc1txt" into the new directory
MMEMory:COpy "/var/user/settings.savrc1txt","/var/user/new/settings.savrc1txt"

// Rename the file "settings.savrc1txt" into the new directory
// and read out the files in this specific directory
MMEMory:CDIRectory "/var/user/new"
MMEMory:MOve "settings.savrc1txt","settings_new.savrc1txt"
MMEMory:CATalog? "/var/user/new"
// 25141,8102789120,".,DIR,4096",".,DIR,4096","settings_new.savrc1txt,BIN,16949"

// Delete an empty directory, e.g. the "test" directory
MMEMory:RDIRectory "/var/user/test"
// Delete the entire directory, including files and subdirectories
:MMEMory:RDIRectory:REcursive "var/user/test"
```

Example: Working with files in the volatile memory

This example shows how to work with files in the `/var/volatile` directory.

```
// Change the default directory for mass storage,
// read out the files, load and play a file with the ARB
MMEMory:CDIRectory "/var/volatile"
MMEMory:CDIRectory?
// "/var/volatile"
MMEMory:CATalog?
//13928,525352960,".,DIR,60",".,DIR,4096","list.lst,BIN,9772"

SOURcel:LIST:SElect "/var/volatile/list"
SOURcel:FREquency:MODE LIST
OUTPut1:STATe 1
```

13.5.4 Remote control commands

:MMEMory:CATalog?	417
:MMEMory:CATalog:LENGth?	417
:MMEMory:CDIRectory	417
:MMEMory:COpy	417
:MMEMory:DATA	418
:MMEMory:DATA:UNPRotected	419
:MMEMory:DCATalog?	420
:MMEMory:DCATalog:LENGth?	420
:MMEMory:DELeTe	421
:MMEMory:LOAD:STATe	421
:MMEMory:MDIRectory	421
:MMEMory:MOve	422
:MMEMory:MSIS	422
:MMEMory:RDIRectory	422
:MMEMory:RDIRectory:REcursive	422
:MMEMory:STORE:STATe	423
:MEMory:HFRee?	423

:MMEMory:CATalog?

Returns the content of a particular directory.

Return values:

<Catalog>	string
-----------	--------

String parameter to specify the directory.
If you leave out the path, the command returns the contents of the directory selected with `:MMEMory:CDIRectory`.
The path may be relative or absolute.

Usage: Query only

Manual operation: See ["Directory, File List and Filename"](#) on page 280

:MMEMory:CATalog:LENGth? [<Path>]

Returns the number of files in the current or in the specified directory.

Query parameters:

<Path>	string
--------	--------

String parameter to specify the directory. If the directory is omitted, the command queries the content of the current directory, queried with `:MMEMory:CDIRectory` command.

Return values:

<FileCount>	integer
-------------	---------

Number of files.

Usage: Query only

:MMEMory:CDIRectory <Directory>

Changes the default directory for mass memory storage. The directory is used for all subsequent `MMEM` commands if no path is specified with them.

Parameters:

<Directory>	<directory_name>
-------------	------------------

String containing the path to another directory. The path can be relative or absolute.
To change to a higher directory, use two dots '..'.

Manual operation: See ["Directory, File List and Filename"](#) on page 280
See ["Directory and Filename"](#) on page 285

:MMEMory:COpy <SourceFile>, <DestinationFile>

Copies an existing file to a new file. Instead of just a file, this command can also be used to copy a complete directory together with all its files.

Setting parameters:

<SourceFile>	string String containing the path and file name of the source file
<DestinationFile>	string String containing the path and name of the target file. The path can be relative or absolute. If <DestinationFile> is not specified, the <SourceFile> is copied to the current directory, queried with the <code>:MMEMory:CDIRectory</code> command. Note: Existing files with the same name in the destination directory are overwritten without an error message.

Usage: Setting only

Manual operation: See "[Cut, Copy&Paste and Delete](#)" on page 286

:MMEMory:DATA <Filename>, <BinaryData>

:MMEMory:DATA? <Filename>

The setting command writes the block data <BinaryBlock> to the file identified by <Filename>.

Tip: Use this command to read/transfer stored instrument settings or waveforms directly from/to the instrument.

Parameters:

<BinaryData>

Setting parameters:

<Filename>	string String parameter to specify the name of the file.
------------	---

Query parameters:

<Filename>	#<number><length_entry><data> #: Hash sign; always comes first in the binary block <number>: the first digit indicates how many digits the subsequent length entry has <length_entry>: indicates the number of subsequent bytes <data>: binary block data for the specified length. For files with a size with more than nine digits (gigabytes), the instrument allows the syntax # (<Length>), where <Length> is the file size in decimal format.
------------	--

Example:

```
MMEMory:DATA '/var/user/test.txt',#15hallo
```

Writes the block data to the file `test.txt`.

The digit 1 indicates a length entry of one digit; the digit 5 indicate a length of the binary data (`hallo`) in bytes.

```
MMEMory:DATA? '/var/user/test.txt'
```

Sends the data of the file `test.txt` from the instrument to the controller in the form of a binary block.

```
Response: #15hallo
```

:MMEMory:DATA:UNPRotected <Msus>, <Data>

The **setting** command sends the I/Q data and the marker data to the file defined with the <Msus> parameter. The required tags are created automatically so that the file content follows the waveform file format.

The **query** reads out the I/Q data part or the marker information of the specified file.

Waveform files can also be created with the command `[:SOURce<hw>] :BB: ARBitrary:WAVeform:DATA`. In this case, the *complete content* of the waveform file must be specified, i.e. not only the I/Q or marker data but all required tags.

(see [Chapter 4.3.5, "Tags for waveforms, data and control lists"](#), on page 94).

Parameters:

<Msus> <Identifier>:<file name>
 Mass Storage Unit Specifier
 A string that specifies whether I/Q data (NVWFM) or marker data (NVMKR) is transferred and the file name the data is stored in. If the file with the specified name does not exist, a file is created. Any existing content in the file is *overwritten*. Complete file path and file extension can also be specified. If omitted, files are stored in the default directory and the extension *.wv is assigned to the file name.

Setting parameters:

<Data> block data
 I/Q data or marker binary data, where the number of marker elements has to be equal to the number of I/Q samples
 Binary block data follows the syntax:
 #<Digits><Length><I0Q0...IxQx...IN-1QN-1> or
 #<Digits><Length><M0M1...Mx...MN-1>
 #
 Indicates the start of the data block
 <Digits>
 Decimal value
 Gives the number of decimal digits used for the <Length> value
 <Length>
 Decimal value
 Number of bytes the follow in the <Binary data> part
I0Q0...IxQx...IN-1QN-1
Binary data in ASCII format
 IxQx represents binary data (16-bit signed integer in 2's complement notation) containing the I and Q component alternately and starting with the I component. Each I and Q component consists of 2 bytes in MSB format (most significant byte first). The values of the 2 bytes in an I component and a Q component are in the range: -32767 to +32767.

M0M1...Mx...MN-1

Binary data in ASCII format

M_x represents one marker byte, where only the 4 least significant bits are used. These 4 bits are assigned to the 4 possible markers of the instrument, 1 bit per marker: Bit₀ = Marker 1 to Bit₃ = Marker 4.

One 4-bit marker element is required for every I/Q sample.

Example:

```
:MMEM:DATA:UNPR "NVWFM:/var/user/wave.wv",#220<IQ00..IxQx>
// the binary data <IQ00..IxQx> is added to a file named wave.wv
// and saved in the selected directory
// <IQ00..IxQx> contains of 20 bytes, i.e. 5 I/Q samples,
// 2 bytes for each I and Q component
// <IQ00..IxQx> is a placeholder;
// the actual ASCII values are not printable

MMEMory:DATA:UNPRotected? "NVWFM:/var/user/wave.wv"
MMEMory:DATA:UNPRotected "NVMKR:/var/user/wave.wv",#15<M0M1...M5>
// the specified marker data is added to a file named wave.wv
// in the specified directory
// used are printable values;
// used are only the 4 least significant bits of a byte
MMEMory:DATA:UNPRotected? "NVMKR:/var/user/wave.wv"
// note that, the query returns binary values
SOURCE1:BB:ARBitrary:WAVEform:CLOCK "/var/user/wave.wv",1.1E6
SOURCE1:BB:ARBitrary:WAVEform:CLOCK? "/var/user/wave.wv"
```

:MMEMory:DCATalog?

Returns the subdirectories of a particular directory.

Return values:

<DCatalog> <file_entry>
Names of the subdirectories separated by colons. The first two strings are related to the parent directory.

Usage: Query only

:MMEMory:DCATalog:LENGth? [<Path>]

Returns the number of subdirectories in the current or specified directory.

Query parameters:

<Path> string
String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory, to be queried with [:MMEMory:CDIRectory](#) command.

Return values:

<DirectoryCount> integer
Number of parent and subdirectories.

Usage: Query only

:MMEMory:DELeTe <Filename>

Removes a file from the specified directory.

Setting parameters:

<Filename> string
String parameter to specify the name and directory of the file to be removed.

Usage: Setting only

Manual operation: See "[Cut, Copy&Paste and Delete](#)" on page 286

:MMEMory:LOAD:STATe <SavRclStateNumb>, <file_name>

Loads the specified file stored under the specified name in an internal memory.

After the file has been loaded, the instrument setting must be activated using an *RCL command.

Setting parameters:

<SavRclStateNumb> Determines to the specific <number> to be used with the *RCL command, e.g. *RCL 4.

<file_name> String parameter to specify the file name with extension *.savrc1txt.

Usage: Setting only

Manual operation: See "[Recall](#)" on page 281

:MMEMory:MDIRectory <Directory>

Creates a subdirectory for mass memory storage in the specified directory. If no directory is specified, a subdirectory is created in the default directory. This command can also be used to create a directory tree.

Setting parameters:

<Directory> string
String parameter to specify the new directory.

Usage: Setting only

Manual operation: See "[Create New Directory](#)" on page 286

:MMEMory:MOVE <SourceFile>, <DestinationFile>

Moves an existing file to a new location or, if no path is specified, renames an existing file.

Setting parameters:

<SourceFile> string
 String parameter to specify the name of the file to be moved.

<DestinationFile> string
 String parameters to specify the name of the new file.

Usage: Setting only

Manual operation: See "[Rename](#)" on page 286

:MMEMory:MSIS <Path>

Defines the drive or network resource (in the case of networks) for instruments with windows operating system, using `msis` (MSIS = Mass Storage Identification String).

Note: Instruments with Linux operating system ignore this command, since Linux does not use drive letter assignment.

:MMEMory:RDIRECTory <Directory>

Removes an empty directory from the mass memory storage system. If no directory is specified, the subdirectory with the specified name is deleted in the default directory.

To remove a directory with contents, use command `:MMEMory:RDIRECTory:RECURSive` on page 422.

Setting parameters:

<Directory> string
 String parameter to specify the directory to be deleted.

Usage: Setting only

:MMEMory:RDIRECTory:RECURSive <Directory>

Removes the specified directory, including files and subdirectories from the mass memory storage system. If no directory is specified, the command removes the subdirectories of the default directory.

The command the entire directory without further prompt or notification.

Setting parameters:

<Directory> string
 String parameter to specify the directory to be deleted.

Usage: Setting only

:MMEMory:STORe:STATe <savecl_state_nr>, <file_name>

Stores the current instrument setting in the specified file.

The instrument setting must first be stored in an internal memory with the same number using the common command *SAV.

Setting parameters:

<savecl_state_nr> Corresponds to the specific <number> defined with the *SAV command, e.g. *SAV 4.

<file_name> String parameter to specify the file name with extension *.savecl.txt.

Usage: Event

Manual operation: See "Save" on page 280

:MEMory:HFRee?

Returns the used and available memory in Kb.

Return values:

<TotalPhysMemKb> integer
Total physical memory.

<ApplicMemKb> integer
Application memory.

<HeapUsedKb> integer
Used heap memory.

<HeapAvailableKb> integer
Available heap memory.

Usage: Query only

13.6 CALibration subsystem

The CALibration subsystem contains the commands needed for performing internal adjustments. This procedure is triggered by the query commands.

Common suffixes

The following common suffixes are used in the remote commands:

Suffix	Value range	Description
CALibration<hw>	[1]	Optional suffix

Understanding the query response

- 1: error-free execution of the adjustments
- 0: indicates that an error occurred; the process has been canceled

:CALibration:ALL[:MEASure]?	424
:CALibration<hw>:ALL:DATE?	424
:CALibration<hw>:ALL:INFormation?	424
:CALibration<hw>:ALL:TEMP?	425
:CALibration<hw>:ALL:TIME?	425
:CALibration<hw>:CONTInueonerror	425
:CALibration:DATA:EXPort	426
:CALibration:DATA:FACTory:DATE?	426
:CALibration:DELAy:MINutes	426
:CALibration:DELAy:SHUTdown[:STATe]	426
:CALibration:DELAy[:MEASure]?	427
:CALibration:ROSCillator[:DATA]	427

:CALibration:ALL[:MEASure]? [<Force>]

Starts all internal adjustments that do not need external measuring equipment.

Query parameters:

<Force> string

Return values:

<Measure> 1 | ON | 0 | OFF

Usage: Query only

Manual operation: See "[Adjust All](#)" on page 637

:CALibration<hw>:ALL:DATE?

Queries the date of the most recently executed full adjustment.

Suffix:

<hw> [1]
Optional suffix

Return values:

<Date> string

Example: CAL:ALL:DATE?
// "2016-01-01"

Usage: Query only

Manual operation: See "[Last Full Adjustment](#)" on page 638

:CALibration<hw>:ALL:INFormation?

Queries the current state of the internal adjustment.

Return values:

<CallInfoText> string

Example:

```
CAL:ALL:INF?
"Instrument is calibrated, no adjustment required."
"UNCAL, instrument is warming up."
"UNCAL, Please perform full adjustment after warming up."
"UNCAL, Please perform full adjustment."
```

Usage: Query only

Manual operation: See ["Information"](#) on page 638

:CALibration<hw>:ALL:TEMP?

Queries the temperature deviation compared to the calibration temperature.

Suffix:

<hw> [1]
Optional suffix

Return values:

<Temperature> string

Example:

```
CALibration:ALL:TEMP?
// "+12.00 K"
```

Usage: Query only

Manual operation: See ["Temperature Offset"](#) on page 638

:CALibration<hw>:ALL:TIME?

Queries the time elapsed since the last full adjustment.

Return values:

<Time> string

Example:

```
CAL:ALL:TIME?
// "22 days"
```

Usage: Query only

Manual operation: See ["Time"](#) on page 638

:CALibration<hw>:CONTinueonerror <State>

Continues the calibration even though an error was detected. By default adjustments are aborted on error.

Suffix:

<hw> [1]
Optional suffix

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: n.a. (factory preset: 0)

Example:

```
CAL:CONT ON
// Continues calibration after an error
```

Manual operation: See "[Continue Adjustment on Error](#)" on page 638

:CALibration:DATA:EXPort

Collects the internal adjustment data and provides the data for export in a zip file. You can export the data for service and evaluation purposes.

Example: :CALibration:DATA:EXPort

Usage: Event

:CALibration:DATA:FACTory:DATE?

Queries the date of the last factory calibration.

Return values:

<Date> string

Example: CAL:DATA:FACT:DATE?
 // "2016-01-01"

Usage: Query only

Manual operation: See "[Last Factory Calibration](#)" on page 623

:CALibration:DELAy:MINutes <Minutes>

Sets the warm-up time to wait before internal adjustment starts automatically.

Automatic execution starts only, if you have enabled the calibration with command :
[CALibration:DELAy\[:MEASure\]? ON](#).

Parameters:

<Minutes> integer
 Range: 30 to 120
 *RST: n.a. (no preset. default: 60)

Example: :CALibration:DELAy:MINutes 30
 // sets the time delay for warm-up of the instrument.

Manual operation: See "[Warm Up Time](#)" on page 638

:CALibration:DELAy:SHUTdown[:STATe] <Shutdown>

Enables the instrument to shut down automatically after calibration.

Parameters:

<Shutdown> 1 | ON | 0 | OFF
 *RST: 0

Example:

```
:CALibration:DElay:SHUTdown[:STATe] ON|1
// initiates that the instrument shuts down when the adjustments are completed
```

Manual operation: See "[Shutdown After Adjustment](#)" on page 639

:CALibration:DElay[:MEASure]?

Starts the delayed adjustment process. When the warm-up time has elapsed (see [:CALibration:DElay:MINutes](#)), it executes the internal adjustments.

If you have enabled automatic shutdown, [:CALibration:DElay:SHUTdown\[:STATe\] ON](#), the instrument shuts down when the adjustments are completed.

Return values:

<Error> 1 | ON | 0 | OFF
 *RST: n.a. (no preset. default: 0)

Example:

```
:CALibration:DElay[:MEASure] ON|1
// enables the adjustment process to start after the warm-up time automatically
```

Usage: Query only

Manual operation: See "[Adjust All Delayed](#)" on page 638

:CALibration:ROSCillator[:DATA] <Data>

Sets a user-defined calibration value for the internal reference frequency.

Parameters:

<Data> integer
 0 = the factory value is used (i.e. user-defined calibration is disabled)
 Value > 0: positive calibration values are used
 Value < 0: negative calibration values are used
 Range: depends on other values
 *RST: 0

Example:

```
See [:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] on page 504.
```

13.7 DIAGnostic subsystem

The `DIAGnostic` subsystem contains the commands used for instrument diagnosis and servicing. SCPI does not define any `DIAGnostic` commands; the commands listed here are all device-specific. All `DIAGnostic` commands are query commands which are not affected by `*RST`.



The test functions are intended for services purposes.

They are thus password-protected functions. Unlock the corresponding protection level to access them, see `:SYSTem:PROTect<ch>[:STATe]`.

For more information, see R&S SFI100A Service Manual.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
DIAGnostic<hw>	[1]	Optional suffix

Example: Programming example

The example lists the commands required to query assemblies and test points for diagnosis purposes.

```
// Query the operating hours and number of power-on so far.
DIAGnostic:INFO:OTIME?
// 112 h
DIAGnostic:INFO:POCount?
// 14
```

Commands

<code>:DIAGnostic<hw>:BGInfo:CATalog?</code>	428
<code>:DIAGnostic<hw>:BGInfo?</code>	428
<code>:DIAGnostic:INFO:OTIME?</code>	429
<code>:DIAGnostic:INFO:POCount?</code>	429
<code>:DIAGnostic<hw>:POINT:CATalog?</code>	430
<code>:DIAGnostic<hw>[:MEASure]:POINT?</code>	430

`:DIAGnostic<hw>:BGInfo:CATalog?`

Queries the names of the assemblies available in the instrument.

Return values:

`<Catalog>` string
 List of all assemblies; the values are separated by commas
 The length of the list is variable and depends on the instrument equipment configuration.

Example: See [Example "Programming example"](#) on page 428.

Usage: Query only

`:DIAGnostic<hw>:BGInfo? [<Board>]`

Queries information on the modules available in the instrument, using the variant and revision state.

Query parameters:

<Board> string
 Module name, as queried with the command :
[DIAGnostic<hw>:BGInfo:CATalog?](#).
 To retrieve a complete list of all modules, omit the parameter.
 The length of the list is variable and depends on the instrument equipment configuration.

Return values:

<BgInfo> <Module name> <Module stock number incl. variant> <Module revision> <Module serial number>
 List of comma-separated entries, one entry per module.
 Each entry for one module consists of four parts that are separated by space characters.

Example: See [Example "Programming example"](#) on page 428.

Usage: Query only

Manual operation: See ["Assembly"](#) on page 622

:DIAGnostic:INFO:OTIME?

Queries the operating hours of the instrument so far.

Return values:

<OperationTime> integer
 Range: 0 to INT_MAX
 *RST: 0

Example: See [Example "Programming example"](#) on page 428.

Usage: Query only

Manual operation: See ["Operation Time / h"](#) on page 622

:DIAGnostic:INFO:POCount?

Queries how often the instrument has been turned on so far.

Return values:

<PowerOnCount> integer
 Range: 0 to INT_MAX
 *RST: 0

Example: See [Example "Programming example"](#) on page 428.

Usage: Query only

Manual operation: See ["Power On Count"](#) on page 623

:DIAGnostic<hw>:POINT:CATalog?

Queries the test points available in the instrument.

For more information, see R&S SFI100A Service Manual.

Return values:

<Catalog> string
List of comma-separated values, each representing a test point

Example: See [Example "Programming example"](#) on page 428.

Usage: Query only

:DIAGnostic<hw>[:MEASure]:POINT? <Name>

Triggers the voltage measurement at the specified test point and returns the measured voltage.

For more information, see R&S SFI100A Service Manual.

Query parameters:

<Name> <test point identifier>
Test point name, as queried with the command :
[DIAGnostic<hw>:POINT:CATalog?](#)

Return values:

<Value> <value><unit>

Example: See [Example "Programming example"](#) on page 428.

Usage: Query only

13.8 DISPlay subsystem

The DISPlay system contains the commands to set the power-save mode of the instrument.

Programming Examples

Example: Activating screen saver mode and display update

Use the following commands to switch on the screen saver of your instrument or to automatic display. These settings are particularly useful when you control the instrument remotely.

```
// Set the wait time interval and activate the screen saver
DISPlay:PSAVE:HOLDoff 10
DISPlay:PSAVE:STATE ON
```

```
// Disable the display of the current frequency and level values in remote control
DISPlay:ANNOtation:ALL ON
```

```
// DISPlay:ANNotation:FREQuency "<password>", ON
// DISPlay:ANNotation:AMPLitude "<password>", ON

// Enable automatic update of the display at defined time intervals
DISPlay:UPDate[:STATe] ON
```

Example: Querying the dialog IDs, opening and closing dialogs

Use the following commands to query the dialog IDs of all currently open dialogs. The dialog ID is a prerequisite for opening and closing dialogs via the remote control.



The dialog ID is also required to define user key actions.

See [Chapter 11.2.4, "How to assign actions to the \[★\] key"](#), on page 309.

```
// Query the dialog IDs of all open dialogs
DISPlay:DIALog:ID?
// CEUltraDLGenSetDlg,_, $A DlgKeyRf_Rosc

// Open and close dialogs via remote control
DISPlay:DIALog:OPEN "CEUltraDLGenSetDlg,_, $A"
DISPlay:DIALog:OPEN "DlgKeyRf_Rosc"
DISPlay:DIALog:CLOSe "DlgKeyRf_Rosc"
DISPlay:DIALog:CLOSe:ALL

:DISPlay:PSAVe:HOLDoff..... 431
:DISPlay:PSAVe[:STATe]..... 432
:DISPlay:BRIGhtness..... 432
:DISPlay:BUTTOn:BRIGhtness..... 432
:DISPlay:UPDate[:STATe]..... 432
:DISPlay:ANNotation:AMPLitude..... 433
:DISPlay:ANNotation:FREQuency..... 433
:DISPlay:ANNotation[:ALL]..... 433
:DISPlay:DIALog:ID?..... 434
:DISPlay:DIALog:OPEN..... 434
:DISPlay:DIALog:CLOSe..... 435
:DISPlay:DIALog:CLOSe:ALL..... 435
```

:DISPlay:PSAVe:HOLDoff <HoldoffTimeMin>

Sets the wait time for the screen saver mode of the display.

Parameters:

<HoldoffTimeMin> integer
 Range: 1 to 60
 *RST: n.a. (factory preset: 10)
 Default unit: minute

Example: see [Example "Activating screen saver mode and display update"](#) on page 430

Manual operation: See ["Wait Time"](#) on page 301

:DISPlay:PSAVe[:STATe] <State>

Activates the screen saver mode of the display.

We recommend that you use this mode to protect the display, if you operate the instrument in remote control.

To define the wait time, use the command `:DISPlay:PSAVe:HOLDoff`.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 0)

Example: See [Example "Activating screen saver mode and display update"](#) on page 430

Manual operation: See ["Screen Saver"](#) on page 301

:DISPlay:BRIGhtness <BRIGhtness>

Sets the brightness of the display.

Parameters:

<BRIGhtness> float
Range: 1.0 to 20.0
Increment: 1.0
*RST: 14.0

Example: `DISPlay:BRIGhtness 14`

Manual operation: See ["Display"](#) on page 301

:DISPlay:BUtTon:BRIGhtness <ButttonBrightnes>

Sets the brightness of the [RF On/Off] key.

Parameters:

<ButttonBrightnes> integer
Range: 1 to 20
*RST: n.a. (no preset. default: 14)

Example: `DISPlay:BUtTon:BRIGhtness 15`

Manual operation: See ["RF Hardkey"](#) on page 301

:DISPlay:UPDate[:STATe] <Update>

Activates the refresh mode of the display.

Parameters:

<Update> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 1)

Example: See [Example "Activating screen saver mode and display update"](#) on page 430

Manual operation: See ["Display Update is"](#) on page 302

:DISPlay:ANNOtation:AMPLitude <SecPassword>, <State>

Indicates asterisks instead of the level values in the status bar.

Parameters:

<SecPassword> string

<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 1)

Example: See [Example "Activating screen saver mode and display update"](#) on page 430

Manual operation: See ["Annotation Amplitude"](#) on page 324

:DISPlay:ANNOtation:FREQuency <SecPassWord>, <State>

Indicates asterisks instead of the frequency values in the status bar.

Parameters:

<SecPassWord> string

<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 1)

Example: See [Example "Activating screen saver mode and display update"](#) on page 430

Manual operation: See ["Annotation Frequency"](#) on page 324

:DISPlay:ANNOtation[:ALL] <State>

Displays asterisks instead of the level and frequency values in the status bar of the instrument.

We recommend that you use this mode if you operate the instrument in remote control.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 1

Example: See [Example "Activating screen saver mode and display update"](#) on page 430

:DISPlay:DIALog:ID?

Returns the dialog identifiers of the open dialogs in a string separated by blanks.

Return values:

<DialogIdList> <DialogID#1>< ><DialogID#2>< > ... < ><DialogID#n>
 Dialog identifiers are string without blanks. Blanks are represented as \$\$.
 Dialog identifiers <DialogID> are composed of two main parts:
 <DialogName>[<OptionalParts>]

<DialogName>

Meaningful information, mandatory input parameter for the commands:

[:DISPlay:DIALog:OPEN](#) on page 434

[:DISPlay:DIALog:CLOSe](#) on page 435

<Optional parts>

String of \$<X> values, where <X> is a character, interpreted as follows:

\$q<DialogQualifier>: optional dialog qualifier, usually the letter A or B, as displayed in the dialog title.

\$i<Instances>: comma-separated list of instance indexes, given in the order h, c, s, d, g, u, 0. Default is zero; the terminating ", 0" can be omitted.

\$t<TabIds>: comma-separated indexes or tab names; required, if a dialog is composed of several tabs.

\$x<Left>\$y<Top>\$h<Left>\$w<Top>: position and size; superfluous information.

Example: See [Example "Querying the dialog IDs, opening and closing dialogs"](#) on page 431

Usage: Query only

Manual operation: See ["SCPI"](#) on page 308

:DISPlay:DIALog:OPEN <DialogId>

Opens the specified dialog.

Setting parameters:

<DialogId> string
 To find out the dialog identifier, use the query [:DISPlay:DIALog:ID?](#).
 The <DialogName> part of the query result is mandatory.

Example: See [Example "Querying the dialog IDs, opening and closing dialogs"](#) on page 431

Usage: Setting only

Manual operation: See ["SCPI"](#) on page 308

:DISPlay:DIALog:CLOSE <DialogId>

Closes the specified dialog.

Setting parameters:

<DialogId> string
 To find out the dialog identifier, use the query `:DISPlay:DIALog:ID?`.
 The <DialogName> part of the query result is sufficient.

Example: See [Example "Querying the dialog IDs, opening and closing dialogs"](#) on page 431

Usage: Setting only

:DISPlay:DIALog:CLOSE:ALL

Closes all open dialogs.

Example: See [Example "Querying the dialog IDs, opening and closing dialogs"](#) on page 431

Usage: Event

13.9 FORMat subsystem

The commands in the FORMat subsystem determine the format of data returned by the R&S SFI100A to the controller. This affects all query commands that return a list of numerical data or block data, noted in the descriptions of the commands. The set data format applies to both paths.

:FORMat:BORDER	435
:FORMat:SREGister	436
:FORMat[:DATA]	436

:FORMat:BORDER <Border>

Determines the sequence of bytes within a binary block. This only affects blocks which use the IEEE754 format internally.

Parameters:

<Border> NORMal | SWAPped

NORMal

Expects/sends the *least* significant byte of each IEEE754 floating-point number first and the *most* significant byte last.

SWAPped

Expects/sends the *most* significant byte of each IEEE754 floating-point number first and the *least* significant byte last.

*RST: NORMal

Example: :FORM:BORD SWAP
transfers the data with the most significant bit first.

:FORMat:SREGister <Format>

Determines the numeric format for responses of the status register.

Parameters:

<Format> ASCII | BINary | HEXadecimal | OCTal

ASCII

Returns the register content as a decimal number.

BINary|HEXadecimal|OCTal

Returns the register content either as a binary, hexadecimal or octal number. According to the selected format, the number starts with #B (binary), #H (hexadecimal) or #O (octal).

*RST: ASCII

Example: :FORM:SREG HEX
returns the register content as a hexadecimal number.

:FORMat[:DATA] <Data>

Determines the data format the instrument uses to return data via the IEC/IEEE bus.

The instrument automatically detects the data format used by the controller, and assigns it accordingly. Data format determined by this SCPI command is in this case irrelevant.

Parameters:

<Data> ASCII | PACKed

ASCII

Transfers numerical data as plain text separated by commas.

PACKed

Transfers numerical data as binary block data.

The format within the binary data depends on the command.

The various binary data formats are explained in the description of the parameter types.

*RST: ASCII

Example: :FORM ASC
transfers the data as ASCII data.

13.10 HCOpy subsystem

The HCOpy subsystem contains the commands to generate and save a hard copy of the display.



To access a stored hard copy file, use the commands of the `MEMM` subsystem.

Example: Store a hard copy of the display

The following example lists commands to configure and execute a hard copy to an automatic named file.

```
:HCOPY:DEVIce:LANGUage PNG
:HCOPY:FILE:NAME:AUTO:STATE 1
// defines the output format
// sets the instrument to automatically create output file names

// *****
// Configure hard copy options, set automatic naming rules
// An automatically generated file name consists of:
// <Prefix><YYYY><MM><DD><Number>.<Format>
// *****
:HCOPY:DEVIce:LANGUage BMP
// defines output format *.bmp
:HCOPY:REGIon DIALog
// selects the region to be copied
:HCOPY:FILE:AUTO:DIR "/usb/HCopy"
// sets destination directory of automatic named file
:HCOPY:FILE:NAME:AUTO:FILE:PREFIx:STATE 1
:HCOPY:FILE:NAME:AUTO:FILE:PREFIx:"hardcopy"
:HCOPY:FILE:NAME:AUTO:FILE:YEAR:STATE 1
:HCOPY:FILE:NAME:AUTO:FILE:MONTH:STATE 1
// uses automatic naming prefix
// sets automatic naming prefix to "hardcopy"
// uses automatic naming date parameters year and month

// *****
// Execute and transfer the hard copy
// *****
:HCOPY:EXECute
:HCOPY:DATA
// generates a hard copy
// transfers the hard copy to the remote client
:HCOPY:FILE:AUTO:FILE?
// queries the automatic file name
// "hardcopy1607001.bmp"
:HCOPY:FILE:AUTO:NUMBer?
// queries the number in the automatic file name
// "001"
:HCOPY:FILE:AUTO?
// queries the path and file name of the automatically generated file
// "/usb/HCopy/hardcopy1607001.bmp"
```

13.10.1 Hard copy settings

With the following commands, you can configure the settings of a hard copy.

:HCOPY:DATA?	438
:HCOPY:IMAGe:FORMat	438
:HCOPY:DEVIce:LANGUage	438
:HCOPY:REGion	438
:HCOPY:FILE[:NAME]	438
:HCOPY[:EXECute]	439

:HCOPY:DATA?

Transfers the hard copy data directly as a NByte stream to the remote client.

Return values:

<Data> block data

Example: See [Example "Store a hard copy of the display"](#) on page 437

Usage: Query only

:HCOPY:IMAGe:FORMat <Format>

:HCOPY:DEVIce:LANGUage <Language>

Selects the graphic format for the hard copy. You can use both commands alternatively.

Parameters:

<Language> BMP | JPG | XPM | PNG
 *RST: PNG

Example: See [Example "Store a hard copy of the display"](#) on page 437

Manual operation: See ["Format"](#) on page 296

:HCOPY:REGion <Region>

Selects the area to be copied.

You can create a snapshot of the screen or an active dialog.

Parameters:

<Region> ALL | DIALog
 *RST: ALL

Example: See [Example "Store a hard copy of the display"](#) on page 437

Manual operation: See ["Region"](#) on page 297

:HCOPY:FILE[:NAME] <Name>

Determines the file name and path to save the hard copy, provided automatic naming is disabled.

Note: If you have enabled automatic naming, the instrument automatically generates the file name and directory, see [Chapter 13.10.2, "Automatic naming"](#), on page 439.

Parameters:

<Name> string

Example: See [Example "Store a hard copy of the display"](#) on page 437

Manual operation: See ["File..."](#) on page 296

:HCOPY[:EXECute]

Generates a hard copy of the current display. The output destination is a file.

Example: See [Example "Store a hard copy of the display"](#) on page 437

Usage: Event

Manual operation: See ["Save"](#) on page 296

13.10.2 Automatic naming

Use the following commands to automatically assign a file name.

:HCOPY:FILE[:NAME]:AUTO?	439
:HCOPY:FILE[:NAME]:AUTO:DIRectory	439
:HCOPY:FILE[:NAME]:AUTO:DIRectory:CLEar	440
:HCOPY:FILE[:NAME]:AUTO:FILE?	440
:HCOPY:FILE[:NAME]:AUTO:STATe	440
:HCOPY:FILE[:NAME]:AUTO[:FILE]:DAY:STATe	441
:HCOPY:FILE[:NAME]:AUTO[:FILE]:MONTH:STATe	441
:HCOPY:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe	441
:HCOPY:FILE[:NAME]:AUTO[:FILE]:NUMBer?	441
:HCOPY:FILE[:NAME]:AUTO[:FILE]:PREFix	441
:HCOPY:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe	441

:HCOPY:FILE[:NAME]:AUTO?

Queries path and file name of the hardcopy file, if you have enabled *Automatic Naming*.

Return values:

<Auto> string

Example: See [Example "Store a hard copy of the display"](#) on page 437

Usage: Query only

:HCOPY:FILE[:NAME]:AUTO:DIRectory <Directory>

Determines the path to save the hard copy, if you have enabled *Automatic Naming*.

If the directory does not yet exist, the instrument automatically creates a new directory, using the instrument name and `/var/user/` by default.

Parameters:

<Directory> string
 *RST: /var/user/

Example: See [Example "Store a hard copy of the display"](#) on page 437

Manual operation: See ["Path..."](#) on page 297

:HCOPY:FILE[:NAME]:AUTO:DIRectory:CLEar

Deletes all files with extensions `*.bmp`, `*.jpg`, `*.png` and `*.xpm` in the directory set for automatic naming.

Example: See [Example "Store a hard copy of the display"](#) on page 437

Usage: Event

Manual operation: See ["Clear Path"](#) on page 298

:HCOPY:FILE[:NAME]:AUTO:FILE?

Queries the name of the automatically named hard copy file.

An automatically generated file name consists of:

<Prefix><YYYY><MM><DD><Number>.<Format>.

You can activate each component separately, to individually design the file name.

Return values:

<File> string

Example: See [Example "Store a hard copy of the display"](#) on page 437.

Usage: Query only

:HCOPY:FILE[:NAME]:AUTO:STATe <State>

Activates automatic naming of the hard copy files.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 1

Example: See [Example "Store a hard copy of the display"](#) on page 437

Manual operation: See ["Automatic Naming"](#) on page 296

```
:HCOPY:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>
:HCOPY:FILE[:NAME]:AUTO[:FILE]:MONTH:STATe <State>
:HCOPY:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>
```

Uses the date parameters (year, month or day) for the automatic naming. You can activate each of the date parameters separately.

Parameters:

```
<State>          1 | ON | 0 | OFF
*RST:           1
```

Example: See [Example "Store a hard copy of the display"](#) on page 437

Manual operation: See ["Prefix, Year, Month, Day"](#) on page 298

```
:HCOPY:FILE[:NAME]:AUTO[:FILE]:NUMBER?
```

Queries the number that is used as part of the file name for the next hard copy in automatic mode.

At the beginning, the count starts at 0. The R&S SFI100A searches the specified output directory for the highest number in the stored files. It increases this number by one to achieve a unique name for the new file.

The resulting auto number is appended to the resulting file name with at least three digits.

Return values:

```
<Number>         integer
Range:           0 to 999999
*RST:            0
```

Example: See [Example "Store a hard copy of the display"](#) on page 437

Usage: Query only

Manual operation: See ["Current Auto Number"](#) on page 298

```
:HCOPY:FILE[:NAME]:AUTO[:FILE]:PREFIX <Prefix>
:HCOPY:FILE[:NAME]:AUTO[:FILE]:PREFIX:STATe <State>
```

Uses the prefix for the automatic generation of the file name, provided `PREF:STAT` is activated.

Parameters:

```
<State>          1 | ON | 0 | OFF
*RST:           1
```

Example: See [Example "Store a hard copy of the display"](#) on page 437

Manual operation: See ["Prefix, Year, Month, Day"](#) on page 298

13.11 KBOard subsystem

The `KBOard` subsystem contains the commands to set a connected keyboard.

<code>:FPANel:KEYBoard:LAYout</code>	442
<code>:KBOard:LAYout</code>	442

`:FPANel:KEYBoard:LAYout` <Layout>

Selects the layout of the front panel keypad.

Parameters:

<Layout> DIGits | LETTers

DIGits

Enables numerical keys only.

LETTers

Enables numerical and alphanumerical keys.

*RST: n.a. (factory preset: DIGits)

Example:

```
:FPANel:KEYBoard:LAYout LETTers
// enables the alphanumerical additional
// and the numerical assignment of the keys.
```

`:KBOard:LAYout` <Layout>

Selects the language for an external keyboard and assigns the keys accordingly.

Parameters:

<Layout> CHINese | DANish | DUTCh | DUTBe | ENGLish | ENGUk |
 FINNish | FRENch | FREBe | FRECa | GERMan | ITALian |
 JAPANese | KORean | NORWegian | PORTuguese | RUSSian |
 SPANish | SWEDish | ENGUS

*RST: n.a. (factory preset: ENGLish)

Example:

```
:KBOard:LAYout US
// activates American keyboard
```

Manual operation: See "[Layout](#)" on page 301

13.12 OUTPut subsystem

In the `OUTPut` subsystem, you can configure the output signals.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
OUTPut<hw>	[1]	Optional suffix

:OUTPut:ALL[:STATe].....	443
:OUTPut<hw>[:STATe].....	443
:OUTPut<hw>[:STATe]:PON.....	443
:OUTPut<hw>:IMPedance?.....	444
:OUTPut<hw>:AFIXed:RANGe:LOWer?.....	444
:OUTPut<hw>:AFIXed:RANGe:UPPer?.....	444
:OUTPut<hw>:PROTection:CLEar.....	444
:OUTPut<hw>:PROTection:TRIPped?.....	444

:OUTPut:ALL[:STATe] <State>

Enables the RF output signal of the instrument.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: n.a. (factory preset: 0)

Example: OUTPut:ALL:STATe 0
 Disables the RF output signal.

:OUTPut<hw>[:STATe] <State>

Activates the RF output signal.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Example: :OUTPut1 ON
 Activates the RF output.

Manual operation: See "[RF State/RF ON](#)" on page 200

:OUTPut<hw>[:STATe]:PON <Pon>

Defines the state of the RF output signal when the instrument is switched on.

Parameters:

<Pon> OFF | UNCHanged
 *RST: n.a. (factory preset: UNCHanged)

Example: :OUTPut1:PON OFF
 The RF output is deactivated when the instrument is switched on.

Manual operation: See "[Power-On State](#)" on page 302

:OUTPut<hw>:IMPedance?

Queries the impedance of the RF outputs.

Return values:

<Impedance> G1K | G50 | G10K
 *RST: G50

Example: :OUTPut1:IMP?
 queries the impedance of RF output.
 Response: 50
 the impedance is 50 ohms

Usage: Query only

Manual operation: See "[RF output impedance](#)" on page 200

:OUTPut<hw>:AFIXed:RANGe:LOWer?**:OUTPut<hw>:AFIXed:RANGe:UPPer?**

Queries the settable minimum/maximum value in mode :OUTPut:AMODE FIXed, i.e. when the attenuator is not being adjusted.

Return values:

<Upper> float
 Increment: 0.01
 Default unit: dBm

Example: :OUTPut1:AMODE FIXed
 :OUTPut1:AFIXed:RANGe:UPPer?
 // -27
 :OUTPut1:AFIXed:RANGe:LOW?
 // -50

Usage: Query only

:OUTPut<hw>:PROTection:CLEAr

Resets the protective circuit after it has been tripped.

To define the output state, use the command :OUTPut<hw>[:STATE].

Example: :OUTPut1:PROT:CLE
 Resets the protective circuit of the RF output.

Usage: Event

:OUTPut<hw>:PROTection:TRIPped?

Queries the state of the protective circuit.

Return values:

<Tripped> 1 | ON | 0 | OFF
 *RST: 0

Example:

```
:OUTPut1:PROT:TRIP
queries the state of the protective circuit of the RF output.
Response: 0
the protective circuit has not tripped.
```

Usage:

Query only

13.13 SENSE, READ, INITiate and SLISt subsystems

These subsystems contain the commands for configuring the power measurements with R&S NRP power sensor connected to the R&S SF1100A.



The local state is set with the `INIT` command. Switching off the local state enhances the measurement performance. Measurements results can be retrieved in local state on or off.

Sensor parameters are set with the `SENSE` commands.

To start the measurement and retrieve the result, use the `:READ<ch>[:POWER]?` command.

Suffix	Value range	Description
SENSE<ch>	[1] to 4	Indicates the sensor Use the <code>:SLISt</code> commands to change the sensor mapping
READ<ch>	[1] to 4	Sensor assignment
INITiate<hw>	[1] to 4	Sensor assignment
ELEMent<ch>	[1] to 25	Sensor-mapping list

Programming examples

Example: Detecting and assigning a power sensor

```

SLISt:LIST?
// Response: "NRP33SN-V-900007-USB Legacy","NRP-Z211-900001-USB Legacy"
// Lists all automatically detected sensors.

SLISt:SCAN:STATe 1
// Searches for sensors connected in the LAN or via the USBTMC protocol.

SLISt:SCAN:LSEnSor 'NRQ6',101624 // sensor name, serial number
SLISt:SCAN:LSEnSor 11.123.1.123, 101624 // IP address, serial number
// Adds sensors to the list, that are connected to LAN.

SLISt:SCAN:USEnSor 'NRQ6',101624 //sensor name, serial number
SLISt:SCAN:USEnSor #H15b,101624 //device ID (hexadecimal), serial number
SLISt:SCAN:USEnSor 347,101624 //device ID (decimal), serial number
// Adds a sensor to the list, that is connected to the USB interface.

SLISt:LIST?
// Response: "NRP33SN-V-900007-USB Legacy","NRP-Z211-900001-USB Legacy",
// "NRP33SN-V-900005-USBTMC","NRP33SN-V-900011-LAN"
// Lists all automatically detected sensors.

SLISt:ELEMent3:MAPPing SENS1
// Maps the third sensor from the list to the first sensor channel.

SLISt:SENSor:MAP "NRPS18S-100654-USB Legacy", SENS3
// Maps the sensor to channel 3.

SLISt:CLEar[ALL]
// Remove all sensors from the list.
SLISt:CLEar:LAN
// Remove all sensors from the list, that are connected over LAN.
SLISt:CLEar:USB
// Remove all sensors from the list, that are connected over USB.

```

Example: Performing a simple power measurement

Prerequisite: The sensor is connected to the instrument and mapped to the first sensor channel.

```

INITiate1:CONTinuous ON
// Switches the continuous power measurement on.

READ1?
// Triggers the measurement and displays the results.

```

Example: Performing a power measurement with a fixed filter

Prerequisite: The sensor is connected to the instrument and mapped to the first sensor channel.

```

SENSe1:SOURce RF
// Sensor measures the power of the RF signal.

SENSe1:FILTer:TYPE NSRatio
// Selects fixed noise filter mode.

SENSe1:FILTer:NSRatio 0.02 DB
// Sets the maximum noise component in the result to 0.02 DB.

SENSe1:FILTer:NSRatio:MTIME 10
//Limits the settling time to 10 seconds.

SENSe1:APERture:DEFault:STATe 0
// Deactivates the default aperture time of the sensor.

SENSe1:APERture:TIME 10e-6
// Sets the aperture time to 10 us.

SENSe1:UNIT DBM
// Selects unit dBm for the measured value.

INITiate:CONTinuous ON
// Switches the continuous power measurement on.

READ?
// Triggers the measurement and displays the results.

```

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:SLISt:SCAN:LSEnSor	448
:SLISt:SCAN:USEnSor	449
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:READ<ch>[:POWer]?	451
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:SENSe<ch>[:POWer]:DISPlay:PERManent:PRiority	453
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:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?	454

:SENSe<ch>[:POWer]:FILTer:LENGth[:USER].....	454
:SENSe<ch>[:POWer]:FILTer:NSRatio.....	455
:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIME.....	455
:SENSe<ch>[:POWer]:FILTer:SONCe.....	455
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:SENSe<ch>[:POWer]:LOGGing:STATe.....	457
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:SENSe<ch>[:POWer]:SNUMber?.....	458
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:SENSe<ch>[:POWer]:STATus[:DEVice]?.....	458
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:SENSe<ch>[:POWer]:TYPE?.....	459
:SENSe<ch>[:POWer]:ZERO.....	459

:SLISt[:LIST]?

Returns a list of all detected sensors in a comma-separated string.

Return values:

<SensorList> String of comma-separated entries

Each entry contains information on the sensor type, serial number and interface.

The order of the entries does not correspond to the order the sensors are displayed in the "NRP Sensor Mapping" dialog.

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Usage: Query only

Manual operation: See ["Sensor Mapping List"](#) on page 226

:SLISt:SCAN[:STATe] <State>

Starts the search for R&S NRP power sensors, connected in the LAN or via the USBTMC protocol.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Manual operation: See ["Scan"](#) on page 227

:SLISt:SCAN:LSENsor <IP>

Scans for R&S NRP power sensors connected in the LAN.

Setting parameters:

<IP> string
 *RST: 0

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Usage: Setting only

Manual operation: See ["Add LAN Sensor"](#) on page 227

:SLISt:SCAN:USENSor <DeviceID>, <Serial>

Scans for R&S NRP power sensors connected over a USB interface.

Parameters:

<Serial> integer
 Range: 0 to 999999

Setting parameters:

<DeviceID> String or Integer
 Range: 0 to 999999
 *RST: 0

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Usage: Setting only

Manual operation: See ["Add USBTMC Sensor"](#) on page 227

:SLISt:CLEAr:LAN

Removes all R&S NRP power sensors connected in the LAN from the list.

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Usage: Event

Manual operation: See ["Clear"](#) on page 227

:SLISt:CLEAr:USB

Removes all R&S NRP power sensors connected over USB from the list.

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Usage: Event

Manual operation: See ["Clear"](#) on page 227

:SLISt:CLEAr[:ALL]

Removes all R&S NRP power sensors from the list.

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Usage: Event

Manual operation: See ["Clear"](#) on page 227

:SLISt:ELEMent<ch>:MAPPING <Mapping>

Assigns an entry from the `:SLISt[:LIST]?` to one of the four sensor channels.

Parameters:

<Mapping> SENS1 | SENSor1 | SENS2 | SENSor2 | SENS3 | SENSor3 |
SENS4 | SENSor4 | UNMapped

Sensor channel.

*RST: UNMapped

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Manual operation: See ["Sensor Mapping List"](#) on page 226

:SLISt:SENSor:MAP <SensorId>, <Mapping>

Assigns a sensor directly to one of the sensor channels, using the sensor name and serial number.

To find out the the sensor name and ID, you can get it from the label of the R&S NRP, or using the command `:SLISt:SCAN[:STATe]`. This command detects all R&S NRP power sensors connected in the LAN or via 'USBTMC protocol.

Setting parameters:

<SensorId> string

<Mapping> enum

Example: See [Example "Detecting and assigning a power sensor"](#) on page 446.

Usage: Setting only

Manual operation: See ["Sensor Mapping List"](#) on page 226

:INITiate<hw>[:POWER]:CONTInuous <Continuous>

Switches the local state of the continuous power measurement by R&S NRP power sensors on and off. Switching off local state enhances the measurement performance during remote control.

The remote measurement is triggered with `:READ<ch>[:POWER]?`). This command also returns the measurement results. The local state is not affected, measurement results can be retrieved with local state on or off.

Parameters:

<Continuous> 1 | ON | 0 | OFF
*RST: 0

Example:

```
INIT1:CONT ON
```

Switches on the local state of continuous power measurement.

Manual operation: See ["State"](#) on page 222

:READ<ch>[:POWER]?

Triggers power measurement and displays the results.

Note: This command does not affect the local state, i.e. you can get results with local state on or off. For long measurement times, we recommend that you use an SRQ for command synchronization (MAV bit).

Suffix:

<ch> 1 to 3

Return values:

<Power> float or float,float

The sensor returns the result in the unit set with command `:SENSe<ch>:UNIT[:POWER]`

Certain power sensors, such as the R&S NRP-Z81, return two values, first the value of the average level and - separated by a comma - the peak value.

Example:

```
:SENS1:UNIT DBM
```

Selects unit dBm for presentation of measurement result.

```
:READ1?
```

Queries the measurement result of the sensor.

```
-45.6246576745440230
```

-45.6 dBm were measured at the given frequency.

Example:

```
R&S NRP-Z81
```

```
:READ1?
```

```
-55.62403263352178, -22.419472478812476
```

-55.6 dBm is the measured average level, -22.4 dBm is the measured peak level at the given frequency.

Usage:

Query only

Manual operation:

See ["Measured Level"](#) on page 219

See ["Level \(Peak\) / Level \(Average\)"](#) on page 222

:SENSe<ch>:UNIT[:POWer] <Power>

Selects the unit (Watt, dBm or dBµV) of measurement result display, queried with `:READ<ch>[:POWer]?`.

Parameters:

<Power> DBM | DBUV | WATT
*RST: DBM

Example:

```
:SENS2:UNIT DBM
Selects dBm as unit for the measured value returned by command READ.
:READ2?
Response: 7.34
7.34 dBm are measured by sensor 2.
```

Manual operation: See ["Measured Level"](#) on page 219
See ["Level \(Peak\) / Level \(Average\)"](#) on page 222

:SENSe<ch>[:POWer]:APERTure:DEFault:STATe <UseDefAp>

Deactivates the default aperture time of the respective sensor.

To specify a user-defined value, use the command `:SENSe<ch>[:POWer]:APERTure:TIME` on page 452.

Parameters:

<UseDefAp> 1 | ON | 0 | OFF
*RST: 1

Example: See [Example "Performing a power measurement with a fixed filter"](#) on page 447.

Manual operation: See ["Default Aperture Time"](#) on page 224

:SENSe<ch>[:POWer]:APERTure:TIME <ApTime>

Defines the aperture time (size of the acquisition interval) for the corresponding sensor.

Parameters:

<ApTime> float
Range: depends on connected power sensor
Increment: 1E-9
*RST: depends on connected power sensor

Example: See [Example "Performing a power measurement with a fixed filter"](#) on page 447.

Manual operation: See ["Aperture Time"](#) on page 225

:SENSe<ch>[:POWer]:CORRection:SPDeVice:SElect <Select>

Several S-parameter tables can be stored in a sensor. The command selects a loaded data set for S-parameter correction for the corresponding sensor.

Parameters:

<Select> float
*RST: 0

Manual operation: See "[S-Parameter](#)" on page 225

:SENSe<ch>[:POWer]:CORRection:SPDeVice:STATe <State>

Activates the use of the S-parameter correction data.

Note: If you use power sensors with attenuator, the instrument automatically activates the use of S-parameter data.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: :SENSe1:POWer:CORRection:SPDeVice:STATe 1
Activates the use of the S-parameters correction data.

Manual operation: See "[S-Parameter](#)" on page 225

:SENSe<ch>[:POWer]:CORRection:SPDeVice:LIST?

Queries the list of the S-parameter data sets that have been loaded to the power sensor.

Return values:

<List> string list
*RST: 0

Usage: Query only

Manual operation: See "[S-Parameter](#)" on page 225

:SENSe<ch>[:POWer]:DISPlay:PERMANent:PRiority <Priority>

Selects average or peak power for permanent display.

Parameters:

<Priority> AVERAge | PEAK
*RST: AVERAge

Example: :SENSe1:DISP:PERM:STAT ON
Turns on the permanent view.
:SENSe1:DISP:PERM:PRI AVER
Sets the average power for display.

Manual operation: See "[Display](#)" on page 222

:SENSe<ch>[:POWer]:DISPlay:PERMANent:STATe <State>

Activates the permanent display of the measured power level results. The instrument also indicates the sensor type, the connection, the measurement source and the offset if set.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: :SENS1:POW:DISP:PERM:STAT ON
Turns on the permanent view.

Manual operation: See "[Display Permanent](#)" on page 222

:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?

Queries the current filter length in filter mode AUTO ([:SENSe<ch>\[:POWer\]:FILTer:TYPE](#))

Return values:

<Auto> float
Range: 1 to depends on R&S NRP power sensor type

Example: :SENS1:FILT:TYPE AUTO
Selects auto filter.
:SENS1:FILT:LENG:AUTO?
Queries the automatically set filter length.
Response: 1024

Usage: Query only

Manual operation: See "[Filter Length](#)" on page 224

:SENSe<ch>[:POWer]:FILTer:LENGth[:USER] <User>

Selects the filter length for [SENS:POW:FILT:TYPE USER](#). As the filter length works as a multiplier for the time window, a constant filter length results in a constant measurement time (see also "[About the measuring principle, averaging filter, filter length, and achieving stable results](#)" on page 213).

The R&S NRP power sensors provide different resolutions for setting the filter length, depending on the used sensor type.

For more information, refer to the specifications document.

Parameters:

<User> float
Range: 1 to depends on R&S NRP power sensor type
*RST: 1

Example: :SENS1:FILT:TYPE USER
 Selects user filter mode.
 :SENS1:FILT:LENG 16
 Sets a filter length of 16. E.g. using a sensor with 20 ms time window, the resulting measurement time is 640 ms (2x16x20 ms)

Manual operation: See ["Filter Length"](#) on page 224

:SENSe<ch>[:POWer]:FILTer:NSRatio <NSRatio>

Sets an upper limit for the relative noise content in fixed noise filter mode (:SENSe<ch>[:POWer]:FILTer:TYPE). This value determines the proportion of intrinsic noise in the measurement results.

Parameters:

<NSRatio> float
 Range: 0.001 to 1
 Increment: 0.001
 *RST: 0.01

Example: See [Example "Performing a power measurement with a fixed filter"](#) on page 447.

Manual operation: See ["Noise/Signal Ratio"](#) on page 224

:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIME <MTime>

Sets an upper limit for the settling time of the auto-averaging filter and thus limits the length of the filter.

Parameters:

<MTime> float
 Range: 1 to 999.99
 Increment: 0.01
 *RST: 4

Example: See [Example "Performing a power measurement with a fixed filter"](#) on page 447.

Manual operation: See ["Timeout"](#) on page 224

:SENSe<ch>[:POWer]:FILTer:SONCe

Starts searching the optimum filter length for the current measurement conditions. You can check the result with command :SENS1:POW:FILT:LENG:USER? in filter mode USER (:SENSe<ch>[:POWer]:FILTer:TYPE).

Example: SENS1:FILT:TYPE USER
 Selects user filter mode.
 :SENS1:FILT:SONC
 Activates the search for the optimum filter length.
 :SENS1:FILT:LENG?
 Returns the found optimum filter length.
 Response: 128

Usage: Event

Manual operation: See "Auto Once" on page 224

:SENSe<ch>[:POWer]:FILTer:TYPE <Type>

Selects the filter mode. The filter length is the multiplier for the time window and thus directly affects the measurement time.

Parameters:

<Type>

AUTO | USER | NSRatio

AUTO

Automatically selects the filter length, depending on the measured value. The higher the power, the shorter the filter length, and vice versa.

Note: To avoid long settling times when the power is low, you can limit the averaging factor limited with the "timeout" parameter (:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIME).

USER

Allows you to set the filter length manually. As the filter-length takes effect as a multiplier of the measurement time, you can achieve constant measurement times.

NSRatio

Selects the filter length (averaging factor) according to the criterion that the intrinsic noise of the sensor (2 standard deviations) does not exceed the specified noise content. You can define the noise content with command :SENSe<ch>[:POWer]:FILTer:NSRatio.

*RST: AUTO

Example: See [Example "Performing a power measurement with a fixed filter"](#) on page 447.

Manual operation: See "Filter" on page 223

:SENSe<ch>[:POWer]:FREQUency <Frequency>

Sets the RF frequency of the signal, if signal source :SENSe<ch>[:POWer]:SOURce USER is selected.

Parameters:

<Frequency> float
 *RST: 1 GHz

Example:

```
:SENS1:SOUR USER
Selects user-defined source.
:SENS1:FREQ 2.44GHz
Sets the RF frequency of the source which is 2.44 GHz.
```

Manual operation: See ["Frequency"](#) on page 223

:SENSe<ch>[:POWer]:LOGGing:STATe <State>

Activates the recording of the power values, measured by a connected R&S NRP power sensor.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Example:

```
:SENS:LOGG:STAT ON
Activates recording of the power measurement of the first sensor.
```

Manual operation: See ["Enable Logging"](#) on page 225

:SENSe<ch>[:POWer]:OFFSet <Offset>

Sets a level offset which is added to the measured level value after activation with command `:SENSe<ch>[:POWer]:OFFSet:STATe`. The level offset allows, e.g. to consider an attenuator in the signal path.

Parameters:

<Offset> float
 Range: -100.0 to 100.0
 *RST: 0
 Default unit: dB

Example:

```
:SENS1:POW:OFFS 10.0
Sets a level offset of 10 dB
```

Manual operation: See ["Level Offset State,Level Offset"](#) on page 223

:SENSe<ch>[:POWer]:OFFSet:STATe <State>

Activates the addition of the level offset to the measured value. The level offset value is set with command `:SENSe<ch>[:POWer]:OFFSet`.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Example: :SENS1:POW:OFFS 0.4dB
Sets a level offset of 0.4 dB
 :SENS1:POW:OFFS:STAT ON
A level offset of 0.4 dB is added to the measured value.

Manual operation: See "[Level Offset State,Level Offset](#)" on page 223

:SENSe<ch>[:POWer]:SNUMber?

Queries the serial number of the sensor.

Return values:

<SNumber> string

Example: :SENS1:SNUM?
Queries the serial number.

Usage: Query only

Manual operation: See "[Sensor type and serial number](#)" on page 222

:SENSe<ch>[:POWer]:SOURce <Source>

Determines the signal to be measured.

Note: When measuring the RF signal, the sensor considers the corresponding correction factor at that frequency, and uses the level setting of the instrument as reference level.

Parameters:

<Source> A | USER | RF
*RST: A

Example: See [Example "Performing a power measurement with a fixed filter"](#) on page 447.

Manual operation: See "[Use Frequency Of](#)" on page 223

:SENSe<ch>[:POWer]:STATus[:DEVice]?

Queries if a sensor is connected to the instrument.

Return values:

<Status> 1 | ON | 0 | OFF
*RST: 0

Example: :SENS1:STAT?
Response: 1
A sensor is connected.

Usage: Query only

Manual operation: See "[State](#)" on page 222

:SENSe<ch>[:POWer]:SVERsion?

Queries the software version of the connected R&S NRP power sensor.

Return values:

<SVersion> string

Example: :SENS1:POW:SVER?
Queries the software version of the power sensor.

Usage: Query only

:SENSe<ch>[:POWer]:TYPE?

Queries the sensor type. The type is automatically detected.

Return values:

<Type> string

Example: :SENS1:TYPE?
Queries the type of sensor.
Response: NRP-Z21
The R&S NRP-Z21 sensor is used.

Usage: Query only

Manual operation: See "[Sensor type and serial number](#)" on page 222

:SENSe<ch>[:POWer]:ZERO

Performs zeroing of the sensor.

Zeroing is required after warm-up, i.e. after connecting the sensor.

Note: Switch off or disconnect the RF power source from the sensor before zeroing.

We recommend that you zero in regular intervals (at least once a day), if:

- The temperature has varied more than about 5 °C.
- The sensor has been replaced.
- You want to measure very low power.

Example: :SENS1:ZERO
Executes zeroing.

Usage: Event

Manual operation: See "[Zero](#)" on page 222

13.14 SCONfiguration subsystem

The SCONfiguration subsystem contains the commands to define the system configuration, stream mapping and baseband configuration.

Required options

Common suffixes

The commands in this chapter use the following common suffixes:

Suffix	Suffix range	Description	Required options
RF<ch>	[1]	One RF output "RF Out", optional suffix	Included in base unit
STReam<st>	[1]	One IQ stream, optional suffix	R&S SFI-K17

Example: Distributing the streams to the output connectors

The following example lists the commands necessary to fulfill this task.

```
// *****
// Map a stream to the output connectors
// *****
SCONfiguration:OUTPut:MAPPING:RF1:STReam1:STATE ON
SCONfiguration:OUTPut:MAPPING:IQOutput:STReam1:STATE?
// Response: "0"
// You can map a stream only to one signal output.

// *****
// Add frequency- or phase offset to stream
// *****
SCONfiguration:OUTPut:MAPPING:STReam1:FOFFset 0.1
SCONfiguration:OUTPut:MAPPING:STReam1:POFFset 0.1
```

Example: Connecting and configuring external instruments

The following example lists commands to connect and configure external instruments.

```
// *****
// Scan interfaces and your network for connected instruments.
// *****
SCONfiguration:EXTErnal:DISPlay ALL
SCONfiguration:EXTErnal:REMote:CLEan
SCONfiguration:EXTErnal:REMote:SCAN
SCONfiguration:EXTErnal:REMote:SCAN:STATE?
// Response: "0"
// The scanning procedure is finished.

// *****
// Connect an external instrument
// *****
SCONfiguration:EXTErnal:REMote:LIST?
// Response: "FE170ST-123456"
SCONfiguration:EXTErnal:RF:REMote:ICONnect "FE170ST-123456"
// The external frontend is connected.
```

```
// *****
// Query information on the external instrument
// *****
SCONfiguration:EXTErnal:RF:RCONnection:STATe?
//Response: "1"
SCONfiguration:EXTErnal:RF:DIRection?
// Response: "OUT"
SCONfiguration:EXTErnal:RF:INAME?
//Response: "FE170ST-123456"
SCONfiguration:EXTErnal:RF:REMOte:INFO?
// Response: "FE170ST-123456","Frontend Connection","FE170ST-123456","FE170ST-123456","connect
SCONfiguration:EXTErnal:REMOte:INITialization:CATalog?
// Response:
SCONfiguration:EXTErnal:REMOte:PURGe
```

Commands:

- [I/Q stream mapper commands](#).....461
- [External RF commands](#).....462

13.14.1 I/Q stream mapper commands

```
:SCONfiguration:OUTPut:MAPPing:RF:STReam<st>:STATe..... 461
:SCONfiguration:OUTPut:MAPPing:IQOutput<ch>:STReam<st>:STATe..... 461
:SCONfiguration:OUTPut:MAPPing:RF<ch>:MODE.....461
:SCONfiguration:OUTPut:MAPPing:IQOutput<ch>:MODE.....461
:SCONfiguration:OUTPut:MAPPing:STReam<st>:FOFFset.....462
:SCONfiguration:OUTPut:MAPPing:STReam<st>:POFFset.....462
```

```
:SCONfiguration:OUTPut:MAPPing:RF:STReam<st>:STATe <State>
:SCONfiguration:OUTPut:MAPPing:IQOutput<ch>:STReam<st>:STATe <State>
```

Maps the I/Q output streams to the output connectors.

Parameters:

```
<State>          1 | ON | 0 | OFF
                  *RST:      0
```

Example: See [Example "Distributing the streams to the output connectors"](#) on page 460.

```
:SCONfiguration:OUTPut:MAPPing:RF<ch>:MODE <Mode>
:SCONfiguration:OUTPut:MAPPing:IQOutput<ch>:MODE <Mode>
```

Parameters:

```
<Mode>          SINGle | ADD | MULTiplex
                  *RST:      SINGle
```

:SCONfiguration:OUTPut:MAPPING:STReam<st>:FOFFset <SmFreqOffset>

Sets the frequency offset per stream.

This offset implies a shift in the frequency domain for all signals that the stream routes to a specific output connector. For example, RF or I/Q output connectors. Value ranges depend on installed options.

For more information, refer to the specifications document.

Parameters:

<SmFreqOffset>	float
Range:	depends on options
Increment:	0.01
*RST:	0

Example: See [Example "Distributing the streams to the output connectors"](#) on page 460.

Manual operation: See ["Frequency Offset"](#) on page 142

:SCONfiguration:OUTPut:MAPPING:STReam<st>:POFFset <SmPhasOffset>

Sets the phase offset per stream.

Parameters:

<SmPhasOffset>	float
Range:	-999.99 to 999.99
Increment:	0.01
*RST:	0

Example: See [Example "Distributing the streams to the output connectors"](#) on page 460.

Manual operation: See ["Phase Offset"](#) on page 142

13.14.2 External RF commands

:SCONfiguration:EXTernal:DISPlay.....	463
:SCONfiguration:EXTernal:ACONnect.....	463
:SCONfiguration:EXTernal:REMote:CONNect[:ALL].....	463
:SCONfiguration:EXTernal:REMote:DISConnect[:ALL].....	463
:SCONfiguration:EXTernal:PBEHaviour.....	463
:SCONfiguration:EXTernal:RF<ch>:DIRection?.....	464
:SCONfiguration:EXTernal:RF<ch>:RCONnection:STATe?.....	464
:SCONfiguration:EXTernal:RF<ch>:INAMe?.....	464
:SCONfiguration:EXTernal:RF<ch>:RF:STATe.....	464
:SCONfiguration:EXTernal:REMote:LIST?.....	465
:SCONfiguration:EXTernal:REMote:ADD.....	465
:SCONfiguration:EXTernal:REMote:REName.....	466
:SCONfiguration:EXTernal:RF<ch>:REMote:ISELect.....	466
:SCONfiguration:EXTernal:RF<ch>:REMote:CONNect.....	466

:SCONfiguration:EXternal:RF<ch>:REMote:ICONnect.....	466
:SCONfiguration:EXternal:RF<ch>:REMote:INFO?.....	466
:SCONfiguration:EXternal:RF<ch>:REMote:DISConnect.....	467
:SCONfiguration:EXternal:REMote:INITialization:CATalog?.....	467
:SCONfiguration:EXternal:RF<ch>:REMote:INITialization:FILE.....	467
:SCONfiguration:EXternal:REMote:PURGe.....	467
:SCONfiguration:EXternal:REMote:CLEan.....	468
:SCONfiguration:EXternal:RF<ch>:REMote:SEND.....	468

:SCONfiguration:EXternal:DISPlay <DisplayMode>

Filters the displayed connectors upon the selected criteria.

Parameters:

<DisplayMode> ALL | MAPPed | INPut | OUTPut
 *RST: MAPPed

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Manual operation: See ["Display"](#) on page 143

:SCONfiguration:EXternal:ACONnect <State>

Enables automatic detection and connection setup of connected external instruments.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Manual operation: See ["Auto Connect"](#) on page 143

:SCONfiguration:EXternal:REMote:CONNect[:ALL] :SCONfiguration:EXternal:REMote:DISConnect[:ALL]

Triggers the instrument to establish the connections to all configured external instruments or to disconnect all existing connections.

Usage: Event

Manual operation: See ["Connect/Disconnect All Remote"](#) on page 144

:SCONfiguration:EXternal:PBEHaviour <State>

If enabled, the connection to the external instruments is retained after preset (*RST) of the instrument.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: n.a. (factory preset: 0)

Manual operation: See ["Preset behavior: Keep connections to external instruments"](#) on page 144

:SCONfiguration:EXTernal:RF<ch>:DIRection?

Queries the connector direction.

Return values:

<Direction> NONE | IN | OUT
*RST: IN

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Query only

Manual operation: See ["Direction"](#) on page 144

:SCONfiguration:EXTernal:RF<ch>:RCONnection:STATe?

Queries the status of the remote connection.

Return values:

<State> 1 | ON | 0 | OFF

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Query only

Manual operation: See ["Rem Conn"](#) on page 145

:SCONfiguration:EXTernal:RF<ch>:INAMe?

Queries the name of the connected external instrument.

Return values:

<InstrName> string

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Query only

Manual operation: See ["Instrument Name"](#) on page 146

:SCONfiguration:EXTernal:RF<ch>:RF:STATe <RemConnState>

Parameters:

<RemConnState> 1 | ON | 0 | OFF

Manual operation: See ["RF State"](#) on page 146

:SCONfiguration:EXTernal:REMOte:LIST?

Lists all available instruments.

Return values:

<InstrNames> String
String with symbolic names and/or alias names

Example: See [Example "Connecting and configuring external instruments"](#) on page 460

Usage: Query only

Manual operation: See ["External Instrument"](#) on page 147

:SCONfiguration:EXTernal:REMOte:ADD <InstrName>, <HwChan>, <TcplporUsbAddr>[, <RfPathNumber>]

Adds manually an external instrument to the list of available instruments.

Parameters:

<HwChan> String
Hardware channel (USB or LAN) used by the remote channel to the external instrument

Range: "LAN" to "USB"

*RST: "LAN"

<TcplporUsbAddr> String
IP address or hostname of the connected external instrument

<RfPathNumber> String
Determines the number of RF paths the external instrument is equipped with

Range: "1" to "2"

*RST: "1"

Setting parameters:

<InstrName> String
Alias name of the instrument

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Setting only

Manual operation: See ["External Instrument"](#) on page 147
See ["Set Symbolic Name"](#) on page 147
See ["Remote Channel"](#) on page 148
See ["Hostname or IP Address"](#) on page 148
See ["Device ID"](#) on page 148

:SCONfiguration:EXTErnal:REMOte:REName

Changes the symbolic name of the instrument.

Usage: Setting only

:SCONfiguration:EXTErnal:RF<ch>:REMOte:ISELect <InstrName>[, <RfPath>]

Selects an external instrument for the selected connector.

Parameters:

<InstrName>	String Instrument alias name, as retrieved with the command : SCONfiguration:EXTErnal:REMOte:LIST? .
<RfPath>	String Determines the used RF output of the external instrument. For a one-path instrument, the output path is fixed.

Manual operation: See ["External Instrument"](#) on page 147
 See ["Apply"](#) on page 148
 See ["Apply and Connect"](#) on page 148

:SCONfiguration:EXTErnal:RF<ch>:REMOte:CONNect

Triggers the connection to the external instrument at the selected connector.

Usage: Event

:SCONfiguration:EXTErnal:RF<ch>:REMOte:ICONNect <InstrName>, <RfPath>

Selects an external instrument for the selected connector and triggers connection.

Parameters:

<InstrName>	string Instrument alias name, as retrieved with the command : SCONfiguration:EXTErnal:REMOte:LIST? .
<RfPath>	string Determines the used RF output of the external instrument. For a one-path instrument, the output path is fixed to RF1.

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Setting only

Manual operation: See ["Apply and Connect"](#) on page 148

:SCONfiguration:EXTErnal:RF<ch>:REMOte:INFO?

Queries information on the external instrument.

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Query only

Manual operation: See ["Rem Conn"](#) on page 145
 See ["Instrument Name"](#) on page 146
 See ["Set Symbolic Name"](#) on page 147
 See ["Remote Channel"](#) on page 148
 See ["Hostname or IP Address"](#) on page 148
 See ["Device ID"](#) on page 148

:SCONfiguration:EXtErnal:RF<ch>:REMOte:DISConnect

Triggers the disconnection of the external instrument at the selected connector.

Usage: Event

Manual operation: See ["Rem Conn"](#) on page 145

:SCONfiguration:EXtErnal:REMOte:INITialization:CATalog?

Queries the names of the existing initialization files in the default directory.

Per default, the instrument saves user-defined files in the `/var/user/` directory. Use the command `:MMEM:CDIRectory` to change the default directory to the currently used one.

Only files with extension `*.iec` are listed.

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Query only

:SCONfiguration:EXtErnal:RF<ch>:REMOte:INITialization:FILE <Filename>

Parameters:
 <Filename> string

:SCONfiguration:EXtErnal:REMOte:PURGe

Removes unused instruments from the pool of external instruments.

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Event

Manual operation: See ["Clean Unused/Clean All"](#) on page 147

:SCONfiguration:EXTernal:REMOte:CLEan

Removes all instruments from the pool of external instruments.

Example: See [Example "Connecting and configuring external instruments"](#) on page 460.

Usage: Event

Manual operation: See ["Clean Unused/Clean All"](#) on page 147

:SCONfiguration:EXTernal:RF<ch>:REMOte:SEND <SendScpiCommand>**Setting parameters:**

<SendScpiCommand>string

Usage: Setting only

13.15 SOURce subsystem

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13.15.1 Connector settings

This section summarizes the commands of the `OUTPut` and `INPut` subsystems to configure the connectors settings. Listed are the commands for configuring the output signals and the inputs for trigger, data, and control signals.

The commands that contain the mnemonic `:USER<ch>` determine the global trigger threshold and input impedance values, that affect all trigger and control signal inputs. The connector settings affect all digital modulations, the generation of waveform signals and all digital standards.

See also [Chapter 4.5, "Configuring global connectors"](#), on page 121.

Example: Configuring global connectors

```
// *****
// Check the signal routing for a global connector, for example connector User 1.
// *****
SOURce1:INPut:USER1:DIRection?
// Response: "UNUS"
// User 1 connector is not in use.
SOURce1:INPut:USER1:SIGnal?
// Response: "NONE"
OUTPut1:USER1:SIGnal?
// Response: "NONE"
// User 1 connector expects no input signal and no output signal.

// *****
// Set signal direction and signal type.
// *****
SOURce1:INPut:USER1:DIRection INP
SOURce1:INPut:USER1:SIGnal?
// Response: "TRIG1"
// The input signal at User 1 connector is a global trigger.
SOURce1:INPut:USER2:DIRection OUTP
OUTPut1:USER2:SIGnal?
// Response: "LOW"
// The output signal at User 2 connector is always 0.

// *****
// Set input signal characteristics.
// *****
// Settings for User 1 connector below, User 2 connector settings are analogous.
SOURce1:INPut:USER1:LEVel 1.5
// Sets a threshold of 1.5 V at the User 1 connector.
SOURce1:INPut:USER1:LLEVel 3.3
// Sets a logical level of 3.3 V at the User 1 connector.
SOURce1:INPut:USER1:IMPedance G100K
// Sets the impedance of 100 kOhm / GND at the User 1 connector.
SOURce1:INPut:TRIGger:SLOPe POS
// Sets a positive polarity of the active slope for the trigger input signals.
```

Commands:

[:SOURce]:INPut:USER<ch>:DIRection	470
:OUTPut:USER<ch>:DIRection	470
:OUTPut:USER<ch>:SIGnal	470
[:SOURce]:INPut:USER<ch>:SIGnal	470
[:SOURce]:INPut:USER:TRIGger:LEVel	471
[:SOURce]:INPut:USER<ch>:CLOCK:LLEVel	471
[:SOURce]:INPut:TRIGger:IMPedance	471
[:SOURce]:INPut:USER:TRIGger:SLOPe	472

[:SOURce] : INPut : USER <ch> : DIRection <Direction>
: OUTPut : USER <ch> : DIRection <Direction>

Sets the direction of the signal at the connector that can be an input or an output.

Suffix:

USER<ch> 1 to 7
 "User" connector number

Parameters:

<Direction> INPut | OUTPut | UNUSed
INPut|OUTPut
 Input signal or output signal
UNUSed
 No signals present at the connector.

Example: See [Example "Configuring global connectors"](#) on page 469.

Manual operation: See ["Direction"](#) on page 127

: OUTPut : USER <ch> : SIGNal <Signal>

Sets the control signal at the selected input connector or output connector.

To define the connector direction, use the command [\[:SOURce \] : INPut : USER <ch> : DIRection](#).

Suffix:

USER<ch> 1 to 3

Parameters:

<Signal> NONE | TRIG1 | LOW | HIGH | TRIGgered
NONE
 No signal
TRIG1
 Global trigger input signal
LOW|HIGH
 Always 0 or always 1
TRIGgered
 Output of the internal trigger signal or output of a received external trigger signal.
 *RST: MARKA1

Manual operation: See ["Signal"](#) on page 127

[:SOURce] : INPut : USER <ch> : SIGNal <Signal>

Sets the control signal at the selected input connector.

To define the connector direction, use the command [\[:SOURce \] : INPut : USER <ch> : DIRection](#).

Suffix:

USER<ch> 1 to 3

Parameters:

<Signal> TRIG1 || NONE

TRIG1

Global trigger input signal

NONE

No input signal

Example: See [Example "Configuring global connectors"](#) on page 469.**[:SOURce]:INPut:USER:TRIGger:LEVel <Level>****Parameters:**

<Level> float
 Range: 0.1 to 2
 Increment: 0.1
 *RST: 1

Example: See [Example "Configuring global connectors"](#) on page 469.**Manual operation:** See ["Threshold User 1 Input/Threshold User 2 Input"](#) on page 128**[:SOURce]:INPut:USER<ch>:CLOCK:LLEVel <ConnGblLogigLev>**

Sets the logical level for output signals at the connectors "User 1" and "User 2"

Parameters:

<ConnGblLogigLev> float
 Range: 0 to 3.3
 Increment: 0.1
 *RST: 3.3

Example: See [Example "Configuring global connectors"](#) on page 469.**Manual operation:** See ["Logic Level User 1/Logic Level User 2"](#) on page 129**[:SOURce]:INPut:TRIGger:IMPedance <Impedance>**

Selects the input impedance for an external trigger input signal at the connectors "User 1" and "User 2".

Parameters:

<Impedance> G50 | G100K
G50
 50 Ω per ground
G100K
 100 kΩ per ground
 *RST: G1K

Example: See [Example "Configuring global connectors"](#) on page 469.

Manual operation: See ["Impedance User 1/Impedance User 2"](#) on page 129

[:SOURce] :INPut :USER :TRIGger :SLOPe <Slope>

Sets the polarity of the active slope of an external trigger signal.

Parameters:

<Slope> NEGative | POSitive
 *RST: POSitive

Example: See [Example "Configuring global connectors"](#) on page 469.

Manual operation: See ["Trigger Input Slope"](#) on page 129

13.15.2 SOURce:CORRection subsystem

The SOURce:CORRection subsystem contains the commands for defining correction values for external test assemblies.

You can acquire the correction values anytime, regardless of the modulation settings of the generator. During correction, the R&S SFI100A adds the correction values to the output level of the respective RF frequency.

Determine the correction values in one of the following ways:

- Measure the RF output level at several frequency points and enter the value pairs manually in a table
- Connect an R&S NRP to the generator output signal and send the command `[:SOURce<hw>] :CORRection :CSET :DATA [:SENSor<ch>] [:POWER] :SONCe` to fill the table automatically.

Save correction values to files with file extension `*.ucco`.

Refer to [Chapter 13.5.2, "Handling files in the default or in a specified directory"](#), on page 414 for general information on file handling in the default and in a specific directory.

User-defined frequency response corrections

Using user-defined frequency response correction requires option R&S SFI-K544.

See the user manual "R&S SFI-K544 User-Defined Frequency Response Correction".

Programming examples

The examples in this section assume that:

- The files are stored in the default directory.
- *RST does not affect data lists.

Example: To create RF level correction values

The following example shows a command sequence to create and activate a list for assigning level correction values to arbitrary RF frequencies. Further hardware settings are not considered.

```
// Reset the instrument to start from an initial state
// Query the available user correction list files in the default
// directory. Select a file or create a file.
// *****
*RST; *CLS
:SOURce1:CORRection:CSET:CATalog?
// Response: "ucor1"
// Select the file ucor1.uco.
:SOURce1:CORRection:CSET:SElect "/var/user/ucor1"

// Enter the frequency/level value pairs in the table; existing data
// is overwritten. Query the number of frequency/power entries.
:SOURce1:CORRection:CSET:DATA:FREQuency 100MHz,110MHz,120MHz,130MHz,140MHz,150MHz
:SOURce1:CORRection:CSET:DATA:POWer -10,-7.5,-5.0,-2.5,0,2.5
:SOURce1:CORRection:CSET:DATA:FREQuency:POINTs?
// 6
:SOURce1:CORRection:CSET:DATA:POWer:POINTs?
// 6

// Enable user correction mode and RF output
:SOURce1:CORRection:STATe 1
:OUTPut1:STATe ON

// Query the currently used correction value
:SOURce1:CORRection:VALue?
// -2.5

// Delete a user correction file
:SOURce1:CORRection:CSET:DELEte "/var/user/ucor1.uco"
```

Example: To fill user correction data with a sensor

The following example shows a command sequence to fill a user correction list automatically supported by a connected R&S NRP.

```
// Fill a user correction list with the level values
// measured by an R&S NRP,
// store the data in a file and enable user correction.

*RST; *CLS

:SOURce1:CORRection:CSET:SElect "/var/user/Ucor1_AutoFill.uco"
:SOURce1:CORRection:CSET:DATA:FREQuency 100MHz,110MHz,120MHz,130MHz,140MHz,150MHz
:SOURce1:CORRection:ZERoing:STATe 1
:SOURce1:CORRection:CSET:DATA:SENSor1:POWer:SONCe
```

```
// Query the number of automatically filled correction level values
:SOURce1:CORRection:CSEt:DATA:POWer:POINtS?
// 6
:SOURce1:CORRection:STATe 1

// Query the correction value at a certain frequency
:FREQ 120000000
:SOURce1:CORRection:VALue?
// -52.13
```

Example: To export user correction lists

The following example shows a command sequence to export a user correction list (here the list created with the example before) into an ASCII file. Further hardware settings are not considered.

```
// Select a user correction file for exporting to file in ASCII format
// Set ASCII data parameters
// Set the ASCII file extension, the decimal separator
// and the column separator for the ASCII data
:SOURce1:CORRection:DEXChange:AFILe:CATALog?
// my_ucor
:SOURce1:CORRection:CSEt:CATALog?
// ucor1,Ucor1_AutoFill
:SOURce1:CORRection:CSEt:SELEct "/var/user/Ucor1_AutoFill.uco"
:SOURce1:CORRection:DEXChange:AFILe:EXTension CSV
:SOURce1:CORRection:DEXChange:AFILe:SEParator:DECimal DOT
:SOURce1:CORRection:DEXChange:AFILe:SEParator:COLumn COMMa

// Select source and destination
:SOURce1:CORRection:DEXChange:AFILe:SELEct "/var/user/ucor2ASCII"

// Export the user correction data into the ASCII file
:SOURce1:CORRection:DEXChange:MODE EXPort
:SOURce1:CORRection:DEXChange:EXECute

// Query the available ASCII files with extension .csv
:SOURce1:CORRection:DEXChange:AFILe:CATALog?
// ucor2ASCII,my_ucor

// Import a user correction ASCII file
:SOURce1:CORRection:DEXChange:MODE IMPort
:SOURce1:CORRection:DEXChange:AFILe:SELEct "/var/user/my_ucor"
:SOURce1:CORRection:DEXChange:EXECute
```

Commands:

- [Correction settings](#)..... 475
- [Correction data exchange](#)..... 478
- [SOURce:CORRection:OPTimize subsystem](#)..... 480

13.15.2.1 Correction settings

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency <Frequency>

Enters the frequency value in the table selected with `[:SOURce<hw>]:CORRection:CSET[:SElect]`.

Parameters:

<Frequency> Frequency#1[, Frequency#2, ...]
 String of values with default unit Hz.

Example: See [Example "To create RF level correction values"](#) on page 473 .

Manual operation: See ["Frequency \(Hz\)"](#) on page 236

[:SOURce<hw>]:CORRection:CSET:DATA:POWer <Power>

Enters the level values to the table selected with `[:SOURce<hw>]:CORRection:CSET[:SElect]`.

Parameters:

<Power> Power#1[, Power#2, ...]
 String of values with default unit dB.
 *RST: 0

Example: See [Example "To create RF level correction values"](#) on page 473 .

Manual operation: See ["Correction Value \(dB\)"](#) on page 236

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts?

[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts?

Queries the number of frequency/level values in the selected table.

Return values:

<Points> integer
 Range: 0 to 10000
 *RST: 0

Example: See [Example "To create RF level correction values"](#) on page 473 .

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

Fills the selected user correction table with the level values measured by the power sensor for the given frequencies.

To select the used power sensor set the suffix in key word `SENSe`.

Example: See [Example "To fill user correction data with a sensor"](#) on page 473.

Usage: Event

Manual operation: See ["Fill User Correction Data with Sensor"](#) on page 238

[:SOURce<hw>]:CORRection:CSET[:SELEct] <Filename>

Selects or creates a file for the user correction data.

If the file with the selected name does not exist, a new file is created.

Parameters:

<Filename> string
Filename or complete file path; file extension can be omitted.

Example: See [Example "To create RF level correction values"](#) on page 473 .

Manual operation: See ["UCOR Data"](#) on page 232

[:SOURce<hw>]:CORRection:VALue?

Queries the current value for user correction.

Return values:

<Value> float
Range: -100 to 100
Increment: 0.01
*RST: 0

Example: See [Example "To create RF level correction values"](#) on page 473 .

Usage: Query only

Manual operation: See ["User Correction"](#) on page 232

[:SOURce<hw>]:CORRection:ZERoing:STATe <State>

Activates the zeroing procedure before filling the user correction data acquired by a sensor.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 1

Example: See [Example "To fill user correction data with a sensor"](#) on page 473.

Manual operation: See ["Fill User Correction Data with Sensor"](#) on page 238

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

Fills the selected user correction list with the level values measured by the power sensor for the given frequencies.

Suffix:

SENSor<ch> Defines the used power sensor, i.e. the sensor whose values are used.

Example: See [Example "To fill user correction data with a sensor"](#) on page 473.

Usage: Event

[:SOURce<hw>]:CORRection[:STATe] <State>

Activates user correction with the currently selected table.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: See [Example "To create RF level correction values"](#) on page 473 .

Manual operation: See ["State"](#) on page 232

[:SOURce]:CORRection:CSET:CATalog?

Queries a list of available user correction tables.

Return values:

<Catalog> string
List of list filenames, separated by commas

Example: See [Example "To create RF level correction values"](#) on page 473 .

Usage: Query only

Manual operation: See ["UCOR Data"](#) on page 232

[:SOURce]:CORRection:CSET:DELeTe <Filename>

Deletes the specified user correction list file.

Setting parameters:

<Filename> string
Filename or complete file path; file extension is optional.

Example: See [Example "To create RF level correction values"](#) on page 473 .

Usage: Setting only

Manual operation: See ["UCOR Data"](#) on page 232

[[:SOURce<hw>]:CORRection:OPTimize:EVM <OptimizeEvm>

Enables further optimization of preexisting excellent EVM performance of I/Q modulated RF signals.

Enable EVM optimization, if your test setup requires the lowest EVM values. For example, if you need to generate 5G NR signals, LTE signals or IEEE 802.11 signals that require optimal EVM performance.

Parameters:

<OptimizeEvm> 1 | ON | 0 | OFF
*RST: 0

Example: :SOURCE1:CORRection:OPTimize:EVM?
 // Response: "0"
 :SOURCE1:CORRection:OPTimize:EVM 1
 Enables EVM optimization for the selected path.

Manual operation: See ["Optimize EVM"](#) on page 154

13.15.2.2 Correction data exchange

With the following commands, you can configure user correction lists and export or import them accordingly.

[[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?

Queries the available ASCII files for export or import of user correction data in the current or specified directory.

Return values:

<Catalog> string
List of ASCII files *.txt or *.csv, separated by commas.

Example: See [Example "To create RF level correction values"](#) on page 473 .

Usage: Query only

Manual operation: See ["Select ASCII Source/Select Destination"](#) on page 234

[[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension <Extension>

Determines the extension of the ASCII files for file import or export, or to query existing files.

Parameters:

<Extension> TXT | CSV
*RST: TXT

Example: See [Example "To export user correction lists"](#) on page 474 .

Manual operation: See ["ASCII File Settings"](#) on page 234

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELEct <Filename>

Selects the ASCII file to be imported or exported.

Parameters:

<Filename> string
 Filename or complete file path; file extension can be omitted.

Example: See [Example "To export user correction lists"](#) on page 474 .

Manual operation: See ["Select ASCII Source/Select Destination"](#) on page 234

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn <Column>

Selects the separator between the frequency and level column of the ASCII table.

Parameters:

<Column> TABulator | SEMicolon | COMMa | SPACe
 *RST: COMMa

Example: See [Example "To export user correction lists"](#) on page 474 .

Manual operation: See ["ASCII File Settings"](#) on page 234

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal <Decimal>

Sets the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Parameters:

<Decimal> DOT | COMMa
 *RST: DOT

Example: See [Example "To export user correction lists"](#) on page 474 .

Manual operation: See ["ASCII File Settings"](#) on page 234

[:SOURce<hw>]:CORRection:DEXChange:EXECute

Executes the import or export of the selected correction list, according to the previously set transfer direction with command `[:SOURce<hw>]:CORRection:DEXChange:MODE`.

Example: See [Example "To export user correction lists"](#) on page 474 .

Usage: Event

Manual operation: See ["Import / Export"](#) on page 234

[:SOURce<hw>]:CORRection:DEXChange:MODE <Mode>

Determines import or export of a user correction list.

Specify the source or destination file with the command `[:SOURce<hw>] :CORRection:DEXChange:SElect`.

Parameters:

<Mode> IMPort | EXPort
*RST: IMPort

Example: See [Example "To export user correction lists"](#) on page 474 .

Manual operation: See ["Mode"](#) on page 233

[:SOURce<hw>]:CORRection:DEXChange:SElect <Filename>

Selects the ASCII file for import or export, containing a user correction list.

Parameters:

<Filename> string
 Filename or complete file path; file extension can be omitted.

Example: See [Example "To export user correction lists"](#) on page 474 .

Manual operation: See ["Select Source/Select ASCII Destination"](#) on page 234

13.15.2.3 SOURce:CORRection:OPTimize subsystem

Option:: R&S SFI-K575

The `SOURce:CORRection:OPTimize` subsystem contains the commands for defining correction values for predefined digital predistortion to linearize the RF signal.

You can acquire the correction values anytime, regardless of the modulation settings of the generator. During correction, the R&S SFI100A adds the correction values to the output level of the respective RF frequency.

Example: Using predefined DPD for RF linearization

*RST

```
:SOURce1:CORRection:OPTimize:RF:LINearize:ADJust
// Calculates correction data for current level and frequency of the RF signal.
:SOURce1:CORRection:OPTimize:RF:LINearize MANual
// Applies the correction data to adjuast level and frequency of the RF signal.
```

Commands:

[\[:SOURce<hw>\]:CORRection:OPTimize:RF:CHARacteristics](#)..... 481
[\[:SOURce<hw>\]:CORRection:OPTimize:RF:HEADroom](#)..... 481
[\[:SOURce<hw>\]:CORRection:OPTimize:RF:IQModulator](#)..... 481

[:SOURce<hw>]:CORRection:OPTimize:RF:IQModulator:ADJust?	481
[:SOURce<hw>]:CORRection:OPTimize:RF:LINearize	481
[:SOURce<hw>]:CORRection:OPTimize:RF:LINearize:ADJust?	482

[:SOURce<hw>]:CORRection:OPTimize:RF:CHARacteristics <Characteristic>

Parameters:

<Characteristic> OFF | EVM | USER
 *RST: OFF

[:SOURce<hw>]:CORRection:OPTimize:RF:HEADroom <State>

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

[:SOURce<hw>]:CORRection:OPTimize:RF:IQModulator <State>

Enables adjustments of the I/Q modulator after each RF frequency change or RF level change.

Parameters:

<State> 1 | ON | 0 | OFF

1|ON

Adjusts the I/Q modulator during modulation after each RF frequency change or RF level change.

0|OFF

No adjustments of the I/Q modulator during modulation.

*RST: 0

Example: See [Example "Using predefined DPD for RF linearization"](#) on page 480.

[:SOURce<hw>]:CORRection:OPTimize:RF:IQModulator:ADJust?

Return values:

<AdjustError> 1 | ON | 0 | OFF
 *RST: n.a. (no preset. default: 0)

Usage: Query only

[:SOURce<hw>]:CORRection:OPTimize:RF:LINearize <Linearize>

Selects the mode to apply a predefined AM/AM digital predistortion (DPD) to the non-linear RF chain to linearize the RF signal.

Parameters:

<Linearize> OFF | AUTO | MANual

OFF

Disables applying the DPD to the nonlinear RF chain.

AUTO

Requires R&S SFI-K575.

Applies an automatic AM/AM predistortion of the nonlinear RF chain. This mode requires correction data from "Linearize RF for current settings".

MANual

Requires R&S SFI-K541.

Applies an AM/AM predistortion of the nonlinear RF chain. This mode requires correction data from "Linearize RF for current settings".

To receive the correction data, use the following command before using the manual mode to linearize the RF signal.

`[:SOURce<hw>] :CORRection:OPTimize:RF:LINearize:ADJust?` on page 482

*RST: OFF

Example: See [Example "Using predefined DPD for RF linearization"](#) on page 480.

`[:SOURce<hw>] :CORRection:OPTimize:RF:LINearize:ADJust?`
Return values:

<AdjustResult> 1 | ON | 0 | OFF

*RST: n.a. (no preset. default: 0)

Example: See [Example "Using predefined DPD for RF linearization"](#) on page 480.

Usage: Query only

13.15.3 SOURce:CORRection:FRES subsystem

The following commands are required to perform signal generation with the option R&S SFI-K544 in a remote environment.

Common suffixes

The remote commands use the following common suffixes:

Suffix	Value range	Description
SLISt<hw>	1 to 10	S-parameter list file number. You can load up to 10 files.
FLISt<hw>	1 to 5	Frequency response (FR) list file number. You can load up to five files.

Programming examples

Example: To enable high-quality table I/Q modulation optimizations

```
SOURcel:CORRection:FRESponse:RF:OPTimization:MODE QHT
SOURcel:CORRection:FRESponse:RF:OPTimization:BANDwidth:MODE AUTO
SOURcel:CORRection:FRESponse:RF:OPTimization:BANDwidth:VALue?
// Response in Hz: 160000000
// Optimization bandwidth is 160 MHz.
SOURcel:CORRection:FRESponse:RF:OPTimization:LOCAl
SOURcel:CORRection:FRESponse:RF:OPTimization:HOLD:STATe 1
```

Example: Applying user-defined FRC

This example illustrates frequency response corrections from S-parameter files * .s<n>p. We assume that the S-parameter files `cable.s1p` and `combiner.s3p` are available in the user directory `/var/user/` of the instrument. These files contain corrections for a cable and a combiner as typical components of a test setup.

```
// *****
// Load S-parameter files that contain the user-defined corrections.
// *****
// Enable absolute level compensation.
:SOURcel:CORRection:FRESponse:RF:USER:ALEvel:STATe 1
:SOURcel:CORRection:FRESponse:RF:USER:SLIST:CATalog?
// Response: "None,None,None,None,None,None,None,None,None"
// The S-parameter list has no files. You can load up to ten files.
// Select available S-parameter files.
:SOURcel:CORRection:FRESponse:RF:USER:SLIST1:SElect "/var/user/cable.s1p"
// The *.s1p file contains a single-port measurement.
:SOURcel:CORRection:FRESponse:RF:USER:SLIST1:PORTs:FROM 1
:SOURcel:CORRection:FRESponse:RF:USER:SLIST1:PORTs:TO 1
:SOURcel:CORRection:FRESponse:RF:USER:SLIST1:STATe 1
// You can also skip rows, for example skip the second row.
:SOURcel:CORRection:FRESponse:RF:USER:SLIST3:SElect "/var/user/combiner.s3p"
:SOURcel:CORRection:FRESponse:RF:USER:SLIST3:STATe 1
:SOURcel:CORRection:FRESponse:RF:USER:SLIST:CATalog?
// Response: "None,None,None,None,None,None,None,None,None"
// If you do not apply changes to the S-parameter list, the list remains empty.
:SOURcel:CORRection:FRESponse:RF:USER:APPLY
:SOURcel:CORRection:FRESponse:RF:USER:SLIST:SIZE?
// Response: "2"
:SOURcel:CORRection:FRESponse:RF:USER:SLIST:CATalog?
// Response: "/var/user/cable.s1p,None,/var/user/combiner.s3p,..."
// *****
// Optionally, exclude S-parameter files from the configuration.
// *****
// Deactivate a file from the list.
:SOURcel:CORRection:FRESponse:RF:USER:SLIST4:STATe 0
// Or, unselect the file.
:SOURcel:CORRection:FRESponse:RF:USER:SLIST4:SElect "None"
```

```

// Apply the changes.
:SOURce1:CORRection:FRESponse:RF:USER:APPLY
:SOURce1:CORRection:FRESponse:RF:USER:SLIST:CATalog?
// "/var/user/cable.slp,None,/var/user/combiner.s3p,None,None,None,None,None,None,None"
// Optionally, clear the whole S-parameter list to empty the list.
:SOURce1:CORRection:FRESponse:RF:USER:SLIST:CLEar

// *****
// Apply FRC with RF list files with file extensions *.fres or *.uco.
// *****
// For RF list files, measure the channel response, save and load the required
// files. The following example assumes that the files tr_channel.fres and
// ucor.uco are available in the user directory of the instrument.
:SOURce1:CORRection:FRESponse:RF:USER:FLIST:STATe 1
:SOURce1:CORRection:FRESponse:RF:USER:FLIST1:SElect "/var/user/tr_channel.fres"
:SOURce1:CORRection:FRESponse:RF:USER:FLIST1:MAGNitude:STATe 1
:SOURce1:CORRection:FRESponse:RF:USER:FLIST1:PHASe:STATe 1
:SOURce1:CORRection:FRESponse:RF:USER:FLIST2:SElect "/var/user/ucor.uco"
:SOURce1:CORRection:FRESponse:RF:USER:FLIST:APPLY
:SOURce1:CORRection:FRESponse:RF:USER:FLIST:CATalog?
// Response: "tr_channel.fres, ucor.uco"
:SOURce1:CORRection:FRESponse:RF:USER:STATe 1
:SOURce1:CORRection:FRESponse:RF:USER:ALEVel:VALUe?
// Response: "0.78"
:SOURce1:CORRection:FRESponse:RF:USER:STORe "/var/user/frc"
:SOURce1:CORRection:FRESponse:RF:USER:PRESet
:SOURce1:CORRection:FRESponse:RF:USER:LOAD "/var/user/frc"

```

Commands:

- [General commands](#).....484
- [Common commands](#).....487
- [S-parameter list commands](#).....489
- [Frequency response \(FR\) list commands](#).....490

13.15.3.1 General commands

- [\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:MODE](#)..... 484
- [\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:BANDwidth:MODE](#).....485
- [\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:BANDwidth\[:VALue\]](#)..... 485
- [\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:HOLD\[:STATe\]](#)..... 486
- [\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:LOCal](#).....486

[:SOURce<hw>]:CORRection:FRESponse:RF:OPTimization:MODE
 <FreqRespOptMode>

Sets the optimization mode for frequency response correction.

This optimization mode also uses the I/Q modulator and vice versa via the command:

SOURce<hw>:BB:IMPairment:OPTimization:MODE

See also ["Optimization Mode"](#) on page 153.

Parameters:

<FreqRespOptMode> FAST | QHTable

FAST

Fast optimization by compensating for I/Q skew.

QHTable

Improves the frequency response while maintaining setting time. There is no signal interruption.

*RST: FAST

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Manual operation: See ["Optimization Mode"](#) on page 170

[:SOURce<hw>]:CORRection:FRESponse:RF:OPTimization:BANDwidth:MODE
 <FreqRespOptBwMo>

For high-quality I/Q modulation optimizations, sets the mode to set the signal bandwidth

To enable these optimizations, see the following command:

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:MODE](#)
 on page 484

Parameters:

<FreqRespOptBwMo>AUTO | MANual

AUTO

Automatic bandwidth settings

MANual

Manual bandwidth setting via the following command:

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:BANDwidth\[:VALue\]](#) on page 485

*RST: AUTO

Example: See [Example "To enable high-quality table I/Q modulation optimizations"](#) on page 483.

Manual operation: See ["Optimization Bandwidth"](#) on page 170

[:SOURce<hw>]:CORRection:FRESponse:RF:OPTimization:BANDwidth[:VALue]
 <FreqRespOptBwVa>

Sets the signal compensation for manual bandwidth mode.

See [\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:BANDwidth:MODE](#) on page 485.

For more information, refer to the specifications document.

Parameters:

<FreqRespOptBwVa> integer

Range: depends on options to depends on options

*RST: depends on options

Example:See [Example "To enable high-quality table I/Q modulation optimizations"](#) on page 483.**Manual operation:** See ["Bandwidth"](#) on page 170

**[:SOURce<hw>]:CORRection:FRESponse:RF:OPTimization:HOLD[:STATe]
<FreqRespHoldSta>**

For high-quality I/Q modulation optimizations, retains the last calculated correction values as long as one of the following holds:

- SOURce1:CORRection:FRESponse:RF:OPTimization:HOLD:STATe 0
- SOURce1:CORRection:FRESponse:RF:OPTimization:LOCAl

To enable these optimizations, see the following command:

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:MODE](#)
on page 484

Parameters:

<FreqRespHoldSta> 1 | ON | 0 | OFF

*RST: 0

Example:See [Example "To enable high-quality table I/Q modulation optimizations"](#) on page 483.**Manual operation:** See ["Hold Filter"](#) on page 170

[:SOURce<hw>]:CORRection:FRESponse:RF:OPTimization:LOCAl

For high-quality I/Q modulation optimizations, triggers optimization for the current settings.

To enable these optimizations, see the following command:

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:OPTimization:MODE](#)
on page 484

Example:See [Example "To enable high-quality table I/Q modulation optimizations"](#) on page 483.**Usage:**

Event

Manual operation: See ["Optimize for current setting"](#) on page 171

13.15.3.2 Common commands

<code>[:SOURce<hw>]:CORRection:FRESponse:RF:USER[:STATe]</code>	487
<code>[:SOURce<hw>]:CORRection:FRESponse:RF:USER:STORe</code>	487
<code>[:SOURce<hw>]:CORRection:FRESponse:RF:USER:PRESet</code>	487
<code>[:SOURce<hw>]:CORRection:FRESponse:RF:USER:LOAD</code>	487
<code>[:SOURce<hw>]:CORRection:FRESponse:RF:USER:ALEVel[:STATe]</code>	488
<code>[:SOURce<hw>]:CORRection:FRESponse:RF:USER:ALEVel:VALue?</code>	488
<code>[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLISt[:STATe]</code>	489
<code>[:SOURce<hw>]:CORRection:FRESponse:RF:USER:APPLY</code>	489

`[:SOURce<hw>]:CORRection:FRESponse:RF:USER[:STATe] <FreqRespState>`

Enables the frequency response correction.

Parameters:

`<FreqRespState>` 1 | ON | 0 | OFF
 *RST: 0

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Manual operation: See ["State"](#) on page 172

`[:SOURce<hw>]:CORRection:FRESponse:RF:USER:STORe <FreqRespRfSave>`

Saves the current settings into the selected file; the file extension (`*.freqresp`) is assigned automatically.

Parameters:

`<FreqRespRfSave>` "<filename>"
 Filename or complete file path

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Manual operation: See ["Save/Recall"](#) on page 172

`[:SOURce<hw>]:CORRection:FRESponse:RF:USER:PRESet`

Sets the parameters to their default values (`*RST` values specified for the commands).

Not affected is the state set with the command `[:SOURce<hw>]:CORRection:FRESponse:RF:USER[:STATe]` on page 487.

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Usage: Event

Manual operation: See ["Set To Default"](#) on page 172

`[:SOURce<hw>]:CORRection:FRESponse:RF:USER:LOAD <FreqRespRfRcl>`

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.freqresp`.

Parameters:

<FreqRespRfRcl> "<filename>"
 Filename or complete file path; file extension can be omitted.

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Manual operation: See ["Save/Recall"](#) on page 172

**[:SOURce<hw>]:CORRection:FRESponse:RF:USER:ALEVel[:STATe]
 <FreqCorrRfAlSta>**

Enables absolute level compensation at the current center frequency.

Query the level correction value with the following command:

[\[:SOURce<hw>\]:CORRection:FRESponse:RF:USER:ALEVel:VALue?](#)
 on page 488

You cannot enable absolute level compensation and user correction simultaneously. These functions exclude each other.

See also ["About UCOR"](#) on page 229.

Parameters:

<FreqCorrRfAlSta> 1 | ON | 0 | OFF
 *RST: 0

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Manual operation: See ["Compensate Absolute Level"](#) on page 172

[:SOURce<hw>]:CORRection:FRESponse:RF:USER:ALEVel:VALue?

Queries the absolute level correction value. Querying real values requires enabled absolute level compensation:

SOURce1:CORRection:FRESponse:RF:USER:ALEVel:STATe 1

See also [\[:SOURce<hw>\]:CORRection:FRESponse:RF:USER:ALEVel\[:STATe\]](#)
 on page 488.

Return values:

<FreqCorRfAbsLVa> float
 Range: -100 to 100
 Increment: 0.001
 *RST: 0
 Default unit: dB

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Usage: Query only

Manual operation: See ["Absolute Level Correction"](#) on page 173

**[[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLISt[:STATe]
<FreqCorrRfFLSta>**

Uses FR list files for user-defined corrections.

Load the FR lists, enable them and apply the configuration with the corresponding FR list commands.

Parameters:

<FreqCorrRfFLSta> 1 | ON | 0 | OFF
*RST: 0

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Manual operation: See ["Additional FR"](#) on page 173

[[:SOURce<hw>]:CORRection:FRESponse:RF:USER:APPLY

Applies the values from all enabled S-parameter correction files.

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Usage: Event

Manual operation: See ["Apply"](#) on page 175
See ["Apply"](#) on page 176

13.15.3.3 S-parameter list commands

[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLISt<ch>:SElect	489
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLISt<ch>:PORTs:FROM	490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLISt<ch>:PORTs:TO	490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLISt<ch>[:STATe]	490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLISt:CATalog?	490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLISt:SIZE?	490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLISt:CLEar	490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:APPLY	490

**[[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLISt<ch>:SElect
<FreqRespRfSlSel>**

Selects an existing S-parameter file with file extension *.s<n>p from the default directory or from a specific directory.

Parameters:

<FreqRespRfSlSel> string
Filename incl. file extension or complete file path
Use "none" to unload a file.

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Manual operation: See ["S-Parameter Filename"](#) on page 174

```
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLIST<ch>:PORTs:FROM
  <FreqRespSListFr>
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLIST<ch>:PORTs:TO
  <FreqRespSListFr>
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLIST<ch>[:STATe]
  <FreqRespSLiStat>
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLIST:CATalog?
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLIST:SIZE?
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:SLIST:CLEar
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:APPLY
```

Applies the values from all enabled S-parameters correction files.

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Usage: Event

Manual operation: See ["Apply"](#) on page 175
See ["Apply"](#) on page 176

13.15.3.4 Frequency response (FR) list commands

```
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST<ch>:SElect..... 490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST<ch>:PHASe[:STATe]..... 490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST<ch>:MAGNitude[:STATe]..... 490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST:CATalog?..... 490
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST:SIZE?..... 491
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST:CLEar..... 491
```

```
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST<ch>:SElect
  <FreqCorrRfFISel>
```

Selects an existing frequency response list file (*.uco or *.fres) from the default directory or from the specific directory.

Parameters:

```
<FreqCorrRfFISel> string
                    Filename incl. file extension or complete file path
                    Use "none" to unload a file.
```

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Manual operation: See ["Frequency Response Filename"](#) on page 176

```
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST<ch>:PHASe[:STATe]
  <FreqCorrRfPhSta>
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST<ch>:MAGNitude[:
  STATe] <FreqCorrRfMagSt>
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLIST:CATalog?
```

```
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLISt:SIZE?
[:SOURce<hw>]:CORRection:FRESponse:RF:USER:FLISt:CLEAr
```

Deletes all entries in the lists.

Example: See [Example "Applying user-defined FRC"](#) on page 483.

Usage: Event

13.15.4 SOURce:FREQuency subsystem

The SOURce:FREQuency subsystem contains the commands used to define the frequency settings for the RF sources and sweeps.

Example: Frequency configuration

```
SOURce1:FREQuency:CW?
// Response 16000000000
SOURce1:FREQuency:CW 19500000000
SOURce1:FREQuency:OFFSet?
// Response 0
SOURce1:FREQuency:OFFSet 5000

SOURce1:FREQuency:STEP:MODE?
// Response: DEC
SOURce1:FREQuency:STEP:INCRement 1000000
SOURce1:FREQuency:CW UP
```

[:SOURce<hw>]:FREQuency[:CW FIXed]	491
[:SOURce<hw>]:FREQuency[:CW FIXed]:RCL	492
[:SOURce<hw>]:FREQuency:OFFSet	492
[:SOURce<hw>]:FREQuency:STEP:MODE	492
[:SOURce<hw>]:FREQuency:STEP[:INCRement]	493

[:SOURce<hw>]:FREQuency[:CW|FIXed] <Fixed>

Sets the frequency of the RF output signal in the selected path.

Parameters:

<Fixed> float

The following settings influence the value range:

An offset set with the command [\[:SOURce<hw>\]:FREQuency:OFFSet](#)

Numerical value

Sets the frequency in CW and sweep mode

UP|DOWN

Varies the frequency step by step in user mode.

The frequency is increased or decreased by the value set with the command [\[:SOURce<hw>\]:FREQuency:STEP\[:INCRement\]](#).

Range: (RFmin + OFFSet) to (RFmax + OFFSet)
 *RST: n.a.

Example: See [Example "Frequency configuration"](#) on page 491

Manual operation: See ["Frequency"](#) on page 201

[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL <Rcl>

Set whether the RF frequency value is retained or taken from a loaded instrument configuration, when you recall instrument settings with command *RCL.

Parameters:

<Rcl> INCLude | EXCLude

INCLude

Takes the frequency value of the loaded settings.

EXCLude

Retains the current frequency when an instrument configuration is loaded.

*RST: INCLude

Example: SOURce1:FREQuency:CW:RCL INCLude

Manual operation: See ["Exclude Frequency"](#) on page 281

[:SOURce<hw>]:FREQuency:OFFSet <Offset>

Sets the frequency offset $f_{\text{FREQ:OFFSet}}$ of a downstream instrument.

Parameters:

<Offset> float

Increment: 0.01

*RST: 0

Example: See [Example "Frequency configuration"](#) on page 491

Manual operation: See ["Offset"](#) on page 201

[:SOURce<hw>]:FREQuency:STEP:MODE <Mode>

Defines the type of step size to vary the RF frequency at discrete steps with the commands [FREQ UP](#) or [FREQ DOWN](#).

Parameters:

<Mode> DECimal | USER

DECimal

Increases or decreases the level in steps of ten.

*RST: DECimal

Example: See [Example "Frequency configuration"](#) on page 491.

Manual operation: See ["Variation Active"](#) on page 204

[[:SOURce<hw>]:FREQUENCY:STEP[:INCREMENT] <Increment>

Sets the step width.

You can use this value to vary the RF frequency with command [FREQ UP](#) or [FREQ DOWN](#).

Note: This value also applies to the step width of the rotary knob on the instrument and, in user-defined step mode, increases or decreases the frequency.

Parameters:

<Increment>	float
Range:	0 Hz to RFmax - 100 kHz
Increment:	0.01 Hz
*RST:	1E6

Example: See [Example "Frequency configuration"](#) on page 491

Manual operation: See ["Variation Step"](#) on page 204

13.15.5 SOURce:INPut subsystem

The `SOURce:INPut` subsystem contains the commands for configuring the inputs for external modulation signals. The instrument trigger setting influences all sweeps and is effective in the List mode (Instrument Trigger).

13.15.6 SOURce:IQ subsystem

The `SOURce:IQ` subsystem contains the commands for configuring the I/Q modulation.

Required options

See ["Required options"](#) on page 151.

[:SOURce<hw>]:IQ:SOURce	493
[:SOURce<hw>]:IQ:STATe	494
[:SOURce<hw>]:BB:IQGain	494

[[:SOURce<hw>]:IQ:SOURce <Source>

Selects the input signal source for the I/Q modulator.

Parameters:

<Source>	BASEband
	BASEband
	Internal baseband signal

ANALog

External analog wideband I/Q signal

Enabling the I/Q modulator disables an enabled amplitude modulation of the RF output signal.

Differential

External analog wideband I/Q signal

Enabling the I/Q modulator disables an enabled amplitude modulation of the RF output signal.

*RST: BASEband

Example:

SOURce1:IQ:SOURce BASEband

Sets the internal baseband signal as I/Q modulator source signal, for example an ARB signal.

Manual operation: See "[Source](#)" on page 153

[:SOURce<hw>]:IQ:STATe <State>

Enables the I/Q modulation.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example:

IQ:STAT ON

Enables the I/Q modulation.

Manual operation: See "[State](#)" on page 152

[:SOURce<hw>]:BB:IQGain <IqGain>

Sets the baseband gain for a wide dynamic range.

You can attenuate this level (negative gain) to optimize the I/Q modulation performance. The optimization is a trade-off between signal distortion and signal-to-noise ratio (SNR).

Parameters:

<IqGain> DB0 | DBM3 | DBM6 | DBM9 | DBM12 | AUTO

Dynamic range of 12 dB divided into 3 dB steps.

DBM3|DBM6|DBM9|DBM12

"-12 dB"/"-9 dB"/"-6 dB"/"-3 dB"

Attenuates the baseband signal internally to minimize signal distortions and optimize the intermodulation characteristics of the modulated signal. But the SNR decreases, the signal noise increases.

DB0

0 dB

No changes on the baseband signal, applies no optimization.

AUTO

The R&S SFI100A automatically sets an optimized gain value. The configured sample rate, the crest factor and the PEP value of the modulated signal affect this gain value.

*RST: AUTO

Example:

SOURce1:BB:IQGain DBM3

Attenuates the power level of the I/Q modulator source signal by 3 dB.

Manual operation: See "Baseband Gain" on page 153

13.15.7 SOURce:IQ:OUTPut subsystem

Option: R&S SFI-K17

The SOURce:IQ:OUTPut subsystem contains the commands for configuring analog I/Q output signals.

Example: Enabling and configuring the analog output

SCONfiguration:OUTPut:MAPPING:IQOutput1:STReam1:STATe 1

```
SOURce1:IQ:OUTPut:ANALog:PRESet
SOURce1:IQ:OUTPut:ANALog:TYPE DIFF
SOURce1:IQ:OUTPut:ANALog:MODE VAR
SOURce1:IQ:OUTPut:LEVel 2
SOURce1:IQ:OUTPut:ANALog:BIAS:COUPling:STATe 1
SOURce1:IQ:OUTPut:ANALog:BIAS:I 1
SOURce1:IQ:OUTPut:ANALog:BIAS:Q?
// 1
SOURce1:IQ:OUTPut:ANALog:OFFSet:I 2
SOURce1:IQ:OUTPut:ANALog:OFFSet:Q 2.5
SOURce1:IQ:OUTPut:ANALog:STATe 1
```

Commands:

[SOURce<hw>]:IQ:OUTPut:ANALog:STATe.....	496
[SOURce<hw>]:IQ:OUTPut:ANALog:PRESet.....	496
[SOURce<hw>]:IQ:OUTPut:ANALog:SETTing:CATalog?.....	496
[SOURce<hw>]:IQ:OUTPut:ANALog:SETTing:STORe.....	496
[SOURce<hw>]:IQ:OUTPut:ANALog:SETTing:LOAD.....	497
[SOURce<hw>]:IQ:OUTPut:ANALog:SETTing:DELeTe.....	497
[SOURce<hw>]:IQ:OUTPut:ANALog:TYPE.....	497
[SOURce<hw>]:IQ:OUTPut:ANALog:MODE.....	497
[SOURce<hw>]:IQ:OUTPut:LEVel.....	497
[SOURce<hw>]:IQ:OUTPut:ANALog:BIAS:COUPling[STATe].....	498
[SOURce<hw>]:IQ:OUTPut:ANALog:BIAS:I.....	498
[SOURce<hw>]:IQ:OUTPut:ANALog:BIAS:Q.....	498
[SOURce<hw>]:IQ:OUTPut:ANALog:OFFSet:I.....	499
[SOURce<hw>]:IQ:OUTPut:ANALog:OFFSet:Q.....	499

[:SOURce<hw>]:IQ:OUTPut:ANALog:STATe <State>

Activates the specified analog I/Q output.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example:

SOURce:IQ:OUTPut:ANALog:STATe ON
Activates the output of the analog I/Q signal on the [I/Q Out 1] connectors.

Manual operation: See ["State"](#) on page 251

[:SOURce<hw>]:IQ:OUTPut[:ANALog]:PRESet

Sets the default settings (*RST values specified for the commands).

Not affected are:

- The state set with the command `[:SOURce<hw>]:IQ:OUTPut:ANALog:STATe`.
- If `SCONfiguration:EXTernal:PBEHaviour 1`, the I/Q output type set with the command `[:SOURce<hw>]:IQ:OUTPut[:ANALog]:TYPE`.

Example:

See [Example "Enabling and configuring the analog output"](#) on page 495.

Usage: Event

Manual operation: See ["Set To Default"](#) on page 251

[:SOURce<hw>]:IQ:OUTPut[:ANALog]:SETting:CATalog?

Queries the files with I/Q output settings in the default directory. Listed are files with the file extension `*.iqout`.

Return values:

<Catalog> string

Usage: Query only

Manual operation: See ["Save/Recall"](#) on page 252

[:SOURce<hw>]:IQ:OUTPut[:ANALog]:SETting:STORe <Filename>

Stores the current settings into the selected file; the file extension (`*.iqout`) is assigned automatically.

Setting parameters:

<Filename> "<filename>"
Filename or complete file path

Usage: Setting only

[[:SOURce<hw>]:IQ:OUTPut[:ANALog]:SETTING:LOAD <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension *.iqout.

Setting parameters:

<Filename> "<filename>"
Filename or complete file path

Usage: Setting only

[[:SOURce<hw>]:IQ:OUTPut[:ANALog]:SETTING:DELEte <Filename>

Deletes the selected file from the default or specified directory. Deleted are files with the file extension *.iqout.

Setting parameters:

<Filename> "<filename>"
Filename or complete file path

Usage: Setting only

[[:SOURce<hw>]:IQ:OUTPut[:ANALog]:TYPE <Type>

Sets the type of the analog signal.

Example: SOURce1:IQ:OUTPut:ANALog:TYPE DIFFerential

Manual operation: See "[I/Q Output Type](#)" on page 252

[[:SOURce<hw>]:IQ:OUTPut[:ANALog]:MODE <Mode>

Determines the mode for setting the output parameters.

Parameters:

<Mode> FIXEd | VARiable
FIXEd
Locks the I/Q output settings
VARiable
Unlocks the settings
*RST: FIXEd

Example: See [Example "Enabling and configuring the analog output"](#) on page 495.

Manual operation: See "[Mode](#)" on page 252

[[:SOURce<hw>]:IQ:OUTPut:LEVEl <Level>

Sets the off-load voltage V_p of the analog I/Q signal output.

To keep the I/Q analog output power levels below the maximum input power level at your DUT, see ["Maximum overall output voltage"](#) on page 245.

Also, the value range depends on instrument settings, for example the modulation signal type and signal bandwidth.

For more information, refer to the specifications document.

Parameters:

<Level> float
 Range: depends on settings
 Increment: 1E-4
 *RST: 1
 Default unit: V

Example: See [Example "Enabling and configuring the analog output"](#) on page 495.

Manual operation: See ["I/Q Level Vp \(EMF\)"](#) on page 253

[:SOURce<hw>]:IQ:OUTPut[:ANALog]:BIAS:COUPling[:STATe] <State>

Couples the bias setting of the I and Q signal components.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Example: See [Example "Enabling and configuring the analog output"](#) on page 495.

Manual operation: See ["Couple I/Q Bias"](#) on page 253

[:SOURce<hw>]:IQ:OUTPut[:ANALog]:BIAS:I <I>
[:SOURce<hw>]:IQ:OUTPut[:ANALog]:BIAS:Q <Q>

Sets the amplifier bias V_{bias} of the I component or Q component.

To keep the I/Q analog output power levels below the maximum input power level at your DUT, see ["Maximum overall output voltage"](#) on page 245.

The value range depends on the I/Q analog output connectors "DAC", "Diff" or "Single".

For more information, refer to the specifications document.

Parameters:

<Q> float
 Range: depends on connector
 Increment: 1E-4
 *RST: 0
 Default unit: V

Example: See [Example "Enabling and configuring the analog output"](#) on page 495.

Manual operation: See ["Bias \(EMF\)"](#) on page 253

```
[ :SOURce<hw>]:IQ:OUTPut[:ANALog]:OFFSet:I <I>
[:SOURce<hw>]:IQ:OUTPut[:ANALog]:OFFSet:Q <Q>
```

Sets an offset V_{offset} between the inverting and non-inverting input of the differential analog I/Q output signal.

To keep the I/Q analog output power levels below the maximum input power level at your DUT, see ["Maximum overall output voltage"](#) on page 245.

The value range depends on the differential I/Q analog output connectors "DAC" or "Diff".

For more information, refer to the specifications document.

Parameters:

<Q>	float
	Range: -0.1 V to 0.1 V
	Increment: 1E-4
	*RST: 0
	Default unit: V

Example: See [Example "Enabling and configuring the analog output"](#) on page 495.

Manual operation: See ["Offset \(EMF\)"](#) on page 254

13.15.8 SOURce:ROSCillator subsystem

The SOURce:ROSCillator subsystem contains the commands for setting the external and internal reference frequency.



The commands of this subsystem are not affected by an instrument reset (*RST on page 409).

Example: Configuring the reference oscillator

```
// Using 8 GHz external reference source
SOURce:ROSCillator:SOURce EXT
SOURce:ROSCillator:EXTErnal:RFOFf:STATe 1
SOURce:ROSCillator:EXTErnal:FREQuency 8GHZ
SOURce:ROSCillator:EXTErnal:FREQuency?
// Response: 8 GHz
SOURce:ROSCillator:EXTErnal:SBANDwidth WIDE
SOURce:ROSCillator:INTernAl:ADJust:STATe 0
// assign the signals to the reference outputs
SOURce:ROSCillator:OUTPut:FREQuency:MODE DER100M
SOURce:ROSCillator:OUTPut2:FREQuency:MODE LOOP
SOURce:ROSCillator:OUTPut:FREQuency:MODE 16G

// Query calibration value
CALibration:ROSCillator?
// 32767
// Set an internal source
// Activate user-defined adjustment value of 1000
SOURce:ROSCillator:SOURce INT
SOURce:ROSCillator:INTernAl:ADJust:STATe 1
SOURce:ROSCillator:INTernAl:ADJust:VALue 1000

// to resume calibrated state
SOURce:ROSCillator:INTernAl:ADJust:VALue 0
SOURce:ROSCillator:INTernAl:ADJust:STATe 0
// or
// SYSTem:FPRest
```

[SOURce]:ROSCillator:EXTErnal:FREQuency.....	500
[SOURce]:ROSCillator:EXTErnal:FREQuency:VARiable.....	501
[SOURce]:ROSCillator:EXTErnal:MLRange?.....	501
[SOURce]:ROSCillator:EXTErnal:NSBandwidth?.....	501
[SOURce]:ROSCillator:EXTErnal:RFOFf[:STATe].....	502
[SOURce]:ROSCillator:EXTErnal:SBANDwidth.....	502
[SOURce]:ROSCillator:OUTPut:FREQuency:MODE.....	502
[SOURce]:ROSCillator:OUTPut2:FREQuency:MODE.....	503
[SOURce]:ROSCillator:OUTPut3:FREQuency:MODE.....	503
[SOURce]:ROSCillator:PRESet.....	503
[SOURce]:ROSCillator:SOURce.....	504
[SOURce]:ROSCillator[:INTernAl]:ADJust[:STATe].....	504
[SOURce]:ROSCillator[:INTernAl]:ADJust:VALue.....	504

[SOURce]:ROSCillator:EXTErnal:FREQuency <Frequency>

Sets the frequency of the external reference.

Parameters:

<Frequency> 10MHZ | VARiable | 1GHZ | 100MHZ | 8GHZ | 640MHZ
 *RST: n.a. (factory preset: 10MHZ)

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Options: R&S SFI-K703, R&S SFI-K704, R&S SFI-K708

Manual operation: See ["External Reference Frequency"](#) on page 208

[:SOURce]:ROSCillator:EXTernal:FREQUENCY:VARIABLE <Frequency>

Specifies the user-defined external reference frequency.

Parameters:

<Frequency> float
 Range: 1E6 to 100E6
 Increment: 0.1
 *RST: n.a. (factory preset: 1E7)
 Default unit: Hz

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Manual operation: See ["Variable Reference Frequency"](#) on page 208

[:SOURce]:ROSCillator:EXTernal:MLRange?

Queries the minimum locking range for the selected external reference frequency.

Depending on the RF hardware version, and the installed options, the minimum locking range varies.

For more information, refer to the specifications document.

Return values:

<MinLockRange> string

Example: SOUR:ROSC:EXT:MLR?

Usage: Query only

Manual operation: See ["Minimum Locking Range"](#) on page 209

[:SOURce]:ROSCillator:EXTernal:NSBandwidth?

Queries the nominal synchronization bandwidth for the selected external reference frequency and synchronization bandwidth.

Return values:

<NomBandwidth> string

Example: SOUR:ROSC:EXT:NSB?

Usage: Query only

Manual operation: See ["Nominal Synchronization Bandwidth"](#) on page 209

[[:SOURce]:ROSCillator:EXTernal:RFOFF[:STATe]] <State>

Determines that the RF output is turned off when the external reference signal is selected, but missing.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: n.a. (factory preset: 0)

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Manual operation: See ["Deactivate RF Output \(if external reference is missing\)"](#) on page 208

[[:SOURce]:ROSCillator:EXTernal:SBANDwidth] <SBandwidth>

Selects the synchronization bandwidth for the external reference signal.

Depending on the RF hardware version and the installed options, the synchronization bandwidth varies.

For more information, refer to the specifications document.

Parameters:

<SBandwidth> WIDE | NARRow
NARRow
 The synchronization bandwidth is a few Hz.
WIDE
 Uses the widest possible synchronization bandwidth.
 *RST: n.a. (factory preset: WIDE)

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Manual operation: See ["Synchronization Bandwidth"](#) on page 209

[[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE] <OutpFreqMode>

Selects the mode for the reference frequency output 1.

Parameters:

<OutpFreqMode> DER10M | DER100M | OFF | LOOPthrough
OFF
 Disables the output.
DER10M|DER100M
 Sets the output reference frequency to 10 MHz, or 100 MHz.
 The reference frequency is derived from the internal reference frequency.
LOOPthrough
 Forwards the signal from reference input 1 to the reference frequency output.
 This setting is not available for
 ROSCillator:EXTernal:FREQuency 640MHz|1GHZ|8GHZ.

*RST: n.a. (factory preset: DER10M)

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Manual operation: See ["Reference Output"](#) on page 210

[[:SOURce]:ROSCillator:OUTPut2:FREQUENCY:MODE <OutpFreqMode>

Selects the mode for the reference frequency output 2.

Parameters:

<OutpFreqMode> OFF | DER1G | LOOPthrough | DER8G

OFF

Disables the output.

DER1G|DER8G

Sets the output reference frequency to 1 GHz, or 8 GHz.

The reference frequency is derived from the internal reference frequency.

LOOPthrough

Forwards the signal from reference input 2 to the reference frequency output.

Loop through is not available for

ROSCillator:EXTernal:FREQUENCY 10MHz|100M.

*RST: n.a. (factory preset: OFF)

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Manual operation: See ["Reference Output"](#) on page 210

[[:SOURce]:ROSCillator:OUTPut3:FREQUENCY:MODE <Rosc16GOutpFreq>

Selects the mode for the reference frequency output 3.

Parameters:

<Rosc16GOutpFreq> OFF | DER16G

OFF

Disables the output.

DER16G

Sets the output reference frequency to 16 GHz.

The reference frequency is derived from the internal reference frequency.

*RST: n.a. (factory preset: OFF)

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Manual operation: See ["Reference Output"](#) on page 210

[[:SOURce]:ROSCillator:PRESet

Resets the reference oscillator settings.

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Usage: Event

Manual operation: See ["Set to Default"](#) on page 207

[:SOURce]:ROSCillator:SOURce <Source>

Selects between internal or external reference frequency.

Parameters:

<Source> INTernal | EXTernal
 *RST: n.a. (factory preset: INTernal)

Example: See [Example "Configuring the reference oscillator"](#) on page 500.

Manual operation: See ["Source"](#) on page 207

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] <State>

Determines whether the calibrated (off) or a user-defined (on) **adjustment value** is used for fine adjustment of the frequency.

Parameters:

<State> 1 | ON | 0 | OFF
0
 Fine adjustment with the calibrated frequency value
1
 User-defined adjustment value.
 The instrument is no longer in the calibrated state.
 The calibration value is, however, not changed. The instrument resumes the calibrated state if you send
 SOURce:ROSCillator:INTernal:ADJust:STATe 0.
 *RST: n.a. (factory preset: 0)

Manual operation: See ["Adjustment Active"](#) on page 211

[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue <Value>

Specifies the frequency correction value (adjustment value).

Parameters:

<Value> integer
 *RST: 0

Example: See [\[:SOURce\]:ROSCillator\[:INTernal\]:ADJust\[:STATe\]](#) on page 504

Manual operation: See ["Adjustment Value"](#) on page 211

13.15.9 SOURce:POWer subsystem

The SOURce:POWer subsystem contains the commands for setting the output level, level control and level correction of the RF signal.

The default units are dBm. To change the units, perform one of the following:

- Enter the unit after the numerical value
Example: :POW 0.5V
- Set the unit with the command :UNIT:POWer.

Example: Power configuration

```
SOURcel:POWer;CW?
// Response -30
SOURcel:POWer:CW -25
SOURcel:POWer:OFFSet?
// Response 0
SOURcel:POWer:OFFSet 2

SOURcel:POWer:STEP:MODE?
// Response: DEC
SOURcel:POWer:STEP:INCRement 2
SOURcel:POWer:CW UP
```

Example: Configure the settings for NRP power control

The example shows a command sequence to configure the parameters for a closed loop power control setup. It is assumed that you have set up the measurement with the amplifier, external coupler, the power sensor and the R&S SF100A as described in [Chapter 7.5.4, "NRP power control"](#), on page 216.

```
// Reset the instrument to start from an initial state
*RST; *CLS

// Select the sensor used for nrp power control
// that is e.g., connected to a second USB interface

SOURcel:POWer:SPC:SElect SENS2

// Configure the nrp power control settings
// use the measured peak power for power control
// set the unit dBm for the target level value
// set the target level, e.g. - 10 dBm
// use the measured target level as reference level
// select single measurement mode to acquire one level value
// set the capture range for the control loop, e.g. +/- 15 dB
// set a time delay between the sensor readings, e.g. 2 ms

SOURcel:POWer:SPC:PEAK ON
SENSE1:UNIT:POWer DMB
```

```

SOURce1:POWer:SPC:TARGet -10
SOURce1:POWer:SPC:MEASure
SOURce1:POWer:SPC:MODE SINGLE
SOURce1:POWer:SPC:CRANge 15
SOURce1:POWer:SPC:DELay 2 ms

// Enable NRP power control measurement
// switch on RF output
// start the single measurement manually

Output1:STATe 1
SOURce1:POWer:SPC:STATe ON
SOURce1:POWer:SPC:SINGLE

// Query if the power control works properly
:SOURce1:POWer:SPC:WARning?
// Response: 1 -> power control doew not work as expected

```

[:SOURce<hw>]:POWer:EMF:STATe	506
[:SOURce<hw>]:POWer:LBEHaviour	507
[:SOURce<hw>]:POWer:LIMit[:AMPLitude]	507
[:SOURce<hw>]:POWer:MODE	507
[:SOURce<hw>]:POWer:PEP?	508
[:SOURce<hw>]:POWer:POWer	508
[:SOURce<hw>]:POWer:SPC:CRANge	509
[:SOURce<hw>]:POWer:SPC:DELay	509
[:SOURce<hw>]:POWer:SPC:MEASure	509
[:SOURce<hw>]:POWer:SPC:MODE	509
[:SOURce<hw>]:POWer:SPC:PEAK	510
[:SOURce<hw>]:POWer:SPC:SELEct	510
[:SOURce<hw>]:POWer:SPC:SINGLE	510
[:SOURce<hw>]:POWer:SPC:STATe	510
[:SOURce<hw>]:POWer:SPC:TARGet	511
[:SOURce<hw>]:POWer:SPC:WARning?	511
[:SOURce<hw>]:POWer:STEP:MODE	511
[:SOURce<hw>]:POWer:STEP[:INCRement]	512
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet	512
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL	512
[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]	513
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:REFLevel	514
[:SOURce<hw>]:POWer:RANGe:LOWer?	514
[:SOURce<hw>]:POWer:RANGe:UPPer?	514
[:SOURce]:POWer:WIGNore	514

[:SOURce<hw>]:POWer:EMF:STATe <State>

Displays the signal level as voltage of the EMF. The displayed value represents the voltage over a 50 Ohm load.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: n.a. (factory preset: 0)

Example:

POW:EMF:STAT 1
 Activates voltage level display.

[[:SOURCE<hw>]:POWER:LBEHAVIOUR <Behaviour>

Set the RF level behaviour.

Parameters:

<Behaviour> AUTO | UNINTERRUPTED
UNINTERRUPTED
 Do not use the uninterrupted level settings in combination with the high-quality optimization mode (see [[:SOURCE<hw>]:BB:IMPAIRMENT:OPTIMIZATION:MODE on page 576)
 *RST: AUTO

Example:

SOURCE1:POWER:LBEHAVIOUR AUTO

Manual operation: See "[Setting Characteristics](#)" on page 204

[[:SOURCE<hw>]:POWER:LIMIT[:AMPLITUDE] <Amplitude>

Limits the maximum RF output level in CW and sweep mode.

It does not influence the "Level" display or the response to the query [[:SOURCE<hw>]:POWER[:LEVEL] [:IMMEDIATE] [:AMPLITUDE]].

Parameters:

<Amplitude> float
 Range: depends on the installed options
 Increment: 0.01
 *RST: n.a. (factory preset: 30)

Example:

SOURCE1:POWER:LIMIT:AMPLITUDE 10

Manual operation: See "[Limit](#)" on page 203

[[:SOURCE<hw>]:POWER:MODE <Mode>

Selects the operating mode of the instrument to set the output level.

Parameters:

<Mode> CW | FIXed | SWEep

CW|FIXed

Operates at a constant level.

CW and FIXed are synonyms.

To set the output level value, use the command [:SOURce<hw>]:POWER[:LEVel][:IMMediate][:AMPLitude].

*RST: CW

Example: See [Example "Power configuration"](#) on page 505.

[:SOURce<hw>]:POWER:PEP?

Queries the PEP (Peak Envelope Power) of digital modulation or digital standards at the RF output. This value corresponds to the level specification, displayed in the status bar (header).

Return values:

<Pep> float

Example:

POW:PEP?

Response: "4"

The PEP value of digital modulation is 4 dBm at the RF output.

Usage:

Query only

Manual operation: See ["PEP"](#) on page 200

[:SOURce<hw>]:POWER:POWER <Power>

Sets the level at the RF output connector.

This value does not consider a specified offset.

The command [:SOURce<hw>]:POWER[:LEVel][:IMMediate][:AMPLitude] sets the level of the "Level" display, that means the level containing offset.

Parameters:

<Power> float

Level at the RF output, without level offset

Range: See specifications document.

Increment: 0.01

Default unit: dBm

Example:

SOURce1:POWER:POWER 15

// sets the level at the RF output.

Manual operation: See ["Amplitude"](#) on page 203
See ["Generator Settings used for Measurement"](#) on page 239

[[:SOURce<hw>]:POWER:SPC:CRANge <PowCntrlCRange>

Defines the capture range of the power control system.

Within the range:

Target Level +/- Catch Range

the power control locks and tries to achieve the target level. Readings outside the range are not considered.

Parameters:

<PowCntrlCRange> float
Range: 0 to 50
Increment: 0.01
*RST: 30

Example: See [Example "Configure the settings for NRP power control"](#) on page 505

Manual operation: See ["Catch Range +/-"](#) on page 219

[[:SOURce<hw>]:POWER:SPC:DELay <PowCntrlDelay>

Sets a waiting time for the generator to adjust the output level. After the delay time has elapsed, the power sensor measures the next value.

Parameters:

<PowCntrlDelay> integer
Range: 0 to 1000
*RST: 0

Example: See [Example "Configure the settings for NRP power control"](#) on page 505

Manual operation: See ["Delay Time"](#) on page 220

[[:SOURce<hw>]:POWER:SPC:MEASure

Sets the measured power value as reference level.

Example: See [Example "Configure the settings for NRP power control"](#) on page 505

Usage: Event

Manual operation: See ["Take Measurement as Target Level"](#) on page 219

[[:SOURce<hw>]:POWER:SPC:MODE <ControlMode>

Selects the measurement mode for the power sensor.

Parameters:

<ControlMode> AUTO | SINGle

AUTO

Measures the level values continuously.

SINGle

Executes one measurement, triggered by the command `[:SOURce<hw>] :POWer:SPC:SINGle` on page 510.

*RST: AUTO

Example: See [Example "Configure the settings for NRP power control"](#) on page 505

Manual operation: See ["Mode"](#) on page 219

[:SOURce<hw>] :POWer:SPC:PEAK <PowCntrlPeak>

Activates power control by means of the peak power values, provided the power sensor supports this function.

Parameters:

<PowCntrlPeak> 1 | ON | 0 | OFF

*RST: 0

Example: See [Example "Configure the settings for NRP power control"](#) on page 505

[:SOURce<hw>] :POWer:SPC:SElect <PowCntrlSelect>

Selects the power sensor used for power control.

Parameters:

<PowCntrlSelect> SENS1 | SENS2 | SENS3 | SENS4 | SENSor1 | SENSor2 | SENSor3 | SENSor4

*RST: SENS1

Example: See [Example "Configure the settings for NRP power control"](#) on page 505

Manual operation: See ["Sensor"](#) on page 218

[:SOURce<hw>] :POWer:SPC:SINGle

Triggers the power sensor to measure the power value once.

Usage: Event

Manual operation: See ["Execute Single"](#) on page 219

[:SOURce<hw>] :POWer:SPC:STATe <PowCntrlState>

Starts power control using the selected sensor. The control loop periodically adjusts the output level of the signal generator. After switching off, the running loop is completed.

Parameters:

<PowCntrlState> 1 | ON | 0 | OFF
 *RST: 0

Example: See [Example "Configure the settings for NRP power control"](#) on page 505

Manual operation: See ["State"](#) on page 218

[:SOURce<hw>]:POWER:SPC:TARGet <PowCntrlTarget>

Sets the target level required at the DUT. To define the unit of the power value, use command [:UNIT:POWER](#) on page 613.

Parameters:

<PowCntrlTarget> float
 Range: -50 to 30
 Increment: 0.01
 *RST: -10

Example: See [Example "Configure the settings for NRP power control"](#) on page 505

Manual operation: See ["Target Level"](#) on page 219

[:SOURce<hw>]:POWER:SPC:WARning?

Queries if the activated power control works properly.

If the power control does not work, the query returns warning state 1. On the screen, the R&S SF100A indicates a warning icon.

Return values:

<WarningState> 1 | ON | 0 | OFF
 *RST: 0

Example: See [Example "Configure the settings for NRP power control"](#) on page 505.

Usage: Query only

[:SOURce<hw>]:POWER:STEP:MODE <Mode>

Defines the type of step width to vary the RF output power step-by-step with the commands [POW UP](#) or [POW DOWN](#).

Parameters:

<Mode> DECimal | USER
DECimal
 Increases or decreases the level in steps of ten.
 *RST: DECimal

Example: See [Example "Power configuration"](#) on page 505.

Manual operation: See ["Variation Active"](#) on page 204

[:SOURce<hw>]:POWer:STEP[:INCRement] <Increment>

Specifies the step width in the appropriate path for `POW:STEP:MODE USER`.

To adjust the level step-by-step with this increment value, use the command `POW UP`, or `POW DOWN`.

Parameters:

<Increment> float
 Range: 0 to 200
 Increment: 0.01
 *RST: 1
 Default unit: dB

Example: See [Example "Power configuration"](#) on page 505.

Manual operation: See ["Variation Step"](#) on page 204

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

Sets the level offset of a downstream instrument.

The level at the RF output is not changed.

To query the resulting level, as it is at the output of the downstream instrument, use the command `[:SOURce<hw>] :POWer [:LEVel] [:IMMediate] [:AMPLitude]`.

Note: The level offset also affects the RF level sweep.

Parameters:

<Offset> float
 Range: -200 to 200
 Increment: 0.01
 *RST: 0
 Default unit: dB
 Level offset is always expreced in dB; linear units (V, W, etc.) are not supported

Example: `POWer:OFFSet 10`
 Sets the RF level offset to 10 dB

Manual operation: See ["Offset"](#) on page 203
 See ["Generator Settings used for Measurement"](#) on page 239

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL <Rcl>

Determines whether the current level is retained or if the stored level setting is adopted when an instrument configuration is loaded.

Parameters:

<Rcl> INCLUDE | EXCLUDE

INCLude

Takes the current level when an instrument configuration is loaded.

EXCLude

Retains the current level when an instrument configuration is loaded.

*RST: INCLude

Example:

POW:RCL INCL

Takes the level value from an instrument configuration loaded with command *RCL.

Manual operation: See "Exclude Level" on page 281

[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

Sets the RF level applied to the DUT.

To activate the RF output use command :OUTPut<hw>[:STATE] ("RF On"/"RF Off").

The following applies $POWer = RF \text{ output level} + OFFSet$, where:

- POWer is the values set with [:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]
- RF output level is set with [:SOURce<hw>]:POWer:POWer
- OFFSet is set with [:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet

Parameters:

<Amplitude>

float

The following settings influence the value range:

OFFSet set with the command [:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet

Numerical value

Sets the level

UP|DOWN

Varies the level step by step.

The level is increased or decreased by the value set with the command [:SOURce<hw>]:POWer:STEP[:INCRement].

Range: (Level_min + OFFSet) to (Level_max + OFFSet)

*RST: -30

Default unit: dBm

Example:

POWer -30

Sets the RF level

Example:

See also [:SOURce<hw>]:POWer:STEP:MODE on page 511.

Manual operation: See "Amplitude" on page 203

```
[:SOURce<hw>]:POWER[:LEVel][:IMMediate]:REFLevel <ReferenceLevel>
```

Queries the reference level of the user correction.

The reference level is the sum of the amplitude and the level offset, set with the commands `[:SOURce<hw>] :POWER:POWER [:SOURce<hw>] :POWER [:LEVel] [:IMMediate] :OFFSet`.

Parameters:

```
<ReferenceLevel>    float
                    Range:    -245 to 120
                    Increment: 0.01
                    *RST:    -30
```

Manual operation: See "[Generator Settings used for Measurement](#)" on page 239

```
[:SOURce<hw>]:POWER:RANGe:LOWer?
```

```
[:SOURce<hw>]:POWER:RANGe:UPPer?
```

Queries the current interruption-free range of the level.

Return values:

```
<Upper>            float
                    Increment: 0.01
                    Default unit: dBm
```

Example:

```
SOURce1:POWER:RANGe:UPPer?
// -15
SOURce1:POWER:RANGe:LOW?
// -50
```

Usage: Query only

Manual operation: See "[Level Range](#)" on page 204

```
[:SOURce]:POWER:WIGNore <State>
```

Ignores level range warnings.

Parameters:

```
<State>            1 | ON | 0 | OFF
                    *RST:    n.a. (factory preset: 0)
```

Example:

```
SOURce:POWER:WIGNore 1
```

13.15.10 SOURce:EFRontend subsystem

The `SOURce:EFRontend` subsystem contains the commands for configuring settings of an RF frontend.

Example: Configuring external frontend connection settings

```
// Query information about the connected RF frontend.
SOURCE:EFRontend:INFO?
// Response: <SymbolicName> "FE170ST-123456", <RemoteChannel> "Frontend Connection"
// <IpAddress>/<HostName> "FE170ST-123456",<ConnectionState> "connected"
// Query all connected external frontends, including equipped options:
SOURCE:EFRontend:LIST?
// Response: "FE170ST-123456"
SOURCE:EFRontend:IDN?
// Response: "Rohde&Schwarz,FE170ST,1234.5678K00/123456,1.34.6"

// Specify and query frontend connection settings.
SOURCE:EFRontend:RFConnector?
// Response: "RFA"
SOURCE:EFRontend:CMODE?
// Response: "AUTO"
SOURCE:EFRontend:FREQuency:REFeRence:LIST?
// Response: "10 MHz,640 MHz,1 GHz"
SOURCE:EFRontend:FREQuency:REFeRence F1G
// Sets 1 GHz reference frequency.
```

Example: Configuring external frontend frequency bands

```
// Load a frequency band configuration.
SOURCE:EFRontend:FREQuency:BAND1:CONFig:CATalog?
// Response: "SFI"
// Query the corresponding intermediate frequency at the RF output of the R&S SF100A.
SOURCE:EFRontend:FREQuency:IFRequency:VALue?
// Response in Hz: "16000000000" (= 16 GHz)

// Query information about operating frequency bands.
SOURCE:EFRontend:FREQuency:BAND:COUNT?
// Response: "1"
// The frontend operates in one frequency band.
// Query the range of the operating frequency band.
SOURCE:EFRontend:FREQuency:BAND1:LOWer?
// Response in Hz: "11000000000" (= 11 GHz)
SOURCE:EFRontend:FREQuency:BAND1:UPPer?
// Response in Hz: "17500000000" (= 17.5 GHz)
```

Example: Configuring LO settings with multiple external frontends

```
// Set R&S FE170ST to provide the LO signal
SOURCE:EFRontend:LOSCillator:MODE INTERNAL
SOURCE:EFRontend:LOSCillator:OUTPut:STATe 1
// Query the LO out frequency
SOURCE:EFRontend:LOSCillator:OUTPut:FREQuency?
// Response in Hz: "15750000000"
```

Example: Configuring external frontend attenuation

```
// Configure attenuation settings.
SOURCE:EFRontend:AMODE?
// Response: "AUTO"
SOURCE:EFRontend:AMODE MANUAL
SOURCE:EFRontend:POWER:ATTenuation 10
// Sets an attenuation of 10 dB.
```

Example: Configuring external frontend cable correction

```
// Query available cable correction files.
SOURCE:EFRontend:ALIGNment:FILE:CATalog?
// Response: "CableCorrIF"
// Add cable correction data by loading the file CableCorrIF.s2p.
SOURCE:EFRontend:ALIGNment:FILE:SELEct CableCorrIF
// Query upper and lower frequency range of the IF correction data.
SOURCE:EFRontend:ALIGNment:FILE:FREquency:RANGE:LOWer?
// Response in Hz: "11000000000" (11 GHz)
SOURCE:EFRontend:ALIGNment:FILE:FREquency:RANGE:UPPer?
// Response in Hz: "21000000000" (21 GHz)
SOURCE:EFRontend:ALIGNment:STATE 1
```

Example: Calibrating external frontends

```
// Start a calibration procedure performing internal adjustments
// at the external frontend.
SOURCE:EFRontend:CAL:ALL
// Query the calibration state.
CALibration1:FREquency:CONVerter:EXTernal?
// Response: "1"
// The external frontend is calibrated.
```

Example: Configuring external frontend network parameters

```
// Search for your external frontend in the network.
SOURCE:EFRontend:INFO?
// Response: <SymbolicName> "FE170ST-123456", <RemoteChannel> "Frontend Connection"
// <IpAddress>/<HostName> "10.123.45.67",<ConnectionState> "not connected"
SOURCE:EFRontend:NETWork?
// Response: <IpAddress> "10.123.45.67",<SubnetMask> "255.255.255.0",<DhcpOn> "1"
// Alternatively, query the IP address directly.
SOURCE:EFRontend:IPAddress?
// Response: "10.123.45.67"
// Switch off DHCP and assign an IP address manually.
SOURCE:EFRontend:NETWork "192.168.0.1","255.255.255.0","0"
```

Example: Querying external devices connected to an external frontend

```
// Refresh the connected external devices.
SOURcel:EFRontend:EXTDevice:REFRESH
// Query a list of connected external devices:
SOURcel:EFRontend:EXTDevice:LIST?
// Response: "FE170_Z50,FE170_Z01"
// Query the information regarding External Device 1:
// Query the name of the connected external device:
SOURcel:EFRontend:EXTDevice1:NAME?
// Response: "FE170_Z50"
//Query the type of the connected external device:
SOURcel:EFRontend:EXTDevice1:TYPE?
// Response: AMPL
// Query the frequency range of the connected external device:
SOURcel:EFRontend:EXTDevice1:FREQUENCY:MINimum?
// Response: 110000000000
SOURcel:EFRontend:EXTDevice1:FREQUENCY:MAXimum?
// Response: 170000000000
// Since the connected external device is an amplifier, query the gain:
SOURcel:EFRontend:EXTDevice1:GAIN?
// Response: 10
```

Commands:

[SOURce<hw>]:EFRontend:ALIGNment:FILE:FREQUENCY:RANGE:LOWer?	518
[SOURce<hw>]:EFRontend:ALIGNment:FILE:FREQUENCY:RANGE:UPPer?	518
[SOURce<hw>]:EFRontend:ALIGNment:FILE:CATalog?	518
[SOURce<hw>]:EFRontend:ALIGNment:FILE[:SElect]	518
[SOURce<hw>]:EFRontend:ALIGNment[:STATE]	519
[SOURce<hw>]:EFRontend:AMODE	519
[SOURce<hw>]:EFRontend:CAL:ALL	519
[SOURce<hw>]:EFRontend:CONNECTION:STATE	519
[SOURce<hw>]:EFRontend:CMODE	520
[SOURce<hw>]:EFRontend:FREQUENCY:BAND:COUNt?	520
[SOURce<hw>]:EFRontend:FREQUENCY:BAND:CONFig:CATalog?	520
[SOURce<hw>]:EFRontend:FREQUENCY:BAND:CONFig:MODE	521
[SOURce<hw>]:EFRontend:FREQUENCY:BAND:CONFig:SElect	521
[SOURce<hw>]:EFRontend:FREQUENCY:BAND<ch>:LOWer?	521
[SOURce<hw>]:EFRontend:FREQUENCY:BAND<ch>:UPPer?	521
[SOURce<hw>]:EFRontend:FREQUENCY:REFerence	522
[SOURce<hw>]:EFRontend:FREQUENCY:REFerence:LIST?	522
[SOURce<hw>]:EFRontend:IDN?	522
[SOURce<hw>]:EFRontend[:FREQUENCY]:IFrequency[:VALue]?	522
[SOURce<hw>]:EFRontend:FREQUENCY:IFrequency:SIDeband?	523
[SOURce<hw>]:EFRontend:INFO?	523
[SOURce<hw>]:EFRontend:IPADdress?	523
[SOURce<hw>]:EFRontend:LIST?	523
[SOURce<hw>]:EFRontend:NETWork	524
[SOURce<hw>]:EFRontend:OPT?	524
[SOURce<hw>]:EFRontend:POWER:ATTenuation	524

<code>[:SOURce<hw>]:EFRontend:POWer:OFFSet</code>	525
<code>[:SOURce<hw>]:EFRontend:RFConnector</code>	525
<code>[:SOURce<hw>]:EFRontend:EXTDevice:REFresh</code>	525
<code>[:SOURce<hw>]:EFRontend:EXTDevice:LIST?</code>	526
<code>[:SOURce<hw>]:EFRontend:EXTDevice<id>:NAME?</code>	526
<code>[:SOURce<hw>]:EFRontend:EXTDevice<id>:TYPE?</code>	526
<code>[:SOURce<hw>]:EFRontend:EXTDevice<id>:FREQUENCY:MINimum?</code>	527
<code>[:SOURce<hw>]:EFRontend:EXTDevice<id>:FREQUENCY:MAXimum?</code>	527
<code>[:SOURce<hw>]:EFRontend:EXTDevice<id>:GAIN?</code>	527
<code>[:SOURce<hw>]:EFRontend:EXTDevice:CORRection:STATe</code>	527
<code>[:SOURce<hw>]:EFRontend:EXTDevice:CORRection:FILE</code>	527
<code>[:SOURce<hw>]:EFRontend:LOSCillator:MODE</code>	528
<code>[:SOURce<hw>]:EFRontend:LOSCillator:OUTPut:STATe</code>	528
<code>[:SOURce<hw>]:EFRontend:LOSCillator:INPut:FREQUENCY?</code>	528
<code>[:SOURce<hw>]:EFRontend:LOSCillator:OUTPut:FREQUENCY?</code>	528

`[:SOURce<hw>]:EFRontend:ALIGNment:FILE:FREQUENCY:RANGe:LOWer?`

`[:SOURce<hw>]:EFRontend:ALIGNment:FILE:FREQUENCY:RANGe:UPPer?`

Queries the upper/lower frequency range of IF values required at the connected external frontend.

We recommend that you cover this range in the cable correction * .s2p file.

Return values:

<CableCorrFreqUp> float

Example: See [Example "Configuring external frontend cable correction"](#) on page 516.

Usage: Query only

Manual operation: See ["Recommended Frequency Range"](#) on page 192

`[:SOURce<hw>]:EFRontend:ALIGNment:FILE:CATalog?`

Queries the cable correction files with settings in the default directory.

Listed are cable correction files with extension * .s2p or * .uco.

Example: See [Example "Configuring external frontend cable correction"](#) on page 516.

Usage: Query only

Manual operation: See ["Load Cable Correction File"](#) on page 191

`[:SOURce<hw>]:EFRontend:ALIGNment:FILE[:SElect] <CableCorrFileName>`

Selects an existing correction file to compensate for cable losses. Selectable file have file extension * .s2p.

Parameters:

<Filename> string

Example: See [Example "Configuring external frontend cable correction"](#) on page 516.

Manual operation: See ["Load Cable Correction File"](#) on page 191

[[:SOURce<hw>]:EFRontend:ALIGNment[:STATe] <CableCorrState>

Activates correction of the IF signal for different IF signal frequencies.

Parameters:

<CableCorrState> 1 | ON | 0 | OFF
*RST: 0

Example: See [Example "Configuring external frontend cable correction"](#) on page 516.

Manual operation: See ["State"](#) on page 191

[[:SOURce<hw>]:EFRontend:AMODE <AttenuationMode>

Sets the attenuator mode of the external frontend.

Parameters:

<AttenuationMode> AUTO | MANual | AOFFset

AUTO

Sets the attenuation value automatically to the attenuation value provided from the connected external frontend.

MANual

Sets an attenuation value manually.

AOFFset

Requires frontend R&S FE170ST or R&S FE110ST. You can define an offset value which is added to the attenuation value provided from the connected external frontend.

*RST: AUTO

Example: See [Example "Configuring external frontend attenuation"](#) on page 516.

Manual operation: See ["Mode"](#) on page 190

[[:SOURce<hw>]:EFRontend:CAL:ALL

Starts all internal calibration routines to adjust the connected external frontend.

Example: See [Example "Calibrating external frontends"](#) on page 516

Usage: Event

[[:SOURce<hw>]:EFRontend:CONNECTION:STATe <ConnState>

Queries the state of the connection between R&S SF1100A and external frontend.

Parameters:

<ConnState> 1 | ON | 0 | OFF
 *RST: 0

Example:

See [Example "Configuring external frontend connection settings"](#) on page 515.

[[:SOURce<hw>]:EFRontend:CMODE <FeConnMode>

Sets the mode of the SSL control connection between R&S SF100A and external frontend.

Parameters:

<FeConnMode> AUTO | LOCK | RXTX

AUTO

The R&S SF100A locks external frontend, when activating the RF output at the R&S SF100A (:OUTPut1 ON) for output of the IF signal.

The R&S SF100A unlocks external frontend, when deactivating the RF output at the R&S SF100A (:OUTPut1 OFF).

LOCK

The external frontend is locked permanently. No other instrument can take over control.

RXTX

Not available for R&S SF100A (grayed out).

Example:

See [Example "Configuring external frontend connection settings"](#) on page 515

Manual operation: See ["Connection Mode"](#) on page 186

[[:SOURce<hw>]:EFRontend:FREQUENCY:BAND:COUNT?

Queries the number of frequency bands available at the connected external frontend.

Return values:

<FEFreqCount> integer

Example:

See [Example "Configuring external frontend frequency bands"](#) on page 515

Usage:

Query only

Manual operation: See ["Frequency Band x"](#) on page 188

[[:SOURce<hw>]:EFRontend:FREQUENCY:BAND:CONFig:CATalog? <CatalogFiles>

Queries the selectable frequency band configuration modes.

Parameters:

<CatalogFiles> string
Returns a string of selectable frequency band configuration modes separated by commas.

Example: See [Example "Configuring external frontend frequency bands"](#) on page 515

Usage: Query only

Manual operation: See ["Frequency Band Config"](#) on page 187

[:SOURce<hw>]:EFRontend:FREQUENCY:BAND:CONFig:MODE <Mode>

Sets the mode for frequency band configuration of the external frontend.

Parameters:

<Mode> AUTO | MANual
AUTO
Configures the frequency band automatically.
MANual
Uses the frequency band configured by [:SOURce<hw>] : EFRontend:FREQUENCY:BAND:CONFig:SElect on page 521.
*RST: AUTO

Manual operation: See ["Mode"](#) on page 187

[:SOURce<hw>]:EFRontend:FREQUENCY:BAND:CONFig:SElect <SelBandConfig>

Selects the frequency band configuration for the connected external frontend.

Parameters:

<SelBandConfig> string

Example: See [Example "Configuring external frontend frequency bands"](#) on page 515

Manual operation: See ["Frequency Band Config"](#) on page 187

[:SOURce<hw>]:EFRontend:FREQUENCY:BAND<ch>:LOWer?

[:SOURce<hw>]:EFRontend:FREQUENCY:BAND<ch>:UPPer?

Queries the lower/upper limit of the corresponding frequency band.

Return values:

<FEFreqBandUp> float

Example: See [Example "Configuring external frontend frequency bands"](#) on page 515

Usage: Query only

Manual operation: See ["Frequency Band x"](#) on page 188

[[:SOURce<hw>]:EFRontend:FREQUENCY:REFerence <FERefFreq>

Sets the reference frequency, that is used for RF frequency conversion at the connected external frontend.

Parameters:

<FERefFreq> FG64 | F1G | F10M

FG64

640 MHz

F1G

1 GHz

F10M

10 MHz

Example: See [Example "Configuring external frontend connection settings"](#) on page 515.

Manual operation: See ["Reference Frequency"](#) on page 186

[[:SOURce<hw>]:EFRontend:FREQUENCY:REFerence:LIST?

Queries reference frequencies of connected RF frontends in a comma-separated list.

Example: See [Example "Configuring external frontend connection settings"](#) on page 515.

Usage: Query only

Manual operation: See ["Reference Frequency"](#) on page 186

[[:SOURce<hw>]:EFRontend:IDN?

Identification

Returns the IDN string, i.e. the identification of the external frontend.

Return values:

<IdnString> string

Example: See [Example "Configuring external frontend connection settings"](#) on page 515.

Usage: Query only

Manual operation: See ["Hardware Config"](#) on page 189

[[:SOURce<hw>]:EFRontend[:FREQUENCY]:IFrequency[:VALue]?

Queries the frequency of the IF signal, that is the frequency at the RF Out connector.

Return values:

<IntFrequency> float

Example: See [Example "Configuring external frontend frequency bands"](#) on page 515.

Usage: Query only

Manual operation: See ["Intermediate Frequency / Sideband"](#) on page 187

[[:SOURce<hw>]:EFRontend:FREQUENCY:IFREQUENCY:SIDeband?

Queries the currently used sideband for frequency conversion.

Return values:

<Sideband> string
USB
 Upper sideband
LSB
 Lower sideband

Usage: Query only

Manual operation: See ["Intermediate Frequency / Sideband"](#) on page 187

[[:SOURce<hw>]:EFRontend:INFO?

Queries information about the connected external frontend.

Return values:

<FEInfo> string

Example: See [Example "Configuring external frontend connection settings"](#) on page 515.

Usage: Query only

[[:SOURce<hw>]:EFRontend:IPADdress?

Queries the IP address of the connected external frontend.

Return values:

<IPAddress> string

Example: See [Example "Configuring external frontend network parameters"](#) on page 516.

Usage: Query only

Manual operation: See ["IP Address"](#) on page 193

[[:SOURce<hw>]:EFRontend:LIST?

Queries connected external frontends in a comma-separated list.

Return values:

<Filter> String

Example: See [Example "Configuring external frontend connection settings"](#) on page 515.

Usage: Query only

[[:SOURce<hw>]:EFRontend:NETWork <IpAddress>, <SubnetMask>, <DhcpOn>

Sets network parameters of the external frontend.

Parameters:

<IpAddress>	string
	IP address of the external frontend
	*RST: 127.0.0.1
<SubnetMask>	string
	Bit group of the subnet in the host identifier
	*RST: 255.255.255.0
<DhcpOn>	integer
	DHCP state
	Range: 0 to 1
	*RST: 1

Example: See [Example "Configuring external frontend network parameters"](#) on page 516.

Manual operation: See ["Apply"](#) on page 194

[[:SOURce<hw>]:EFRontend:OPT?

Option identification query

Queries the options included in the external frontend.

For more information, refer to the specifications document.

Return values:

<OptString>	string
	The query returns a list of options. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.

Usage: Query only

[[:SOURce<hw>]:EFRontend:POWer:ATTenuation <Attenuation>

Requires [[:SOURce<hw>]:EFRontend:AMODe MANual.

Sets the attenuation of the external frontend.

Parameters:

<Attenuation>	float	
Range:	depends on connected device	to depends on connected device
Increment:	depends on connected device	
*RST:	0	

Example: [Example "Configuring external frontend attenuation"](#) on page 516

Manual operation: See ["Attenuation"](#) on page 190

[[:SOURce<hw>]:EFRontend:POWer:OFFSet <Offset>

Requires frontend R&S FE170ST or R&S FE110ST.

Requires [[:SOURce<hw>]:EFRontend:AMODe AOFFset.

Adds an offset value to the attenuation value provided from the external frontend.

Parameters:

<Offset>	float	
Range:	depends on connected device	to depends on connected device
Increment:	depends on connected device	
*RST:	0	

Manual operation: See ["Offset"](#) on page 190

[[:SOURce<hw>]:EFRontend:RFConnector <FEOutpPath>

Queries the active RF output connector at the connected RF frontend.

Parameters:

<FEOutpPath>	NONE RFA RFB
NONE	No frontend connected.
RFA	Output connector "RF A" is active at the external frontend.
RFB	Output connector "RF B" is active at the external frontend.

Example: See [Example "Configuring external frontend connection settings"](#) on page 515.

Manual operation: See ["Active RF Connector"](#) on page 187

[[:SOURce<hw>]:EFRontend:EXTDevice:REFResh

Updates the external devices connected to the external frontend.

Use this command before the query

```
[ :SOURce<hw> ] :EFRontend:EXTDevice:LIST?.
```

Example: See [Example "Querying external devices connected to an external frontend"](#) on page 517.

Usage: Event

Manual operation: See ["Refresh External Devices"](#) on page 195

[:SOURce<hw>] :EFRontend:EXTDevice:LIST?

Queries the external devices connected to the external frontend in a comma-separated list.

Example: See [Example "Querying external devices connected to an external frontend"](#) on page 517.

Usage: Query only

Manual operation: See ["Type"](#) on page 195

[:SOURce<hw>] :EFRontend:EXTDevice<id>:NAME?

Queries the name of the connected external device.

Return values:

<DeviceName> string

Example: See [Example "Querying external devices connected to an external frontend"](#) on page 517.

Usage: Query only

Manual operation: See ["Connected Device"](#) on page 195

[:SOURce<hw>] :EFRontend:EXTDevice<id>:TYPE?

Queries the type of the connected external device.

Return values:

<Type> FILTER | AMPLifier | ATTenuator | NONE

FILTER

A filter is connected to the frontend as external device.

AMPLifier

An amplifier is connected to the frontend as external device.

ATTenuator

An attenuator is connected to the frontend as external device.

NONE

No external device is connected to the frontend.

Example: See [Example "Querying external devices connected to an external frontend"](#) on page 517.

Usage: Query only
Manual operation: See ["Type"](#) on page 195

[[:SOURce<hw>]:EFRontend:EXTDevice<id>:FREQUENCY:MINimum?
[[:SOURce<hw>]:EFRontend:EXTDevice<id>:FREQUENCY:MAXimum?

Queries the maximum value of the frequency of the connected external device.

Example: See [Example "Querying external devices connected to an external frontend"](#) on page 517.

Usage: Query only
Manual operation: See ["Frequency Range"](#) on page 195

[[:SOURce<hw>]:EFRontend:EXTDevice<id>:GAIN?

Queries the gain of the amplifier connected as external device.

Return values:

<Gain> float
 *RST: n.a. (factory preset)

Example: See [Example "Querying external devices connected to an external frontend"](#) on page 517.

Usage: Query only
Manual operation: See ["Gain"](#) on page 195

[[:SOURce<hw>]:EFRontend:EXTDevice:CORRection:STATE <State>

Activates correction of the RF signal for different RF signal frequencies.

Activation requires loading of a valid correction file.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Manual operation: See ["State"](#) on page 196

[[:SOURce<hw>]:EFRontend:EXTDevice:CORRection:FILE <Filename>

Selects an existing correction file, e.g. to compensate for cable losses. Selectable files have file extension *.s2p.

Parameters:

<Filename> string

Manual operation: See ["Load Correction File"](#) on page 196

[:SOURce<hw>]:EFRontend:LOSCillator:MODE <Mode>

Selects the LO input source for the connected external frontend.

Parameters:

<Mode> INTernal | EXTernal

INTernal

Uses the internally generated LO signal.

EXTernal

Uses an externally supplied LO signal.

*RST: n.a. (factory preset: INTernal)

Example: See [Example "Configuring LO settings with multiple external frontends"](#) on page 515.

Manual operation: See "[Mode](#)" on page 196

[:SOURce<hw>]:EFRontend:LOSCillator:OUTPut:STATe <OutState>

Activates or deactivates the LO output of the connected external frontend.

Parameters:

<OutState> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 0)

Example: See [Example "Configuring LO settings with multiple external frontends"](#) on page 515.

Manual operation: See "[Out State](#)" on page 197

[:SOURce<hw>]:EFRontend:LOSCillator:INPut:FREQuency?

Requires [:SOURce<hw>]:EFRontend:LOSCillator:MODE EXTernal.

Queries the required frequency on the "LO In" connector of the connected external frontend.

Return values:

<LoInFreq> float

Example: See [Example "Configuring LO settings with multiple external frontends"](#) on page 515.

Usage: Query only

Manual operation: See "[Mandatory LO IN Frequency](#)" on page 197

[:SOURce<hw>]:EFRontend:LOSCillator:OUTPut:FREQuency?

Requires [:SOURce<hw>]:EFRontend:LOSCillator:OUTPut:STATe 1.

Queries the current frequency on the "LO Out" connector of the connected external frontend.

Return values:

<OutputFrequency> float

Example:See [Example "Configuring LO settings with multiple external frontends"](#) on page 515.**Usage:**

Query only

Manual operation:See ["LO OUT Frequency"](#) on page 197

13.16 SOURce:BB subsystem

The SOURce:BB subsystem contains all commands for digital signal generation. It provides the following subsystems and commands.

• General commands	529
• SOURce:BB:ARbitrary subsystem	531
• SOURce:BB:GRAPHics subsystem	569
• SOURce:BB:IMPairment subsystem	572
• SOURce:BB:PROGress subsystem	577

13.16.1 General commands

This section describes the commands for setting the frequency shift and the phase offset for the signal at the output of the "Baseband" block.

Commands:

[:SOURce<hw>]:BB:FOFFset	529
[:SOURce<hw>]:BB:POFFset	530
[:SOURce<hw>]:BB:ROUte	530
[:SOURce<hw>]:BB:CFACTOR?	530
[:SOURce<hw>]:BB:POWer:PEAK?	530
[:SOURce<hw>]:BB:POWer:RMS?	531

[:SOURce<hw>]:BB:FOFFset <FOffset>

Sets a frequency offset for the internal or external baseband signal. The offset affects the generated baseband signal.

Parameters:

<FOffset>	float
Range:	depends on the installed options
Increment:	0.01
*RST:	0
Default unit:	Hz

Example:

SOURce1:BB:FOFFset 2MHZ

Manual operation:See ["Frequency Offset"](#) on page 138

[:SOURce<hw>]:BB:POFFset <POffset>

Sets the relative phase offset for the selected baseband signal.

Parameters:

<POffset>	float
	Range: 0 to 359.9
	Increment: 0.01
	*RST: 0
	Default unit: DEG

Example: SOURce1:BB:POFFset 0.5DEG**Manual operation:** See "[Phase Offset](#)" on page 139

[:SOURce<hw>]:BB:ROUte <Route>

Selects the signal route for the baseband signal.

Parameters:

<Route>	A
---------	---

Example: SOURce1:BB:ROUte A

[:SOURce<hw>]:BB:CFACTOR?

Queries the crest factor of the baseband signal.

Return values:

<CFactor>	float
	Range: 0 to 100
	Increment: 0.01
	*RST: 0
	Default unit: dB

Example: SOURce1:BB:CFACTOR?
Queries the crest factor of the baseband signal.**Usage:** Query only

[:SOURce<hw>]:BB:POWER:PEAK?

Queries the peak level of the baseband signal relative to full scale of 0.5 V (in terms of dB full scale).

Return values:

<Peak>	float
	Range: -145 to 30
	Increment: 0.01
	*RST: 0
	Default unit: dBfs

Example: BB:POW:PEAK
Queries the peak level of the baseband signal.

Usage: Query only

[:SOURce<hw>]:BB:POWer:RMS?

Queries the RMS level of the baseband signal relative to full scale of 0.5V (in terms of dB full scale).

Return values:

<Rms> float
Range: -145 to 30
Increment: 0.01
*RST: 0
Default unit: dBfs

Example: BB:POW:RMS?
Queries the rms level of the baseband signal.

Usage: Query only

13.16.2 SOURce:BB:ARbitrary subsystem

This section list the commands of the SOURce:BB:ARbitrary subsystem.

Required options

See [Chapter 4.3.1, "Required options"](#), on page 64.

Commands:

- [Programming examples](#)..... 532
- [General commands](#)..... 535
- [Test signal commands](#)..... 535
- [Waveform commands](#)..... 539
- [Multicarrier commands](#)..... 543
- [Trigger commands](#)..... 555
- [Marker commands](#)..... 561
- [Clock commands](#)..... 563
- [Crest factor reduction commands](#)..... 563

13.16.2.1 Programming examples

Example: To create test signals

This example provides the commands to configure the different test signals.

```
// *****
// Reset the instrument first.
// *****
*RST; *CLS
:SOURce1:BB:ARbitrary:PRESet

// *****
// Create test signals.
// *****
:SOURce1:BB:ARbitrary:SIGNAL:TYPE CIQ
:SOURce1:BB:ARbitrary:TSIGNAL:CIQ:I -0.5
:SOURce1:BB:ARbitrary:TSIGNAL:CIQ:Q -0.33
:SOURce1:BB:ARbitrary:TSIGNAL:CIQ:CREate

:SOURce1:BB:ARbitrary:TSIGNAL:SINE:FREQuency 1MHz
:SOURce1:BB:ARbitrary:TSIGNAL:SINE:SAMPles 100
:SOURce1:BB:ARbitrary:TSIGNAL:SINE:PHASe -90
:SOURce1:BB:ARbitrary:TSIGNAL:SINE:CREate:NAMed "/var/user/sine_test"

:SOURce1:BB:ARbitrary:TSIGNAL:RECTangle:FREQuency 100kHz
:SOURce1:BB:ARbitrary:TSIGNAL:RECTangle:SAMPles 1000
:SOURce1:BB:ARbitrary:TSIGNAL:RECTangle:AMPLitude 0.5
:SOURce1:BB:ARbitrary:TSIGNAL:RECTangle:OFFSet -0.3
:SOURce1:BB:ARbitrary:TSIGNAL:RECTangle:CREate:NAMed "/var/user/rect_test"

:SOURce1:BB:ARbitrary:STATe ON
```

Example: To manage waveform files

The following example lists the commands provided for handling of waveform files.

```
// *****
// Reset instrument first
// *****
*RST; *CLS
:SOURce1:BB:ARbitrary:PRESet

// *****
// Set the default directory and list the available waveform files
// *****
MMEM:CDIR "/var/user/ARBtestSigs"
:SOURce1:BB:ARbitrary:WAVEform:CATalog?
// sineTest,rectTest,ciqTestSignal,waveformTest,test2
:SOURce1:BB:ARbitrary:WAVEform:CATalog:LENGth?
// Response is the number of files: "5"
```

```
// Optionally query free disk space.
:SOURce1:BB:ARbitrary:WAVEform:FREE?

// *****
// Select a waveform and query information
// *****
:SOURce1:BB:ARbitrary:WAVEform:DElete "/var/user/ARBtestSigs/test2"
:SOURce1:BB:ARbitrary:WAVEform:SElect "/var/user/ARBtestSigs/wvTest"
:SOURce1:BB:ARbitrary:WAVEform:POINTs?
// 100
:SOURce1:BB:ARbitrary:WAVEform:TAG? "TYPE"
// "SMU-WV"
:SOURce1:BB:ARbitrary:WAVEform:TAG? "COMMENT"
// "Waveform for test purposes"
// alternatively: query the comment tag of the current waveform file
:SOURce1:BB:ARbitrary:WAVEform:DATA?
// Response is the comment: "Waveform for test purposes"
// Query the date tag of a specific waveform file.
:SOURce1:BB:ARbitrary:WAVEform:DATA? "/var/user/ARBtestSigs/waveformTest","date"
// Response: #2192014-04-15;16:19:30
```

Example: To configure marker signals

This example provides the commands to configure the marker signals.

```
// *****
// Configure and enable standard marker signals
// *****
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:MODE REStart
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:MODE RATio
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:ONTime 40
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:OFFTime 20
// *****
// Configure a pulsed marker signal.
// *****
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:MODE PULSe
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:PULSe:DIVider 5
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:PULSe:FREQUency?
// Response in Hz: "20000000"
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:DELay 16
// *****
// Configure a pattern marker signal.
// *****
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:MODE PATtern
SOURce1:BB:ARbitrary:TRIGger:OUTPut1:PATtern #HE0F52,20
```

Example: To configure clock settings

This example provides the commands to configure the clock settings.

```
// *****
// Clock settings
// *****
SOURcel:BB:ARbitrary:CLOCK:SOURce INTernal
SOURcel:BB:ARbitrary:CLOCK?
// Response in Hz: "1000000"
// The clock frequency is 1 MHz.
// Or alternatively use the following tag:
SOURcel:BB:ARbitrary:WAVEform:TAG? "CLOCK"
```

Example: To generate a multicarrier signal

The following example lists the commands to configure and generate an ARB multicarrier signal.

```
// *****
// Enable a multicarrier scenario with 4 carriers and carrier spacing of 5 MHz.
// *****
SOURcel:BB:ARbitrary:MCARrier:CARRIER:COUNT 4
SOURcel:BB:ARbitrary:MCARrier:CARRIER:SPACING 5 MHz
SOURcel:BB:ARbitrary:MCARrier:CARRIER1:STATE ON
SOURcel:BB:ARbitrary:MCARrier:CARRIER2:STATE ON
SOURcel:BB:ARbitrary:MCARrier:CARRIER3:STATE ON
SOURcel:BB:ARbitrary:MCARrier:CARRIER4:STATE ON

// *****
// Select and load a waveform file "3gpp_arb" to all 4 carriers
// *****
// The file "3gpp_arb" is in default directory "/var/user".
SOURcel:BB:ARbitrary:MCARrier:CARRIER1:FILE "3gpp_arb"
SOURcel:BB:ARbitrary:MCARrier:CARRIER2:FILE "3gpp_arb"
SOURcel:BB:ARbitrary:MCARrier:CARRIER3:FILE "3gpp_arb"
SOURcel:BB:ARbitrary:MCARrier:CARRIER4:FILE "3gpp_arb"

// *****
// Trigger the signal caulation and load the waveform in the ARB generator
// *****
// Define the file name of the multi carrier output file, e.g. "3gpp_mc"
SOURcel:BB:ARbitrary:MCARrier:OFIle "3gpp_mc"
// Create and load the multi carrier waveform file in the ARB generator
SOURcel:BB:ARbitrary:MCARrier:CLOad
// Alternatively: create the multi carrier waveform and
// load it subsequently in the ARB generator
// SOURcel:BB:ARbitrary:MCARrier:CREate
// SOURcel:BB:ARbitrary:WAVEform:SElect"3gpp_mc"

// Activate the ARB generator
SOURcel:BB:ARbitrary:STATE ON
```

```
// *****
// Use the save and recall function.
// *****
// Query available settings files in a specified directory
MME:CDIR "/var/user/waveform"
SOURce:BB:ARbitrary:MCARrier:SETting:CATalog?
// mcar1, mcar2
// the directory contains the settings files mcar1.arb_multcarr and mcar2.arb_multcarr
SOURce:BB:ARbitrary:MCARrier:SETting:STORE "3gpp_mc"
```

13.16.2.2 General commands

[:SOURce<hw>]:BB:ARbitrary:PRESet

Sets all ARB generator parameters to their default values.

Example: See [Example "To create test signals"](#) on page 532.

Usage: Event

Manual operation: See ["Set To Default"](#) on page 70

[:SOURce<hw>]:BB:ARbitrary:STATe <State>

Enables the ARB generator.

A waveform must be selected before the ARB generator is activated.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["State"](#) on page 70

13.16.2.3 Test signal commands

[:SOURce<hw>]:BB:ARbitrary:SIGNal:TYPE	536
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:CIQ:I	536
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:CIQ:Q	536
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:RECTangle:AMPLitude	536
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:RECTangle:FREQuency	536
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:RECTangle:OFFSet	537
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:RECTangle:SAMPles	537
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:SINE:FREQuency	537
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:SINE:PHASe	538
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:SINE:SAMPles	538
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:CIQ:CREate:NAMed	538
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:RECTangle:CREate:NAMed	538
[:SOURce<hw>]:BB:ARbitrary:TSIGNal:SINE:CREate:NAMed	538

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:CIQ:CREate.....	539
[:SOURce<hw>]:BB:ARbitrary:TSIGnal:RECTangle:CREate.....	539
[:SOURce<hw>]:BB:ARbitrary:TSIGnal:SINE:CREate.....	539

[:SOURce<hw>]:BB:ARbitrary:SIGnal:TYPE <ArbSignalType>

Selects the type of test signal.

Parameters:

<ArbSignalType> SINE | RECT | CIQ
 *RST: SINE

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["Test Signal Form"](#) on page 71

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:CIQ:I <I>

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:CIQ:Q <TSig>

Sets the value for the I and Q component of the test signal

Parameters:

<TSig> float
 Range: -1 to 1
 Increment: 0.001
 *RST: 0
 Default unit: FS

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["I Value/Q Value"](#) on page 76

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:RECTangle:AMPLitude <Amplitude>

Sets the digital amplitude of the rectangular wave.

Parameters:

<Amplitude> float
 Range: 0 to 1
 Increment: 0.001
 *RST: 0.800
 Default unit: FS

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["Amplitude"](#) on page 74

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:RECTangle:FREQuency <Frequency>

Sets the frequency of the test signal.

Parameters:

<Frequency> float
 Range: 100 to depends on the installed options
 Increment: 0.01
 *RST: 1000
 Default unit: Hz

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["Frequency"](#) on page 74

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:RECTangle:OFFSet <Offset>

Sets the DC component.

Parameters:

<Offset> float
 Range: -1 to 1
 Increment: 0.001
 *RST: 0
 Default unit: FS

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["Offset DC"](#) on page 75

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:RECTangle:SAMPles <Samples>

Sets the number of sample values required for the rectangular signal per period.

Parameters:

<Samples> integer
 Range: 4 to 1000
 *RST: 100

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["Samples per Period"](#) on page 74

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:SINE:FREQUENCY <Frequency>

Sets the frequency of the simple sinusoidal test signal.

Parameters:

<Frequency> float
 Range: 100 to depends on the installed options
 Increment: 0.01
 *RST: 1000
 Default unit: Hz

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["Frequency"](#) on page 73

[[:SOURce<hw>]:BB:ARbitrary:TSIGnal:SINE:PHASe <Phase>

Sets the phase offset of the sine wave on the Q channel relative to the sine wave on the I channel.

Parameters:

<Phase> float
 Range: -180 to 180
 Increment: 0.01
 *RST: 90
 Default unit: DEG

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["Phase Offset Q"](#) on page 73

[[:SOURce<hw>]:BB:ARbitrary:TSIGnal:SINE:SAMPles <Samples>

Sets the sample rate for the sine signal in samples per period.

Make sure that the resulting clock rate does not exceed the maximum ARB clock rate. The maximum value is automatically restricted by reference to the set frequency and has to fulfill the rule *Frequency * Samples <= ARB clock rate*.

For more information, refer to the specifications document.

Parameters:

<Samples> integer
 Range: 4 to 1000
 *RST: 100

Example: See [Example "To create test signals"](#) on page 532.

Manual operation: See ["Samples per Period"](#) on page 73

[[:SOURce<hw>]:BB:ARbitrary:TSIGnal:CIQ:CREate:NAMed <Filename>

[[:SOURce<hw>]:BB:ARbitrary:TSIGnal:RECTangle:CREate:NAMed <Filename>

[[:SOURce<hw>]:BB:ARbitrary:TSIGnal:SINE:CREate:NAMed <Filename>

Generates a signal and saves it to a waveform file.

Setting parameters:

<Filename> string

Example: See [Example "To create test signals"](#) on page 532.

Usage: Setting only

Manual operation: See ["Generate Signal File"](#) on page 73

[:SOURce<hw>]:BB:ARbitrary:TSIGnal:CIQ:CREate
[:SOURce<hw>]:BB:ARbitrary:TSIGnal:RECTangle:CREate
[:SOURce<hw>]:BB:ARbitrary:TSIGnal:SINE:CREate

Generates a signal and uses it as output straight away.

Example: See [Example "To create test signals"](#) on page 532.

Usage: Event

Manual operation: See ["Generate Signal RAM"](#) on page 73
 See ["Generate Signal RAM"](#) on page 75

13.16.2.4 Waveform commands



The following rule applies for all commands described in this section.

By default, the waveform files are saved in the default directory of the instrument that is the `/var/user/` directory or the directory specified with the command `:MMEMory:CDIRectory`. To access the waveform files in this default directory, only the filename is required, without the path and the file extension (`*.wv`).

However, to access waveform files located in a directory different to the default one, the complete file path and filename are required.

[:SOURce<hw>]:BB:ARbitrary:WAVeform:CATalog?	539
[:SOURce<hw>]:BB:ARbitrary:WAVeform:CATalog:LENGth?	540
[:SOURce<hw>]:BB:ARbitrary:WAVeform:SELEct	540
[:SOURce<hw>]:BB:ARbitrary:WAVeform:DELEte	540
[:SOURce<hw>]:BB:ARbitrary:WAVeform:FREE?	540
[:SOURce<hw>]:BB:ARbitrary:WAVeform:POINts?	541
[:SOURce<hw>]:BB:ARbitrary:WAVeform:DATA	541
[:SOURce<hw>]:BB:ARbitrary:WAVeform:TAG?	542
[:SOURce<hw>]:BB:ARbitrary:CLOCK	542
[:SOURce<hw>]:BB:ARbitrary:WAVeform:CLOCK	542

[:SOURce<hw>]:BB:ARbitrary:WAVeform:CATalog?

Reads out the files extension `*.wv` in the default directory.

Return values:

<Catalog> string
 Returns a list of the file names separated by commas

Example: See [Example "To manage waveform files"](#) on page 532.

Usage: Query only

[:SOURce<hw>]:BB:ARbitrary:WAVEform:CATalog:LENGth?

Reads out the files with extension * .wv in the default directory and returns the number of waveform files in this directory. The default directory is set using command `MMEM:CDIRectory`.

Return values:

<Length> integer
 Number of waveform files in default directory
 Range: 0 to INT_MAX
 *RST: 0

Example: See [Example "To manage waveform files"](#) on page 532.

Usage: Query only

[:SOURce<hw>]:BB:ARbitrary:WAVEform:SElect <Filename>

Selects an existing waveform file, i.e. file with extension * .wv.

Parameters:

<Filename> string

Example: See [Example "To manage waveform files"](#) on page 532.

Manual operation: See ["Load Waveform"](#) on page 70

[:SOURce<hw>]:BB:ARbitrary:WAVEform:DElete <Filename>

Deletes the specified waveform file. If the file is not on the default path, the path must be specified at the same time. The file extension may be omitted. Only files with the file extension * .wv are deleted.

Setting parameters:

<Filename> string

Example: See [Example "To manage waveform files"](#) on page 532.

Usage: Setting only

[:SOURce<hw>]:BB:ARbitrary:WAVEform:FREE?

Queries the free disk space on the default path of the instrument's hard disk.

Return values:

<Free> integer
 Range: 0 to INT_MAX
 *RST: 1

Example: See [Example "To manage waveform files"](#) on page 532.

Usage: Query only

[:SOURce<hw>]:BB:ARbitrary:WAVEform:POINTS?

Queries the number of samples (the number of I/Q values pairs) in the selected waveform file.

Return values:

<Points> <waveform filename>
 Range: 0 to 1000
 *RST: 1

Example: See [Example "To manage waveform files"](#) on page 532.

Usage: Query only

[:SOURce<hw>]:BB:ARbitrary:WAVEform:DATA <Filename>, <Data>
[:SOURce<hw>]:BB:ARbitrary:WAVEform:DATA? <Tag>

The **setting** command writes the binary block data <data> to the file identified by <filename>. The *complete content* of the waveform file (i.e. including all tags) must be specified; the complete content is transmitted as binary data block.

Tip: To ensure trouble-free data transmission, set the GPIB delimiter to EOI.

The **query** command retrieves the content of the specified tag of the currently selected waveform file or the waveform file specified with the <filename>.

See also [Chapter 4.3.5, "Tags for waveforms, data and control lists"](#), on page 94.

Parameters:

<Filename> string
 Specifies the name of the waveform file in that the binary data is copied

Setting parameters:

<Data> block data
 Binary block data with the following syntax:
 #<Digits><Length><Binary data>
 #
 Indicates the start of the binary block
 <Digits>
 Decimal value
 Gives the number of decimal digits used for the <Length> value
 <Length>
 Decimal value
 Number of bytes the follow in the <Binary data> part
 <Binary data>
 Binary data in ASCII format

Query parameters:

<Tag> 'comment' | 'copyright' | 'date' | 'lacpfilter' | 'marker name' | 'poweroffset'

Example: **Query**
See [Example "To manage waveform files"](#) on page 532.

Example: **Setting**

```
SOURce:BB:ARB:WAVeform:DATA "/var/user/test1.wv",#220<binary data>
// Writes the binary block data <binary data> to file test1.wv
// <binary data> contains 20 bytes
// <binary data> is a placeholder;
// the actual ASCII values are not printable
```

[:SOURce<hw>]:BB:ARbitrary:WAVeform:TAG?

Queries the content of the specified tag of the selected waveform file (see also [Chapter 4.3.5, "Tags for waveforms, data and control lists"](#), on page 94).

Return values:
 <Tag> 'comment' | 'copyright' | 'date' | 'lacpfilter' | 'marker name' |
 'poweroffset' | 'samples'

Example: See [Example "To manage waveform files"](#) on page 532.

Usage: Query only

[:SOURce<hw>]:BB:ARbitrary:CLOCK <Clock>

Sets the clock frequency.

If you load a waveform, the clock rate is determined as defined with the waveform tag {**CLOCK: frequency**}. This command subsequently changes the clock rate; see specifications document for value range.

For more information, refer to the specifications document.

Parameters:
 <Clock> float
 Range: depends on the installed options
 Increment: 0.001
 *RST: 1E6
 Default unit: Hz

Example: See [Example "To manage waveform files"](#) on page 532.

Manual operation: See ["Clock Frequency"](#) on page 71

[:SOURce<hw>]:BB:ARbitrary:WAVeform:CLOCK <Filename>, <Clock>

Appends information on the ARB clock rate to the specified waveform file. This file must contain I/Q or marker data.

Use the following command to create the data:

[:MMEMory:DATA:UNPRotected](#) on page 419

Parameters:

<Filename> string
 Complete file path and filename with file extension (* .wav).
 If the file is in the default directory, the file path can be omitted.

Setting parameters:

<Clock> float
 Range: 400 to 100E6
 Increment: 1E-3
 *RST: 1E6

Example: See :MMEMory:DATA:UNPRotected on page 419.

13.16.2.5 Multicarrier commands**Required options**

See [Chapter 4.4.1, "Required options"](#), on page 104.

Common suffixes

Suffix	Value range
CARRier<ch>	1 to 512

[:SOURce<hw>]:BB:ARBitrary:MCARrier:PRESet.....	544
[:SOURce<hw>]:BB:ARBitrary:MCARrier:SETTing:CATalog?.....	544
[:SOURce<hw>]:BB:ARBitrary:MCARrier:SETTing:LOAD.....	544
[:SOURce<hw>]:BB:ARBitrary:MCARrier:SETTing:STORE.....	545
[:SOURce<hw>]:BB:ARBitrary:MCARrier:CARRier:COUNT.....	545
[:SOURce<hw>]:BB:ARBitrary:MCARrier:CARRier:MODE.....	545
[:SOURce<hw>]:BB:ARBitrary:MCARrier:CARRier:SPACing.....	545
[:SOURce<hw>]:BB:ARBitrary:MCARrier:SAMPles?.....	546
[:SOURce<hw>]:BB:ARBitrary:MCARrier:TIME.....	546
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`[:SOURce<hw>]:BB:ARBitrary:MCARrier:PRESet`

Sets all the multicarrier parameters to their default values.

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Usage: Event

Manual operation: See ["Set to Default"](#) on page 107

`[:SOURce<hw>]:BB:ARBitrary:MCARrier:SETTING:CATalog?`

Queries the files with settings in the default directory. Listed are files with the file extension `*.arb_multcarr`.

Return values:

<Catalog> string

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Usage: Query only

Manual operation: See ["Save/Recall"](#) on page 108

`[:SOURce<hw>]:BB:ARBitrary:MCARrier:SETTING:LOAD <Filename>`

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.arb_multcarr`.

Setting parameters:

<Filename> "<filename>"

Filename or complete file path; file extension can be omitted.

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Usage: Setting only

Manual operation: See ["Save/Recall"](#) on page 108

[:SOURce<hw>]:BB:ARBitrary:MCARrier:SETTing:STORe <Filename>

Saves the current settings into the selected file; the file extension (*.arb_multcarr) is assigned automatically.

Setting parameters:

<Filename> string
 Filename or complete file path

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Usage: Setting only

Manual operation: See ["Save/Recall"](#) on page 108

[:SOURce<hw>]:BB:ARBitrary:MCARrier:CARRier:COUNT <Count>

Sets the number of carriers in the ARB multicarrier waveform.

Parameters:

<Count> integer
 Range: 1 to 512
 *RST: 1

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Manual operation: See ["Number of Carriers"](#) on page 108
 See ["Number of Carriers"](#) on page 114

[:SOURce<hw>]:BB:ARBitrary:MCARrier:CARRier:MODE <Mode>

Sets the carrier frequency mode for the single carriers.

Parameters:

<Mode> EQUidistant | ARBitrary
 *RST: EQUidistant

Example: BB:ARB:MCAR:CARR:MODE EQU
 Sets an equidistant carrier spacing. The carrier frequency cannot be set.

Manual operation: See ["Mode"](#) on page 108

[:SOURce<hw>]:BB:ARBitrary:MCARrier:CARRier:SPACing <Spacing>

Sets the frequency spacing between adjacent carriers of the multicarrier waveform.

See also [Chapter 4.4.2.1, "Defining the carrier frequency"](#), on page 105.

Parameters:

<Spacing> float
 Range: 0.0 to depends on the installed options, for example 120E6
 Increment: 0.01
 *RST: 0
 Default unit: Hz

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Manual operation: See ["Carrier Spacing"](#) on page 108

[:SOURce<hw>]:BB:ARbitrary:MCARrier:SAMPles?

Queries the resulting file size.

Return values:

<Samples> integer
 Range: 0 to INT_MAX
 *RST: 0
 Default unit: samples

Example: SOURce1:BB:ARbitrary:MCARrier:SAMPles?
 Queries the file size of the currently calculated multi-carrier waveform.

Usage: Query only

Manual operation: See ["File Size"](#) on page 113

[:SOURce<hw>]:BB:ARbitrary:MCARrier:TIME <Time>

Sets the user-defined signal period.

Parameters:

<Time> float
 Range: 0 to 1E9
 Increment: 1E-9
 *RST: 0
 Default unit: s

Example: SOURce1:BB:ARbitrary:MCARrier:MODE USER
 Selects signal period mode user.
 SOURce1:BB:ARbitrary:MCARrier:TIME 10
 Sets a signal period of 10 seconds

Manual operation: See ["Signal Period Mode"](#) on page 110

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CFACTOR:MODE <Mode>

Sets the mode for optimizing the crest factor by calculating the carrier phases.

Parameters:

<Mode> OFF | MIN | MAX
 *RST: OFF

Example:

SOURce1:BB:ARbitrary:MCARrier:CFACTOR:MODE OFF
 Switches off automatic crest factor optimization.

Manual operation: See ["Crest Factor Mode"](#) on page 109

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CLIPping:CFACTOR <CFactor>

Sets the value of the desired crest factor, if baseband clipping is enabled.

A target crest factor above the crest factor of the unclipped multicarrier signal has no effect.

Parameters:

<CFactor> float
 Range: -50 to 50
 Increment: 0.01
 *RST: 50
 Default unit: dB

Example:

See [\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:CLIPping\[:STATe\]](#) on page 547.

Manual operation: See ["Target Crest Factor"](#) on page 109

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CLIPping:CUTOFF <Cutoff>

Sets the cutoff frequency of the final low pass filter, if baseband clipping is enabled.

Parameters:

<Cutoff> float
 Range: 0 to 250E6
 Increment: 0.01
 *RST: 75E6

Example:

See [\[:SOURce<hw>\]:BB:ARbitrary:MCARrier:CLIPping\[:STATe\]](#) on page 547.

Manual operation: See ["Filter Cut Off Frequency"](#) on page 109

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CLIPping[:STATe] <State>

Switches baseband clipping on and off.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Example:

```
SOURce1:BB:ARbitrary:MCARrier:CLIPPING:STATE ON
SOURce1:BB:ARbitrary:MCARrier:CLIPPING:CFACTOR 37
SOURce1:BB:ARbitrary:MCARrier:CLIPPING:CUTOFF 50
```

Manual operation: See ["Clipping"](#) on page 109

[:SOURce<hw>]:BB:ARbitrary:MCARrier:TIME:MODE <Mode>

Selects the mode for calculating the resulting signal period of the multi-carrier waveform. The resulting period is always calculated for all carriers in the carrier table irrespective of their state (ON/OFF).

Parameters:

<Mode> USER | LONG | SHORT | LCM
*RST: LONG

Example: BB:ARB:MCAR:TIME:MODE LONG
The resulting signal period is defined by the longest I/Q file in the carrier table. Shorter I/Q files are periodically repeated.

Manual operation: See ["Signal Period Mode"](#) on page 110

[:SOURce<hw>]:BB:ARbitrary:MCARrier:POWER:REFERENCE <Reference>

Defines the way the individual carriers in a composed multi carrier signal are leveled.

Parameters:

<Reference> RMS | PEAK
*RST: RMS

Manual operation: See ["Power Reference"](#) on page 110

[:SOURce<hw>]:BB:ARbitrary:MCARrier:OFILE <OFile>

Sets the output filename for the multicarrier waveform (file extension *.wav).

This filename is required to calculate the waveform with the commands [:SOURce<hw>]:BB:ARbitrary:MCARrier:CLOAD or [:SOURce<hw>]:BB:ARbitrary:MCARrier:CREATE.

Parameters:

<OFile> string

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Manual operation: See ["Output File"](#) on page 112

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CLOAD

Creates a multicarrier waveform using the current entries of the carrier table and enables the ARB.

Use the command `[:SOURce<hw>] :BB:ARbitrary:MCARrier:OFILe` to define the multicarrier waveform filename. The file extension is `*.wv`.

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Usage: Event

Manual operation: See ["Create/Create and Load"](#) on page 112

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CLOCK?`

Queries the resulting sample rate at which the multi-carrier waveform is output by the arbitrary waveform generator. The output clock rate depends on the number of carriers, carrier spacing, and input sample rate of the leftmost or rightmost carriers.

Return values:

<Clock> float
 Range: 400 to Max
 Increment: 1E-3

Example: `BB:ARB:MCAR:CLOC?`
 Queries the ARB multi-carrier output clock rate.

Usage: Query only

Manual operation: See ["Clock Rate"](#) on page 113

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CREate`

Creates a multicarrier waveform using the current settings of the carrier table.

Use the command `[:SOURce<hw>] :BB:ARbitrary:MCARrier:OFILe` to define the multicarrier waveform filename. The file extension is `*.wv`.

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Usage: Event

Manual operation: See ["Create/Create and Load"](#) on page 112

`[:SOURce<hw>] :BB:ARbitrary:MCARrier:CARRier<ch>:STATe <State>`

Enables the selected single carrier of the multicarrier signal.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Manual operation: See ["State"](#) on page 114

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CARRier<ch>:FREQuency <Frequency>

Sets or indicates the carrier frequency, depending on the selected carrier frequency mode.

Parameters:

<Frequency> integer
 Range: depends on the installed options
 *RST: 0

Example: SOURce1:BB:ARbitrary:MCARrier:CARRier:MODE ARB
 SOURce1:BB:ARbitrary:MCARrier:CARRier1:
 FREQuency 5.0
 Sets 5.0 MHz carrier frequency.

Manual operation: See "[Carrier Freq. Offs. \(MHz\)](#)" on page 114

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CARRier<ch>:PHASe <Phase>

Sets the start phase of the selected carrier.

Parameters:

<Phase> float
 Range: 0 to 359.99
 Increment: 0.01
 *RST: 0
 Default unit: DEG

Example: SOURce1:BB:ARbitrary:MCARrier:CARRier19:PHASe
 90
 Sets a start phase.

Manual operation: See "[Phase \(deg\)](#)" on page 114

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CARRier<ch>:POWER <Power>

Sets the gain of the selected carrier.

Parameters:

<Power> float
 Range: -80 to 0
 Increment: 0.01
 *RST: 0
 Default unit: dB

Example: SOURce1:BB:ARbitrary:MCARrier:CARRier15:POWER
 -50
 Sets the power of carrier 15 to -50 dB.

Manual operation: See "[Gain \(dB\)](#)" on page 114

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CARRier<ch>:DELay <Delay>

Sets the start delay of the selected carrier.

Parameters:

<Delay> float
 Range: 0 to 1
 Increment: 1E-9
 *RST: 0
 Default unit: s

Example: BB:ARB:MCAR:CARR15:DEL 5us
 sets a start delay of 50 us for carrier 15.

Manual operation: See ["Delay \(ns\)"](#) on page 115

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CARRier<ch>:FILE <File>

Selects the I/Q data file that contains the I/Q samples for modulation onto the selected single carrier.

Parameters:

<File> <file name>

Example: See [Example "To generate a multicarrier signal"](#) on page 534.

Manual operation: See ["File"](#) on page 115

[:SOURce<hw>]:BB:ARbitrary:MCARrier:CARRier<ch>:CONFLICT?

Queries carrier conflicts. A conflict arises when the carriers overlap.

Return values:

<Conflict> 1 | ON | 0 | OFF
0
 No conflict
 *RST: 0

Example: BB:ARB:MCAR:CARR:CONF?

Usage: Query only

Manual operation: See ["!!!"](#) on page 115

[:SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:STATE <State>

Switches all the carriers in the selected carrier range on or off.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 1

Example: BB:ARB:MCAR:EDIT:CARR:STAT ON
 Sets all the carriers in the carrier range to ON.

Manual operation: See "[Carrier State](#)" on page 116

```
[ :SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:START <Start>
[ :SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:STOP <Stop>
```

Selects the last carrier in the carrier range to which the settings shall apply.

Parameters:

```
<Stop>                integer
                        Range:    0 to 511
                        *RST:    0
```

Example: `BB:ARB:MCAR:EDIT:CARR:STOP 4`
The carrier range stops at carrier 4.

Manual operation: See "[Carrier Start](#)" on page 116
See "[Carrier Stop](#)" on page 117

```
[ :SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:POWER:STEP <Step>
```

Sets the step width by which the starting power of the carriers in the defined carrier range is incremented.

Parameters:

```
<Step>                float
                        Range:    -80 to 80
                        Increment: 0.01
                        *RST:    0
                        Default unit: dB
```

Example: `BB:ARB:MCAR:EDIT:CARR:POW -80dB`
Sets a power of -80 dB for the carriers in the carrier range.
`BB:ARB:MCAR:EDIT:CARR:POW:STEP 1 dB`
The power is incremented by 1dB for each carrier.
That is, the first carrier has -80 dB, the second -79 dB, and so on.

Manual operation: See "[Gain Step](#)" on page 117

```
[ :SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:POWER[:START] <Start>
```

Sets the power for the individual carriers in the defined carrier range.

Parameters:

```
<Start>                float
                        Range:    -80 to 0
                        Increment: 0.01
                        *RST:    0
                        Default unit: dB
```

Example: `BB:ARB:MCAR:EDIT:CARR:POW -50 dB`
sets the power of the carriers in the carrier range to -50 dB.

Manual operation: See ["Gain Start"](#) on page 117

[[:SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:PHASe:STEP <Step>

Sets the step width by which the start phases of the carriers in the defined carrier range is incremented.

Parameters:

<Step> float
 Range: -359.99 to 359.99
 Increment: 0.01
 *RST: 0
 Default unit: DEG

Example:

BB:ARB:MCAR:EDIT:CARR:PHAS 90 DEG

Sets a start phase of 90° for the carriers in the carrier range.

BB:ARB:MCAR:EDIT:CARR:PHAS:STEP 1 DEG

The start phase is incremented by 1° for each carrier. That is, the first carrier has a start phase of 90°, the second a start phase of 91°, and so on.

Manual operation: See ["Phase Step"](#) on page 117

[[:SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:PHASe[:START] <Start>

Sets the start phase for the individual carriers in the defined carrier range.

Parameters:

<Start> float
 Range: 0 to 359.99
 Increment: 0.01
 *RST: 0
 Default unit: DEG

Example:

BB:ARB:MCAR:EDIT:CARR:PHAS 90 DEG

sets a start phase of 90° for the carriers in the carrier range.

Manual operation: See ["Phase Start"](#) on page 117

[[:SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:DELay:STEP <Step>

Sets the step width by which the start delays of the carriers in the defined carrier range is incremented.

Parameters:

<Step> float
 Range: -1 to 1
 Increment: 1E-9
 *RST: 0
 Default unit: s

Example: `BB:ARB:MCAR:EDIT:CARR:DEL 5 us`
 Sets a start delay of 5 us for the carriers in the carrier range.
`BB:ARB:MCAR:EDIT:CARR:DEL:STEP 1 us`
 The start delay is incremented by 1us for each carrier. That is, the first carrier has a start delay of 5 us, the second a start delay of 6 us, and so on.

Manual operation: See "[Delay Step](#)" on page 118

[:SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:DELay[:START] <Start>

Sets the start delay for the individual carriers in the defined carrier range.

Parameters:

<Start> float
 Range: 0 to 1
 Increment: 1E-9
 *RST: 0
 Default unit: s

Example: `BB:ARB:MCAR:EDIT:CARR:DEL 5us`
 Sets a start delay of 5 us for the carriers in the carrier range.

Manual operation: See "[Delay Start](#)" on page 117

[:SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:FILE <File>

Selects the input file. The data of the file are modulated onto the carriers in the defined carrier range.

Parameters:

<File> string

Example: `BB:ARB:MCAR:EDIT:CARR:FILE`
`"/var/user/temp/IQ_wcdma"`
 selects input file IQ_wcdma.

Manual operation: See "[Input Waveform File](#)" on page 118

[:SOURce<hw>]:BB:ARbitrary:MCARrier:EDIT:CARRier:EXECute

Adopts the settings for the selected carrier range.

Example: `BB:ARB:MCAR:EDIT:CARR:STAR 4`
`BB:ARB:MCAR:EDIT:CARR:STOP 20`
`BB:ARB:MCAR:EDIT:CARR:STAT ON`
`BB:ARB:MCAR:EDIT:CARR:EXEC`

Usage: Event

Manual operation: See "[Apply Assistant Settings](#)" on page 118

13.16.2.6 Trigger commands

This section provides trigger commands for the `SOURce:BB:ARbitrary` subsystem.

Example: To configure trigger settings

This example provides the commands to configure the trigger settings.

```
// *****
// Configure for a single trigger event.
// *****
SOURcel:BB:ARbitrary:TRIGger:SEQuence SINGLE
SOURcel:BB:ARbitrary:TRIGger:SLUNit SAMPLES
SOURcel:BB:ARbitrary:TRIGger:SLENgth 200
// Outputs the first 200 samples of the waveform after the next trigger event.
SOURcel:BB:ARbitrary:TRIGger:SOURce?
// Response: "INTernal"
SOURcel:BB:ARbitrary:STATe ON

// *****
// Configure for an external trigger event.
// *****
SOURcel:BB:ARbitrary:TRIGger:SEQuence ARETrigger
// Sets the armed retrigger mode.
SOURcel:BB:ARbitrary:TRIGger:SOURce EGT1
// Expects an external trigger signal at a USER connector.
SOURcel:BB:ARbitrary:TRIGger:EXTernal:SYNChronize:OUTPut ON
// Synchronizes the baseband signal output to the external trigger event.
// Query the processing time between the input of the external trigger event
// and the output of the baseband signal.
SOURcel:BB:ARbitrary:TRIGger:PTIMe?
// Response: "0.00021"
// The processing time is 210 mircoseconds.
// Optionally, add a trigger delay.
SOURcel:BB:ARbitrary:TRIGger:EXTernal:DELay 200
SOURcel:BB:ARbitrary:TRIGger:EXTernal:INHibit 100
SOURcel:BB:ARbitrary:STATe ON

// *****
// Execute an internal trigger manually.
// *****
SOURcel:BB:ARbitrary:TRIGger:SEQuence AAUTO
SOURcel:BB:ARbitrary:TRIGger:SOURce INTernal
SOURcel:BB:ARbitrary:STATe ON
SOURcel:BB:ARbitrary:TRIGger:EXEC
SOURcel:BB:ARbitrary:TRIGger:RMODE?
// Response: "RUN"
```

Example: To specify delay and inhibit values in time units

The following example lists the commands to configure trigger delays and trigger inhibit values. See also ["To set delay and inhibit values"](#) on page 58.

```

SOURcel:BB:ARBitrary:TRIGger:SEQuence AAUT
SOURcel:BB:ARBitrary:TRIGger:SOURce EGT1
SOURcel:BB:ARBitrary:TRIGger:DELAy:UNIT SAMP
SOURcel:BB:ARBitrary:TRIGger:EXTErnal:DELAy 100
SOURcel:BB:ARBitrary:TRIGger:EXTErnal:RDELAy?
// Response in samples: 100
SOURcel:BB:ARBitrary:TRIGger:DELAy:UNIT TIME
SOURcel:BB:ARBitrary:TRIGger:EXTErnal:TDELAy 0.00001
SOURcel:BB:ARBitrary:TRIGger:EXTErnal:RDELAy?
// Response in seconds: 0.00001
// The actual external delay is 10 microseconds.
SOURcel:BB:ARBitrary:TRIGger:DELAy:UNIT SAMP
SOURcel:BB:ARBitrary:TRIGger:EXTErnal:DELAy 10

```

Commands:

[SOURce<hw>]:BB:ARBitrary[:TRIGger]:SEQuence.....	556
[SOURce<hw>]:BB:ARBitrary:TRIGger:SOURce.....	557
[SOURce<hw>]:BB:ARBitrary:TRIGger:RMODE?.....	557
[SOURce<hw>]:BB:ARBitrary:TRIGger:SLENgth.....	557
[SOURce<hw>]:BB:ARBitrary:TRIGger:SLUNit.....	558
[SOURce<hw>]:BB:ARBitrary:TRIGger:ARM:EXECute.....	558
[SOURce<hw>]:BB:ARBitrary:TRIGger:EXECute.....	558
[SOURce<hw>]:BB:ARBitrary:TRIGger[:EXTErnal]:SYNChronize:OUTPut.....	558
[SOURce<hw>]:BB:ARBitrary:TRIGger:PTIME?.....	559
[SOURce<hw>]:BB:ARBitrary:TRIGger:DELAy:UNIT.....	559
[SOURce<hw>]:BB:ARBitrary:TRIGger[:EXTErnal]:DELAy.....	559
[SOURce<hw>]:BB:ARBitrary:TRIGger[:EXTErnal]:TDELAy.....	560
[SOURce<hw>]:BB:ARBitrary:TRIGger[:EXTErnal]:RDELAy?.....	560
[SOURce<hw>]:BB:ARBitrary:TRIGger[:EXTErnal]:INHibit.....	560

[SOURce<hw>]:BB:ARBitrary[:TRIGger]:SEQuence <Sequence>

Selects the trigger mode:

- AUTO = auto
- RETRigger = retrigger
- AAUTO = armed auto
- ARETrigger = armed retrigger
- SINGle = single

See also [Chapter 4.2.2, "About trigger modes"](#), on page 53.

Parameters:

<Sequence> AUTO | RETRigger | AAUTO | ARETrigger | SINGle
 *RST: AUTO

Example: See [Example "To configure trigger settings"](#) on page 555.

Manual operation: See ["Mode"](#) on page 77

[:SOURce<hw>]:BB:ARbitrary:TRIGger:SOURce <Source>

Selects the trigger signal source and determines the way the triggering is executed. Provided are the following trigger sources:

- **INTernal**: Internal manual triggering of the instrument
- **External** trigger signal via one of the global connectors:
EGT1: External global trigger
- **EXTernal**: Setting only
Provided only for backward compatibility with other Rohde & Schwarz signal generators. The R&S SF100A accepts this value and maps it automatically as follows:
EXTernal = EGT1

Parameters:

<Source> INTernal|EXTernal
*RST: INTernal

Example: See [Example "To configure trigger settings"](#) on page 555.

Manual operation: See ["Source"](#) on page 78

[:SOURce<hw>]:BB:ARbitrary:TRIGger:RMODE?

Queries the status of waveform output.

Return values:

<RMode> STOP | RUN
RUN
Outputs the waveform. A trigger event occurred in the triggered mode.
STOP
No waveform output. A trigger event did not occur in the triggered modes, or waveform output was stopped/armed.

Example: See [Example "To configure trigger settings"](#) on page 555.

Usage: Query only

Manual operation: See ["Running/Stopped"](#) on page 78

[:SOURce<hw>]:BB:ARbitrary:TRIGger:SLENgth <SLength>

Sets the length of the signal sequence that is output in the **SINGLE** trigger mode.

Parameters:**<SLength>** integer

The maximum value depends on the selected units [:
[SOURce<hw>\]:BB:ARbitrary:TRIGger:SLUNit](#) as follows:

SAMPle: Max = $2^{32}-1$

SEQuence: Max = 1000

Range: 1 to dynamic

*RST: 1

Example: See [Example "To configure trigger settings"](#) on page 555.**Manual operation:** See ["Signal Duration"](#) on page 78**[:SOURce<hw>]:BB:ARbitrary:TRIGger:SLUNit <SLUnit>**

Sets the unit for the entry of the length of the signal sequence to be output in the
 Single trigger mode.

Parameters:**<SLUnit>** SEQuence | SAMPle

*RST: SEQuence

Example: See [Example "To configure trigger settings"](#) on page 555.**Manual operation:** See ["Signal Duration Unit"](#) on page 78**[:SOURce<hw>]:BB:ARbitrary:TRIGger:ARM:EXECute**

Stops the waveform output to arm the trigger.

Example: See [Example "To manage waveform files"](#) on page 532.**Usage:** Event**Manual operation:** See ["Arm"](#) on page 78**[:SOURce<hw>]:BB:ARbitrary:TRIGger:EXECute**

Triggers signals generation manually for an internal trigger event.

Example: See [Example "To configure trigger settings"](#) on page 555.**Usage:** Event**Manual operation:** See ["Execute Trigger"](#) on page 78**[:SOURce<hw>]:BB:ARbitrary:TRIGger[:EXTERNAL]:SYNChronize:OUTPut
<Output>**

Enables signal output synchronous to the trigger event.

Parameters:

<Output> 1 | ON | 0 | OFF
 *RST: 1

Example: See [Example "To configure trigger settings"](#) on page 555.

Manual operation: See ["Sync. Output to External Trigger/Sync. Output to Trigger"](#) on page 79

[:SOURce<hw>]:BB:ARbitrary:TRIGger:PTIME?

Queries the internal processing time.

The processing time is the elapsed time between the input of the external trigger event and the output of the baseband signal.

Return values:

<ArbTrigProcTime> string

Example: See [Example "To configure trigger settings"](#) on page 555.

Usage: Query only

Manual operation: See ["Processing Time"](#) on page 79

[:SOURce<hw>]:BB:ARbitrary:TRIGger:DElay:UNIT <TrigDelUnit>

Sets the unit of the trigger delay.

Parameters:

<TrigDelUnit> SAMPLE | TIME
 *RST: SAMPLE

Example: See [Example "To specify delay and inhibit values in time units"](#) on page 555.

Manual operation: See ["\(External\) Delay Unit"](#) on page 79

[:SOURce<hw>]:BB:ARbitrary:TRIGger[:EXternal]:DElay <Delay>

Specifies the trigger delay in samples.

Maximum trigger delay and trigger inhibit values depend on the installed options. See ["To set delay and inhibit values"](#) on page 58.

Parameters:

<Delay> float
 Range: 0 to depends on the sample rate
 Increment: 0.01
 *RST: 0
 Default unit: sample

Example: See [Example "To specify delay and inhibit values in time units"](#) on page 555.

Manual operation: See "[\(Specified\) External Delay/\(Specified\) Trigger Delay](#)" on page 79

[:SOURce<hw>]:BB:ARbitrary:TRIGger[:EXternal]:TDElay <ExtTimeDelay>

Specifies the trigger delay for external triggering. The value affects all external trigger signals.

Maximum trigger delay and trigger inhibit values depend on the installed options. See "[To set delay and inhibit values](#)" on page 58.

Parameters:

<ExtTimeDelay> float
 Range: 0 to 2147483647 / (clock frequency)
 Increment: 1E-9
 *RST: 0
 Default unit: s

Example: See [Example "To specify delay and inhibit values in time units"](#) on page 555.

Manual operation: See "[\(Specified\) External Delay/\(Specified\) Trigger Delay](#)" on page 79

[:SOURce<hw>]:BB:ARbitrary:TRIGger[:EXternal]:RDElay?

Queries the time (in seconds) an external trigger event is delayed for.

Return values:

<ResTimeDelaySec> float
 Range: 0 to 688
 Increment: 0.25E-9
 *RST: 0

Example: See [Example "To specify delay and inhibit values in time units"](#) on page 555.

Usage: Query only

Manual operation: See "[Actual Trigger Delay/Actual External Delay](#)" on page 80

[:SOURce<hw>]:BB:ARbitrary:TRIGger[:EXternal]:INHibit <Inhibit>

Sets the number of samples that inhibit a restart of the signal generation.

Maximum trigger delay and trigger inhibit values depend on the installed options. See "[To set delay and inhibit values](#)" on page 58.

Parameters:

<Inhibit> integer
 Range: 0 to 21.47 * (clock frequency)
 *RST: 0
 Default unit: samples

Example: See [Example "To specify delay and inhibit values in time units"](#) on page 555.

Manual operation: See ["External Inhibit/Trigger Inhibit"](#) on page 79

13.16.2.7 Marker commands

[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:MODE	561
[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:ONTime	561
[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:OFFTime	561
[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:PATtern	561
[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:PULSe:DIVider	562
[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:PULSe:FREQuency?	562
[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:DELay	562
[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:DINSec?	563

[\[:SOURce<hw>\]:BB:ARbitrary:TRIGger:OUTPut<ch>:MODE <Mode>](#)

Sets the marker mode that is the marker signal for the selected marker output.

See also [Chapter 4.2.4.1, "Marker modes"](#), on page 59.

Parameters:

<Mode> UNCHanged | REStart | PULSe | PATtern | RATio

UNCHanged

A marker signal as defined in the waveform file (tag 'marker mode x') is generated.

*RST: UNCHanged

Example: See [Example "To configure marker signals"](#) on page 533.

Manual operation: See ["Mode"](#) on page 81

[\[:SOURce<hw>\]:BB:ARbitrary:TRIGger:OUTPut<ch>:ONTime <OnTime>](#)

[\[:SOURce<hw>\]:BB:ARbitrary:TRIGger:OUTPut<ch>:OFFTime <OffTime>](#)

Sets the number of samples or duration of the marker-on and marker-off periods.

Parameters:

<OffTime> integer

Range: 1 to 14913079

*RST: 1

Example: See [Example "To configure marker signals"](#) on page 533.

Manual operation: See ["Mode"](#) on page 81

[\[:SOURce<hw>\]:BB:ARbitrary:TRIGger:OUTPut<ch>:PATtern <Pattern>, <BitCount>](#)

Sets the bit pattern to generate the marker signal.

Parameters:

<Pattern> numeric
 *RST: #H2

<BitCount> integer
 0 = marker off, 1 = marker on
 Range: 1 to 64
 *RST: 2

Example: See [Example "To configure marker signals"](#) on page 533.

Manual operation: See ["Mode"](#) on page 81

[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>

Sets the divider for the pulsed marker signal.

Parameters:

<Divider> integer
 Range: 2 to 1024
 *RST: 2

Example: See [Example "To configure marker signals"](#) on page 533.

Manual operation: See ["Mode"](#) on page 81

[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:PULSe:FREQuency?

Queries the pulse frequency of the pulsed marker signal. The pulse frequency is the symbol rate divided by the divider.

Return values:

<Frequency> float
 Increment: 0.001

Example: See [Example "To configure marker signals"](#) on page 533.

Usage: Query only

Manual operation: See ["Mode"](#) on page 81

[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:DELay <Delay>

Sets the delay between the signal on the marker outputs and the start of the signal.

Parameters:

<Delay> integer
 Range: 0 to depends on other values
 Increment: 0.001
 *RST: 0
 Default unit: Symbol

Example: See [Example "To configure marker signals"](#) on page 533.

Manual operation: See ["Delay"](#) on page 81

[:SOURce<hw>]:BB:ARbitrary:TRIGger:OUTPut<ch>:DINSec?

Queries the marker delay in microseconds.

You can define a marker delay in samples via the following command:

[\[:SOURce<hw>\]:BB:ARbitrary:TRIGger:OUTPut<ch>:DELay](#) on page 562

Return values:

<DelayInS>	float
	Range: 0 to 16777215
	Increment: 1E-3
	*RST: 0

Example: See [Example "To configure marker signals"](#) on page 533.

Usage: Query only

Manual operation: See ["Delay \(Time\)"](#) on page 81

13.16.2.8 Clock commands

[:SOURce<hw>]:BB:ARbitrary:CLOCK:SOURCE <Source>

Selects the clock source:

- `INTernal`: Internal clock reference

Parameters:

<Source>	INTernal
	*RST: INTernal

Example: See [Example "To configure clock settings"](#) on page 534.

Manual operation: See ["Clock Source"](#) on page 82

13.16.2.9 Crest factor reduction commands

Option: R&S SFI-K548

This section provides commands for the `SOURce:BB:ARbitrary:CFR` subsystem.

Example: Preparing for CFR

```
// Load an ARB waveform file, e.g., the file "test.wv".
SOURcel:BB:ARbitrary:LOAD "test"
// Activate ARB.
SOURcel:BB:ARbitrary:STATe 1
```

Example: Applying clipping and filtering algorithm

```
// Set for filter and clipping CFR algorithm.
SOURcel:BB:ARbitrary:CFR:ALGorithm CLFiltering
SOURcel:BB:ARbitrary:CFR:DCFDelta -3
SOURcel:BB:ARbitrary:CFR:ITERations 5

// Configure simple filtering.
SOURcel:BB:ARbitrary:CFR:FILTer SIMPlE
SOURcel:BB:ARbitrary:CFR:CSPacing 20E6
SOURcel:BB:ARbitrary:CFR:SBANdwidth 18E6

// Configure enhanced filtering.
SOURcel:BB:ARbitrary:CFR:FILTer ENHanced
SOURcel:BB:ARbitrary:CFR:PFReq 9E6
SOURcel:BB:ARbitrary:CFR:SFReq 11E6
SOURcel:BB:ARbitrary:CFR:FORDer 100
```

Example: Applying peak cancellation algorithm

```
// Set for peak cancellation CFR algorithm.
SOURcel:BB:ARbitrary:CFR:ALGorithm PCANcellation
SOURcel:BB:ARbitrary:CFR:DCFDelta -3
// Set a cancellation pulse bandwidth of 800 kHz.
SOURcel:BB:ARbitrary:CFR:CPBandwidth 800000
// Set a transition bandwidth of 10 kHz.
SOURcel:BB:ARbitrary:CFR:TBANdwidth 10000
```

Example: Activating and monitoring CFR characteristics

```
SOURcel:BB:ARbitrary:CFR:STATe 1
SOURcel:BB:ARbitrary:CFR:MEASure:STATe?
// Response: "1"
// Query the original crest factor.
SOURcel:BB:ARbitrary:CFR:OCFactor?
// Response: "6"
// Query the resulting crest factor.
SOURcel:BB:ARbitrary:CFR:RCFactor?
// Response: "3"
// Create the waveform file "cfr.wv" with reduced crest factor.
SOURcel:BB:ARbitrary:CFR:CREate "cfr"
```

Commands:

[:SOURce<hw>]:BB:ARbitrary:CFR[:STATe]	565
[:SOURce<hw>]:BB:ARbitrary:CFR:ALGorithm	565
[:SOURce<hw>]:BB:ARbitrary:CFR:CPBandwidth	565
[:SOURce<hw>]:BB:ARbitrary:CFR:CSPacing	566
[:SOURce<hw>]:BB:ARbitrary:CFR:DCFDelta	566
[:SOURce<hw>]:BB:ARbitrary:CFR:FILTer	566
[:SOURce<hw>]:BB:ARbitrary:CFR:FORDer	566
[:SOURce<hw>]:BB:ARbitrary:CFR:ITERations	567
[:SOURce<hw>]:BB:ARbitrary:CFR:MEASure[:STATe]?	567

[:SOURce<hw>]:BB:ARbitrary:CFR:OCFactor?	567
[:SOURce<hw>]:BB:ARbitrary:CFR:PFReq	568
[:SOURce<hw>]:BB:ARbitrary:CFR:RCFactor?	568
[:SOURce<hw>]:BB:ARbitrary:CFR:SBANdwidth	568
[:SOURce<hw>]:BB:ARbitrary:CFR:SFRReq	569
[:SOURce<hw>]:BB:ARbitrary:CFR:TBANdwidth	569
[:SOURce<hw>]:BB:ARbitrary:CFR:WAVEform:CREate	569

[:SOURce<hw>]:BB:ARbitrary:CFR[:STATe] <ArbCfrState>

Enables the crest factor reduction calculation.

Parameters:

<ArbCfrState> 1 | ON | 0 | OFF
 *RST: 0

Manual operation: See ["State"](#) on page 133

[:SOURce<hw>]:BB:ARbitrary:CFR:ALGORITHM <ArbCfrAlgorithm>

Defines the algorithm for crest factor reduction.

Parameters:

<ArbCfrAlgorithm> CLFiltering | PCANcellation

CLFiltering

Clipping and filtering algorithm. This algorithm performs a hard clipping of the baseband signal. It is followed by a low pass filtering of the result in an iterative manner until the target crest factor is reached. You can define the settings of the filter that is used for the calculation.

PCANcellation

Peak cancellation algorithm. This algorithm subtracts Blackman windowed sinc pulses from the signal wherever the amplitude is above a defined threshold.

*RST: CLFiltering

Example: See [Example "Applying clipping and filtering algorithm"](#) on page 564.

Example: See [Example "Applying peak cancellation algorithm"](#) on page 564.

Manual operation: See ["Algorithm"](#) on page 133

[:SOURce<hw>]:BB:ARbitrary:CFR:CPBandwidth <ArbCfrCancPulBw>

Sets the cancellation pulse bandwidth for peak cancellation CFR algorithm.

Parameters:

<ArbCfrCancPulBw> float
 Range: 0 to 250E6
 Increment: 0.1

Example: See [Example "Applying peak cancellation algorithm"](#) on page 564.

Manual operation: See ["Cancellation Pulse Bandwidth"](#) on page 136

[:SOURce<hw>]:BB:ARbitrary:CFR:CSPacing <ArbCfrChanSpac>

Sets the channel spacing, if [:SOURce<hw>]:BB:ARbitrary:CFR:FILTer is set to SIMPLe.

Parameters:

<ArbCfrChanSpac> float
 Range: 0 to depends on the sample rate of the loaded file
 Increment: 0.1
 *RST: 250E6

Manual operation: See ["Channel Spacing"](#) on page 135

[:SOURce<hw>]:BB:ARbitrary:CFR:DCFDelta <ArbCfrDCFDelta>

Sets the value difference by which you want to change your crest factor.

Parameters:

<ArbCfrDCFDelta> float
 Range: -20 to 0
 Increment: 0.1
 *RST: -3

Manual operation: See ["Desired Crest Factor Delta"](#) on page 133

[:SOURce<hw>]:BB:ARbitrary:CFR:FILTer <ArbCfrFilterMod>

Selects which filter mode is used for the filtering.

Parameters:

<ArbCfrFilterMod> SIMPLe | ENHanced
 *RST: SIMPLe

Manual operation: See ["Filter Mode"](#) on page 134

[:SOURce<hw>]:BB:ARbitrary:CFR:FORDER <ArbCfrMaxFilOrd>

Sets the maximum filter order, if [:SOURce<hw>]:BB:ARbitrary:CFR:FILTer is set to ENHanced.

Parameters:

<ArbCfrMaxFilOrd> integer
 Range: 0 to 300
 *RST: 100

Example: See [Example "Applying clipping and filtering algorithm"](#) on page 564.

Manual operation: See ["Maximum Filter Order"](#) on page 136

[:SOURce<hw>]:BB:ARBitrary:CFR:ITERations <ArbCfrMaxIter>

Sets the number of iterations that are used for calculating the resulting crest factor. The iteration process is stopped when the desired crest factor delta is achieved by 0.1 dB.

Parameters:

<ArbCfrMaxIter> integer
 Range: 1 to 10
 *RST: 5

Manual operation: See ["Max Iterations"](#) on page 133

[:SOURce<hw>]:BB:ARBitrary:CFR:MEASure[:STATe]?

Queries the state of the crest factor reduction calculation.

Return values:

<MeasureState> 1 | ON | 0 | OFF
 ON: the original and resulting crest factors are already calculated.
 *RST: 0

Example: See [Example "Activating and monitoring CFR characteristics"](#) on page 564.

Usage: Query only

[:SOURce<hw>]:BB:ARBitrary:CFR:OCFactor?

Queries the original crest factor of the waveform after the calculation of the resulting crest factor is completed. The original crest factor is calculated as an average over the whole waveform, including any idle periods that might be present in TDD waveforms.

Return values:

<ArbCfrOCrestFac> float
 Range: 1 to 100
 Increment: 0.01
 *RST: 6

Usage: Query only

Manual operation: See ["Original Crest Factor"](#) on page 134

[:SOURce<hw>]:BB:ARbitrary:CFR:PFReq <ArbCfrPassBFreq>

Sets the passband frequency, if [:SOURce<hw>]:BB:ARbitrary:CFR:FILTer is set to ENHanced. Frequency components lower than the passband frequency are passed through unfiltered.

Parameters:

<ArbCfrPassBFreq> float
 Range: 0 to depends on the sample rate of the loaded file
 Increment: 0.1
 *RST: 250E6

Example: See [Example "Applying clipping and filtering algorithm"](#) on page 564.

Manual operation: See ["Passband Frequency"](#) on page 135

[:SOURce<hw>]:BB:ARbitrary:CFR:RCFactor?

Queries the resulting crest factor of the waveform after the calculations are completed. The resulting crest factor is calculated as an average over the whole waveform, including any idle periods that might be present in TDD waveforms.

Return values:

<ArbCfrResCreFac> float
 Range: 1 to 100
 Increment: 0.1
 *RST: 6

Example: See [Example "Activating and monitoring CFR characteristics"](#) on page 564.

Usage: Query only

Manual operation: See ["Resulting Crest Factor"](#) on page 134

[:SOURce<hw>]:BB:ARbitrary:CFR:SBANdwidth <ArbCfrSignalBw>

Sets the signal bandwidth, if [:SOURce<hw>]:BB:ARbitrary:CFR:FILTer is set to SIMPLe.

The value of the signal bandwidth should not be higher than the channel spacing ([:SOURce<hw>]:BB:ARbitrary:CFR:CSPacing).

Parameters:

<ArbCfrSignalBw> float
 Range: 0 to depends on the sample rate of the loaded file
 Increment: 0.1
 *RST: 250E6

Manual operation: See ["Signal Bandwidth"](#) on page 135

[:SOURce<hw>]:BB:ARbitrary:CFR:SFReq <ArbCfrStopBFreq>

Sets the stopband frequency of the filter, if [:SOURce<hw>]:BB:ARbitrary:CFR:FILTer is set to ENHanced. Frequency components higher than the stopband frequency are filtered out by the lowpass filter.

Parameters:

<ArbCfrStopBFreq> float
 Range: 0 to depends on the sample rate of the loaded file
 Increment: 0.1
 *RST: 250E6

Example: See [Example "Applying clipping and filtering algorithm"](#) on page 564.

Manual operation: See ["Stopband Frequency"](#) on page 135

[:SOURce<hw>]:BB:ARbitrary:CFR:TBANdwidth <DDArbCfrTranBw>

Sets the transition bandwidth of the cancellation pulse for peak cancellation CFR algorithm.

Parameters:

<DDArbCfrTranBw> float
 Range: 0 to 250E6
 Increment: 0.1

Example: See [Example "Applying peak cancellation algorithm"](#) on page 564.

Manual operation: See ["Transition Bandwidth"](#) on page 136

[:SOURce<hw>]:BB:ARbitrary:CFR:WAVeform:CREate <CreateWvFile>

With enabled signal generation, triggers the instrument to save the current settings in a waveform file. Waveform files can be further processed.

The filename and the directory it is saved in are user-definable; the predefined file extension for waveform files is *.wv.

Setting parameters:

<CreateWvFile> string

Example: See [Example "Activating and monitoring CFR characteristics"](#) on page 564.

Usage: Setting only

Manual operation: See ["Generate Waveform"](#) on page 133

13.16.3 SOURce:BB:GRAPHics subsystem

This subsystem contains the commands used to setup the graphical display.

Required options

See [Chapter 9.1, "Required options"](#), on page 255.

[:SOURce<hw>]:BB:GRAPhics:MODE	570
[:SOURce<hw>]:BB:GRAPhics:SRATe:MODE	570
[:SOURce<hw>]:BB:GRAPhics:SRATe:USER	570
[:SOURce]:BB:GRAPhics:CLoSe	571
[:SOURce]:BB:GRAPhics:ADD	571
[:SOURce]:BB:GRAPhics:SOURce	571
[:SOURce]:BB:GRAPhics:FFTLen	572
[:SOURce]:BB:GRAPhics:FFTFscale	572
[:SOURce<hw>]:BB:GRAPhics:TRIGger:SOURce	572

[:SOURce<hw>]:BB:GRAPhics:MODE <Mode>

Selects the graphics mode of the graphical signal display.

Parameters:

<Mode> IQ | VECTor | CCDF | PSPectrum | CONSTellation | EYEI | EYEQ
*RST: IQ

Example:

BB:GRAP:MODE VECT

Selects the vector diagram graphics mode.

Manual operation: See "[Mode](#)" on page 264

[:SOURce<hw>]:BB:GRAPhics:SRATe:MODE <Mode>

Sets how the time resolution of the signal is determined. Maximum resolution corresponds to a diagram covering the entire signal bandwidth. The higher the resolution is, the shorter the length of the displayed signal segment will be for the specified recording depth.

Parameters:

<Mode> AUTO | FULL | USER
*RST: AUTO

Example:

BB:GRAP:SRAT:MODE FULL

Sets the sample rate mode.

Manual operation: See "[Sample Rate Mode](#)" on page 265

[:SOURce<hw>]:BB:GRAPhics:SRATe:USER <User>

(Enabled for BB:GRAP:SRAT:MODE USER)

Selects the signal bandwidth for the diagram. The setting range moves between the minimum and maximum bandwidth which is possible for the selected graphical signal display. The selection is made graphically by moving the pointer.

Parameters:

<User> float
 Range: 0.01 to 100
 Increment: 0.01
 *RST: 10
 Default unit: PCT

Example: BB:GRAP:SRAT:USER 20
 sets the sample rate factor.

Example: BB:GRAP:SRAT:MODE USER
 sets the sample rate mode.

Manual operation: See ["Sample Rate"](#) on page 265

[:SOURce]:BB:GRAPhics:CLOSe

Closes all graphical signal displays.

Usage: Event

Manual operation: See ["Remove"](#) on page 266

[:SOURce]:BB:GRAPhics:ADD <Size>

Adds a graphical signal display (according to the current MODE, SOURce, SRATe:* and TRIGger:* settings).

Setting parameters:

<Size> MAXimized | MINimized

Usage: Setting only

Manual operation: See ["Add"](#) on page 265

[:SOURce]:BB:GRAPhics:SOURce <Source>

Defines the signal acquisition point, that is the location in the signal flow where the displayed signal is tapped from.

See [Chapter 9.2.2, "Signal acquisition points"](#), on page 260.

Parameters:

<Source> STRA | BBA | RFA | BBIA | DO1 | IQO1

STRA
 Stream A; input stream of the "IQ Stream Mapper"

BBA
 Baseband signal

BBIA
 Digital baseband input signals

RFA
 RF signal

*RST: STRA

Manual operation: See "Source" on page 264

[:SOURce]:BB:GRAPhics:FFTLen <Mode>

Sets the FFT size.

Parameters:

<Mode> LEN256 | LEN512 | LEN1024 | LEN2048 | LEN4096

*RST: LEN2048

Example: SOURce:BB:GRAPhics:FFTLen LEN2048

Manual operation: See "FFT Length" on page 264

[:SOURce]:BB:GRAPhics:FFTFscale <State>

Defines the normalization of the power values in the power spectrum diagram.

Parameters:

<State> 1 | ON | 0 | OFF

1

Normalized power in dBFS

0

Shows power distribution in dB/Hz

*RST: 0

Example:

SOURce:BB:GRAPhics:FFTFscale PSpectrum

SOURce:BB:GRAPhics:FFTFscale 1

// the power spectrum shows the normalized power in dBFS

Manual operation: See "Full Scale (dBFS)" on page 264

[:SOURce<hw>]:BB:GRAPhics:TRIGger:SOURce <Source>

Defines the trigger for the starting time of the graphic recording.

Parameters:

<Source> SOFTware | MARKer

*RST: SOFTware

Example:

SOURce1:BB:GRAPhics:TRIGger:SOURce MARKer

Sets the trigger source.

Manual operation: See "Trigger Source" on page 264

13.16.4 SOURce:BB:IMPairment subsystem

This subsystem contains the commands for the analog and digital I/Q impairments.

This subsystem contains the commands for digital I/Q impairments before the I/Q modulator and at the analog I/Q outputs.

Common suffixes

Suffix	Value range	Description
RF<ch>	1	Digital impairments for RF connector
IQOutput<ch>	1	Analog I/Q connector

Required options

See [Chapter 6.4.1, "Required options"](#), on page 156.

Commands:

[:SOURce]:BB:IMPairment:IQOutput<ch>:STATe	573
[:SOURce]:BB:IMPairment:RF<ch>:STATe	573
[:SOURce]:BB:IMPairment:IQOutput<ch>:DELay	574
[:SOURce]:BB:IMPairment:RF<ch>:DELay	574
[:SOURce]:BB:IMPairment:IQOutput<ch>:IQRatio[:MAGNitude]	574
[:SOURce]:BB:IMPairment:RF<ch>:IQRatio[:MAGNitude]	574
[:SOURce]:BB:IMPairment:IQOutput<ch>:LEAKage:I	575
[:SOURce]:BB:IMPairment:IQOutput<ch>:LEAKage:Q	575
[:SOURce]:BB:IMPairment:RF<ch>:LEAKage:I	575
[:SOURce]:BB:IMPairment:RF<ch>:LEAKage:Q	575
[:SOURce]:BB:IMPairment:IQOutput<ch>:QUADrature[:ANGLE]	575
[:SOURce]:BB:IMPairment:RF<ch>:QUADrature[:ANGLE]	575
[:SOURce]:BB:IMPairment:IQOutput<ch>:SKEW	575
[:SOURce]:BB:IMPairment:RF<ch>:SKEW	575
[:SOURce]:BB:IMPairment:IQOutput<ch>:POFFset	576
[:SOURce]:BB:IMPairment:RF<ch>:POFFset	576
[:SOURce<hw>]:BB:IMPairment:OPTimization:MODE	576

[\[:SOURce\]:BB:IMPairment:IQOutput<ch>:STATe <State>](#)

[\[:SOURce\]:BB:IMPairment:RF<ch>:STATe <State>](#)

Activates the impairment or correction values LEAKage, QUADrature and IQRatio for the corresponding stream.

Parameters:

<State> 1 | ON | 0 | OFF
 *RST: 0

Example:

SOURce1:BB:IMPairment:RF1:STATe ON
 Activates digital impairment.

Manual operation: See ["State"](#) on page 159

```
[:SOURce]:BB:IMPairment:IQOutput<ch>:DELay <Delay>
[:SOURce]:BB:IMPairment:RF<ch>:DELay <Delay>
```

Defines the time delay of both I and Q vectors between the marker signal at the marker outputs relative to the signal generation start.

A positive value means that the I and Q vectors delay relative to the marker/trigger and vice versa.

Table 13-1: Value range

Output	Min /s	Max /s	Increment
RF<ch>	0	10E-6	1E-12
IQOutput<ch>	-500E-9	500E-9	1E-12
	-500E-9	500E-9	1E-12

Parameters:

```
<Delay>          float
                  Range:    0 to 10E-6
                  Increment: 1E-12
                  *RST:     0
```

Example: `SOURce1:BB:IMPairment:RF1:DELay 32.0E-9`

Manual operation: See "IQ Delay" on page 160

```
[:SOURce]:BB:IMPairment:IQOutput<ch>:IQRatio[:MAGNitude] <IqRatio>
[:SOURce]:BB:IMPairment:RF<ch>:IQRatio[:MAGNitude] <IqRatio>
```

Sets the ratio of I modulation to Q modulation (amplification imbalance) of the corresponding digital channel.

Table 13-2: Value range

Impairments	Min /dB	Max /dB	Increment
Digital	-4	4	0.0001
Analog	-1	1	0.0001

Parameters:

```
<IqRatio>        float
                  The setting value can be either in dB or %. An input in percent is
                  rounded to the closest valid value in dB.
                  Range:    -4 to 4
                  Increment: 1E-4
                  *RST:     0
                  Default unit: dB | PCT (setting command) / dB (result value)
```

Example:

```
SOURce:BB:IMPairment:RF1:IQRatio:MAGNitude 10 PCT
SOURce:BB:IMPairment:RF1:IQRatio:MAGNitude?
// 0.848
// the value is returned in dB
```

Manual operation: See ["Gain Imbalance"](#) on page 160

```
[:SOURce]:BB:IMPairment:IQOutput<ch>:LEAKage:I <I>
[:SOURce]:BB:IMPairment:IQOutput<ch>:LEAKage:Q <Q>
[:SOURce]:BB:IMPairment:RF<ch>:LEAKage:I <I>
[:SOURce]:BB:IMPairment:RF<ch>:LEAKage:Q <Q>
```

Determines the leakage amplitude of the I or Q signal component of the corresponding stream

Parameters:

```
<Q> float
Range: -10 to 10
Increment: 0.01
*RST: 0
```

Example: SOURce:BB:IMPairment:RF1:LEAKage:Q 4 PCT
Sets the leakage for the Q-component to 4 percent.

Manual operation: See ["I Offset/Q Offset"](#) on page 159

```
[:SOURce]:BB:IMPairment:IQOutput<ch>:QUADrature[:ANGLE] <Angle>
[:SOURce]:BB:IMPairment:RF<ch>:QUADrature[:ANGLE] <Angle>
```

Sets a quadrature offset (phase angle) between the I and Q vectors deviating from the ideal 90 degrees.

A positive quadrature offset results in a phase angle greater than 90 degrees.

Table 13-3: Value range

Impairments	Min /dB	Max /dB	Increment
Digital	-30	30	0.01
Analog	-10	10	0.01

Parameters:

```
<Angle> float
Range: -30 to 30
Increment: 0.01
*RST: 0
Default unit: DEG
```

Example: SOURce:BB:IMPairment:RF1:QUADrature:ANGLE -5
Sets the quadrature offset to -5 degrees.

Manual operation: See ["Quadrature Offset"](#) on page 160

```
[:SOURce]:BB:IMPairment:IQOutput<ch>:SKEW <Skew>
[:SOURce]:BB:IMPairment:RF<ch>:SKEW <Skew>
```

Sets a delay between the Q vector and the I vector of the corresponding stream.

Parameters:

<Skew> float
 Range: -500E-9 to 500E-9
 Increment: 1E-12
 *RST: 0

Manual operation: See "Skew" on page 160

[:SOURce]:BB:IMPairment:IQOutput<ch>:POFFset <PhaseOffset>

[:SOURce]:BB:IMPairment:RF<ch>:POFFset <PhaseOffset>

Adds an additional phase offset after the stream mapper.

You can shift the phase at the different stages in the signal generation flow, see:

- [:SOURce<hw>] :BB:POFFset on page 530

Parameters:

<PhaseOffset> float
 Range: -999.99 to 999.99
 Increment: 0.01
 *RST: 0

Example: SOURce:BB:IMPairment:RF1:POFFset 0

Manual operation: See "Phase Offset" on page 160

[:SOURce<hw>]:BB:IMPairment:OPTimization:MODE <Mode>

Sets the optimization mode for I/Q modulation.

If equipped with option R&S SFI-K544, the optimization mode applies for the I/Q modulation performance and for the user-defined frequency response corrections.

See the user manual "R&S SFI-K544 User-Defined Frequency Response Correction".

Parameters:

<Mode> FAST | QHTable
FAST
 Fast optimization by compensating for I/Q skew.
QHTable
 Improves the frequency response while maintaining setting time, there is no signal interruption.
 *RST: FAST
 *RST: QHTable for the R&S SFI100A

Example:
 :SOURce1:IQ:SOURce?
 // Response: "BAsEband"
 // The I/Q signal source is the internal baseband signal.
 :SOURce1:BB:IMPairment:OPTimization:MODE FAST

Manual operation: See "Optimization Mode" on page 153

13.16.5 SOURce:BB:PROGress subsystem

In the R&S SFI100A, some calculation processes take longer time. While operating the instrument manually, you can observe the status of an initiated process by the busy indicator. The following commands fulfill the same task in the remote control operation.

Example: Querying the status of the "Create Waveform"

The following example provides information on the status during the "Create Waveform" file processing. You can query progress information of this process.

```
:SOURce1:BB:PROGress:MCODer?
// 100 (task completed)
:SOURce1:BB:ARB:STATe ON
:SOURce1:BB:PROGress:MCODer?
// 67 (task in progress)
```

```
[:SOURce<hw>]:BB:PROGress:MCODer?.....577
[:SOURce<hw>]:BB:PROGress:MCODer:ARBitrary:MCARrier?.....577
```

[:SOURce<hw>]:BB:PROGress:MCODer?

[:SOURce<hw>]:BB:PROGress:MCODer:ARBitrary:MCARrier?

Queries the status of an initiated process, like, for example, the calculation of a multi-carrier waveform file.

Return values:

<MCarrier>	integer
	Indicates the task progress in percent
Range:	0 to 100
*RST:	100

Example: See [Example "Querying the status of the "Create Waveform" on page 577.](#)

Usage: Query only

13.17 STATus subsystem

This system contains the commands for the status reporting system. See also [Chapter 12.4, "Status reporting system"](#), on page 354 for detailed information.

*RST on page 409 has no effect on the status registers.

Value ranges

- Queries return the current value of the respective register, which permits a check of the device status.
Return values: A decimal value in the range 0 to 32767 ($=2^{15}-1$)

- The configuration commands set the respective register thus determining which status changes of the R&S SF100A cause the status registers to be changed.
Setting values: A decimal value in the range 0 to 32767 ($=2^{15}-1$)

:STATus:OPERation:CONDition?	578
:STATus:OPERation:ENABle	578
:STATus:OPERation[:EVENT]	578
:STATus:OPERation:NTRansition	579
:STATus:OPERation:PTRansition	579
:STATus:PRESet	579
:STATus:QUEStionable:CONDition	580
:STATus:QUEStionable:ENABle	580
:STATus:QUEStionable[:EVENT]	580
:STATus:QUEStionable:NTRansition	580
:STATus:QUEStionable:PTRansition	581
:STATus:QUEue[:NEXT]?	581

:STATus:OPERation:CONDition?

Queries the content of the CONDition part of the STATus:OPERation register.

This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out because it indicates the current hardware status.

Return values:

<Condition> string

Example: :STATus:OPERation:CONDition?

Usage: Query only

:STATus:OPERation:ENABle <Enable>

Sets the bits of the ENABle part of the STATus:OPERation register. This setting determines which events of the Status-Event part are forwarded to the sum bit in the status byte. These events can be used for a service request.

Parameters:

<Enable> string

Example: :STAT:OPER:ENAB 32767
all events are forwarded to the sum bit of the status byte.

:STATus:OPERation[:EVENT] < >

Queries the content of the EVENT part of the STATus:OPERation register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENT part is deleted after being read out.

Parameters:

< > string

Example: :STAT:OPER:EVEN?
queries the STATus:OPERation:EVENT register.

:STATus:OPERation:NTRansition <Ntransition>

Sets the bits of the NTRansition part of the STATus:OPERation register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENT part of the register. The disappearance of an event in the hardware is thus registered, for example the end of an adjustment.

Parameters:

<Ntransition> string

Example: :STAT:OPER:NTR 0
a transition from 1 to 0 in the condition part of the Status:Operation register does not cause an entry to be made in the EVENT part.

:STATus:OPERation:PTRansition <Ptransition>

Sets the bits of the PTRansition part of the STATus:OPERation register. If a bit is set, a transition from 0 to 1 in the condition part causes an entry to be made in the EVENT part of the register. A new event in the hardware is thus registered, for example the start of an adjustment.

Parameters:

<Ptransition> string

Example: :STAT:OPER:PTR 32767
all transitions from 0 to 1 in the condition part of the Status:Operation register cause an entry to be made in the EVENT part.

:STATus:PRESet <Preset>

Resets the status registers. All PTRansition parts are set to FFFFh (32767), i.e. all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e. a transition from 1 to 0 in a CONDition bit is not detected. The ENABLE parts of STATus:OPERation and STATus:QUESTionable are set to 0, i.e. all events in these registers are not passed on.

Parameters:

<Preset> string

Example: STAT:PRES
resets the status registers.

:STATus:QUEStionable:CONDition <Condition>

Queries the content of the CONDition part of the STATus:QUEStionable register. This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out since it indicates the current hardware status.

Parameters:

<Condition> string

Example:

`:STATus:QUEStionable:CONDition?`
queries the Status:Questionable:Condition register.

:STATus:QUEStionable:ENABle <Enable>

Sets the bits of the ENABle part of the STATus:QUEStionable register. The enable part determines which events of the STATus:EVENT part are enabled for the summary bit in the status byte. These events can be used for a service request.

If a bit in the ENABle part is 1, and the corresponding EVENT bit is true, a positive transition occurs in the summary bit. This transition is reported to the next higher level.

Parameters:

<Enable> string

Example:

`STAT:QUES:ENAB 1`
Problems when performing an adjustment cause an entry to be made in the sum bit.

:STATus:QUEStionable[:EVENT] < >

Queries the content of the EVENT part of the STATus:QUEStionable register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENT part is deleted after being read out.

Parameters:

< > string

Example:

`STAT:QUES:EVENT?`
queries the Status:Questionable:Event register.

:STATus:QUEStionable:NTRansition <Ntransition>

Sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENT part of the register.

Parameters:

<Ntransition> string

Example: `STAT:QUES:NTR 0`
 a transition from 1 to 0 in the condition part of the STATus:QUEStionable register does not cause an entry to be made in the EVENT part

:STATus:QUEStionable:PTRansition <PTransition>

Sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENT part of the register.

Parameters:

<PTransition> string

Example: `STAT:QUES:PTR 32767`
 all transitions from 0 to 1 in the condition part of the STATus:QUEStionable register cause an entry to be made in the EVENT part

:STATus:QUEue[:NEXT]?

Queries the oldest entry in the error queue and then deletes it. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI. If the error queue is empty, 0 ("No error") is returned.

The command is identical to `:SYSTem:ERRor[:NEXT]?` on page 588.

Return values:

<Next> string

Example: `:STATus:QUEue?`
 queries the oldest entry in the error queue.
 Response: 0, 'no error'
 no errors have occurred since the error queue was last read out

Usage: Query only

13.18 SYSTem subsystem

The SYSTem subsystem contains a series of commands for general functions which do not directly affect signal generation.

Example: Retrieving instrument specification

Note: The following values are merely an example.

```
// Retrieve information on data sheet versions.
// Query all data sheet versions saved on the instrument:
SYSTem:SPECification:VERSion:CATalog?
"04.03,04.02,04.01,04.00,03.04,03.03,03.02,03.01,03.00,02.96,02.95,02.94,
02.02,02.01,02.00,01.03,01.02,01.01,01.00"
```

```
// Query the initial data sheet version on delivery
SYSTem:SPECification:VERSion:FACTory?
// Response: "04.00"

// Select a specific data sheet version:
SYSTem:SPECification:VERSion "04.01"

// Retrieve information on parameters that belong to a particular data sheet.
// Query the IDs of all parameters listed in the selected version:
SYSTem:SPECification:VERSion "04.03"
SYSTem:SPECification:IDentification:CATalog?
"ID_RF_FREQ_SETTING_TIME_ALC_ON_MS,ID_RF_FREQ_SETTING_TIME_MS,..."

// Query data sheet information on a specific parameter by its ID.
SYSTem:SPECification? "ID_RF_FREQ_SETTING_TIME_ALC_ON_MS"
// Returns the specified value of the parameter.
```

Example: Retrieving information on network-related settings

```
SYSTem:COMMunicate:NETWork:STATus?
// 1
SYSTem:PROTection1:STATe 0,123456

SYSTem:COMMunicate:NETWork:IPAddress:MODE STAT
SYSTem:COMMunicate:NETWork:IPAddress "10.113.0.104"
SYSTem:COMMunicate:NETWork:IPAddress:DNS "10.0.2.166"
SYSTem:COMMunicate:NETWork:COMMON:HOSTname?
// "SF100A-102030"
SYSTem:COMMunicate:NETWork:COMMON:WORKgroup "instrument"
SYSTem:COMMunicate:NETWork:COMMON:DOMAIN "rsint.net"
SYSTem:COMMunicate:NETWork:IPAddress:GATeway "10.113.0.1"
SYSTem:COMMunicate:NETWork:IPAddress:SUBNet:MASK "255.255.252.0"
SYSTem:COMMunicate:NETWork:MACaddress "08 00 27 a3 a1 70"
SYSTem:PROTection1:STATe 1
```

Example: Restarting the network

```
SYSTem:COMMunicate:NETWork:REStart
// terminates the network connection and sets it up again
```

Example: Finding out VISA resource strings

```
SYSTem:COMMunicate:NETWork:RESource?
// Response: "TCPIP::10.113.0.104::inst0::INSTR"

SYSTem:COMMunicate:HISLip:RESource?
// Response: "TCPIP::10.113.0.104::hislip0::INSTR"

SYSTem:COMMunicate:SOCKet:RESource?
// Response: "TCPIP::10.113.0.104::5025::SOCKET"
```

```
SYSTem:COMMunicate:USB:RESource?
// "USB::0x0AAD::0x01df::100001::INSTR"
```

Disabling LAN services

- ▶ **NOTICE!** Risk of loosing access over LAN. Disabling the LAN interface or the common services "LAN", "SCPI over LAN", "VNC" and "HTTP" locks the remote access to the instrument.

Use the commands in [Example "To disable the LAN interface and LAN services"](#) on page 583 to disable or enable the LAN interface and LAN interface services individually.

- a) For the first parameter of the command, enter the security password of your instrument.
The default password is 123456.
- b) For the second parameter of the command, enter the state: 1 (ON), 0 (OFF)

Example: To disable the LAN interface and LAN services

```
// *****
// Disable the LAN interface.
// *****
SYSTem:SECurity:NETWork:STATe "<password>", 0
```

Example: Querying the error queue

```
SYSTem:ERRor:STATic?
// Response: -221,"Settings conflict", 153,"Input voltage out of range", ...
// Returns all static errors that are collected in the error queue.

SYSTem:ERRor:HISTory:ClEar
// Deletes the history entries.
```

Example: Configuring date and time

```
// Query the date and time setting of the instrument
// Query the current timezone and setting
SYSTem:DATE?
// Response: 2023,1,16;1
SYSTem:TIME?
// Response: 18,15,17;1
SYSTem:TIME:ZONE?
// Response: "";1 //default UTC setting
SYSTem:TIME:PROTOcol?
// Response: "OFF";1 // no protocol selected
SYSTem:NTP:STATe?
// Response: 0;1 // NTP is disabled

// Setting the timezone and NTP time protocol
SYSTem:TIME:ZONE:CATalog?
// Response: "UTC,leap-seconds.list,leapseconds,Africa/Abidjan,..."
SYSTem:TIME:ZONE "Europe/Berlin"
SYSTem:NTP:HOST "timesource.net" // sets the NTP server address
SYSTem:NTP:STATe?
// Response: 1 // the NTP time server is enabled
```

Commands

:SYSTem:ERRor:ALL?	586
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:SYSTem:LOCK:OWNer?	590
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:SYSTem:LOCK:REQuest[:EXCLusive]?	591
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:SYSTem:SECurity:NETWork:VNC[:STATe].....	601
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:SYSTem:ERRor:ALL?

Queries the error/event queue for all unread items and removes them from the queue.

Return values:

<All> string
 Error/event_number,"Error/event_description>[;Device-dependent info]"
 A comma separated list of error number and a short description of the error in FIFO order.
 If the queue is empty, the response is 0, "No error"
 Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.
 Volatile errors are reported once, at the time they appear. Identical errors are reported repeatedly only if the original error has already been retrieved from (and hence not any more present in) the error queue.

Example:

```
SYSTem:ERRor:ALL?
// queries all entries in the error queue.
Response: 0, 'no error'
// no errors have occurred since the error queue was last read out.
```

Usage: Query only

Manual operation: See "[Clear History](#)" on page 618

:SYSTem:ERRor:CODE:ALL?

Queries the error numbers of all entries in the error queue and then deletes them.

Return values:

<All> string
 Returns the error numbers. To retrieve the entire error text, send the command `:SYSTem:ERRor:ALL?`.
0
 "No error", i.e. the error queue is empty
Positive value
 Positive error numbers denote device-specific errors
Negative value
 Negative error numbers denote error messages defined by SCPI.

Example:

```
SYSTem:ERRor:CODE:ALL?
// queries all entries in the error queue.
Response: 0
// no errors have occurred since the error queue was last read out.
```

Usage: Query only

:SYSTem:ERRor:CODE[:NEXT]?

Queries the error number of the oldest entry in the error queue and then deletes it.

Return values:

<Next> string
Returns the error number. To retrieve the entire error text, send the command `:SYSTem:ERRor:ALL?`.

0
"No error", i.e. the error queue is empty

Positive value
Positive error numbers denote device-specific errors

Negative value
Negative error numbers denote error messages defined by SCPI.

Example:

```
SYSTem:ERRor:CODE:NEXT?
// queries the oldest entry in the error queue.
Response: 0
// no errors have occurred since the error queue was last read out.
```

Usage: Query only

:SYSTem:ERRor:COUNT?

Queries the number of entries in the error queue.

Return values:

<Count> integer
0
The error queue is empty.

Example:

```
SYSTem:ERRor:COUNT?
// queries the number of entries in the error queue.
Response: 1
// one error has occurred since the error queue was last read out.
```

Usage: Query only

:SYSTem:ERRor[:NEXT]?

Queries the error/event queue for the oldest item and removes it from the queue.

Return values:

<Next> string
 Error/event_number,"Error/event_description>[:Device-dependent info]"
 Error number and a short description of the error.
 If the queue is empty, the response is 0, "No error"
 Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.
 Volatile errors are reported once, at the time they appear. Identical errors are reported repeatedly only if the original error has already been retrieved from (and hence not any more present in) the error queue.

Example:

```
SYSTem:ERRor:NEXT?
// queries the oldest entry in the error queue.
Response: 0, 'no error'
// no errors have occurred since the error queue was last read out.
```

Usage: Query only

Manual operation: See ["Static Notifications/History"](#) on page 618

:SYSTem:ERRor:GNEXt?

Similar to [:SYSTem:ERRor\[:NEXT\]?](#), but queries the next entry from the global persistent error/event queue.

Return values:

<NextGlobalError> string
 Error/event number, "Error/event description> [:Device dependent info]"
 An error number and a short description of the error.
 Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Example:

```
SYSTem:ERRor:GNEXt?
// queries the next error message from the global error queue.
```

Usage: Query only

:SYSTem:ERRor:HISTory:CLEar

Clears the error history.

Example: See [Example "Querying the error queue"](#) on page 583

Usage: Event

Manual operation: See ["Clear History"](#) on page 618

:SYSTem:ERRor:STATic?

Returns a list of all errors existing at the time when the query is started. This list corresponds to the display on the info page under manual control.

Return values:

<StaticErrors> string

Example: See [Example "Querying the error queue"](#) on page 583

Usage: Query only

Manual operation: See ["Static Notifications/History"](#) on page 618

:SYSTem:DLOCK <DispLockStat>

Disables the manual operation over the display, including the front panel keyboard of the instrument.

Parameters:

<DispLockStat> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 0)

Example: SYST:DLOC ON

Activates the display lock. The instrument cannot be operated via the display until it has been enabled with SYST:DLOC OFF.

Manual operation: See ["User Interface"](#) on page 325
See ["Enabling a locked user interface for manual operation"](#) on page 326

:SYSTem:KLOCK <State>

Disables the front panel keyboard of the instrument.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 0)

Example: SYST:KLOC ON

Locks the front panel and external controls.
To enable the controls, send SYST:KLOC OFF.

Manual operation: See ["User Interface"](#) on page 325
See ["Enabling a locked user interface for manual operation"](#) on page 326

:SYSTem:NINformation?

Queries the oldest information message ("Error History > Level > Info") in the error/event queue.

Return values:

<NextInfo> string

Example:

```
:SYSTem:NINFormation?
```

Queries the oldest entry in the info message queue.

```
Response: 90,"Info;=== Instrument startup...
==="
```

Information message containing error number 90, that states, that the instrument startup is complete.

Usage:

Query only

:SYSTem:ULOCK <SecPassWord>, <Mode>

Locks or unlocks the user interface of the instrument.

Parameters:

<Mode> ENABLEd | DONLy | DISabled | TOFF | VNConly

ENABLEd

Unlocks the display, the touchscreen and all controls for the manual operation.

DONLy

Locks the touchscreen and controls for the manual operation of the instrument. The display shows the current settings.

VNConly

Locks the touchscreen and controls for the manual operation, and enables remote operation over VNC. The display shows the current settings.

TOFF

Locks the touchscreen for the manual operation of the instrument. The display shows the current settings.

DISabled

Locks the display, the touchscreen and all controls for the manual operation.

*RST: n.a. (factory preset: ENABLEd)

Setting parameters:

<SecPassWord> string

Example:

```
:SYST:ULOC "<password>", DIS
```

Activates the user interface lock, including display and controls.

Manual operation:

See ["User Interface"](#) on page 325

See ["Enabling a locked user interface for manual operation"](#) on page 326

:SYSTem:LOCK:OWNer?

Queries the sessions that have locked the instrument currently.

If an exclusive lock is set, the query returns the owner of this exclusive lock, otherwise it returns `NONE`.

Return values:

<Owner> string

Example:

`SYST:LOCK:OWN?`

Returns the owner of locking.

Response: `NONE`

The instrument is not locked.

Usage:

Query only

:SYSTem:LOCK:RELease:ALL

Revokes the exclusive access to the instrument.

Usage:

Setting only

:SYSTem:LOCK:REQuest[:EXCLusive]?

Queries whether a lock for exclusive access to the instrument via ethernet exists. If successful, the query returns a 1, otherwise 0.

Return values:

<Success> integer

Example:

`SYST:LOCK:REQ?`

Queries the state of exclusive locking.

Response: 1

The exclusive locking is active.

Usage:

Query only

:SYSTem:SAV <Pathname>

Saves the current R&S SF100A settings in a file. To determine the file name and storage location, enter the directory and file name with the command. According to the file type, the R&S SF100A assigns the extension (`*.savrcltxt`) automatically.

Setting parameters:

<Pathname> string

Example:

`SYSTem:SAV "/var/user/temp/Test"`

`// saves the file "Test.savrcltxt" in the directory /var/user/temp/.`

Usage:

Setting only

:SYSTem:RCL <Pathname>

Selects and uploads a `*.savrcltxt` file with previously saved R&S SF100A settings from the default or a specified directory.

Setting parameters:

<Pathname> string

Example:

```
SYSTem:RCL "/var/user/temp/Test"  
// loads the "Test.savrcltxt" file from the directory /var/user/temp/.
```

Usage:

Setting only

:SYSTem:PROTect<ch>[:STATe] <State>[, <Key>]

Activates and deactivates the specified protection level.

Suffix:

<ch> Indicates the protection level.
See also "[Protection](#)" on page 319

Parameters:

<State> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 1)

Setting parameters:

<Key> integer
The respective functions are disabled when the protection level is activated. No password is required for activation of a level. A password must be entered to deactivate the protection level. The default password for the first level is 123456. This protection level is required to unlock internal adjustments for example.

Example:

To activate protection level:
SYSTem:PROTect1:STATe 1
Internal adjustments or hostname cannot be changed.
To unlock protection level 1:
SYSTem:PROTect1:STATe 0,123456
Internal adjustments are accessible.

Manual operation: See "[Protection Level/Password](#)" on page 321

:SYSTem:COMMunicate:HISLip:RESource?

Queries the VISA resource string. This string is used for remote control of the instrument with HiSLIP protocol.

Return values:

<Resource> string

Example:

See [Example "Finding out VISA resource strings"](#) on page 582.

Usage:

Query only

Manual operation: See "[HISLIP](#)" on page 361

:SYSTem:COMMunicate:NETWork:IPADdress <IpAddress>

Sets the IP address.

Parameters:

<IpAddress> string
Range: 0.0.0.0. to ff.ff.ff.ff

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["IP Address"](#) on page 359

:SYSTem:COMMunicate:NETWork:IPADdress:MODE <Mode>

Selects manual or automatic setting of the IP address.

Parameters:

<Mode> AUTO | STATic
*RST: n.a. (factory preset: AUTO)

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["Address Mode"](#) on page 359

:SYSTem:COMMunicate:NETWork:MACaddress <MacAddress>

Queries the MAC address of the network adapter.

This is a password-protected function. Unlock the protection level 1 to access it.

Parameters:

<MacAddress> string

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["MAC Address"](#) on page 360

:SYSTem:COMMunicate:NETWork:RESource?

Queries the visa resource string for Ethernet instruments.

Return values:

<Resource> string

Example: See [Example "Finding out VISA resource strings"](#) on page 582.

Usage: Query only

Manual operation: See ["VXI11"](#) on page 361

:SYSTem:COMMunicate:NETWork:REStart

Restarts the network.

Example: See [Example "Restarting the network"](#) on page 582.

Usage: Event

Manual operation: See ["Restart Network"](#) on page 358

:SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

Return values:

<State> 1 | ON | 0 | OFF

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Usage: Query only

Manual operation: See ["Network Status"](#) on page 358

:SYSTem:COMMunicate:NETWork[:COMMON]:DOMain <Domain>

Determines the primary suffix of the network domain.

Parameters:

<Domain> string

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["DNS Suffix"](#) on page 360

:SYSTem:COMMunicate:NETWork[:COMMON]:HOSTname <Hostname>

Sets an individual hostname for the R&S SF1100A.

Note: We recommend that you do not change the hostname to avoid problems with the network connection. If you change the hostname, be sure to use a unique name.

This is a password-protected function. Unlock the protection level 1 to access it.

Parameters:

<Hostname> string

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["Hostname"](#) on page 359

:SYSTem:COMMunicate:NETWork[:COMMON]:WORKgroup <Workgroup>

Sets an individual workgroup name for the instrument.

Parameters:

<Workgroup> string

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["Workgroup"](#) on page 359

:SYSTem:COMMunicate:NETWork[:IPAddress]:DNS <DNS>

Determines or queries the network DNS server to resolve the name.

Parameters:

<DNS> string

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["DNS Server"](#) on page 360

:SYSTem:COMMunicate:NETWork[:IPAddress]:GATeway <Gateway>

Sets the IP address of the default gateway.

Parameters:

<Gateway> string
Range: 0.0.0.0 to ff.ff.ff.ff

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["Default Gateway"](#) on page 360

:SYSTem:COMMunicate:NETWork[:IPAddress]:SUBNet:MASK <Mask>

Sets the subnet mask.

Parameters:

<Mask> string

Example: See [Example "Retrieving information on network-related settings"](#) on page 582.

Manual operation: See ["Subnet Mask"](#) on page 359

:SYSTem:COMMunicate:SOCKet:RESource?

Queries the visa resource string for remote control via LAN interface, using TCP/IP socket protocol.

Return values:

<Resource> string

Example: See [Example "Finding out VISA resource strings"](#) on page 582.

Usage: Query only

Manual operation: See ["Socket"](#) on page 361

:SYSTem:COMMunicate:USB:RESource?

Queries the visa resource string for remote control via the USB interface.

Return values:

<Resource> string

Example: See [Example "Finding out VISA resource strings"](#) on page 582.

Usage: Query only

:SYSTem:HELP:EXPort

Saves the online help as zip archive in the user directory.

Example:

```

:SYSTem:HELP:EXPort
MMEM:CDIR?
// "/var/user"
MMEM:CAT?
// .., "Log,DIR,4096", "help.tgz,BIN,69836600"
// confirms that help zip archive is saved.

```

Usage: Event

Manual operation:: "Setup > Help > Export Help to User Path"

:SYSTem:IDENtification <Identification>

Selects the mode to determine the "IDN String" and the "OPT String" for the instrument, selected with command [:SYSTem:LANGuage](#).

Note: While working in an emulation mode, the R&S SF100A specific command set is disabled, that is, the SCPI command `SYST:IDEN` is discarded.

Parameters:

<Identification>

AUTO | USER

AUTO

Automatically determines the strings.

USER

User-defined strings can be selected.

*RST: n.a. (factory preset: AUTO)

Example:

```
SYST:IDEN AUTO
```

Automatically assigns the OPT and IDN strings according to the selected instrument language.

Manual operation: See ["Mode"](#) on page 363

:SYSTem:IDENtification:PRESet

Sets the *IDN and *OPT strings in user defined mode to default values.

Example:

```
SYST:IDEN USER
SYST:IDEN:PRES
```

Usage: Event

Manual operation: See ["Set to Default"](#) on page 363

:SYSTem:IRESpOse <IdnResponse>

Defines the user defined identification string for *IDN.

Note: While working in an emulation mode, the instrument's specific command set is disabled, i.e. the SCPI command SYST:IRES is discarded.

Parameters:

<IdnResponse> string

Example:

```
SYST:IDEN USER
// Selects a user-defined identification
SYST:IRES "Test Device"
// Defines identification string 'test device'
*IDN?
// Response: 'test device'
```

Manual operation: See ["IDN String"](#) on page 363

:SYSTem:ORESpOse <OResponse>

Defines the user defined response string for *OPT.

Note: While working in an emulation mode, the instrument's specific command set is disabled, i.e. the SCPI command SYST:ORES is discarded.

Parameters:

<OResponse> string

Example:

```
SYST:IDEN USER
// Selects a user-defined identification
SYST:ORES "Test Option"
// Defines the OPT string 'test option'
*OPT?
// Response: 'test option'
```

Manual operation: See ["OPT String"](#) on page 363

:SYSTem:LANGUage <Language>

Sets the remote control command set.

Parameters:

<Language> string

Example:

```
SYSTem:LANGUage "SCPI"  
// selects SCPI command set
```

Manual operation: See ["Language"](#) on page 363

:SYSTem:INFormation:SCPI <InfoString>

Inserts system information in recorded SCPI command lists, for example information on a missing command.

Parameters:

<InfoString> string

Example:

```
SYST:INF:SCPI "missing command"  
enters the information into a recorded SCPI command list.
```

:SYSTem:SECurity:NETWork:AVAHi[:STATe] <SecPassWord>, <AvahiState>

Disables the Avahi service for automatic configuration of the instrument in a network.

Parameters:

<AvahiState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTem:SECurity:NETWork:FTP[:STATe] <SecPassWord>, <FtpState>

Disables FTP protocol for file transfer between the instrument and host.

Parameters:

<FtpState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTem:SECurity:NETWork:HTTP[:STATe] <SecPassWord>, <HttpState>

Disables control of the instrument over HTTP, the protocol for hypermedia information systems.

Parameters:

<HttpState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTem:SECurity:NETWork:RAW[:STATe] <SecPassWord>, <RawState>

Disables the LAN interface for remote control of the instrument over raw socket port.

Parameters:

<RawState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

:SYSTem:SECurity:NETWork:REMSupport[:STATe] <NetRemSupport>

Disables communication over SSH (SCP) for service purposes.

Parameters:

<NetRemSupport> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 1)

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTem:SECurity:NETWork:RPC[:STATe] <SecPassWord>, <RpcState>

Enables the LAN interface for remote control of the instrument via remote procedure calls (RPC).

Parameters:

<RpcState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

:SYSTem:SECurity:NETWork:SMB[:STATe] <SecPassWord>, <SmbState>

Disables access to the file system, printers and serial ports in a network over SMB.

Parameters:

<SmbState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTem:SECurity:NETWork:SOE[:STATe] <SecPassWord>, <SoeState>

Disables control of the instrument over LAN using SCPI commands.

Parameters:

<SoeState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTem:SECurity:NETWork:SSH[:STATe] <SecPassWord>, <SshState>

Disables control of the instrument over LAN using the SSH network protocol.

Parameters:

<SshState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTEM:SECURITY:NETWORK:SWUPDATE[:STATE] <SecPassWord>,
<SwUpdateState>

Disables software update over LAN.

Parameters:

<SwUpdateState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTEM:SECURITY:NETWORK:VNC[:STATE] <SecPassWord>, <VncState>

Disables the VNC interface for remote control of the instrument.

Parameters:

<VncState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583.

Manual operation: See ["LAN Services"](#) on page 328

:SYSTEM:SECURITY:NETWORK[:STATE] <SecPassWord>, <LanStorState>

Disables the LAN interface in general, including all services.

Parameters:

<LanStorState> 1 | ON | 0 | OFF

Setting parameters:

<SecPassWord> string
Current security password.
The default password is 123456.

Example: See [Example "To disable the LAN interface and LAN services"](#) on page 583

Manual operation: See ["LAN"](#) on page 328

:SYSTEM:SECURITY:SANITIZE[:STATE] <SecPassWord>, <MmemProtState>

Sanitizes the internal memory.

Parameters:

<MmemProtState> 0 | 1 | OFF | ON
 *RST: 0

Setting parameters:

<SecPassWord> string

Example:

SYSTem:SECurity:SANitize[:STATE] 1

Manual operation: See "[Sanitize](#)" on page 324

:SYSTem:SECurity:SUPolicy <SecPassWord>, <UpdatePolicy>

Configures the automatic signature verification for firmware installation.

Parameters:

<UpdatePolicy> STRict | CONFirm | IGNore
 *RST: n.a. (factory preset: CONFirm)

Setting parameters:

<SecPassWord> string

Manual operation: See "[Secure Update Policy](#)" on page 322

:SYSTem:SECurity:VOLMode[:STATE] <SecPassWord>, <MmemProtState>

Activates volatile mode, so that no user data can be written to the internal memory permanently.

To enable volatile mode, reboot the instrument. Otherwise the change has no effect.

Parameters:

<MmemProtState> 0 | 1 | OFF | ON
 *RST: 0

Setting parameters:

<SecPassWord> string
 Current security password
 The default password is 123456.

Example:

SYSTem:SECurity:VOLMode:STATE "123456", 1
 SYSTem:REBoot

Manual operation: See "[Volatile Mode](#)" on page 323

:SYSTem:SPECification? <Id>

Retrieves data sheet information for a specific parameter.

Setting parameters:

<Id> string
 Identifies the name of the entry in the data sheet, as queried with the command `:SYSTem:SPECification:IDENTification:CATalog?` on page 603

Return values:

<ValList> float
 Comma-separated list with the specified and, if available, the typical value of the parameter, as specified in the data sheet.

Example: See [Example "Retrieving instrument specification"](#) on page 581.

Usage: Query only

:SYSTem:SPECification:VERSion <Version>

Selects a data sheet version from the data sheets saved on the instrument.

Further queries regarding the data sheet parameters (<Id>) and their values refer to the selected data sheet.

To query the list of data sheet versions, use the command `:SYSTem:SPECification:VERSion:CATalog?` on page 604.

Parameters:

<Version> string

Example: See `:SYSTem:SPECification?` on page 602.

:SYSTem:SPECification:IDENTification:CATalog?

Queries the parameter identifiers (<Id>) available in the data sheet.

Return values:

<IdList> string
 Comma-separated string of the parameter identifiers (<Id>)

Example: See `:SYSTem:SPECification?` on page 602.

Usage: Query only

:SYSTem:SPECification:PARAmeter? <Id>[, <Parameter>]

Retrieves data sheet information for a specific parameter.

Setting parameters:

<Id> string
 Identifies the name of the entry in the data sheet.
 Query the data sheet parameters with the command `:SYSTem:SPECification:IDENTification:CATalog?`.

<Parameter>	float
	An additional value the result (ValList) depends on.
Return values:	
<ValList>	float
	Comma-separated list with the specified and, if available, the typical value of the parameter, as specified in the data sheet.
Example:	<p>Note: The following values are merely an example. Your instrument may not support the same parameters.</p> <pre>SYST:SPEC:PAR? "ID_RF_FREQ_SETTING_TIME_MS",0.1 SYST:SPEC:PAR? "ID_RF_LEVEL_MAX_GENERAL_DBM", 0.1</pre>
Usage:	Query only

:SYSTem:SPECification:VERSion:CATalog?

Queries all data sheet versions stored in the instrument.

Return values:

<VersCatalog> string

Example: See [:SYSTem:SPECification?](#) on page 602.

Usage: Query only

:SYSTem:SPECification:VERSion:FACTory?

Queries the data sheet version of the factory setting.

Return values:

<Version> string

Example: See [:SYSTem:SPECification?](#) on page 602.

Usage: Query only

Manual operation: See ["Versions"](#) on page 624

:SYSTem:SRData?

Queries the SCPI recording data from the internal file.

This feature enables you to transfer an instrument configuration to other test environments, as e.g. laboratory virtual instruments.

Return values:

<FileData> block data

Example:

```
SYSTem:SRData?
// #3118:SOURce1:ROSCillator:SOURce EXT
// :SOURce1:FREQuency:CW 4000000000
// :SOURce1:FREQuency:OFFSet 1000000
// :SOURce1:AM1:STATe 1
// :OUTPut1:STATe 1
```

Usage: Query only

:SYSTem:STARtup:COMPLete?

Queries if the startup of the instrument is completed.

Return values:

```
<Complete> 1 | ON | 0 | OFF
*RST:      0
```

Example:

```
SYSTem:STARtup:COMPLete?
Response: 1
// the instrument has started and is ready for operation.
```

Usage: Query only

:SYSTem:DATE <Year>, <Month>, <Day>

Queries or sets the date for the instrument-internal calendar.

This is a password-protected function. Unlock the protection level 1 to access it.

Parameters:

```
<Year>      integer
<Month>     integer
             Range: 1 to 12
<Day>      integer
             Range: 1 to 31
```

Example: See [Example "Configuring date and time"](#) on page 584.

Manual operation: See ["Date"](#) on page 631

:SYSTem:NTP:HOSTname <NTPName>

Sets the address of the NTP server. You can enter the IP address, or the hostname of the time server, or even set up an own vendor zone. See the Internet for more information on NTP.

Parameters:

```
<NTPName>  string
```

Manual operation: See ["NTP Address"](#) on page 632

:SYSTem:NTP:STATe <UseNtpState>

Activates clock synchronization via NTP.

Parameters:

<UseNtpState> 1 | ON | 0 | OFF
 *RST: n.a. (factory preset: 0)

Example: See [Example "Configuring date and time"](#) on page 584.

Manual operation: See ["NTP Address"](#) on page 632

:SYSTem:TIME <Hour>, <Minute>, <Second>

Queries or sets the time for the instrument-internal clock.

This is a password-protected function. Unlock the protection level 1 to access it.

Parameters:

<Hour> integer
 Range: 0 to 23
 <Minute> integer
 Range: 0 to 59
 <Second> integer
 Range: 0 to 59

Example: See [Example "Configuring date and time"](#) on page 584.

Manual operation: See ["Time"](#) on page 631

:SYSTem:TIME:ZONE <TimeZone>

Sets the timezone. You can query the list of the available timezones with `:SYSTem:TIME:ZONE:CATalog?`.

Parameters:

<TimeZone> string

Example: See [Example "Configuring date and time"](#) on page 584.

Manual operation: See ["Timezone"](#) on page 632

:SYSTem:TIME:ZONE:CATalog?

Queries the list of available timezones.

Return values:

<Catalog>

Example: See [Example "Configuring date and time"](#) on page 584.

Usage: Query only

Manual operation: See ["Timezone"](#) on page 632

:SYSTem:TIME:PROTocol <TimeProtocol>

Sets the date and time of the operating system.

Parameters:

<TimeProtocol> OFF | NONE | 0 | NTP | ON | 1

NONE

Sets the date and time according to the selected timezone, see [:SYSTem:TIME:ZONE:CATalog?](#) on page 606 and [:SYSTem:TIME:ZONE](#) on page 606.

NTP

Sets the date and time derived from the network time protocol. To select the NTP time server, use the commands [:SYSTem:NTP:HOSTname](#) on page 605 and [:SYSTem:NTP:STATE](#) on page 606.

*RST: n.a. (factory preset: NONE)

Example: See [Example "Configuring date and time"](#) on page 584.

Manual operation: See ["Time Protocol"](#) on page 632

:SYSTem:UPTime?

Queries the up time of the operating system.

Return values:

<UpTime> "<ddd.hh:mm:ss>"

Example:

SYSTem:UPTime?
Response: "0.08:11:00"

Usage: Query only

:SYSTem:BIOS:VERSion?

Queries the BIOS version of the instrument.

Return values:

<Version> string

Example:

SYST:BIOS:VERS?
queries the BIOS version.
Response: 123456

Usage: Query only

:SYSTem:VERSion?

Queries the SCPI version the instrument's command set complies with.

Return values:

<Version> string

Example:

```

SYSTem:VERSion
// queries the SCPI version.
Response: "1996"
// the instrument complies with the SCPI version from 1996.

```

Usage: Query only

:SYSTem:OSYSstem?

Queries the operating system of the instrument.

Return values:

<OperSystem> string

Example:

```

SYSTem:OSYSstem?
Response: "Linux"

```

Usage: Query only

:SYSTem:MMEMory:PATH:USER?

Queries the user directory, that means the directory the R&S SFI100A stores user files on.

Return values:

<PathUser> string

Example:

```

SYSTem:MMEMory:PATH:USER?
Response: ""/var/user/"

```

Usage: Query only

:SYSTem:DFPRint <Directory>

Creates a file with the device footprint of the product.

The content is formatted in machine-readable form, suitable for automatic further processing.

The generic file name is composed of

DeviceFootprint_<SerialNumber>_<Date>_<Time>.xml. R&S SFI100A saves the file in the definable directory. If the directory is not specified, it saves the footprint file in the internal default directory (/var/lib/Rohde-Schwarz/DeviceFootprint).

You can download the file by using the SCPI commands of the MMEMory subsystem.

Setting parameters:

<Directory> string

Path to the directory for saving the device footprint file.
Ensure that you have the permission to write into the directory.

Return values:**<DeviceFootprint>** string

Information on the product type, identification and the installed hardware, software and further service-related information on the product's configuration.

Example:

```
SYSTem:DFPrint "/var/user/devicefootprint"

SYSTem:DFPrint?
// MMEM:DATA?
// returns the device footprint information saved with SYST:DFPrint
```

:SYSTem:REBoot

Reboots the instrument including the operating system.

Usage: Event**:SYSTem:REStart**

Restarts the instrument without restarting the operating system.

Usage: Event**:SYSTem:SHUTdown**

Shuts down the instrument.

Usage: Event**:SYSTem:WAIT <TimeMs>**

Delays the execution of the subsequent remote command by the specified time.

This function is useful, for example to execute an SCPI sequence automatically but with a defined time delay between some commands.

See [Chapter 11.2.4, "How to assign actions to the \[★\] key"](#), on page 309.

Setting parameters:

<TimeMs> integer
 Wait time in ms
 Range: 0 to 10000
 *RST: 0

Example:

```
SYSTem:WAIT 10000
// Waits 10s before resetting the instrument.
*RST
```

Usage: Setting only

13.19 TEST subsystem

The TEST subsystem contains the commands for performing test routines directly at the hardware assemblies.

The selftest responses with a 0 if the test is performed successfully, otherwise a value other than 0 is returned. None of the commands of this system has a *RST value.

Example: Testing the screen display

```
// show the check screen
:TEST:PIXel:WINDow 1
// select the color for the display, e.g. blue
TEST:PIXel:COLor BLUE
// select the sequence for changing the color automatically
TEST:PIXel:COLor AUTO //(~3s per color)
// select a specific RGB color, e.g. black
TEST:PIXel:RGBA 0,0,0,255
// turn on the gradient
TEST:PIXel:GRADient 1
// switch to text mode
:TEST:PIXel:TEXT 1
// set the point size of the text
:TEST:PIXel:POINtsize 600
// exit the check screen
:TEST:PIXel:WINDow 0
```

:TEST<hw>:ALL:START.....	610
:TEST<hw>:ALL:RESult?.....	610
:TEST:PIXel:COLor.....	611
:TEST:PIXel:GRADient.....	611
:TEST:PIXel:POINtsize.....	611
:TEST:PIXel:RGBA.....	612
:TEST:PIXel:TEXT.....	612
:TEST:PIXel:WINDow.....	612

:TEST<hw>:ALL:START

Usage: Event

Manual operation: See "Run Module Test" on page 640

Starts the selftest. Use the command `:TEST<hw>:ALL:RESult?` to query the result.

:TEST<hw>:ALL:RESult?

Queries the result of the performed selftest. Start the selftest with `:TEST<hw>:ALL:START`.

Return values:

<Result> 0 | 1 | RUNning | STOPped
 *RST: STOPped

Usage: Query only

Manual operation: See ["Result"](#) on page 641
 See ["Last Full Test"](#) on page 641

:TEST:PIXel:COLor <PixTestColor>

Selects the color of the screen.

"AUTO" switches from one color to the next in time intervals of approximately 3 s per color.

Setting parameters:

<PixTestColor> RED | BLUE | WHITE | GREen | AUTO | GR25 | GR50 | GR75 | BLACK
 *RST: RED

Example: See [Example "Testing the screen display"](#) on page 610.

Usage: Setting only

Manual operation: See ["Check Display Screen"](#) on page 636

:TEST:PIXel:GRADient <PixTestGradStat>

Activates the gradient for display screen test.

Parameters:

<PixTestGradStat> 1 | ON | 0 | OFF
 *RST: 0

Example: See [Example "Testing the screen display"](#) on page 610.

Manual operation: See ["Check Display Screen"](#) on page 636

:TEST:PIXel:POINtsize <PixTestGradStat>

Sets the point size of the test text.

Parameters:

<PixTestGradStat> integer
 Range: 0 to 999
 *RST: n.a. (no preset. default: 0)

Example: See [Example "Testing the screen display"](#) on page 610.

Manual operation: See ["Check Display Screen"](#) on page 636

:TEST:PIXel:RGBA

Sets a specific RGBA color for the screen.

Example: See [Example "Testing the screen display"](#) on page 610.

Manual operation: See ["Check Display Screen"](#) on page 636

:TEST:PIXel:TEXT <PixTestGradStat>

Activats the test text mode.

Parameters:

<PixTestGradStat> 1 | ON | 0 | OFF
*RST: 0

Example: See [Example "Testing the screen display"](#) on page 610.

Manual operation: See ["Check Display Screen"](#) on page 636

:TEST:PIXel:WINDow <PixTestWindow>

Activates the check display screen.

Setting parameters:

<PixTestWindow> 1 | ON | 0 | OFF
*RST: 0

Example: See [Example "Testing the screen display"](#) on page 610.

Usage: Setting only

Manual operation: See ["Check Display Screen"](#) on page 636

13.20 UNIT subsystem

The UNIT subsystem is used to set default units for parameters if no unit is indicated in a command. These settings are valid for the entire instrument.

Example: Setting default units for remote control

```
UNIT:POW V
UNIT:ANGL DEG
```

Sets V (volts) as unit of all power parameters, DEG (degrees) for the phase modulation angle and KMH for the speed.

[:UNIT:ANGLE](#).....613
[:UNIT:POWER](#).....613

:UNIT:ANGLE <Angle>

Sets the default unit for phase modulation angle. The command affects no other parameters, such as RF phase, or the manual control or display.

Parameters:

<Angle> DEGree | DEGRee | RADian
*RST: RADian

:UNIT:POWer <Power>

Sets the default unit for all power parameters. This setting affects the GUI, as well as all remote control commands that determine power values.

Parameters:

<Power> V | DBUV | DBM
*RST: DBM

14 Troubleshooting and notifications

Understanding R&S SF100A notifications

The R&S SF100A distinguishes between various notifications caused by events or functions. It displays a notification in the "Info" line on the screen temporarily, and saves all notifications in a history list. In addition, an event initiates an entry in the event/error queue of the status reporting system.

14.1 Notifications

Notifications inform about operation states of the instrument, and point out deviations, deficiencies or erroneous functions that initiate an event in the instrument. The instrument distinguishes the notifications according to the significance of the events by different icons.



Some events require that you eliminate the deviation to make sure that the instrument operates correctly.

To access the notifications and history list dialog, see [Chapter 14.4, "Querying notifications"](#), on page 617. In remote control mode, you can query the notifications using the command `:SYSTem:ERRor:ALL?` on page 586.

14.1.1 Volatile notifications

Volatile notifications report automatic settings in the instrument (e.g. switching off incompatible types of modulation) or on entries that are not accepted by the instrument (e.g. range violations).

Volatile notifications do not normally demand user actions and disappear automatically after a short period of time. They are saved in the history list, however.

Remote command:

```
:SYSTem:ERRor:ALL? or  
:SYSTem:ERRor:CODE[:NEXT]?
```

14.1.2 Permanent notifications

Permanent notifications are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signaled by a permanent notification must be eliminated before correct instrument operation can be continued.

The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

Remote command:

```
:SYSTem:ERRor:STATic?
```

14.2 SCPI notifications

The SCPI notifications are similar for all SCPI instruments. Detailed information and an overview of all notifications as defined in the SCPI standard can be found in the corresponding documentation.

SCPI notifications have negative codes (numbers). The error text being entered into the error/event queue or being displayed is printed in bold face on the left together with the error code. Below the error text, there is an explanation to the respective error.

14.3 Device-specific notifications

The following table contains all error messages specific for the instrument in alphabetical order and an explanation of the error situation. The positive error codes mark the errors specific to the instrument.

The device-specific error messages set bit 3 in the ESR register.



The index provides a list of the error messages sorted according to their error codes.

Error code	Error	Description	Remedy
50	External reference out of range or disconnected	The configured reference frequency source is external but there is no physical external signal or this signal is out of range.	In the "RF Frequency" > "Reference Frequency" dialog, set the correct reference signal source.
80	Adjustment missing. Please run "Adjust All".	Alignment data is not available.	Select "System Config" > "Setup" > "General" > "Internal Adjustments" and select "Adjust All".
180	Adjustment failed	The instrument cannot execute an adjustment.	Generate the adjustment data and load it into the device.
182	Adjustment data missing	Adjustment data is missing.	Generate the adjustment data and load it into the device.
183	Adjustment data invalid	Adjustment data is invalid.	Generate the adjustment data and load it into the device.
200	Cannot access hardware	The data transmission to a hardware module was unsuccessful.	The hardware module is not installed, not properly installed or missing.
201	Hardware revision out of date	You cannot execute a specific function because of a too old hardware version. The driver does not support the installed version of a hardware module.	Consider installing a newer hardware module or downgrading the driver version

Error code	Error	Description	Remedy
202	Cannot access the EEPROM	An error occurs when writing or reading a EEPROM.	The EEPROM is possibly defective. Replace it.
203	Invalid EEPROM data	Reading a EEPROM is possible but the data are inconsistent.	
204	Driver initialization failed	Initialization of a driver fails when booting the instrument firmware.	The driver is not compatible with the hardware or software configuration of the instrument.
241	No current list	There is no list file selected to execute the required operation.	Select a list file with the correct file extension. If no list files is available, create a list file.
242	Unknown list type specified	The list type selected is not valid for the required operation. For example, the file extension for waveform list files is *.wv. It is not possible to enter another file extension when selecting a list.	Check the selected list type.
261	Waveform protected	You cannot transfer a waveform file to an Rohde & Schwarz instrument because the file is encrypted. For example, the simulation software R&S WinIQSIM2 creates protected waveform files.	Install the related waveform file software option or select an unprotected waveform file.
300	No tachometer signal detected on fan #x	Fan number #x is not working.	Send the R&S SF1100A to your local Rohde & Schwarz customer support.
300	Temperature too high	The R&S SF1100A overheats, for example, if you cover the fan openings.	Relocate the R&S SF1100A to cool down and remove all coverings from the R&S SF1100A. After cooling down switch on the R&S SF1100A. If you still encounter problems, contact the Rohde & Schwarz customer support.
300	Reference PLL unlocked	The configured reference frequency source is external but there is no physical external signal.	In the "RF Frequency" > "Reference Frequency" dialog, set a valid reference frequency source and frequency: <ul style="list-style-type: none"> Set "Source" > "Internal". Set "Source" > "External". Connect a 10 MHz 100 MHz, 640 MHz, 1 GHz, 8 GHz or a variable frequency reference source at the connector Ref In.
300	Overload (Reverse Power) detected	The connected load feeds in a voltage at the RF output connector RF Out. You can also trigger the reverse power protection without a connected DUT, if there is a too high RF level and an open RF output.	Remove the overload and switch on the RF output via "RF" > "On".
300	Overtemperature protection shut-down	The R&S SF1100A overheats, for example, if you cover the fan openings.	Relocate the R&S SF1100A to cool down and remove all coverings from the R&S SF1100A. After cooling down switch on the R&S SF1100A. If you still encounter problems, contact the Rohde & Schwarz customer support.

Error code	Error	Description	Remedy
460	Cannot open file	You or the application cannot open the selected file.	Check the file path and filename.
461	Cannot write file	You or the application cannot edit or write the selected file.	Check if the file is read-only.
462	Cannot read file	You or the application cannot read the selected file.	Check if the file contents are compatible with the file type.
463	Filename missing	You cannot execute a task because the filename is missing.	Enter a valid filename.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extension. For example, the file extension for waveform list files is *.wv. It is not possible to enter another file extension when saving a list.
465	File contains invalid data	The file with its file extension contains invalid data. The file extension is wrong for the expected data. For example, if you change the standard file extension of a waveform file from *.wv to *.txt, the instrument cannot read the waveform file anymore.	Check the file extension.

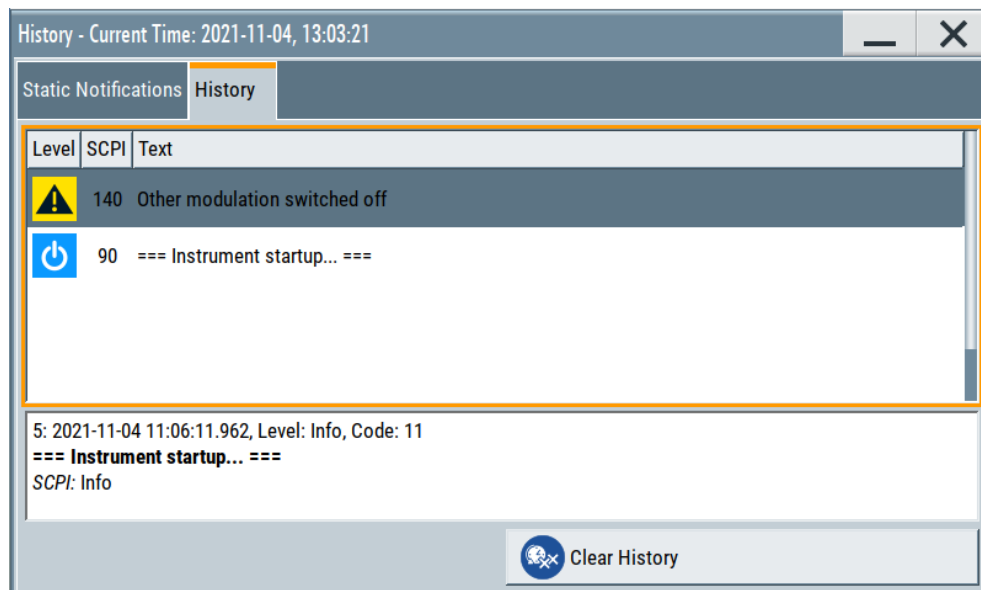
14.4 Querying notifications

The R&S SF100A monitors the functions performed and automatically detects irregularities. The instrument displays corresponding notifications in the "Info" line and collects all notifications in a history with a detailed description.

Find details to the system notifications in [Chapter 14, "Troubleshooting and notifications"](#), on page 614.

To monitor static notifications and history


- ▶ In the taskbar, select the "System Config > Info/Notifications".



- The "Static Notifications" dialog lists the recently monitored notifications chronologically and displays additional information on the highlighted message.
- The "History" dialog lists the accumulated messages with a short description. The software reports volatile notifications once. The "Info" line displays identical errors repeatedly only if the original error disappeared. Selecting this info line also opens the "Static Notifications" dialog.



Handling permanent notifications

If any critical error occurs, the R&S SF100A automatically shows the warning icon  in the taskbar. Select the icon to obtain information on the error and the number of occurrences.

The icon is assigned to permanent notifications. The notification and icon are displayed until the error is eliminated.

Static Notifications/History

Toggles between "Static Notifications" and the "History" tab in the info dialog.

Remote command:

`:SYSTem:ERRor[:NEXT]?` on page 588

Each time a `SYST:ERR:NEXT?` query is sent, the eldest entry in the error queue is returned and at the same time cleared in the list.

`:SYSTem:ERRor:STATIC?` on page 589

Queries the list of all errors.

Clear History

Clears all messages in the "History" tab.

Remote command:

`:SYSTem:ERRor:ALL?` on page 586

Each time a `SYST:ERR:ALL?` query is sent, the error queue is returned and at the same time cleared.

`:SYSTem:ERRor:HISTory:CLEar` on page 588

Clears the messages in the "History" view.

14.5 Resolving network connection failures

Several issues may cause failures in the network connection to the instrument. This section lists the most likely reasons and the recommended solutions.

Common reasons for network connection failures

- Network connecting cables and cable connectors of poor quality
- Incompatibility between the network interface of the R&S SF100A and certain switches or routers available on the market
- An invalid IP address assigned to the instrument

Possible solutions to network connection failures

1. **NOTICE!** Risk of network failure. Connecting to the network can cause network failure. Errors can affect the entire network.

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
 - Configuring the network
 - Changing IP addresses
2. Try out the following to resolve network connection failures:
 - Exchange connecting cables, if obvious damage is visible.
 - If a link failure is detected, connect the instrument to a different device port or to a different network device.
 - Check whether the LAN interface and the required LAN services are enabled.
 - If the IP address is set manually (no DHCP) or obtained with the Zeroconf (Avahi) protocol:
 - Check whether the IP address of the instrument is within the network's address range.
 - Check whether the IP address is valid.

14.6 Resolving errors during internal adjustments

Internal adjustments can fail for various reasons, e.g. if the adjustment data is invalid or missing, or if any error causes process to abort.

To resolve a failed adjustment process, you have the following options:

- Abort on error (default setting), see ["To resolve aborted internal adjustments"](#) on page 620
- Continue on error, see ["To continue internal adjustments on error"](#) on page 620

To resolve aborted internal adjustments

If an error occurs, the R&S SF100A displays a notification in the "Information" field and saves the notification in the history list.

1. Select "System Config > Info / Notifications".
2. Look up the error code of the notification in the overview of device-specific notifications.

See [Chapter 14.3, "Device-specific notifications"](#), on page 615.

The overview provides a brief explanation of all notifications and information on how to fix an error.

3. To resolve an adjustment failure, generate adjustment data and load it into the instrument.
4. Restart internal adjustments as described in ["Running internal adjustments"](#) on page 639

If the error persists:

Contact the Rohde & Schwarz customer support, see [Chapter 14.9, "Collecting information for technical support"](#), on page 624.

To continue internal adjustments on error

If the failed internal adjustments has no significant effect on your application, you can skip it and continue the calibration despite the error message. This function is password-protected.

1. Select "System Config > Setup > Security > Protection".
2. Unlock protection level 1, see ["Protection Level/Password"](#) on page 321.
3. Select "System Config > Setup > Internal Adjustment > Configuration > Continue Adjustment on Error > On".
4. Proceed as described in ["Running internal adjustments"](#) on page 639.

14.7 Measuring USB cable quality

To check the quality of the USB cable, see the service manual of the R&S SF100A.

14.8 Checking the instrument configuration

The R&S SF100A uses various hardware and software components. To get an overview, you can check the instrument assemblies, hardware options, software options and the firmware version. The "Hardware Config" and "Versions/Options" dialogs list all components according to their hardware configuration, software options and connected Rohde & Schwarz equipment, like R&S NRP power sensors.

Installing software and hardware options

Activate newly purchased software options with a keycode. After purchase, the key-code is part of the delivery of the software option. See also [Chapter 11.3, "Managing licenses and license keys"](#), on page 310.

For installing newly purchased hardware options, contact Rohde & Schwarz customer support.

Checking the installed hardware options

To find out the installed options:

1. Select "System Config" > "Setup" > "Instrument Assembly" > "Versions / Options".
2. Select "Hardware Options".

Firmware	Hardware Options	Software Options	Versions	Conan Packages	
Option		Designation			
SFI-B1016		IF frequency 16 GHz			

The dialog lists installed hardware options on the R&S SF100A.

Proceed the same way to get information on the firmware or the installed software options in the corresponding tab.

Checking the RF hardware assembly

To find out the installed RF hardware:

1. Select "System Config" > "Setup" > "Instrument Assembly" > "Hardware Config".
2. Select "RF Assembly".

General	RF Assembly	Baseband Assembly	Counter	
Assembly	Part Number	Serial Number	Revision	Slot
REF16	1347.4560.02	100000	01.00	
REF16 MCU			0.0.1	

The dialog lists the installed RF hardware components installed on the R&S SF100A.

Proceed the same way to get information on general or baseband hardware modules or on the operating times of the R&S SF100A in the corresponding tab.

14.8.1 Hardware configuration settings

Access:

- ▶ Select "System Config" > "Setup" > "Instrument Assembly" > "Hardware Config".

Assembly	Part Number	Serial Number	Revision	Slot
SF100A	1444.4001k02	0	--	
IPS3	1206.3322.00	100000	00.00	PCI-E slot
BIOS			1.8	
SMARTCARD			--	
FRONTCV	1432.8707.02	100000	01.00	PCI-E slot

The "Hardware Config" dialog lists all installed assemblies and connected external instruments with information on their part and serial numbers, and revision states. Also, it lists the BIOS version. A firmware update does not update the BIOS version. The "Counter" tab provides information on the operation time, the number of times that the instrument was powered on and the last factory calibration of the instrument.

The remote commands required to query the hardware configuration are described in [Chapter 13.7, "DIAGnostic subsystem"](#), on page 427.

Assembly

The tables in the tabs show characteristics of the installed assemblies.

"Assembly" Assembly designation.

"Part Number" Part number of the assembly.

"Serial Number"

Serial number of the assembly.

"Revision" Revision state of the assembly.

"Slot" Indicates whether the assembly is connected to the serial bus or PCI bus.

Remote command:

[:DIAGnostic<hw>:BGInfo?](#) on page 428

Counter

Displays information on the operation times of the R&S SF100A.

Operation Time / h ← Counter

Displays the operation time in hours so far.

Remote command:

[:DIAGnostic:INFO:OTIME?](#) on page 429

Power On Count ← Counter

Displays the number the instrument has been turned on.

Remote command:

[:DIAGnostic:INFO:POCount?](#) on page 429

Last Factory Calibration ← Counter

Displays the date of the last factory calibration.

Remote command:

[:CALibration:DATA:FACTory:DATE?](#) on page 426

14.8.2 Versions and options settings

Access:

- ▶ Select "System Config" > "Setup" > "Instrument Assembly" > "Versions / Options".

Firmware	Hardware Options	Software Options	Versions	Conan Packages
Package	Version			
FW	5.00.113			
Service Pack	not installed			
BIOS Version	1.6			
Downgrade Info				
Package	Version			
Factory Version	5.00.113			
Min. Version	4.30.005.26			
<p>The Min. Version is the first version supporting all hardware modules installed in this instrument. Please read release notes carefully before downgrading, some software options and features may get lost.</p>				
Show Open Source Acknowledgments		LucasFonts RSCorpid EULA		

The "Versions / Options" dialog shows the version of the installed instrument firmware, the hardware and software options, the data sheet and the software components of the firmware. The BIOS version is also listed; firmware updates do not update the BIOS version.

The remote commands required to query the hardware configuration are described in [Chapter 13.7, "DIAGnostic subsystem"](#), on page 427.

Firmware

Shows the firmware version and the version of the software platform.

Note: Your instrument is delivered with the latest firmware version available.

You can download firmware updates and the "Release Notes" that describe the modifications and the firmware update procedure.

Remote command:

n.a.

Downgrade Info

Shows downgrade information, like factory firmware version and minimum firmware version to that the instrument can be downgraded.

Remote command:

n.a.

Show Open Source Acknowledgments

Accesses the list of the used open-source software packages and the corresponding verbatim license texts.

LucasFonts RSCorpid EULA

Accesses copyright information on LucasFonts font type RSCorpid EULA.

Hardware Options/Software Options

The tables in the "Hardware" and "Software" tabs list the installed hardware and software options.

"Option" Short name of option

"Designation" Name of option

"Expiration Date"

For regular options, "Permanent" is indicated in this column.

Remote command:

*[OPT?](#) on page 408

*[IDN?](#) on page 408

Versions

The "Versions" tab shows the versions of the technical specification of the R&S SF100A and of the software components that comprise the firmware.

"Package" Name of the component.

"Version" Current issue of the component.

Remote command:

:[SYSTEM:SPECification:VERSION:FACTory?](#) on page 604

14.9 Collecting information for technical support

If you encounter problems that you cannot solve yourself, contact your Rohde & Schwarz support center at www.rohde-schwarz.com/support. Our support center staff is optimally trained to assist you in solving problems.

The support center finds solutions more quickly and efficiently if you provide them with information on the instrument and an error description.

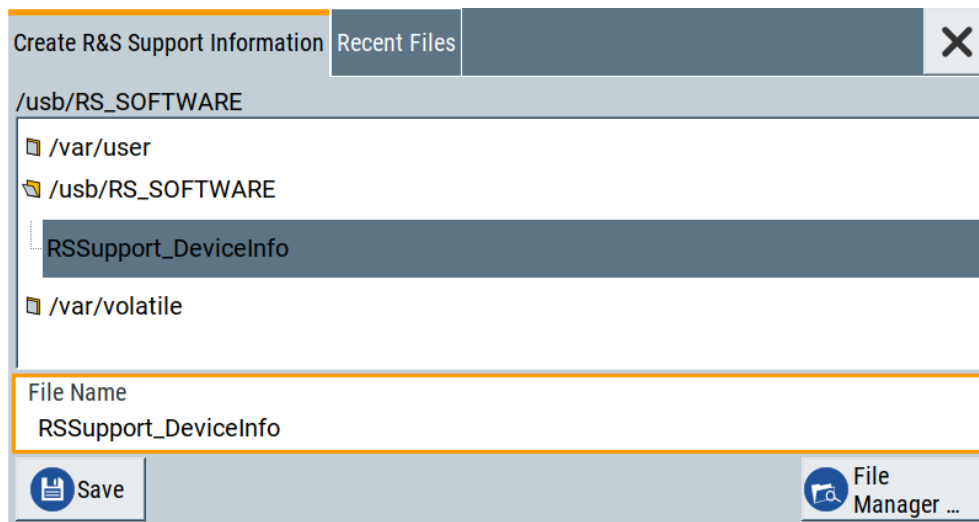
- The following dialog boxes in the "Setup > Instrument Assembly" menu provide useful information:
 - **Hardware Configuration:** hardware assemblies
 - **Software and Options:** the status of all software and hardware options installed on your instrument

- **System Messages:** displayed in the "Info" line and provide information on any errors that have occurred
- **Support file:** a special file (*.tar.gz file) with important support information that can be created automatically.
The support *.tar.gz file has a user-definable name and contains the following files and information:
 - SgErrors.txt: chronological record of errors
 - SystemRestorationSF100A.savrc1.txt: instrument settings at the last correct shutdown of the instrument
 - UndoHistSuppInfo.xml: list of the last user interactions
 - DeviceFootprint_<SerialNumber>_<Date>_<Time>.xml: service-related information on the instrument's configuration.
 - crashlog.txt, coredump: Postmortem debug info
 - Several files with information on the last performed adjustment and self-test.

See also the description of error messages [Chapter 14.1, "Notifications"](#), on page 614.

To collect error information in a support file

1. Connect a USB device to the R&S SF100A.
2. Select "System Config > Setup > Maintenance > Create R&S Support Information".
3. In the "Create R&S Support Information" dialog, navigate to the /usb directory. Enter the support filename, for example RSupport_DeviceInfo.



The error information and further required data are collected automatically. The support file RSupport_DeviceInfo.tar.gz is created and stored in the /usb directory.

Collect the error information and attach it to an email in which you describe the problem. Send the email to the customer support address as listed on the Internet (www.rohde-schwarz.com/support).

To remove sensitive data

- ▶ For information on how to handle or remove the sensitive data from your instrument, refer to the description "R&S SF100A Instrument Security Procedures".

To pack and transport the instrument

- ▶ If you need to transport or ship the instrument, see [Chapter 15, "Transporting"](#), on page 627.

14.10 Contacting customer support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz product, contact our customer support center. A team of highly qualified engineers provides support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz products.

Contact information

Contact our customer support center at www.rohde-schwarz.com/support, or follow this QR code:



Figure 14-1: QR code to the Rohde & Schwarz support page

15 Transporting

Lifting and carrying

For safety information, see:

- ["Lifting and carrying the product"](#) on page 10

Packing

Use the original packaging material. It consists of antistatic wrap for electrostatic protection and packing material designed for the product.

If you do not have the original packaging, use similar materials that provide the same level of protection. You can also contact your local Rohde & Schwarz service center for advice.

Securing

When moving the R&S SFI100A in a vehicle or using transporting equipment, make sure that the R&S SFI100A is properly secured. Only use items intended for securing objects.

Transport altitude

The maximum transport altitude without pressure compensation is specified in the specifications document.

16 Maintenance, storage and disposal

The product does not require regular maintenance. It only requires occasional cleaning. It is however advisable to check the nominal data from time to time.

- [Cleaning](#)..... 628
- [Changing fuses](#)..... 628
- [Storage](#)..... 629
- [Performing maintenance tasks](#)..... 630
- [Disposal](#)..... 641

16.1 Cleaning

How to clean the product is described in "[Cleaning the product](#)" on page 11.

Do not use any liquids for cleaning. Cleaning agents, solvents, acids and bases can damage the front panel labeling, plastic parts and display.

16.2 Changing fuses

If the product does not start, it is possible that a blown fuse is the cause. The power connector of the product is protected by two line fuses F1 and F2 (order number 0020.7630.00). The two line fuses are in the socket of the power supply on the rear panel.

To check fuse characteristics

- ▶ To find out fuse characteristics, check the label to the right of the power switch on the rear panel. See [Figure 16-1](#).

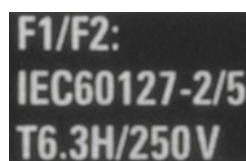


Figure 16-1: Fuse label

The label lists the characteristics of the fuses. For an explanation of these characteristics, see [Table 16-1](#).

Table 16-1: Fuse characteristics

Label	Description
F1/F2	Name of the fuse. The number relates to the location of the fuse in the fuse holder.
IEC60127-2/5	Standard that the fuse complies with.
T	Triggering characteristic

Label	Description
6.3 A	Rated current
H	Breaking capacity
250 V	Rated power level

For more information, refer to the specifications document.

To change the fuses

- WARNING!** The fuse is part of the AC power supply. Handling the fuse while the power is on can lead to electric shock.

Before changing the fuse:

- Set the switch on the power supply to position [0] (3 in [Figure 16-2](#)).

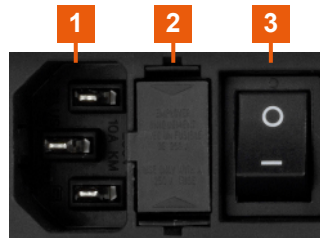


Figure 16-2: Power supply

- 1 = Power connector: power outlet with ground contact
- 2 = Fuse holder
- 3 = Power switch

- Disconnect the product from the power source (1).
- Open the cover of the fuse holder (2) with a screw driver size 1 or similar.
 - Pull out the fuse holder with a screw driver size 3 or similar.
 - Check the condition of the fuse.
 - Replace the blown fuse. Only use a fuse of the specified type.
The fuse type and its characteristics are indicated next to the fuse holder, see [Table 16-1](#).
 - Insert the fuse holder into the mains power inlet.
 - Close the cover of the fuse holder.

16.3 Storage

Protect the product against dust. Ensure that the environmental conditions, e.g. temperature range and climatic load, meet the values specified in the specifications document.

16.4 Performing maintenance tasks

The R&S SF1100A is accurate due to integrated adjustment procedures and the following additional capabilities that assure correct functioning:

- **Internal adjustments**
Internal adjustments are integrated self-calibration routines, which you can execute directly on the instrument.
How to: See [Chapter 16.4.4.3, "How to use the internal adjustments"](#), on page 639.
Self-calibration routines that require additional equipment are performed at an authorized Rohde & Schwarz service center. For a description, see the R&S SF1100A service manual.
- **Self-test**
A self-test is provided for service purposes. We recommend that you perform a self-test, if the instrument does not respond as expected.
- **Test points**
If necessary for service purposes, internal test points can be queried. For a description, see the R&S SF1100A service manual.
- [Date and time](#).....630
- [Check the front panel](#).....633
- [Check display screen](#).....635
- [Internal adjustments](#).....636
- [Selftest](#).....640

16.4.1 Date and time

The R&S SF1100A uses an internal real-time clock to determine the date and time. It adjusts the time and date to the timezone of your location automatically, by providing a selection list of continents and cities.

The instrument records the time whenever you create or modify files on your instrument or you use timed licenses. By default, the instrument is set to the UTC timezone, but you can select the timezone according to your location.

Moreover, the instrument supports [NTP](#) protocol for synchronizing all connected instruments and computer systems to minimize time delays in the network.

16.4.1.1 Date and time settings

Access:

- ▶ Select "System Config" > "Setup" > "Maintenance" > "Date / Time".

The "Date / Time" dialog contains the time and data settings of the operating system.

This function is password-protected. Unlock the protection level 1 to access it.

You can also set the time zone for your location, and select a time protocol controlled by a time server for synchronization.

The required remote commands are described in [Chapter 13.18, "SYSTEM subsystem"](#), on page 581.

Settings:

Date	631
Time	631
Timezone	632
Time Protocol	632
NTP Address	632

Date

Displays the date set in the operating system in the format [yyyy.mm.dd].

Remote command:

:[SYSTem:DATE](#) on page 605

Time

Displays the time set in the operating system in the format [hh.mm.ss].

The time setting corresponds to the selected [Timezone](#).

Remote command:

:[SYSTem:TIME](#) on page 606

Timezone

Selects the timezone in the date and time settings of the operating system.

You can select the timezone according to the major cities on the respective continents.

Tip: By typing the first letter, you can quickly navigate through the lists to find the desired destination.

Remote command:

:SYSTem:TIME:ZONE on page 606

:SYSTem:TIME:ZONE:CATalog? on page 606

Time Protocol

Enables the instrument to refer to a network time protocol.

A network time protocol synchronizes the system clocks of all participating devices in a computer network (Ethernet). A time server in the network provides the time base for the connected devices that refer to this time to synchronize events.

You can select a high-precision time protocol to achieve high clock accuracy and thus reduce the impact of varying network delays.

"None" Refers to the selected timezone, see "Timezone" on page 632.

"NTP" Uses the network time protocol (NTP).

Remote command:

:SYSTem:TIME:PROTocol on page 607

NTP Address

Sets the IP address or host name of the NTP server.

When the server is detected and verified, the instrument enables the connection automatically.

Remote command:

:SYSTem:NTP:HOSTname on page 605

:SYSTem:NTP:STATe on page 606

16.4.1.2 How to set date and time

To select the timezone

1. Select "Maintenance > Date /Time > Timezone".
2. Select continent and city of your location.
Tip: By typing the first letter, you can quickly navigate through the lists to find the desired destination.
3. Close the dialogs.

The instrument adjusts the time according to the selected location.

To set the date and time

1. Select "Security > Protection".

2. Enable the "Protection Level 1".
The default password is 123456.
3. Select "Setup > Maintenance > Date / Time".
4. Adjust the settings.
5. Close the dialogs.
The instrument sets the new date and time.

16.4.2 Check the front panel

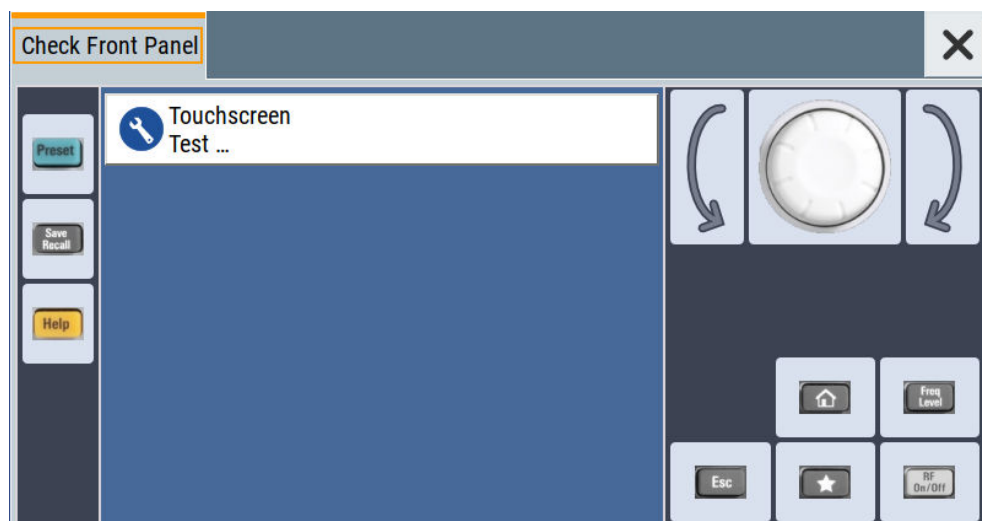
Within this dialog, you can verify the functionality of the control keys.

How to: [Chapter 16.4.2.2, "How to test the front panel"](#), on page 634

16.4.2.1 Check front panel settings

Access:

- ▶ Select "System Config > Setup > Maintenance > Check Front Panel".



Reflecting the front panel, the "Check Front Panel" dialog contains all functions to test the operating elements of the instrument. In addition, you can check the touch-sensitive functionality by dragging one or more lines across the screen with your finger.

16.4.2.2 How to test the front panel

Testing the key panel

To perform the key panel test, you operate the keys at the front panel, and check the response of the instrument in the "Check Front Panel" dialog. To perform this test properly, check each key of the front panel. The test is only completed, when you have verified all keys.

During the test, the actual functions of the keys are disabled.

1. Select "Maintenance > Check Front Panel"
The "Check Front Panel" dialog opens.
2. Press a key on the front panel.
Check if the corresponding key in the "Check Front Panel" dialog turns green.
3. Press the same key a second time.
Check that the key in the dialog turns red.
Note: Pressing the same key again has no further effect, except for the [Esc] key. Pressing this key a third time, terminates the test procedure.
4. Continue with the next key on the front panel and repeat [step 2](#) to [step 4](#) until all keys are tested.

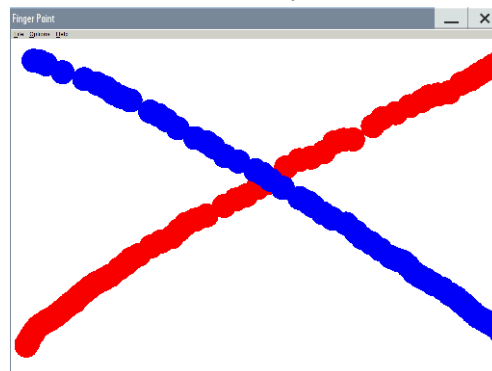
The test is completed, when each key is verified successfully, confirmed by a "Test passed" message.

Testing the touchscreen

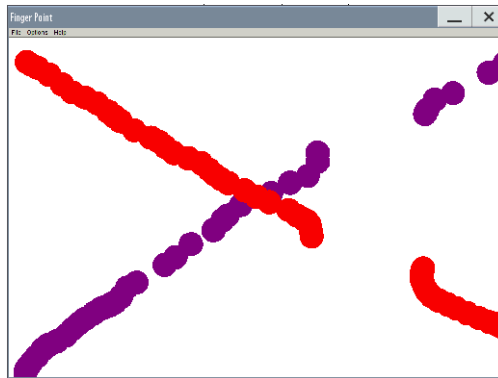
- ▶ Drag with your finger one or more lines, for example diagonally across the screen. The test traces the movements of your finger on the screen.

The following results are expected:

- If the lines are uninterrupted, the touchscreen works properly.



- If there are any gaps, the touch-sensitive functionality is damaged.



- To return to the "Check Front Panel" dialog, press [Esc].

Terminating the test

- ▶ Press the [Esc] key.
Exits the "Check Front Panel" dialog.

Debugging

- ▶ If you detect a malfunction, for example, when you press the front panel key for the first time, and the color of the button in the dialog turns red (instead of green), the front panel key has probably stuck.

16.4.3 Check display screen

Using this function, you can verify the color depth and gradient, pixels and the text display of the screen.

Access:

- ▶ Select "System Config > Setup > Maintenance > Check Display Screen".
The R&S SF100A fades out the current display and indicates the screen in red. Short instructions on the screen explain how to execute the test.

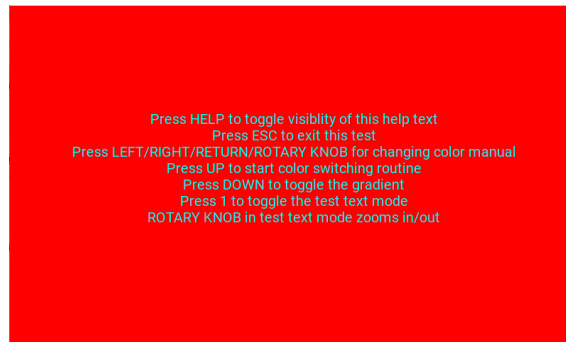
The remote commands required to define these settings are described in [Chapter 13.19, "TEST subsystem"](#), on page 610.

Testing the display screen



To test the screen display on the R&S SF100A manually, you need a keypad with cursor and numeric keys.

1. Connect an external keyboard to the USB interface.
2. Select "System Config" > "Setup" > "Maintenance" > "Check Display Screen".
3. Test the color and gradient of the display screen:



- a) Use the [Help] key to hide the indicated text.
 - b) To toggle between the provided colors manually, use the [Left/Right] cursor keys.
 The R&S SF100A provides the colors red, green, blue, white, three levels of gray shades and black.
 - c) To switch between the screen colors automatically, use the [Up] key.
 - d) To toggle the gradient, use the [Down] key.
4. Check if the R&S SF100A indicates the text correctly:
 - a) Press [1] on the numeric keypad.
 The R&S SF100A displays a test text over the entire screen.
 - b) To inspect the text in detail, you can use the rotary knob to zoom it out.
 5. To exit the test, press the [Esc] key.

Check Display Screen.....636

Check Display Screen

Opens the test window with instructions on how to perform the test.

Remote command:

:TEST:PIXel:WINDow on page 612
 :TEST:PIXel:COLor on page 611
 :TEST:PIXel:RGBA on page 612
 :TEST:PIXel:GRADient on page 611
 :TEST:PIXel:TEXT on page 612
 :TEST:PIXel:POINTsize on page 611

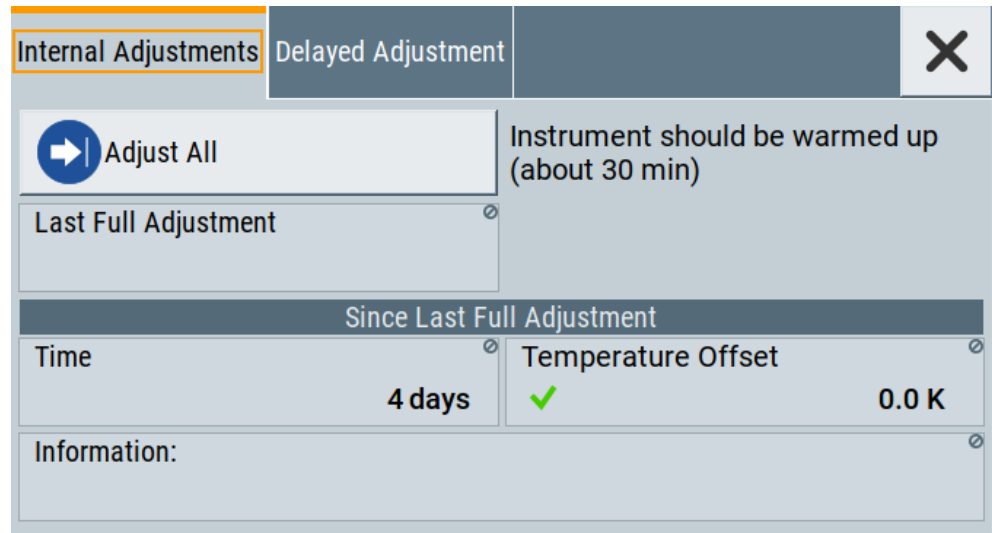
16.4.4 Internal adjustments

Using the integrated adjustment procedures, you can start the calibration directly on the instrument.

16.4.4.1 Internal adjustments settings

Access:

- ▶ Select "System Config > Setup > General > Internal Adjustments".



In this dialog, you can perform internal calibration routines, and get information on the last performed calibration.

The "Temperature Offset" indicates the deviation of the current temperature of the instrument, compared to the temperature of the last adjustment.

The remote commands required to define these settings are described in [Chapter 13.6, "CALibration subsystem"](#), on page 423.

How to: [Chapter 16.4.4.3, "How to use the internal adjustments"](#), on page 639

Settings:

Adjust All	637
Last Full Adjustment	638
Time	638
Temperature Offset	638
Information	638
Continue Adjustment on Error	638

Adjust All

Executes all available internal calibration routines of the instrument.

Note: Before you start the internal adjustment, make sure that you have connected a termination resistor, if necessary.

Remote command:

`:CALibration:ALL[:MEASure]?` on page 424

Last Full Adjustment

Displays the date of the last fully performed adjustment.

Remote command:

`:CALibration<hw>:ALL:DATE?` on page 424

Time

Displays the elapsed time since the last full adjustment.

Remote command:

`:CALibration<hw>:ALL:TIME?` on page 425

Temperature Offset

Displays the temperature difference, comparing the temperature of the last adjustment to the current instrument temperature.

A green checkmark indicates that the offset is within the permitted range. If the temperature deviates more than ± 5 K, the instrument indicates a warning icon.

Remote command:

`:CALibration<hw>:ALL:TEMP?` on page 425

Information

Displays information to the current adjustment state.

Remote command:

`:CALibration<hw>:ALL:INformation?` on page 424

Continue Adjustment on Error

Continues the calibration even though an error was detected. By default adjustments are aborted on error.

This function is password-protected. Unlock the protection level 1 to access it.

Remote command:

`:CALibration<hw>:CONTinueonerror` on page 425

16.4.4.2 Delayed adjustment settings**Adjust All Delayed**

Performs all available internal calibration routines of the instrument.

How to: See [Starting internal adjustments automatically](#).

Remote command:

`:CALibration:DElay[:MEASure]?` on page 427

Warm Up Time

Sets the time for warming up the instrument before the calibration starts automatically.

How to: See [Starting internal adjustments automatically](#).

Remote command:

`:CALibration:DElay:MINutes` on page 426

Shutdown After Adjustment

Enables the automatic shutdown after internal adjustments.

How to: See [Starting internal adjustments automatically](#).

Remote command:

`:CALibration:DElay:SHUTdown[:STATe]` on page 426

16.4.4.3 How to use the internal adjustments

Deciding whether to run internal adjustments

1. Select "System Config > Setup > Internal Adjustment".
2. Check the status and color indication in the section "Since Last Full Adjustment".
Green: internal adjustments are not required.
Red: internal adjustments are required. Observe also the indication in the "Information" field.
3. We recommend that you run internal adjustments in the following cases:
 - Before starting any application that requires a maximum of level accuracy.
 - When a long period of time has passed since the last adjustments.
 - If the ambient temperature of the instrument significantly differs from the one of the last adjustments.
4. Proceed as described in ["Running internal adjustments"](#) on page 639.

Running internal adjustments

1. After switching on, the R&S SFI100A requires up to 30 minutes to warm up. Wait until the instrument has reached operating temperature to achieve accurate adjustments.
2. Select "System Config > Setup > Internal Adjustment > Adjust All".
The adjustment process takes some time depending on the equipment of the instrument.
If any error occurs, the process aborts. To resolve adjustment issues, see [Chapter 14.6, "Resolving errors during internal adjustments"](#), on page 619.

Starting internal adjustments automatically

The delayed adjustment function executes the adjustments automatically. You can set the warm-up time and shut down after the adjustment process finishes. Using this function, you can execute adjustments without being on-site and start measurements directly when back.

1. If necessary, terminate the RF Out output. See ["Running internal adjustments"](#) on page 639.
2. Select "System Config > Setup > General > Internal Adjustment".
3. Select "Delayed Adjustment".

4. Set the "Warm Up Time", e.g. *40 min*.

The R&S SFI100A requires a warm-up time of at least 30 min.

5. Enable "Shut Down After Adjustment"
6. Select "Adjust All Delayed".

The process starts with warming up the instrument, indicating the progress in a status dialog. In this dialog, you can abort the process again, if necessary.

After warming up, the R&S SFI100A executes the internal adjustments and shuts down when finished.

16.4.5 Selftest

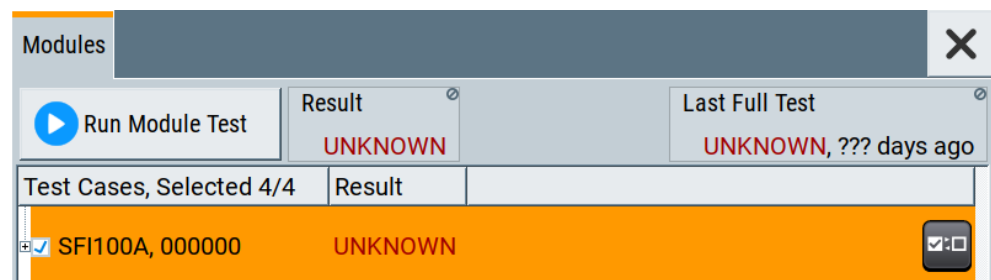
Self-test is provided for service purposes.

16.4.5.1 Selftest modules settings

Access:

- ▶ Select "System Config > Setup > Maintenance > Selftest".

The "Modules" dialog opens.



The dialog contains parameters for testing the baseband and RF hardware modules of the R&S SFI100A.

The remote commands required to define these settings are described in [Chapter 13.19, "TEST subsystem"](#), on page 610.

Run Module Test	640
Result	641
Last Full Test	641

Run Module Test

Runs selftests of the hardware modules selected in the test table.

You can run selftests for the "BBCV" baseband module and the "RFCV" RF module. Also you can execute the tests separately.

Remote command:

:TEST<hw>:ALL:START on page 610

Result

Displays the result of the hardware module selftests.

Remote command:

`:TEST<hw>:ALL:RESult?` on page 610

Last Full Test

Displays the result and date of the last hardware module test run including the elapsed time since the last test run.

For example, "PASS, 4 Jul 20, 10 days ago" implies a successful test on July 04, 2020.

Remote command:

`:TEST<hw>:ALL:RESult?` on page 610

16.5 Disposal

Rohde & Schwarz is committed to making careful, ecologically sound use of natural resources and minimizing the environmental footprint of our products. Help us by disposing of waste in a way that causes minimum environmental impact.

Disposing of electrical and electronic equipment

A product that is labeled as follows cannot be disposed of in normal household waste after it has come to the end of its life. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.



Figure 16-3: Labeling in line with EU directive WEEE

Rohde & Schwarz has developed a disposal concept for the eco-friendly disposal or recycling of waste material. As a manufacturer, Rohde & Schwarz completely fulfills its obligation to take back and dispose of electrical and electronic waste. Contact your local service representative to dispose of the product.

Annex

A Available user files and file extensions

The table [Table A-1](#) lists available file extensions for user files on the instrument. Some files depend on the installed options.

For more information, refer to the specifications document.

Table A-1: User files and file extensions on the instrument

Context or function	Content type	File contents	File extension
Instrument state	Settings	Instrument settings	*.savrc1txt
User menu	Settings	User-defined favorite settings	*.user_menu
License key	License	License key	*.xml
User correction	List	User-defined level correction values	*.uco
Power sensing	Settings	R&S NRP settings	*.nrp, *.rsu
SCPI command list	List	Export file containing list of SCPIs	*.iec
SCPI command script	Command script	SCPI script file formats: Plain SCPI, MATLAB, NICVI, Python3	*.txt, *.m, *.c, *.py
R&S support information	Support file	Automatically collected support information	*.tar.gz
Tutorials	Tutorial files	Lists containing SCPIs and explanations	*.tut
Frequency response correction	Settings	User-defined baseband frequency response correction file	*.frc
ARB	Waveform	ARB waveforms	*.wv
ARB	Waveform	ARB multicarrier settings	*.arb_multcarr
ARB	I/Q data files	I/Q data	*.iq.tar, *.csv, *.mat

B Unit shortcuts

When specifying units or quantities during data entry, the R&S SF1100A provides the following shortcuts for simplified input.

Shortcut	Designation	Context	Unit
a, A	ampere	Current	A
	atto-	Area, surface	am ²
c, C	centi-	Distance, length	cm
d, D	deci-	Distance, length	dm
		Level, power	dB, dBFS, dBm, dBu, dBW
	degree	Phase, polar/spherical coordinates	deg
e, E	exa-	Area, surface	em ²
f, F	femto-	Area, surface	fm ²
g, G	giga-	Area, surface	Gm ²
		Data rate, sample rate, symbol rate	Gbit/s, Gsample/s, Gsymbol/s, Gchip/s
		Frequency	GHz
		Impedance, resistance	GΩ
h, H	hertz	Frequency	Hz
k, K	kilo-	Area, surface	km ²
		Data rate, sample rate, symbol rate	kbit/s, ksample/s, ksymbol/s, kchip/s
		Distance, length	km
		Frequency	kHz
		Impedance, resistance	kΩ
		Velocity	km/h
m, M	milli-	Area, surface	mm ²
		Current	mA
		Distance, length	mm
		Electromagnetic force, level	mV
		Power	mW
		Time, period, etc.	ms
	mega-	Area, surface	Mm ²
		Data rate, sample rate, symbol rate	Mbit/s, Msample/s, Msym/s, Mchip/s
		Frequency	MHz
		Impedance, resistance	MΩ

Shortcut	Designation	Context	Unit
n, N	nano-	Area, surface Current Distance, length Electromagnetic force, level Power Time, period, etc.	nm ² nA nm nV nW ns
o, O	ohm	Impedance, resistance	Ω
p, P	peta-	Area, surface	pm ²
	percent	Level, ratio	%
	pico-	Area, surface Current Electromagnetic force, level Power Time, period, etc.	pm ² pA pV pW ps
r, R	radiant	Phase, polar/spherical coordinates	rad
s, S	second	Time, period, etc.	s
t, T	terra-	Area, surface Data rate, sample rate, symbol rate Frequency Impedance, resistance	Tm ² Tbit/s, Tsample/s, Tsym/s, Tchip/s THz TΩ
u, U	micro-	Current Distance, length Electromagnetic force, level Power Time, period, etc.	μA μm μV μW μs
v, V	volt	Level, voltage	V
w, W	watt	Level, power	W

Glossary: Terms and abbreviations

A

Avahi: A licensed [Zeroconf](#) networking feature, including DNS service. The feature enables a device to self-configure an IP address and subnet mask automatically, when a [DHCP](#) server in the LAN is not available.

B

Base unit: This term describes a R&S SF100A equipped with the option R&S SFI-B103.

Baseband: The baseband signal, i.e. the I/Q stream at the output of the "Baseband" block.

In rear cases, the term Baseband is used as abbreviation of a "Baseband" block itself.

Baseband domain: A common term for signal processing up to the I/Q modulation. The signal in the baseband domain of the R&S SF100A is digital.

Baseband signal: [Baseband](#)

BS: Base station

C

Channel (digital Input, Digital Output): The signal provided at a digital interface connector or the output stream at the digital output interface can consist of several multiplexed channels. Do not mistake the term *channel* used here with the term signal path. A digital channel is a part of an I/Q stream.

Clock: A mandatory internal or an external reference clock signal for generating the timing pulse in the instrument.

Complete file path: The complete file path specifies the root directory and all subdirectories that contain a file or folder.

Synonyms to this expression are "full file path" and "absolute file path".

See also [Chapter 13.5.2, "Handling files in the default or in a specified directory"](#), on page 414.

Computer name: [Hostname](#)

Continuous Wave Mode: [CW/Mod](#)

CW/Mod: An internally generated control signal that turns off/on digital modulation, i.e. the signal is generated in unmodulated form.

D

daisy chain: A connection scheme in which instruments are connected together in sequence, i.e. an output of the first one is connected to an input of the second one, etc.

DHCP: Dynamic host configuration protocol

DNS: Domain name system server

E

e.g.: For example

External mass memory: External memory, connected to the instrument via USB connector (Type A female). It can hold stored files with user data.
See also [System drive](#)

F

File transfer: The transmission of files from or to the instrument by a remote client. The instrument supports the standard methods [FTP](#) and file sharing according to [SAMBA/SMB](#).

FTP: File transfer protocol

G

Glossary: List of the often used terms and abbreviations

GUI: Graphical user interface

H

Hostname: An unambiguous indication of the instrument in a LAN that uses a [DNS](#) server.

The default hostname follows the syntax `SF1100A-<serial number>`, e.g. `SF1100A-102030`.

See [Serial number](#).

Synonym: [Computer name](#)

I

i.e.: That is

I/Q Stream: Stream

L

LF: Low frequency

LSB: Least significant bit

M

MIMO: Multiple input multiple outputs

MSB: Most significant bit

N

NTP: Network Time Protocol synchronizes all connected instruments and computer systems to minimize time delays in the network.

P

PC: Personal computer

Power: A term describing the signal level of the RF signal

product page: A designation of the R&S SFI100A product page www.rohde-schwarz.com/product/SMA100B.html

R

Remote access: [Remote operation](#)

Remote control: The operation of the R&S SFI100A by remote control commands or programs to perform automated tests.

The instrument is connected to a system controller via LAN/VXI-11 using [VISA](#). The instrument is controlled directly or supported by instrument drivers.

Remote device: External device controls the R&S SFI100A in remote operation mode, see [Remote operation](#).

Synonyms: External controller, client device

Remote operation: Allows you to operate the R&S SFI100A from a remote device using VNC.

Both the R&S SFI100A and the remote device are connected in a LAN.

Synonym: Remote access

RF: Radio frequency

S

SAMBA/SMB: Server message protocol

Serial number: Unique instrument identification, provided on the rear panel of the instrument and required to build the [Computer name](#).

The serial number are the last 6 digits in the string <stock no.>-<serial number>, e.g. SFI100A-102030

Smart device: A mobile, cordless device, such as a smartphone or tablet, capable of Internet browsing.

Synonyms: Smartphone, tablet

System drive: The system drive is a built-in internal memory that holds the operating system, the firmware, and the stored user data.

Throughout this description, the system drive is referred as an internal memory.

See also Removable memory

T

Trigger: Internally generated or externally supplied signal which starts signal generation at a particular point in time.

Trigger event: A trigger event is caused by the received trigger signal or executed manual trigger.

U

UE: User equipment

USBTMC: (USB test & measurement class)

A protocol built on top of USB for communication with USB devices. Using [VISA](#) library, it supports service request, triggers, and other specific operations, similar to GPIB.

User directory: Describes the default file storage location for user data.

In the file system, user directory is indicated as `/var/user/`.

It is physically located on the internal memory or on the removable memory.

V

VISA: Virtual instrument software architecture

VNC: Virtual network computing

VNC client software: Application on a remote device that enables remote operation of an instrument over LAN.

Z

Zeroconf: Zero-configuration, see [Avahi](#).

Glossary: Publications and references

Symbols

1GP60: Rohde & Schwarz application note "MATLAB Toolkit for R&S® Signal Generators"

www.rohde-schwarz.com/appnote/1GP60

1GP72: Rohde & Schwarz application note "Connectivity of Rohde & Schwarz Signal Generators"

www.rohde-schwarz.com/appnote/1GP72

1GP141: Rohde & Schwarz application note "Using R&S® Power Sensors with R&S® Signal Generators"

www.rohde-schwarz.com/appnote/1GP141

1MA074: Rohde & Schwarz application note "RSCommander"

www.rohde-schwarz.com/appnote/1MA074

1MA99: Rohde & Schwarz application note "Guidance on Selecting and Handling Coaxial RF Connectors used with Rohde & Schwarz Test Equipment"

www.rohde-schwarz.com/appnote/1MA99

1MA100: Rohde & Schwarz application note "Test Port Adapter, R&S Interchangeable Port Connector"

www.rohde-schwarz.com/appnote/1MA100

1MA208: Rohde & Schwarz application note "Fast Remote Instrument Control with HiSLIP"

www.rohde-schwarz.com/appnote/1MA208

List of commands

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:CALibration<hw>:ALL:TEMP?	425
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