R&S®SMB100B
RF Signal Generator
User Manual

1178371102

ROHDE & SCHWARZ

This document describes the R&S®SMB100B, stock no. 1422.1000.02 and its options:

- R&S®SMBB-B1/-B1H
- R&S®SMBB-B3
- R&S®SMBB-B5
- R&S®SMBB-B32
- R&S®SMBB-B86
- R&S®SMBB-B101/-B103/-B106
- R&S®SMBB-K22/-K23/-K24/-K27
- R&S®SMBB-K31
- R&S®SMBB-K704
- R&S®SMBB-K720

This manual describes firmware version FW 4.60.112.xx and later of the R&S®SMB100B.

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®SMB100B is indicated as R&S SMB100B, R&S®VISA as R&S VISA. Linux® is abbreviated as Linux.

Contents

1 Preface

The R&S SMB100B is a new high-performance signal generator developed to meet demanding customer requirements. Offering excellent signal characteristic and straightforward and intuitive operation, the signal generator makes signal generation fast and easy.

1.1 Key Features

Outstanding key features of the R&S SMB100B are:

- SCPI macro recorder and code generator for generating executable remote control code from manual operating steps (for MATLAB®, CVI, etc.)
- Frequency range from 8 kHz to 1 GHz, 3 GHz or up to 6 GHz
- Excellent SSB phase noise of -134 dBc (meas.) at 1 GHz, 20 kHz offset
- Low wideband noise. For frequencies between 15 MHz and 6 GHz and 30 MHz offset, < 153 dBc (typ.)
- Ultra high output power of 34 dBm (meas.) for 1 GHz
- Compact rack with a height of 2 U and a ¾ 19" width
- Pulse train generation
- 5" Graphical User Interface with touchscreen

For more information, see data sheet.

1.2 About this Manual

This user manual describes general instrument functions, the manual operation of the instrument and remote control.

The main focus of this manual is on the signal generation capabilities of the instrument and the tasks required to achieve them. The following topics are included:

- **Welcome to the R&S SMB100B**
  Introduction to and getting familiar with the instrument, including introduction to the signal generation principles.
- **Getting Started**
  Information that you have received as a printed book together with your instrument
- **Configuration of the RF Signal**
  Descriptions of the individual operation modes, including configuration settings and task descriptions
- **File and Data Management**
  Description of general functions to handle data files and work with the file system of the instrument
- **System and General Instrument Configuration**
  Description of the general instrument settings and functions

- **Network and Remote Control Operation**
  Information on setting up the instrument in a network and operating it remotely.

- **Remote Commands**
  Remote commands required to configure and perform measurements in a remote environment, sorted by tasks.
  Remote commands required to set up the environment and to perform common tasks on the instrument, sorted by tasks.
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes.

- **Maintenance**
  Information on tasks required to maintain the operability of the instrument

- **Troubleshooting and Error Messages**
  Hints and tips on how to handle errors

- **Appendix**
  Extensive reference information on remote control, hardware interfaces, etc.

- **Glossary**
  List of often used terms and abbreviations

- **List of Commands**
  Alphabetical list of all remote commands described in the manual

- **Index**

Contents and scope

This help system describes the full functionality of an R&S SMB100B. Depending on your model and the installed options, some of the functions may not be available on your instrument.

Notes on screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as much as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

1.3 Documentation Overview

This section provides an overview of the R&S SMB100B user documentation. Unless specified otherwise, you find the documents on the R&S SMB100B product page at:

www.rohde-schwarz.com/manual/smb100b

1.3.1 Getting Started Manual

Introduces the R&S SMB100B 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.

1.3.2 User Manuals and Help

Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.

The contents of the user manuals are available as help in the R&S SMB100B. The help offers quick, context-sensitive access to the complete information.

All user manuals are also available for download or for immediate display on the Internet.

1.3.3 Service Manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS, https://gloris.rohde-schwarz.com).

1.3.4 Instrument Security Procedures

Deals with security issues when working with the R&S SMB100B in secure areas. It is available for download on the Internet.

1.3.5 Basic Safety Instructions

Contains safety instructions, operating conditions and further important information. The printed document is delivered with the instrument.

1.3.6 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S SMB100B. It also lists the options and their order numbers and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/smb100b

1.3.7 Release Notes and Open Source Acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The open source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/smb100b

1.3.8 Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/smb100b

2 Safety Information

The product documentation helps you use the R&S SMB100B safely and efficiently. Follow the instructions provided here and in the printed "Basic Safety Instructions". Keep the product documentation nearby and offer it to other users.

Intended use

The R&S SMB100B is intended for the development, production and verification of electronic components and devices in industrial, administrative, and laboratory environments. Use the R&S SMB100B only for its designated purpose. Observe the operating conditions and performance limits stated in the data sheet.

Where do I find safety information?

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

- The printed "Basic Safety Instructions" provide safety information in many languages and are delivered with the R&S SMB100B.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation.

3 Getting Started

3.1 Preparing for Use

3.1.1 Putting into Operation

This section describes the basic steps to be taken when setting up the R&S SMB100B for the first time.

⚠ WARNING

Risk of injury due to disregarding safety information

Observe the information on appropriate operating conditions provided in the data sheet to prevent personal injury or damage to the instrument. Read and observe the basic safety instructions provided with the instrument, in addition to the safety instructions in the following sections. In particular:

● Do not open the instrument casing.

NOTICE

Risk of instrument damage due to inappropriate operating conditions

Specific operating conditions are required to ensure accurate measurements and to avoid damage to the instrument. Observe the information on appropriate operating conditions provided in the basic safety instructions and the instrument's data sheet.

NOTICE

Instrument damage caused by electrostatic discharge

Electrostatic discharge (ESD) can damage the electronic components of the instrument and the device under test (DUT). Electrostatic discharge is most likely to occur when you connect or disconnect a DUT or test fixture to the instrument's test ports. To prevent electrostatic discharge, use a wrist strap and cord and connect yourself to the ground, or use a conductive floor mat and heel strap combination.

NOTICE

Risk of instrument damage due to inappropriate operating conditions

An unsuitable operating site or test setup can damage the instrument and connected devices. Before switching on the instrument, observe the information on appropriate operating conditions provided in the data sheet. In particular, ensure the following:

- All fan openings are unobstructed and the airflow perforations are unimpeded. A minimum distance of 10 cm to other objects is recommended.
- The instrument is dry and shows no sign of condensation.
- The instrument is positioned as described in the following sections.
- The ambient temperature does not exceed the range specified in the data sheet.
- Signal levels at the input connectors are all within the specified ranges.
- Signal outputs are connected correctly and are not overloaded.

3.1.1.1 EMI Suppression

Electromagnetic interference (EMI) may affect the measurement results.

To suppress generated Electromagnetic Interference (EMI),

- Use suitable shielded cables of high quality. For example use double-shielded RF, BNC and LAN cables (CAT6 STP).
  Note: USB cables are of varying and often poor quality. Therefore, check the quality of each individual USB cable as described in the service manual.
- Always terminate open cable ends.

Note the EMC classification in the data sheet.

3.1.1.2 Unpacking and Checking the Instrument

Unpack the R&S SMB100B carefully and check the contents of the package.

- Check if all items listed on the delivery note, including this getting started manual, are included in the delivery.
- Check the R&S SMB100B for any damage.
  If the contents are damaged, immediately contact the carrier who delivered the package.

Packing material

Retain the original packing material. If the instrument needs to be transported or shipped later, you can use the material to protect the control elements and connectors.

⚠ **WARNING**

Risk of injury during transportation

The carrying handles at the front and side of the casing are designed to lift or carry the instrument. Do not apply excessive force to the handles. If a handle is ripped off, the falling instrument can cause injury.

3.1.1.3 Accessory List

The instrument comes with the following accessories:

● Power cable
● Getting Started printed manual

3.1.1.4 Placing or Mounting the Instrument

The R&S SMB100B is designed for use under laboratory conditions, either on a bench top or in a rack using the standard rackmount kit.

Bench top operation

If the R&S SMB100B is operated on a bench top, the surface must be flat. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

⚠ **WARNING**

Risk of injury if feet are folded out

The feet can fold in if they are not folded out completely or if the instrument is shifted. Collapsing feet can cause injury or damage the instrument.

● Fold the feet completely in or out to ensure stability of the instrument. Never shift the instrument when the feet are folded out.
● When the feet are folded out, do not work under the instrument or place anything underneath.
● The feet can break if they are overloaded. The overall load on the folded-out feet must not exceed 500 N.
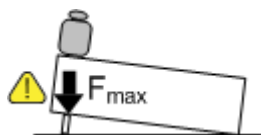
⚠ **WARNING**

Risk of injury when stacking instruments

A stack of instruments can tilt over and cause injury if not stacked correctly. Furthermore, the instruments at the bottom of the stack can be damaged due to the load imposed by the instruments on top.

Observe the following instructions when stacking instruments:

- Never stack more than three instruments. If you need to stack more than three instruments, install them in a rack.
- The overall load imposed on the lowest instrument must not exceed 500 N.
- It is best if all instruments have the same dimensions (width and length).
  If you need to stack smaller instruments on the top, the overall load imposed on the lowest instrument must not exceed 250 N.
- If the instruments have foldable feet, fold them in completely.

Correct   Too many instruments   Different dimensions   Feet folded out
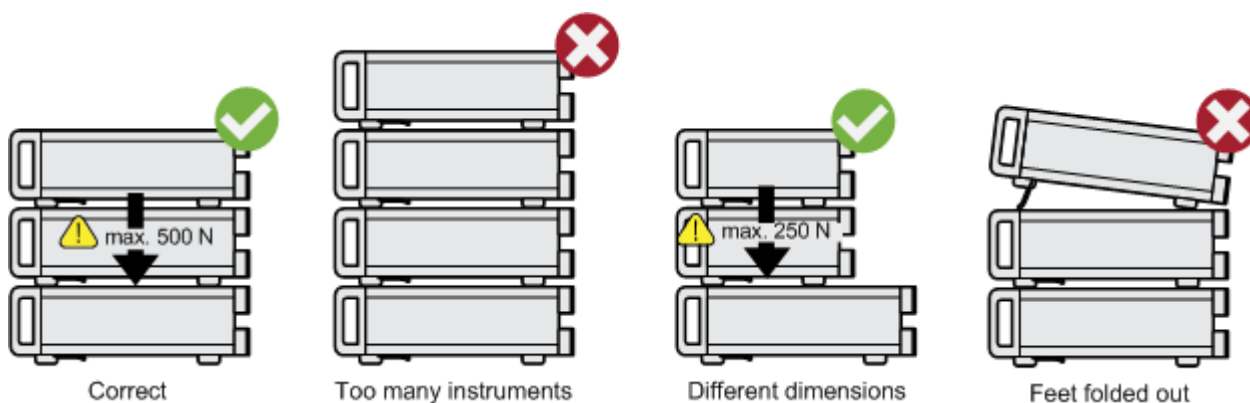
Mounting in a rack

The R&S SMB100B can be installed in a rack using a rack adapter kit (Order No. see data sheet). The installation instructions are part of the adapter kit.

NOTICE

Risk of instrument damage due to insufficient airflow in a rack

If you mount several instruments in a rack, you need an efficient ventilation concept to ensure that the instruments do not overheat. Insufficient airflow for a longer period can disturb the operation and even cause damage.

3.1.1.5 Connecting AC Power

The R&S SMB100B is equipped with an AC power supply connector, that can be operated with different AC power voltages. Once it is connected, the instrument automatically adjusts to the given voltage. Refer to the data sheet for the requirements of voltage and frequency. There is no need to set the voltage manually or change fuses.

The AC supply and power switch is at the rear of the unit.

To connect the AC supply

► Connect the R&S SMB100B to the AC power source using the supplied power cable.

Note: Since the instrument is designed in compliance with standard EN 61010-1 safety class I, it must only be connected to an outlet that has a ground contact.

Characteristics of the AC power supply:

● 100 V to 240 V AC

● 50 Hz to 60 Hz; 400 Hz

● Max 2.1 A

3.1.1.6 Turning the Instrument On and Off

To turn on the R&S SMB100B

1. Connect the instrument to the AC supply.

2. Turn on the main AC power switch at the rear panel of the R&S SMB100B (position "I" (on)).

   The instrument is supplied with AC power.

Warm-up time for OCXO

When the instrument is switched on, the OCXO requires an extended warm-up time (see data sheet).

To start the R&S SMB100B

Starting the R&S SMB100B requires that it is connected and turned on.

► At the front panel, press the [On/Standby] key briefly.

   The instrument boots the operating system and starts the instrument firmware.

   After booting, the instrument is in the state before the last power off (standby or ready), indicated by the color of the [On/Standby] key's LEDs:
   ● Green: the R&S SMB100B is running and ready for operation.
     All modules are power-supplied.
   ● Orange: the R&S SMB100B is in standby mode (main AC power switch is in position "I").
     The standby power mode keeps the power switch circuits and the oven-control-led crystal oscillator OCXO active. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply.
   To switch between standby and ready state, briefly press the [On/Standby] key.

If a previous session was terminated regularly, the instrument uses the last setup with the relevant instrument settings.

► To set up a new configuration, press the [Preset] key to return the instrument to its defined reset/preset state.

To shut down and turn off the R&S SMB100B

NOTICE

Risk of losing data

If you switch off the running instrument using the rear panel switch or by disconnecting the power cord, the instrument loses its current settings. Furthermore, program data can be lost.

Press the On/Standby key first to shut down the application properly.

---

1. Press the [On/Standby] key.

   The current setup is saved, the operating system shuts down and sets the instrument to standby state.
   The [On/Standby] LED must be orange.

2. Turn off the main AC power switch at the rear panel of the R&S SMB100B (position "0" (off)).

   The instrument is no longer supplied with AC power.

Turning off the AC power

You can leave the AC power on permanently. Switching off is required only if the instrument must be disconnected from all power supplies.

3.1.1.7 Functional Check

When the instrument is switched on, it automatically monitors the main functions.

A detected fault is indicated by an "Error" message displayed in the "Info" line of the instrument together with a brief error description. For an in-depth identification of the error, tap on the "Info" indication. In response, a description of the errors is displayed. For more information, refer to the "Troubleshooting and Error Messages" section in the user manual.

Apart from the automatic monitoring, the R&S SMB100B provides internal adjustments to check correct functioning. See the corresponding sections under "Maintenance" in the user manual.

3.1.1.8 Checking the Supplied Options and Licenses

The instrument can be equipped with both, hardware and firmware options. To check whether the installed options correspond to the options indicated on the delivery note, proceed as follows:

1. Press the [Setup] key.

2. Select "Instrument Assembly > Hardware Config" and "Software / Options".

   A list with hardware and firmware information is displayed.

3. Check the availability of the hardware options as indicated in the delivery note. For an overview of the available options, refer to the data sheet.

See also Chapter 13.3.5, "Requesting Instrument Configuration and Specifications", on page 526.

3.1.2 Connecting USB Devices

The USB interfaces of the R&S SMB100B allow you to connect USB devices, including USB hubs directly to the instrument. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the R&S SMB100B.

The following list shows various USB devices that can be useful:
● Memory stick for easy transfer of data to/from a computer (for example firmware updates)
● Keyboard or mouse to simplify the entry of data, comments, filenames, etc.
● Power sensors of the R&S NRP families

All USB devices can be connected to or disconnected from the instrument during operation.

Connecting a USB storage device

When a USB storage device like a memory stick, a CD-ROM drive, or a hard disk is connected, it is detected automatically. The device is made available as a new drive (`/usb`). The name of the drive is manufacturer-dependent.

Connecting a keyboard

A keyboard is detected automatically when it is connected. The default keyboard layout is English – US.

Use the "Setup > User Interface > USB Keyboard Settings" dialog to configure the keyboard properties (see Chapter 10.1.4.1, "Setting the Keyboard Language", on page 226).

Connecting a mouse

A mouse is detected automatically when it is connected.

3.1.3 Setting Up a Network (LAN) Connection

The R&S SMB100B is equipped with a network interface and can be connected to an Ethernet LAN (local area network). Provided the appropriate rights have been assigned by the network administrator, the interface can be used, for example:

● To transfer data between a controller and the instrument, for example to run a remote control program.
See Chapter 11, "Network Operation and Remote Control", on page 251.

● To access or operate the instrument from a remote computer using the Ultr@VNC program (or a similar tool, like another VNC client or any Web browser supporting Java).

● To transfer data from a remote computer and back, for example using network folders.

● To use power sensors with network capability, e.g. the R&S NRP LAN power sensors.

This section describes how to configure the LAN interface.

Accessing operating system

No access to the operating system is required for normal operation.

All necessary system settings can be made in the "Setup" dialog.

3.1.3.1 Connecting the Instrument to the Network

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

For addressing, both the instrument and the computer require an IP address. The address information is usually assigned to the devices automatically, depending on the network capabilities.

If the IP address is not assigned automatically, see Chapter 3.1.3.3, "Assigning the IP Address", on page 29 for information on how to assign the address manually.

To set up a network (LAN) connection

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

● Connecting the instrument to the network
● Configuring the network
● Changing IP addresses

Errors can affect the entire network.

► Connect the instrument to the network or to a single PC.

If the instrument is connected to the LAN, the operating system automatically detects the network connection and activates the required drivers.
By default, the instrument is configured to use DHCP (dynamic host configuration protocol) configuration and to obtain the whole address information automatically.

When connected, the R&S SMB100B displays the address information on the screen.

System Config
IP: 10.113.0.19
GPIB Address: 28
FW: 4.00.040

Risk of network connection failure

Network cables and cable connectors of poor quality, or failures in the autonegotiation process, can cause network connection failures.

If the network connection to the instrument fails, check the network infrastructure and contact your network administrator.

For details, see section "Troubleshooting and Error Messages".

3.1.3.2 Using Computer Names (Hostnames)

In a LAN that uses a DNS server, each PC or instrument connected in the LAN can be accessed via an unambiguous computer name (*hostname*) instead of the IP address. The DNS server translates the hostname to the IP address. It is especially useful when a DHCP server is used, as a new IP address can be assigned each time the instrument is restarted.

Each instrument is delivered with an assigned computer name, that remains permanent as long as it is not explicitly changed.

The default computer name follows the syntax `<INST>-<Serial Number>` (previous syntax: `rs<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 .

Example:

The default hostname of an R&S SMB100B with a serial number 102030 is `SMB100B-102030`.

To query and change a computer name

1. Press the [Setup] key.

2. Select "Remote Access > Network".

   The computer name is displayed under "Hostname".

3. Press the [Setup] key.

4. Select "Security > Protection".

5. Enable the "Protection Level 1".
   The default password is *123456*.

   The parameter "Hostname" in the "Network" tab is now enabled for configuration.

6. Change the "Hostname".

3.1.3.3 Assigning the IP Address

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.

- If the network supports DHCP (dynamic host configuration protocol), the address information is assigned automatically.
- If the network does not support DHCP, the instrument tries to obtain the IP address via Zeroconf (APIPA) protocol. If this attempt does not succeed or if the instrument is set to use alternate TCP/IP configuration, the addresses must be set manually.

Since the dynamic TCP/IP configuration assigns the address information automatically, it is safe to establish a physical connection to the LAN without any previous instrument configuration.

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses

Errors can affect the entire network.

To assign the IP address manually on the instrument

Use computer names to identify the instrument

In networks using a DHCP server, we recommend that you address the instrument by its unambiguous computer name, see Chapter 3.1.3.2, "Using Computer Names (Hostnames)", on page 28.

1. Press the [Setup] key.

2. Select "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. Every block contains 3 numbers in maximum.

6. Select the "Subnet Mask" and enter the subnet mask, for example *255.255.255.0*.

   The subnet mask consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.

To assign the IP address manually on the computer

► Obtain the necessary information from your network administrator. If you use more than one LAN connector, you need separate address information for each connector.
For information on how to perform the configurations, refer to the documentation of the operating system the computer uses.

3.2 Instrument Tour

The following topics help you to get familiar with the instrument and perform the first steps:

- Chapter 3.2.1, "Front Panel Tour", on page 31

- Chapter 3.2.2, "Rear Panel Tour", on page 36

This section explains the control elements and the connectors of the R&S SMB100B with the aid of the front and rear views. For specifications of the interfaces, refer to the data sheet.

3.2.1 Front Panel Tour

This section provides an overview of the control elements at the front panel of the R&S SMB100B. Most of the connectors are at the rear panel and are described in Chapter 3.2.2, "Rear Panel Tour", on page 36.

Figure 3-1: Front panel view

1 = Utility keys
2 = [On/Standby]
3 = Touchscreen
4 = Function keys
5 = Keypad
6 = Navigation controls
7 = Display keys
8 = USB connector
9 = RF output connector

3.2.1.1 Touchscreen

The screen at the front panel is the graphical user interface. It shows the settings dialogs and parameters, and the current configuration at a glance, see Chapter 3.4.3, "Understanding the Display Information", on page 48.
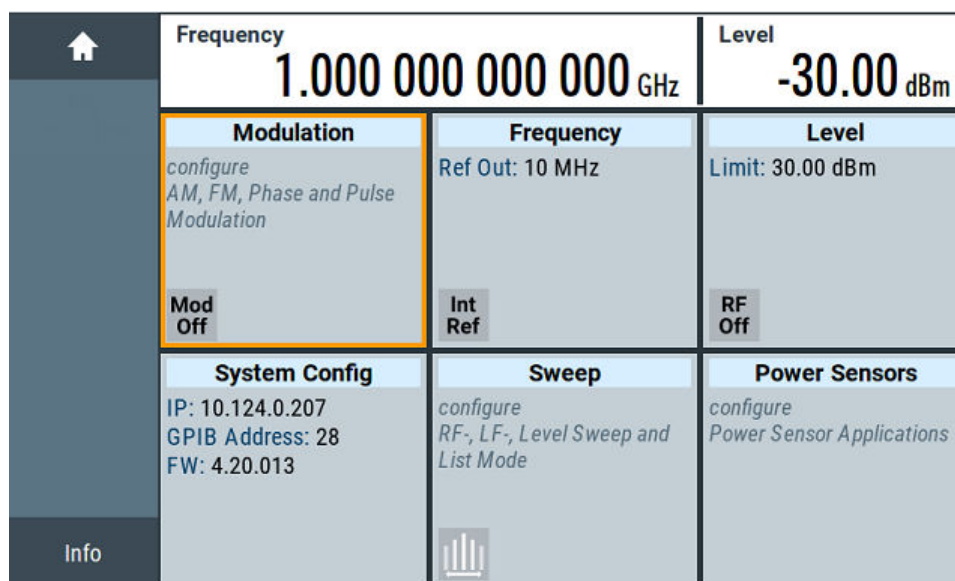
Figure 3-2: Touchscreen

The touch-sensitive panel provides an alternative means of user interaction for quick and easy handling of the instrument, see Chapter 3.4.2, "Means of Manual Interaction", on page 47.

NOTICE

Risk of touchscreen damage

Inappropriate tools or excessive force can damage the touchscreen.

Observe the following instructions when operating the touchscreen:

- Never touch the screen with ball point pens or other sharp objects, use your fingers instead.
  As an alternative, you can use a stylus pen with a smooth soft tip.

- Never apply excessive force to the screen. Touch it gently.

- Never scratch the screen surface, for example with a finger nail.

- Never rub the screen surface strongly, for example with a dust cloth.
  For instructions on cleaning the screen, see Chapter 13.1, "Cleaning", on page 515.

3.2.1.2 Utility Keys

The utility keys set the R&S SMB100B to a defined state, and provide access to basic settings and information on assistance.

Table 3-1: Utility keys

Utility Key	Assigned functions
[Preset]	Sets the instrument to a defined state
[Local]	Switches from remote control to local (manual) control
[Setup]	Accesses the general instrument settings
[Help]	Displays context-sensitive help text

3.2.1.3 On/Standby

The [On/Standby] key starts up and shuts down the instrument, and switches between the standby and the ready state.

- In the ready state, On/Standby key lights green. The instrument is ready for operation.
- In the standby state, the On/Standby key lights orange. The standby power mode keeps the power switch circuits and the oven-controlled crystal oscillator OCXO active. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply.

3.2.1.4 Function Keys

Function keys provide access to the most common generator settings and functions. You can find a detailed description of the corresponding functions in the user manual.

Table 3-2: Function keys

Function key	Assigned functions
[Freq]	Activates frequency entry.
[Level]	Activates level entry.
[Mod on/off]	Switches the modulation on and off.
[RF on/off]	Switches the RF output on and off.

3.2.1.5 Keypad

The keypad enables you to enter alphanumeric parameters, including the corresponding units. It contains the following keys:

Table 3-3: Keys on the keypad

Type of key	Description
Alphanumeric keys	Enter numbers and (special) characters in edit dialog boxes.
Decimal point	Inserts a decimal point "." at the cursor position.

Type of key	Description
Sign key	Changes the sign of a numeric parameter. In the case of an alphanumeric parameter, inserts a "-" at the cursor position.
Unit keys (G/n dBμV, M/μ μV, k/m mV and x1 dB(m))	These keys add the selected unit to the entered numeric value and complete the entry. In the case of level entries (e.g. in dB) or dimensionless values, all units have the value "1" as multiplying factor. Thus, they have the same function as an [Enter] key.

3.2.1.6 Navigation Controls

The navigation controls include a rotary knob, navigation keys, and the display keys. They allow you to navigate within the display or within dialog boxes.

Rotary Knob

The rotary knob has several functions:

- Increments (clockwise direction) or decrements (counterclockwise direction) the instrument parameter at a defined step size in the case of a numeric entry.
- Moves the selection, e.g. to a function block in the block diagram
- Shifts the selection bar within focused areas (e.g. lists).
- Acts like the [Enter] key, when it is pressed.

Editing Keys

Editing keys enable you to confirm an entry, delete individual characters, or exit the current operation.

Table 3-4: Editing keys

Type of key	Description
[Esc] key	Closes all kinds of dialog boxes, if the edit mode is not active. Quits the edit mode, if the edit mode is active. In dialog boxes that contain a "Cancel" button it activates that button. For "Edit" dialog boxes the following mechanism is used: • If data entry has been started, it retains the original value and closes the dialog box. • If data entry has not been started or has been completed, it closes the dialog box.
[Enter] key	Has the same effect as pressing the rotary knob • Concludes the entry of dimensionless entries. The new value is accepted. • With other entries, this key can be used instead of the default unit key. • In a dialog box, selects the default or focused element. • Calls the next dialog level. • Confirms and closes open input windows.
[Backspace] key	Deletes the character to the left of the cursor in editing mode.

Navigation Keys

As an alternative to the rotary knob or the touchscreen, you can use the navigation keys to navigate through dialog boxes, diagrams, or tables.

Table 3-5: Navigation keys

Type of key	Description
[Up/Down] Key	The [Up] and the [Down] key does the following: • In a numeric edit dialog box, increase or decrease the instrument parameter. • In a list, scroll forward and backward through the list entries. • In a table, move the selection bar vertically. • In windows or dialog boxes with vertical scrollbar, move the scrollbar.
[Left/Right] Key	The [Left] and the [Right] key does the following: • In an alphanumeric edit dialog box, move the cursor. • In a list, scroll forward and backward through the list entries. • In a table, move the selection bar horizontally. • In windows or dialog boxes with horizontal scrollbar, move the scrollbar.

3.2.1.7 Display Keys

The display keys arrange different windows on the display.

Table 3-6: Display keys

Display key	Assigned functions
[Home]	Returns to the initial feature screen.
[Next window]	Toggles between the entry fields in the taskbar.
[On/Off]	• Switches highlighted elements or a function block on and off. • Switches between two or more settings, e.g. items of selection lists. At the end of a list, the cursor is set on the first entry again.
[Undo]	Reverts the last operation.
[★ (User)]	Adds a parameter to the user menu for quick access.

3.2.1.8 USB Connector

USB (universal serial bus) interfaces of type A (host USB).

• Connection of peripherals such as mouse or keyboard
• Connection of memory stick for file transmission
• Firmware update

Further USB interface type A (host USB) and a USB interface type B (USB In) are available on the rear panel.

See also Chapter 3.1.2, "Connecting USB Devices", on page 26.

3.2.1.9   RF 50 Ω

Output of the RF signal.

NOTICE

Maximum input levels

Do not overload the RF output.

The instrument is equipped with a reverse power protection that prevents the RF output against back feed, see Chapter 7.1.2, "Reverse Power Protection", on page 149. The maximum permissible reverse power is specified in the data sheet.

The connector type depends on the installed frequency option.

NOTICE

Risk of RF connector and cable damage

If you tighten the connectors too strongly, you can damage the cables and connectors. If you do not tighten the connectors enough, the measurement results can be inaccurate.

Always use an appropriate torque wrench suitable for this type of connector and apply the torque specified in the application note 1MA99.

The application notes are available on the Internet and provide additional information on care and handling of RF connectors.

Rohde & Schwarz offers appropriate torque wrenches for various connectors. For ordering information, see the R&S SMB100B data sheet or product brochure.

3.2.2   Rear Panel Tour

This section provides an overview of the connectors at the rear panel of the instrument. For technical data of the connectors, refer to the data sheet.
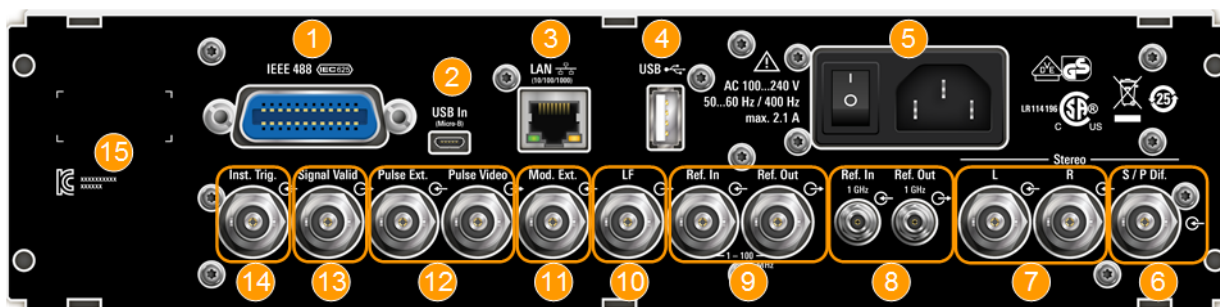
Figure 3-3: Rear panel view R&S SMB100B RF Signal Generator

1 = IEC 625/IEEE 488 connector
2 = USB In connector (type micro-B)
3 = LAN connector
4 = USB connector (type A)
5 = AC power supply connection and main power switch
6 = S/P Dif digital stereo signal input connector (BNC)
7 = Stereo L/R analog stereo modulation signal input connectors (BNC)
8 = Ref In 1GHz and Ref Out 1GHz connectors (SMA)
9 = Ref In and Ref Out connectors (BNC)
10 = LF output connector (BNC)
11 = Mod. Ext. input connector (BNC)
12 = Pulse Video and Pulse Ext. connectors (BNC)
13 = Signal Valid output connector (BNC)
14 = Inst Trig input connector (BNC)
15 = Serial number (six digits in the string 1400.1000.02-<serial number>-<checksum>)

3.2.2.1 Connectors

IEC 625/IEEE 488
Option: R&S SMBB-B86

GPIB-bus interface for remote control of the instrument.

The IEC 625 interface is in compliance with IEEE488 and SCPI. A computer for remote control can be connected via this interface. To set up the connection, we recommend that you use a shielded cable.

Note: To avoid electromagnetic interference (EMI) caused by open lines, always terminate any connected IEC-bus cable with an instrument or a controller.

See also Chapter B.1, "GPIB-Bus Interface", on page 565 and Chapter 11, "Network Operation and Remote Control", on page 251.

USB/USB In
- Female USB type A connector, to connect devices like a keyboard, a mouse, a memory stick, or the R&S NRP-Z3/Z4 cable for the R&S NRP power sensors
- Female USB In connector (USB type B), for example for remote control.
  Option: R&S SMBB-B86

See also Chapter 3.1.2, "Connecting USB Devices", on page 26.

LAN
The LAN interface can be used to connect the R&S SMB100B to a local network for remote control, remote operation, and data transfer.

For details, see Chapter 3.1.3, "Setting Up a Network (LAN) Connection", on page 27.

AC supply and power switch
The AC power supply connector and the main power switch are located in a unit on the rear panel of the instrument.

Main power switch function:
- Position 1: The instrument is in operation.
- Position 0: The entire instrument is disconnected from the AC power supply.

For details, refer to Chapter 3.1.1.6, "Turning the Instrument On and Off", on page 24.

S/P Dif

Input for digital stereo signals (stereo modulation is available with option R&S SMBB-B5).

See also Chapter 5.4.3, "Stereo Modulation", on page 78.

Stereo L/R

Inputs for analog stereo modulation signals. External modulation sources or the internal LF generator can be used (stereo modulation is available with option R&S SMBB-B5).

See also Chapter 5.4.3, "Stereo Modulation", on page 78.

Ref In/Ref Out

Input/output for external reference signal.

Incl. dedicated connectors for the 1GHz reference signal.

See Chapter 8, "Reference Oscillator", on page 178.

Mod. Ext.

Input for an external analog modulation signal.

Pulse Video

Output of the internal pulse generator signal or the looped through pulse signal from Pulse Ext. connector (video signal).

See Chapter 5.4.1, "Pulse Modulation", on page 71.

Pulse Ext.

Input for an external pulse modulation signal or an external trigger/gate signal for the pulse generator.

Signal Valid

Output signal that marks the valid signal times (valid level and frequency) for all analog modulations.

Alternatively, you can use this connector to synchronize pulse signals by activating the "Pulse Sync" in the dialog Chapter 5.4.4, "Pulse Generator", on page 86.

Inst Trig

Input for external trigger of sweeps and list mode.

For detailed information on the sweep modes and the triggering, see Chapter 6.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 112.

3.3 Trying Out the Instrument

This chapter introduces the first steps with the R&S SMB100B. It shows how to operate and configure the instrument using simple examples. The complete description of the functionality and its usage is given in the R&S SMB100B user manual. Basic instrument operation is described in Chapter 3.4, "Instrument Control", on page 46.

Prerequisites

The instrument is set up, connected to the power supply, and started up as described in Chapter 3.1, "Preparing for Use", on page 20.

The first signal generation tasks explain how to generate an unmodulated signal, to configure the RF signal output, and how you can vary the RF frequency and level in sweep mode.

The instrument is manually operated via the touchscreen. Try out the following:

3.3.1 Generating an Unmodulated Carrier

We start to generate a simple unmodulated signal. In this example, the R&S SMB100B can be in its minimal configuration.

1. On the R&S SMB100B front panel, press the [Preset] key to set a defined initial instrument state.

2. Set the frequency:

   a) In the "Status Bar", tap the "Frequency" field.
   b) On the on-screen keypad, enter "6" and press the "GHz" key.
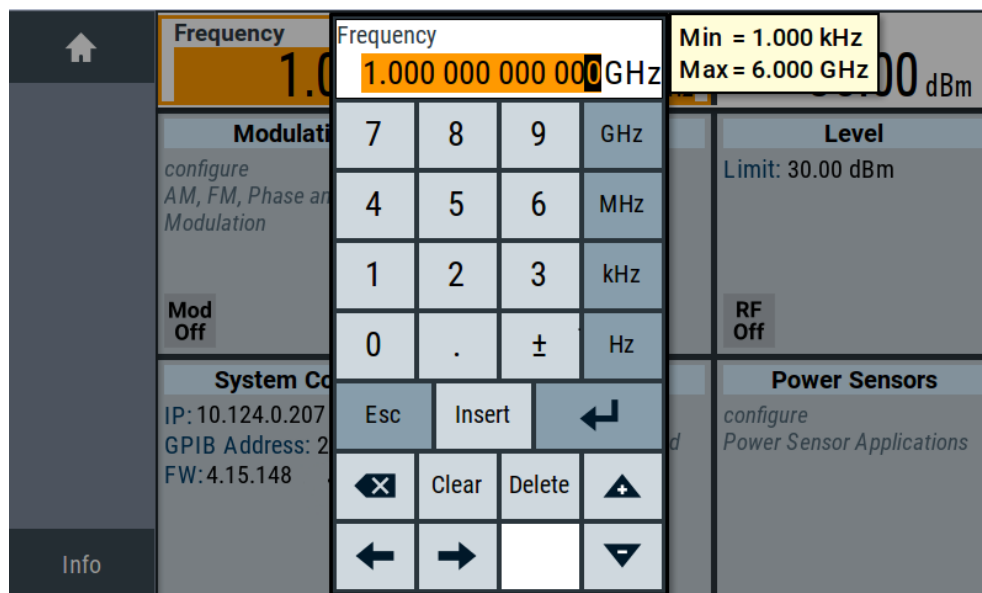
The on-screen key pad closes and the frequency value is displayed.

3. To set the signal level, tap the "Level" field and enter the level in the same way.

4. To activate RF signal output, select "Level" > "RF On" in the tile diagram.
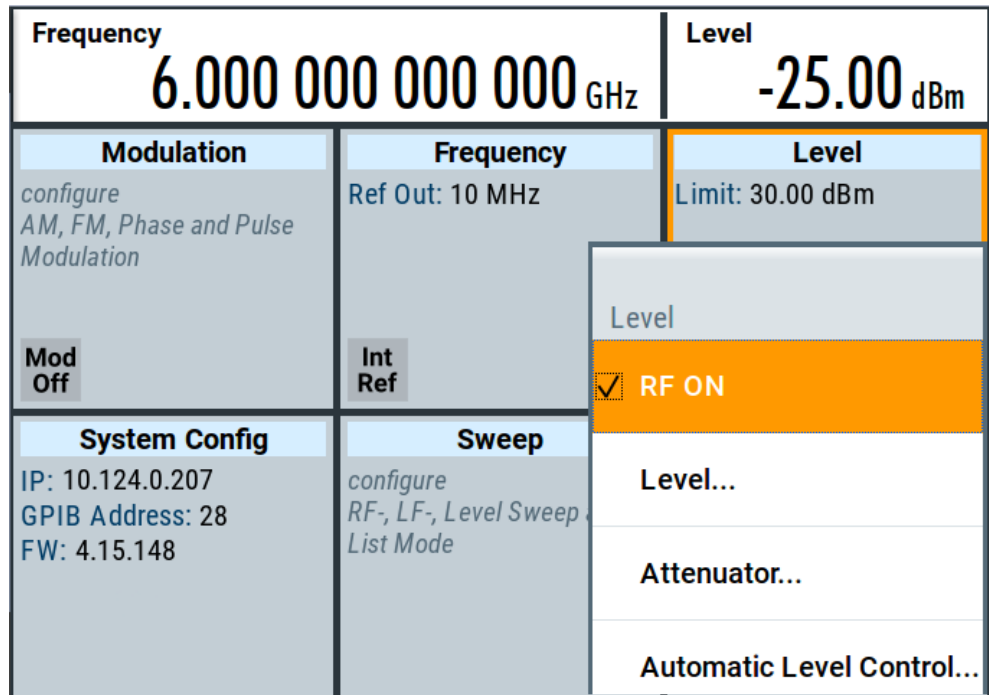
The blue colored "RF On" icon indicates that the RF output is activated.

The R&S SMB100B provides the 6 GHz signal at the RF connector at the front panel.
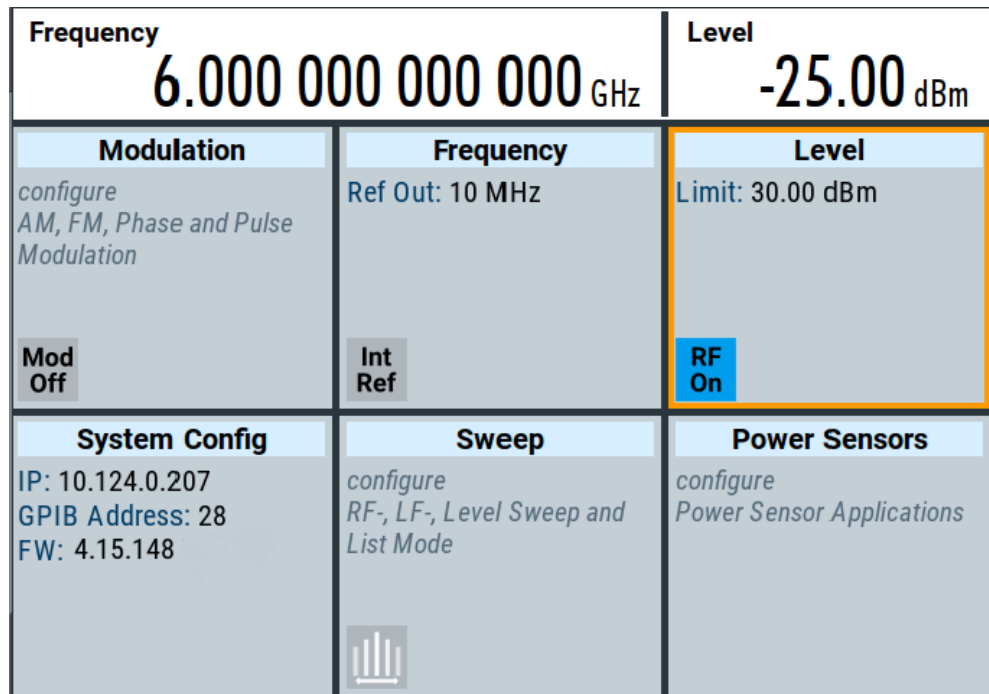
Figure 3-4: Generating an unmodulated signal

Alternative ways to access the instrument functions

To fulfill the same task, you can also use the front panel keys or the setting parameters provided in the frequency and level dialogs.

Try out the settings dialogs

1. In the "Frequency" tile, select "Frequency...".

    a) In the "RF Frequency" tab, tap the "Frequency" field.
    b) Set the frequency via the on-screen keypad.

2. Access the "RF Level" dialog via the "Level" tile.

    a) In the "RF Level" tab, select "Amplitude".
    b) Set the amplitude (level) via the on-screen keypad.

3. Select "RF State > On" to activate the RF signal generation.

See Chapter 4, "RF Signal Configuration", on page 57.

Try out the front panel keys

► Use the [Freq], [Level], and [RF on/off] key on the front panel.

Connect RF of the R&S SMB100B to a signal analyzer, for example R&S®FSW, to display the generated signal.

For the required settings of the signal analyzer, refer to its user manual or its online help.

3.3.2 Generating an RF Frequency Sweep Signal

The "Sweep" operating mode allows you to generate an RF signal with periodically varying frequencies or amplitudes.

This example deals with an RF signal with varying frequency and constant level. To configure the sweep, you need to determine a defined start and end frequency with constant time intervals between the frequency steps.

The sweep function does not require specific options.

1. On the front panel, press the [Preset] key to set a defined initial instrument state.

2. Set the signal output level, if required, e.g. set "Level > -25 dBm".

3. In the tile diagram, select "Sweep" > "Frequency Sweep".

4. In the "General" tab:

General Auto	Frequency Range		✕
State	0	Current Frequency	570.000 000 000 MHz
Mode	Auto		
Shape	Sawtooth		
Spacing	Linear	Dwell Time	15.0 ms
⟵ Reset Sweep			
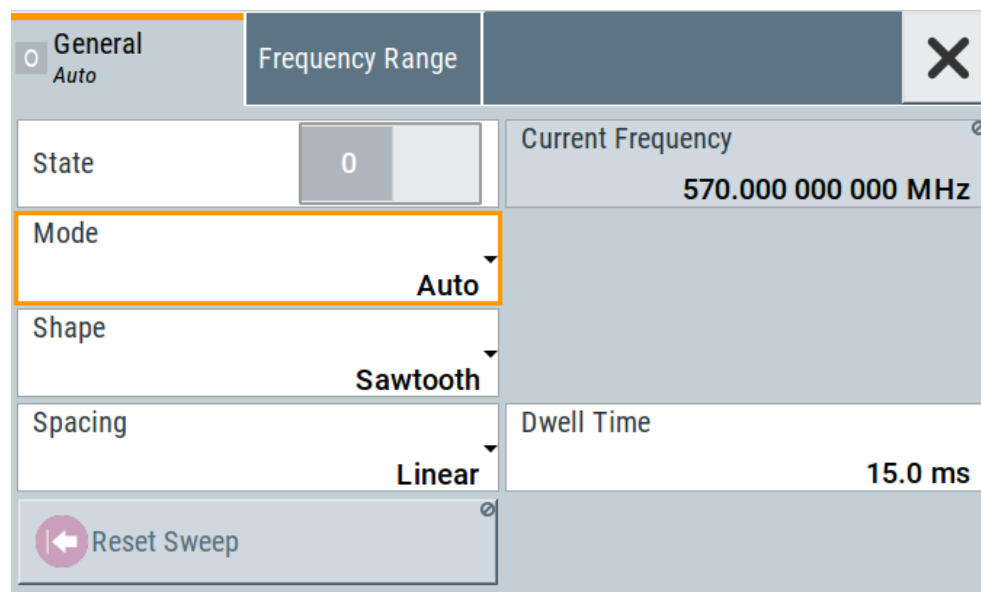
a) Select "Mode > Auto" to run the sweep continuously.

b) Select "Shape > Sawtooth" to set the waveform shape of the sweep signal.

c) Select "Spacing > Linear", to determine the calculation method for the frequency shift of a step.

d) Set "Dwell Time > 15.0 ms", to determine the time interval of the sweep steps.

5. Select the "Frequency Range" tab.

Start Frequency	Stop Frequency
200.000 000 000 MHz	600.000 000 000 MHz
Center Frequency	Span
400.000 000 000 MHz	400.000 000 000 MHz
Spacing	Step Linear
Linear	10.000 000 000 MHz
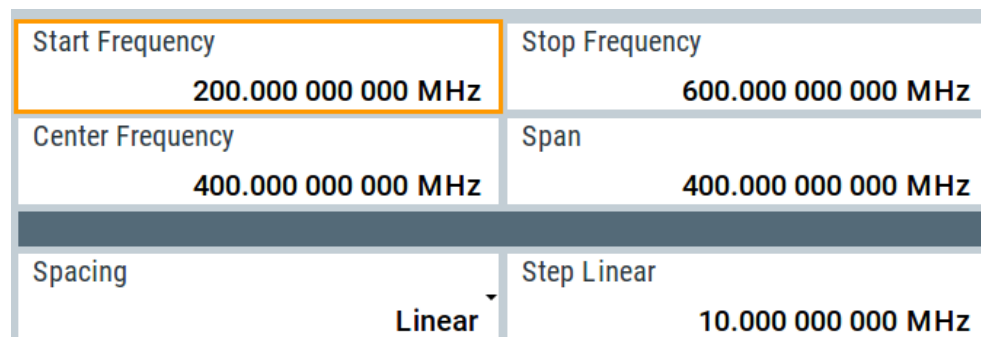
a) Set "Start Freq > 200 MHz" and "Stop Freq > 600 MHz" to determine the frequency sweep range.

b) Set the step width "Step Lin > 10.0 MHz" to determine the width for a frequency step.

6. In the "General" tab, activate the frequency sweep with "State > On".

7. Close the sweep dialog.
   (Alternatively, tap the "Home" button to minimize the dialog. The R&S SMB100B indicates the "Sweep" dialog as active dialog in the task bar.)

8. To activate the RF signal output, select "Level" > "RF On".
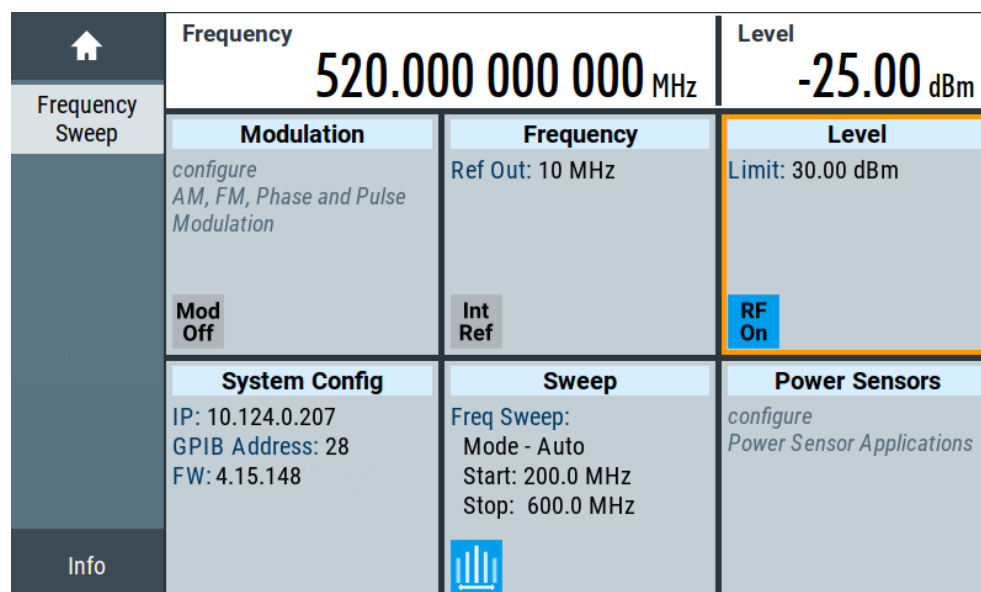
Figure 3-5: Generating a frequency sweep signal

The frequency field in the status bar indicates the continuously changing frequency, i.e. the running sweep.

3.3.3 Saving and Recalling Settings

To restore the results of our measurements later, we save the instrument settings in a file.

To save the instrument settings in a file

We assume, a test configuration as described in Chapter 3.3.2, "Generating an RF Frequency Sweep Signal", on page 41.

1. Press the [Setup] key on the front panel.

2. In the "Setup" menu, select "Settings > Save/Recall".

3. In the "Save/Recall" dialog, select "Operation Mode > Save".
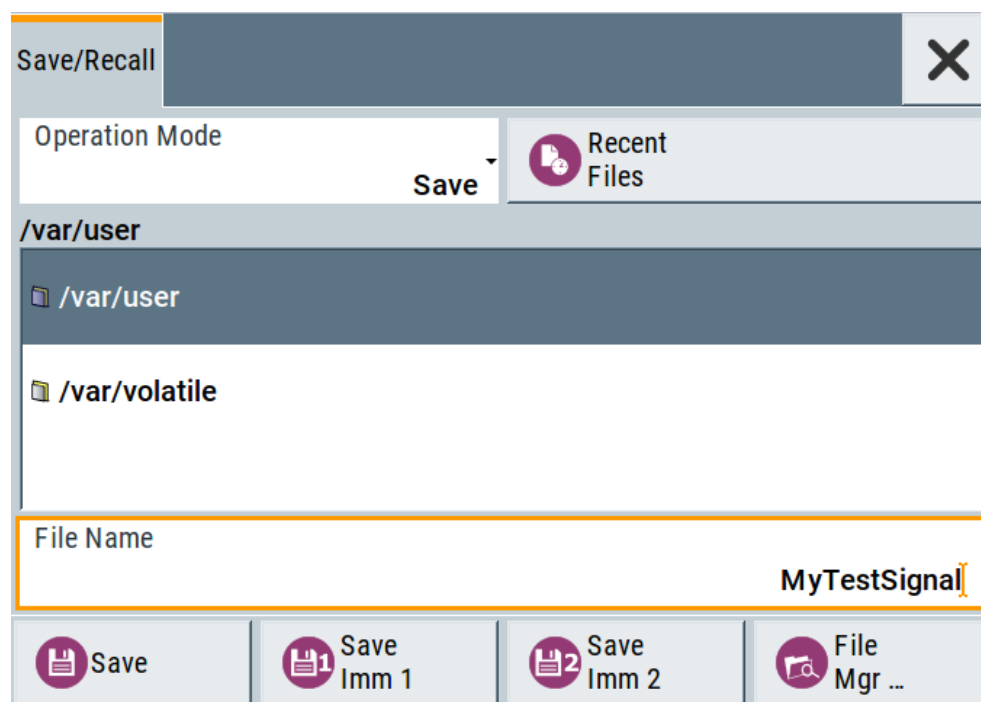
4. Tap the "Filename", use the on-screen keyboard, and enter *MyTestSignal*.

5. Tap the "Save" button.

   The file `MyTestSignal.savrcltxt` is stored in the default direc-
   tory `/var/user/`.

To load saved instrument settings

You can restore the settings to the instrument at any time using the settings file.

1. Press the [Preset] button to restore the default instrument settings so you can
   check that the stored user settings are restored afterwards.

2. Press the [Setup] key on the front panel.

3. In the "Setup" menu, select "Settings > Save/Recall".

4. In the "Save/Recall" dialog, select "Operation Mode > Recall".
   Navigate to the directory the file is saved in and select the `MyTestSignal` file.
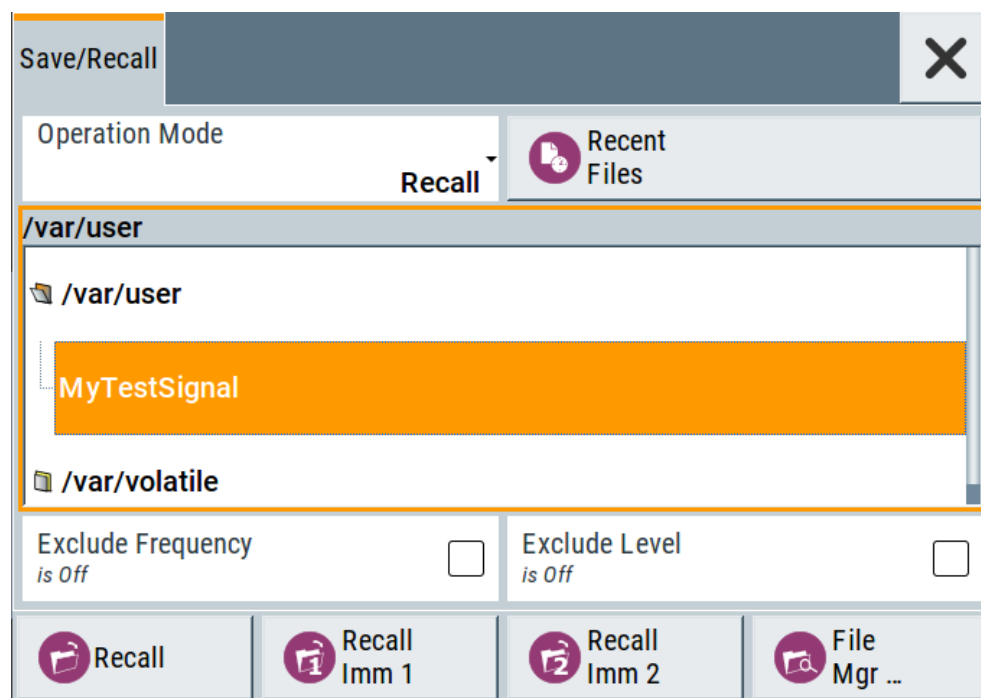
5. Tap the "Recall" button.

   All instrument settings are restored and the display resembles Chapter 3.3.2, "Generating an RF Frequency Sweep Signal", on page 41, which shows the instrument display right before the settings were saved.

How to display all parameters with values different to their preset values

When you load a file to your instrument, you do not have enough information on the changed settings. In such case, it is useful to visualize all parameters that have been changed from their default state.

Try out the following:

● Touch and hold a spot in the tile diagram for at least 1 second to access the context-sensitive menu.

● Select "Mark All Parameters Changed from Preset".

Mark All Parameters Changed from Preset

Start SCPI Recording

Undo

Redo

Help

Key Emulation

- All changed parameters are highlighted.

Frequency	Level
580.000 000 000 MHz	**-25.00** dBm

	Frequency Sweep	Modulation	Frequency	Level
		configure AM, FM, Phase and Pulse Modulation	Ref Out: 10 MHz	Limit: 30.00 dBm
		Mod Off	Int Ref	RF On

System Config	Sweep	Power Sensors
IP: 10.124.0.207 GPIB Address: 28 FW: 4.15.148	Freq Sweep: Mode - Auto Start: 200.0 MHz Stop: 600.0 MHz	*configure Power Sensor Applications*

Info

See also .

3.4 Instrument Control

This chapter provides an overview on how to work with the R&S SMB100B.

It covers the following topics:

3.4.1 Possible Ways to Operate the Instrument

There are three ways to operate the R&S SMB100B:

- Manual operation:
  Use the touchscreen, hard keys and rotary knob, or an optional mouse and/or keyboard.
  The description under Chapter 3.4, "Instrument Control", on page 46 shows how to operate the instrument manually.

- Remote control:
  Create programs to automatize repeating settings, tests and measurements. The instrument is connected to a computer running the program.
  This way of operation is described in Chapter 11, "Network Operation and Remote Control", on page 251.

- Remote operation from a computer:
  Remote monitoring and control of the instrument from a connected computer is based on the common cross-platform technology VNC (Virtual Network Computing). On the remote computer, any standard web browser (supporting Java) or a dedicated VNC client (like Ultr@VNC) can be used. See also Chapter 3.4.8, "Remote Operation over VNC", on page 56.

3.4.2 Means of Manual Interaction

For the manual interaction with the R&S SMB100B, 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 touch-screen and navigation keys is described in Chapter 3.4.4, "Accessing the Functional-ity", on page 51.

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

3.4.3 Understanding the Display Information

The home screen of the R&S SMB100B displays all main settings and generator states, divided into three main operation areas.
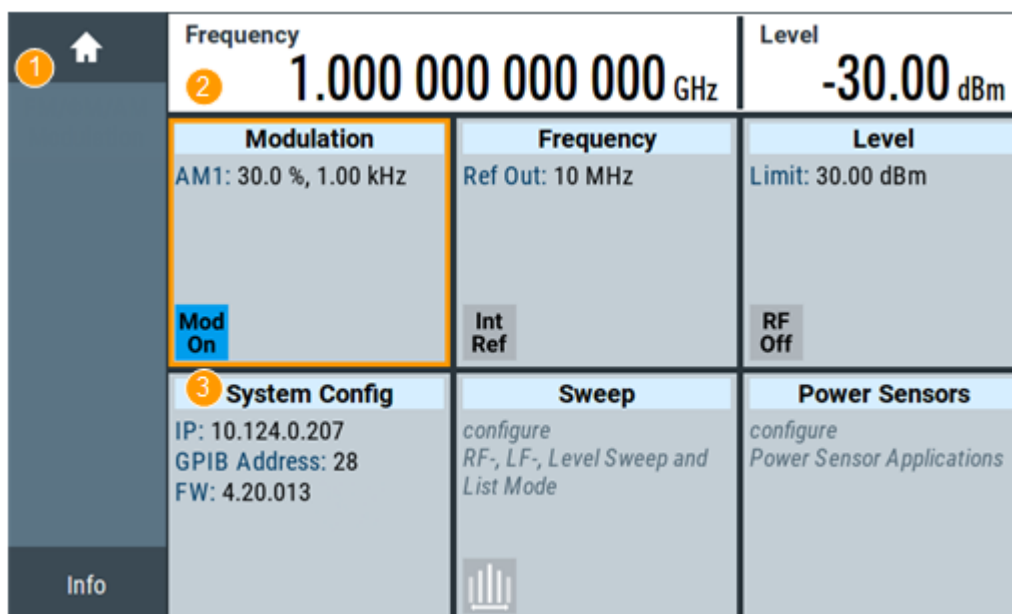
Figure 3-6: Home screen

1 = Taskbar/softkey bar with "Home" and "Info" key
2 = Status bar
3 = Tile diagram

3.4.3.1 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.

3.4.3.2 Tile Diagram

The tile diagram is the main entry to the settings of the R&S SMB100B.
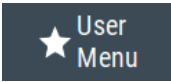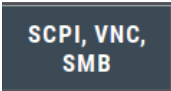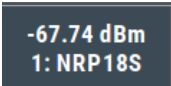
Tile	Access to:
"Modulation"	• Analog and stereo[1], and pulse[1] modulation settings • Built in LF generator
"System Config"	• "Save/Recall": settings for saving and loading instrument configurations • "Remote access": Network and emulation settings. • "Setup": general system configuration
"Sweep"	• Frequency and level sweeps • List mode
"Frequency"	• RF frequency and phase • Reference frequency
"Level"	• RF level • Attenuator • Automatic level control • User correction
"Power sensors"	• Power sensors
[1] requires additional options	

3.4.3.3 Taskbar

The "Taskbar" shows a home and an info button, and assigns a labeled button whenever you open a dialog. If more dialogs are open than the taskbar can display, touch and swipe the taskbar to scroll up and down.

The buttons shown in the following example represent the variants.

Table 3-7: Example of buttons in the taskbar

🏠	"Home" button Returns to the home screen.
★ User Menu	"User Menu" Lists parameters that can be defined for quick access.
SCPI, VNC, SMB	Shows the current remote access connections when the instrument is remotely controlled. **Tip:** An indicator in the "System Config" tile shows the current remote control status.
-67.74 dBm 1: NRP18S	R&S NRP power sensors Shows a connected external power sensor. The button displays the current readings when the sensor is active.
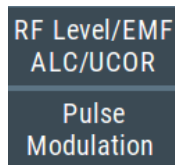
Active dialogs

Indicates the dialog name of each active dialog in a separate button.

"Info" key

Provides access to status and error messages.

Note: The warning symbol signifies a permanent error message.

3.4.3.4 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 operating 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 additional means of interacting with the instrument without having to connect an external keyboard, either a numerical or alphanumerical on-screen keypad appears when you activate an entry field (see Chapter 3.4.5, "Entering Data", on page 52).
- **Info line**
  The "Info line" shows brief status information and error messages. It appears when an event generates a message.
- **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.
- **Scroll bar handle**
  An arrow icon that appears when you touch a scroll bar helps you to scroll in a dialog or list.
  If no scrollbar handle appears, you can touch and swipe an element to scroll up and down.
- **Context-sensitive menus**
  Within the entire screen display, including single parameters, you can access context-sensitive menus that provide some additional functions.
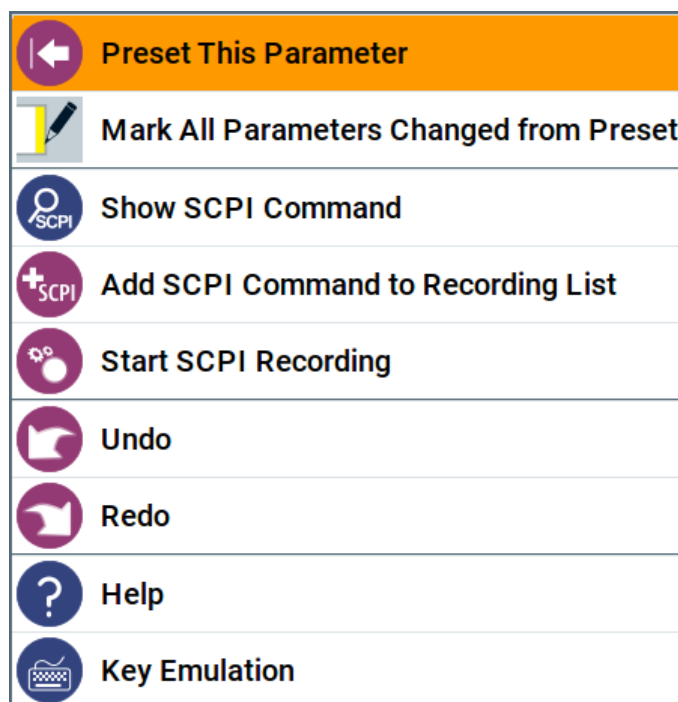
3.4.4 Accessing the Functionality

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
- 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:

- Tap the required tile, and then the menu entry.
- Tap the minimized view (button) on the taskbar.

Some of the utility keys access a dedicated dialog, too.

To minimize a dialog box

1. To return to the home screen, tap the "Home" button.

2. To switch to another dialog, press the [Next Window] 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:

- Tap the "Close" icon in the upper right corner.
- Press the [Esc] key on the front panel.
- Drag and drop a minimized dialog from the taskbar to the tile diagram.

To select an option in a dialog box

► Tap the required option.

3.4.5 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. Thus, you can always set the parameters via the touchscreen, the front panel, or an external keyboard.

Correcting an entry

1. Using the arrow keys, move the cursor to the right of the entry you want to delete.

2. Press the [Backspace] key.

3. Deletes the entry to the left of the cursor.

4. Enter your correction.

Completing the entry

► Press the [Enter] key or the rotary knob.

Aborting the entry

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

3.4.5.1 Entering Numeric Parameters

To enter 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.

2. Tap the unit button to complete the entry.

   The unit is added to the entry.

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

To enter values by using the front panel controls

1. Change the currently used parameter value by using the rotary knob or the [Up/Down] keys.

2. If the parameter does not require a unit, confirm the entered value by pressing the [Enter] key or any of the unit keys.
   The instrument highlights the editing line to confirm the entry.

If you edit numeric data in tables, the entry field must be in edit mode: Press [Enter], or the rotary knob to activate the edit mode.

3.4.5.2 Entering Alphanumeric Parameters

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

3.4.5.3 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.
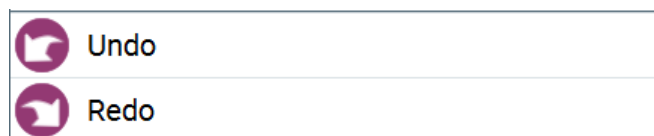
"Redo" restores a previously undone action.

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 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.
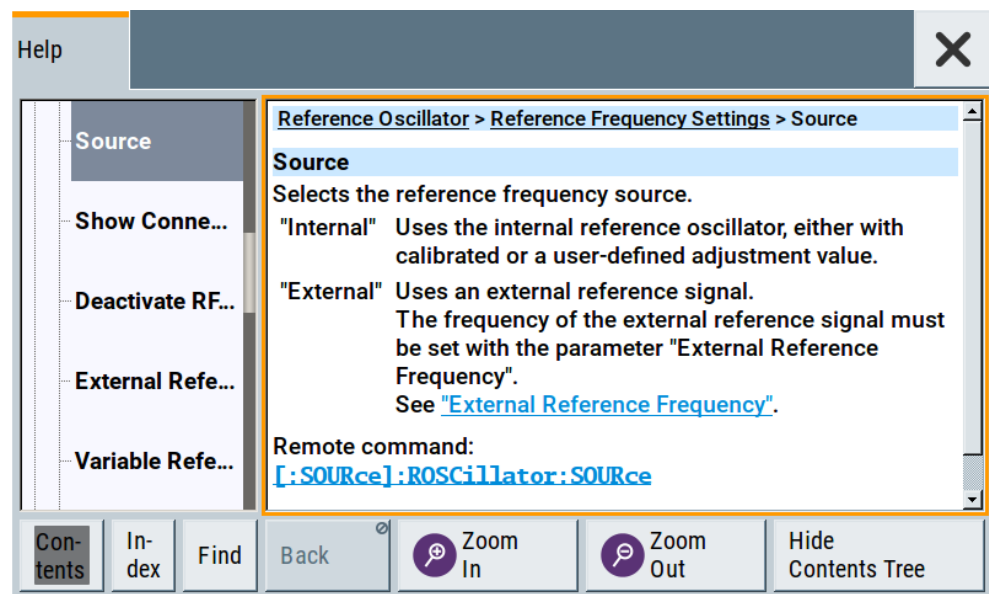
Contents of the help dialog box

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 or the [Up/Down] keys.
   Entries with a plus sign contain further entries.

2. To display a help topic, tap on the topic name or double click on the topic name or press the [Enter] key.

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 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 you are interested in.

   The entries starting with these characters are displayed.

3. Tap on the index entry.

   The corresponding help topic is displayed.

3.4.7 Remote Control

In addition to working with the R&S SMB100B interactively, located directly at the instrument, it is also possible to operate and control it from a remote PC.

The R&S SMB100B supports various methods for remote control:

- Connecting the instrument to a (LAN) network (see Chapter 3.1.3, "Setting Up a Network (LAN) Connection", on page 27)
- Using the LXI browser interface in a LAN network
- Connecting a PC via the IEC-bus (IEEE 488) interface
- Remote control via the USB interface

For remote control over LAN or USB, you can use the R&S VISA (Virtual Instrument Software Architecture) library provided for download at the Rohde & Schwarz website http://www.rohde-schwarz.com/rsvisa.

How to configure the remote control interfaces is described in Chapter 11, "Network Operation and Remote Control", on page 251.

3.4.8 Remote Operation over VNC

The VNC is an application which can be used to access and control the instrument from a remote computer through a LAN connection. While the instrument is in operation, the instrument screen contents are displayed on the remote computer, and VNC provides access to all applications, files, and network resources of the instrument. Thus, remote operation of the instrument is possible.

Instrument control from a remote computer

To access the basic utility functions of the R&S SMB100B, perform a right mouse click on the block diagram and select "Key Emulation".

A key panel to the right of the block diagram gives access to the utility functions provided by the front panel keys.

The VNC is an add-on program, included in operating system Linux/Unix, and available as a free-of-charge download on the internet.

For more information, refer to Chapter 11.16, "How to Set Up Remote Operation via VNC", on page 300.

4 RF Signal Configuration

The R&S SMB100B signal generator generates RF signals with outstanding spectral purity within the frequency range from 8 kHz up to 6 GHz and with adjustable signal level over a wide range.

In addition to these real-time CW signals, you can generate RF signals from predefined lists and sweep signals that vary according to the frequency or amplitude curves.

You can also apply versatile analog modulation types with definable characteristics.

The variably adjustable output level due to the built-in attenuator, allows you to vary the RF signal level over the full level range. There are different methods to improve signal performance and to optimize the signal quality for the particular application, or to increase the accuracy and reliability of the generated RF signal.

The R&S SMB100B supports R&S NRP power sensors, e.g. to monitor the output level of the generator or to determine the level correction values for user correction lists.

Signal modes and characteristics

The R&S SMB100B generates unmodulated or analog modulated RF signals. You can output the signal in fixed mode or as a signal having periodically varying frequencies or amplitudes.

Signal modes for RF signal generation:

* Unmodulated signal
  Generates an unmodulated continuous wave (CW) of constant frequency and amplitude.

  For information on the signal frequency and level settings and an example on how to configure a simple CW signal, see:
  – Chapter 4.3, "RF Frequency Settings", on page 60
  – Chapter 4.4, "RF Level Settings", on page 62
  – Chapter 3.3.1, "Generating an Unmodulated Carrier", on page 39
* Analog modulated signal
  Modulates the signal with an analog signal and generates amplitude, phase, frequency and pulse modulation.
  See Chapter 5, "Analog Modulations", on page 68.

The R&S SMB100B allows you to provide the RF signal with constant or varying frequencies and/or amplitudes at the output:

* Constant frequency and level (CW/Fixed mode)
  The RF output signal has the set frequency and level.
* Varying frequency and/or level
  – Sweep mode
    An RF or LF frequency and RF level sweep signal, processed continuously, step-by-step or individually and with selectable trigger modes. You can only run one sweep at a time.
  – List mode

The RF signal is based on a list of predefined frequency and level values pairs and step widths.

See Chapter 6, "List and Sweep Mode", on page 110.

4.1 Activating RF Signal Output

Per default, the RF output signal is deactivated.

To activate the RF output

1. Configure the RF signal as required.
   Set, for example, the frequency and level values.

2. Activate the RF output in one of the following ways:

   a) Select "Level > RF ON > On"
   b) Press the [RF on/off] key at the front panel.

3. In the "Level" tile, observe the color of the "RF On" icon.

   The blue color indicates that the RF output is activated.

RF State/RF ON
Activates or deactivates the RF output.

Acts as the [RF on/off] key.

Remote command:
`:OUTPut<hw>[:STATe]` on page 345

RF output impedance
You can query the impedance of the RF output.

Remote command:
`:OUTPut<hw>:IMPedance?` on page 346

4.2 How 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, level and phase.

► Use one of the following:

   ● "Status Bar > Frequency and Level"
   ● "Frequency panel > Frequency"
   ● "Level panel > Level"
   ● "Frequency panel > Frequency > Phase"

● On the front panel, press the [Freq] or the [Level] key.

Current frequency and level values are indicated in the "Status bar" so that you can see them at a glance. Values displayed in the status bar and in the "Frequency/Level" dialogs can deviate from each other.

See "RF frequency and level display with a downstream instrument" on page 59.

RF frequency and level display with a downstream instrument

If your test setup includes a downstream instrument, you can enter the parameter of the downstream instrument in the frequency or level settings dialog of the R&S SMB100B. Examples of downstream instruments are mixers, frequency multipliers, amplifiers or attenuators and of their corresponding major parameters offset, multiplier, amplitude. The R&S SMB100B generates the signal without the downstream parameters, but considers all additional parameters concerning the frequency and level.

Example parameters that affect the frequency and level:

● Frequency offset
● Multiplication factor
● User correction

Any of these cases are indicated by a dedicated icon, displayed in the "Frequency" or "Level" tile, depending on the affected parameter.

Figure 4-1 illustrates the calculation of the "Frequency" and "Level" values, displayed in the status bar.
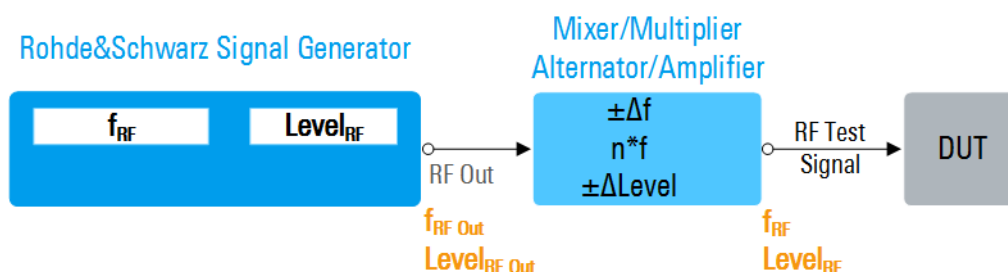
Figure 4-1: Frequency and Level display vs frequency and level at the RF output

f_{RF}, $Level_{RF}$ = Frequency and level ("Status bar > Frequency and Level") at the output of the downstream instrument, see also Calculation of f_{RF} and $Level_{RF}$)

$f_{RF\ Out}$, $Level_{RF\ Out}$ = Frequency and level at the output connector [RF] ("RF > RF Frequency > Frequency" and "RF > RF Level > Amplitude")

$n*f$ = Multiplication factor ("RF > RF Frequency > Multiplier")

Δf = Frequency offset ("RF > RF Frequency > Offset")

$\Delta Level$ = Power offset ("RF > RF Level > Offset")

Calculation of f_{RF} and $Level_{RF}$

● $f_{RF} = n*f_{RF\ Out} + \Delta f$
● $Level_{RF} = Level_{RF\ Out} + \Delta Level$

4.3 RF Frequency Settings

Access:

1. Select "Frequency" > "RF Frequency".
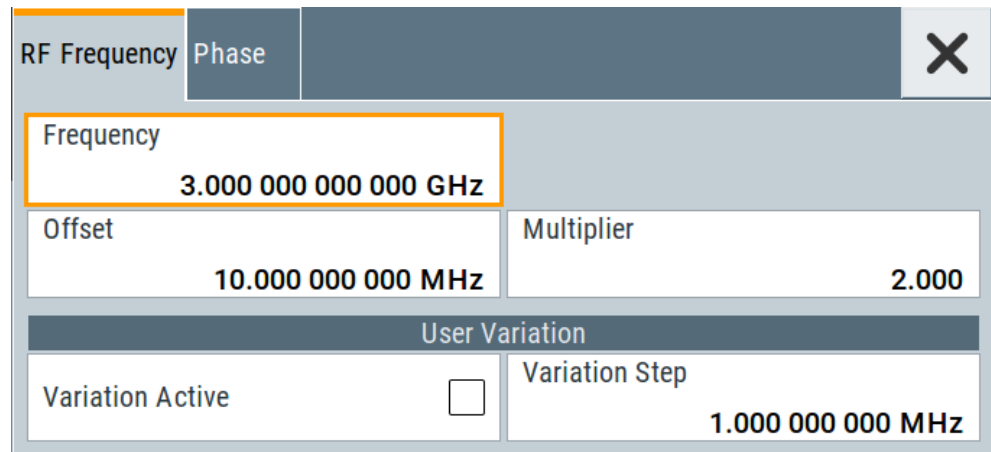
2. Observe the information on the home screen, "Frequency" tile.
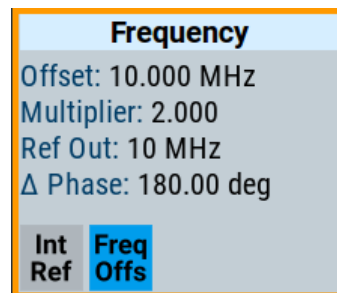
The "Frequency" tile indicates the reference frequency, current frequency offset and multiplier values, and phase offset value.

In the "RF Frequency" dialog, you can configure:
*   RF frequency, incl. an offset or multiplication factor of a downstream instrument
*   The step size for varying the frequency with the rotary knob.

The remote commands required to define the settings are described in Chapter 12.14.3, "SOURce:FREQuency Subsystem", on page 401.

Settings

Frequency

Sets the RF frequency.

This frequency is output at the RF connector. It does not consider an Offset or multiplication factor (Multiplier).

See "RF frequency and level display with a downstream instrument" on page 59.

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
    – Annotation Amplitude

- ▰▰▰.▰▰

  The display is disabled when list mode is running, see Chapter 6, "List and Sweep Mode", on page 110.

Remote command:

[:SOURce<hw>]:FREQuency[:CW|FIXed] on page 403

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 SMB100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 59.

Remote command:

[:SOURce<hw>]:FREQuency:OFFSet on page 404

Multiplier

Sets the multiplication factor for the RF frequency.

This value represents the multiplication factor of a downstream instrument, as for example a multiplier.

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 SMB100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 59.

Remote command:

[:SOURce<hw>]:FREQuency:MULTiplier on page 404

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 406
[:SOURce<hw>]:POWer:STEP:MODE on page 444

Variation Step ← User Variation

Sets the user-defined step width.

Remote command:
[:SOURce<hw>]:FREQuency:STEP[:INCRement] on page 407
[:SOURce<hw>]:POWer:STEP[:INCRement] on page 444

4.4 RF Level Settings

Access:

1. Select "Level" > "RF Level".
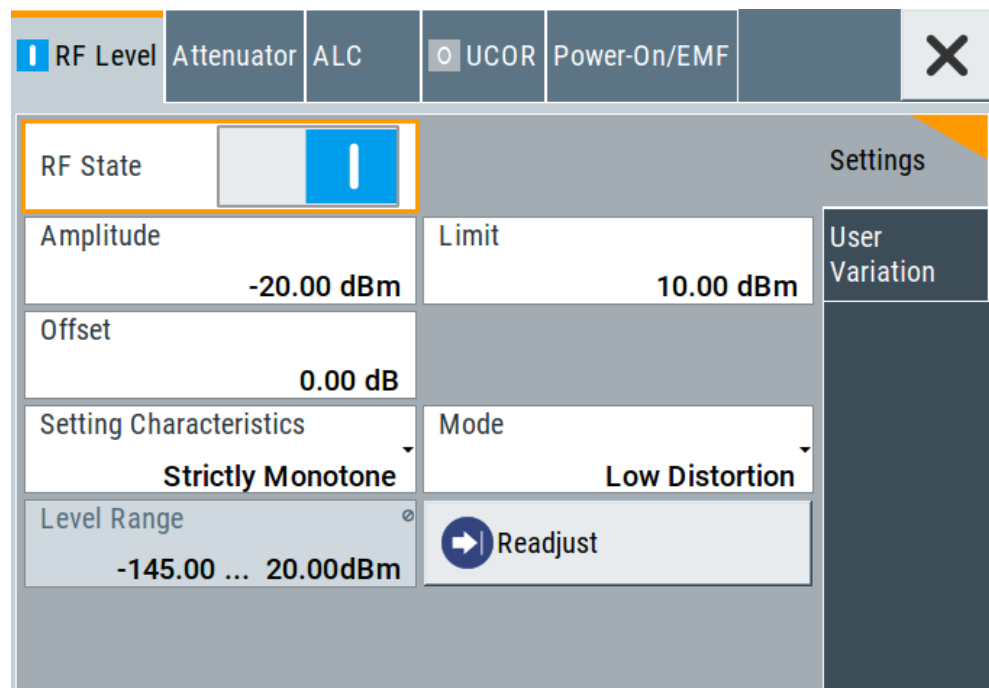
In the "RF Level" dialog, you can configure the offset-free level, the level limit, and the step width for varying the level with the rotary knob.

2. Select "User Variation" to set the step width to be used when setting the RF level using the rotary knob.

RF Level	Attenuator	ALC	UCOR	Power-On/EMF	✕

Variation Active ☑	Variation Step 0.50 dB	Settings
		User Variation
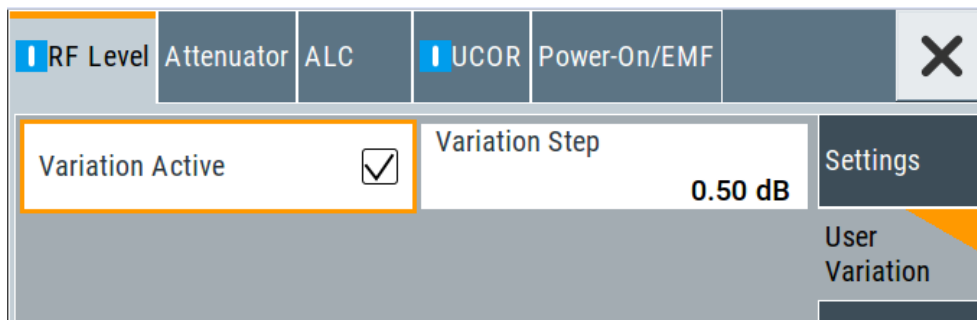
3. Observe the information on the home screen, "Level" tile.

Level
Limit: 10.00 dBm
Ucor: 0.00 dB
Mode: Low Distortion
Sett.: Strictly Monotone

RF On | Lev Ucor
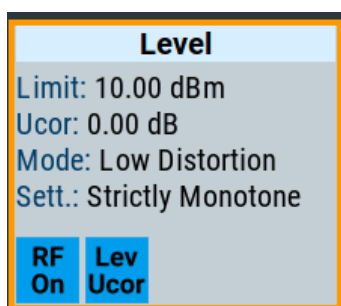
The "Level" tile indicates the level limit, the user correction status and current correction value, current setting characteristics incl. mode.

The remote commands required to define the settings are described in Chapter 12.14.10, "SOURce:POWer Subsystem", on page 438.

Settings

RF State/RF ON

Activates or deactivates the RF output.

Acts as the [RF on/off] key.

Remote command:
`:OUTPut<hw>[:STATe]` on page 345

Amplitude

Sets the level of the RF signal.

The value is offset-free and corresponds to the level at the RF connector.

See "RF frequency and level display with a downstream instrument" on page 59.

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
    – Annotation Amplitude

- ▬▬▬.▬▬

  The display is disabled when list mode is running, see Chapter 6, "List and Sweep Mode", on page 110.

Remote command:

`[:SOURce<hw>]:POWer:POWer` on page 443

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 RF output power.

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 441

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 SMB100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 59.

Remote command:

`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet` on page 444

Setting Characteristics

Selects additional quality characteristics to optimize the behavior of the RF signal level for the corresponding 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, as specified in the data sheet.
The RF signal is shortly blanked when the step attenuator is switching.

"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.

"Strictly Monotone"

Executes signal level changes monotonically increasing or decreasing.
The setting makes sure that increasing the level value exclusively results in an increased output level, and vice versa.
All electronic switches, which might affect the monotonicity are fixed.
The operation mode is useful for applications using level searching algorithms which rely on a strictly monotonous behavior.

"Constant-VSWR"

Suppresses output impedance variations at the RF output connector, due to changed level settings.

"User"
Indicates that a setting has been modified in the expert mode. The expert mode is a protected function, that requires protection level 2 password.

Remote command:
[:SOURce<hw>]:POWer:LBEHaviour on page 441

Mode

Allows you to optimize the RF output signal for applications, where improved harmonic distortion or improved wideband noise is required.

"Normal"
Generates an RF output signal with high signal to noise ratio as well as low distortion, according to the data sheet.

"Low Noise"
Optimizes the signal to noise ratio.

"Low Distortion"

Reduces distortion (harmonics) of the RF signal to a minimum.

Remote command:
[:SOURce<hw>]:POWer:LMODe on page 441

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 446

[:SOURce<hw>]:POWer:RANGe:UPPer? on page 446

Readjust

Recalculates and adjusts the internal switch positions of the RF chain according to the current level.

Remote command:

[:SOURce<hw>]:POWer:ALC:SONCe on page 440

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 406

[:SOURce<hw>]:POWer:STEP:MODE on page 444

Variation Step ← User Variation

Sets the user-defined step width.

Remote command:

[:SOURce<hw>]:FREQuency:STEP[:INCRement] on page 407

[:SOURce<hw>]:POWer:STEP[:INCRement] on page 444

4.5 RF Phase Settings

The phase in sinusoidal signals defines the initial angle at its origin.

Access:

1. Select "Frequency" > "Phase".
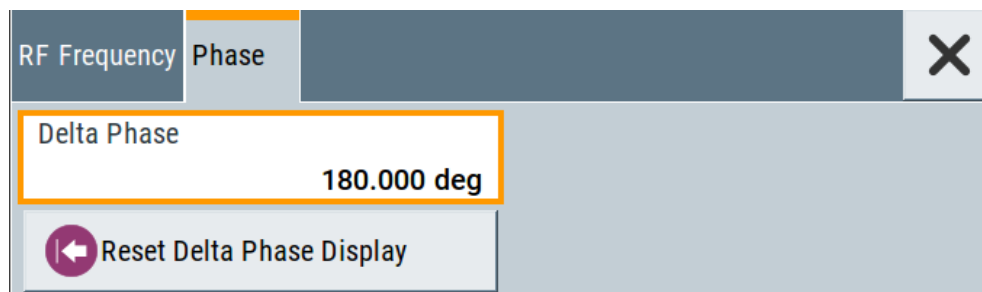
In the "Phase" tab, you can determine the delta phase value and reset the phase to this reference.

2. Observe the information on the home screen, "Frequency" tile.

    The "Frequency" tile indicates used reference frequency, current frequency offset and multiplier values, and the delta phase value.

Frequency
Offset: 10.000 MHz
Multiplier: 2.000
Ref Out: 10 MHz
Δ Phase: 180.00 deg

Int Ref Freq Offs
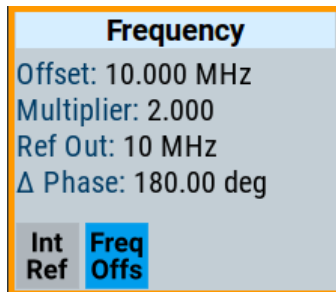
The remote commands required to define the settings are described in Chapter 12.14.9, "SOURce:PHASe Subsystem", on page 438.

Settings

Delta Phase
Sets the phase of the RF signal.

The current phase of the signal is used as the reference.

Remote command:
[:SOURce<hw>]:PHASe on page 438

Reset Delta Phase Display
Adopts the selected "Delta Phase" value as the current value, and resets delta phase to 0 degrees.

Remote command:
[:SOURce<hw>]:PHASe:REFerence on page 438

5 Analog Modulations

The R&S SMB100B supports AM (amplitude modulation), FM (frequency modulation), ΦM (phase modulation (PhiM)), and also PULM (pulse modulation). It generates low frequency signals (LF) as sine, triangle, trapezoidal or square (pulse) waveform, that can be output and further processed by a downstream instrument.

Option: R&S SMBB-B5, Stereo/RDS-Coder enables generation of stereo-modulated RF signals.

5.1 Required Options

R&S SMB100B base unit equipped with the following options:
- Option frequency (R&S SMBB-B10x)
- Option Stereo/RDS-Coder (R&S SMBB-B5)
- Option pulse modulator (R&S SMBB-K22)
- Option pulse generator (R&S SMBB-K23)
  (supports generation of single and double pulse signals)
- Option multi-function generator (R&S SMBB-K24)
- Option pulse train generator (R&S SMBB-K27)
  (requires R&S SMBB-K23)
- Option AM/FM/PhiM, up to 6 GHz (R&S SMBB-K720)

For more information, see data sheet.

5.2 Modulation Types and Signal Sources

Radio transmitters do not transmit an audio signal directly. Instead, they modulate the audio signal onto a continuous wave (CW) carrier with much higher frequency.

A CW carrier has a sinusoidal waveform with constant amplitude and constant frequency. Modulating a signal onto the carrier means varying a property of the carrier according to the modulating signal. The three basic modulation types FM, AM and PhiM for example, vary one property of the carrier proportional to the instantaneous amplitude of the modulating signal.

Signal sources

If fully equipped, the R&S SMB100B modulates signals from the following sources:
- **Internal modulation source**
  - *Two LF generators*
    Each of the LF generators provides a modulation signal with sine, pulse, triangle or trapezoid shape.
  - *Noise generator*

The noise generator supplies white noise with selectable bandwidth and distribution.

- *High-performance pulse generator*
  Generates single and double pulse, or pulse train signals.

- **External modulation source**

  - Amplitude, frequency or phase modulation signals are input at the Mod. Ext. connector.

  - Pulse modulation signals, at the Pulse Ext. connector.

  - Stereo modulation signals, at the Stereo L/R and S/P Dif connector.

Signal output

You can perform AM, FM and PhiM with the signal of any of the provided sources. Moreover, you can combine two modulation signals and generate a two-tone signal. Regardless of the signal source, the generated signal can be output for further processing in a downstream instrument.

Current configuration is indicated in the "Analog Modulations > Overview" dialog; the output signal routing can be changed, too.

Input and output connectors

Direction	Modulation	Connector	Required option
Output	Pulse modulation from internal signal Loop through of pulse signal from Pulse Ext.	Pulse Video	R&S SMBB-K22/-K23
	All analog modulations Marks the valid level and frequency	Signal Valid	
	LF generator	LF	
Input	AM, FM, PhiM	Mod. Ext. **)	R&S SMBB-K720
	Stereo modulation from external source	Stereo L/R	R&S SMBB-B5
	Pulse modulation from external source*) Or External trigger or gate signal*)	Pulse Ext.**)	R&S SMBB-K22

- *) External trigger signal and external signal for the pulse modulation cannot be used simultaneously, because these signals are expected at the same connector Pulse Ext.. Signal polarity and impedance are the same for both signals.

- **) The external modulation signal must have a voltage of US = 1 V (UEFF = 0.707 V) to achieve the displayed modulation depth and range.
  Note that the input voltage does not exceed 1 V, otherwise modulation distortions can occur.

For more information, see data sheet.

Interactions and characteristics

- FM and PhiM modulations exclude each other and cannot be performed simultaneously.
- In sweep mode, LF frequency sweep is possible.
- The settings of the modulation signal affect all analog modulations that use an internal modulation source.
- You can feed an external LF signal in each of the two paths.

For more information, see data sheet.

5.3 Activating Analog Modulations

► Use one of the following:

- Select "Modulation > Amplitude Modulation/Frequency Modulation/Phase Modulation > State > ON".
- Select "Modulation > MOD ON".
- Press the [Mod on/off] key.

[Mod on/off]
Activate one or more analog modulations and press the [Mod on/off] key to toggle the state of them all.

Pressing the key again restores the status that was active before the last switch-off.

Remote command:
[:SOURce<hw>]:MODulation[:ALL][:STATe] on page 360

5.4 Modulation Settings

Access:

► Select "Modulation" > "Modulation Sources".

The "Modulation" dialog contains all functions and settings to configure the analog modulations, the LF signal sources for performing a modulation, and the LF signal output.

The remote commands required to define these settings are described in:
- Chapter 12.14.1.2, "SOURce:AM Subsystem", on page 361
- Chapter 12.14.1.3, "SOURce:FM Subsystem", on page 366
- Chapter 12.14.1.4, "SOURce:PM Subsystem", on page 370
- Chapter 12.14.1.5, "SOURce:PULM Subsystem", on page 375
- Chapter 12.14.1.6, "SOURce:STEReo Subsystem", on page 386
- Chapter 12.14.5, "SOURce:LFOutput Subsystem", on page 408

5.4.1 Pulse Modulation

Option: see Chapter 5.1, "Required Options", on page 68.

Access:

► Select "Modulation" > "Pulse Modulation".

| Pulse Generator | Pulse Graph | ▮ Pulse Modulation | Pulse External / Trigger | ✕ |

State	▮
Source		Pulse Generator ▾
Transition Type		Fast ▾
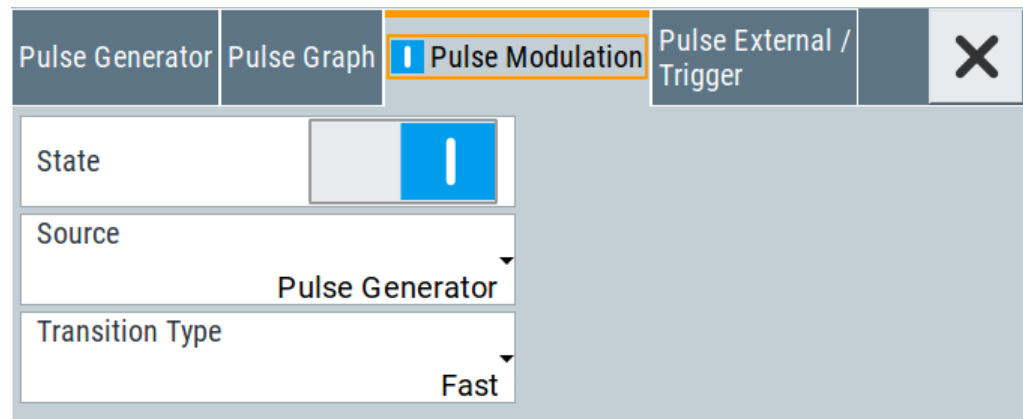
The "Pulse Modulation" dialog contains all parameters required to configure the pulse modulator and the pulse generator.
It also displays the pulse signal graphically.

For an overview of the supported signals sources and related connectors, see Chapter 5.2, "Modulation Types and Signal Sources", on page 68.

The remote commands required to define these settings are described in Chapter 12.14.1.5, "SOURce:PULM Subsystem", on page 375.

Settings:

State
Activates pulse modulation and triggers the following automatic settings:

● Pulse generator is activated.
The signal is output at the Pulse Video connector.
To deactivate the signal output, set "Pulse Generator" > Pulse Output State > "Off".

Remote command:
`[:SOURce<hw>]:PULM:STATe` on page 379

Source
Selects between the internal "Pulse Generator" or an "External" pulse signal for the modulation.

"Pulse Generator"

Selects the internal generator.

See Pulse Generator.

"External"

Modulation source is fed to the input connector.

See "Signal sources" on page 68.

Remote command:

[:SOURce<hw>]:PULM:SOURce on page 379

Transition Type

Selects between "Fast" or "Smoothed" slew rate (slope).

"Fast"

Enables fast transitions with shortest rise and fall times.

"Smoothed"

Flattens the slew rate, resulting in longer rise / fall times. Use this mode if you are working with devices that are sensitive to steep slopes.

Remote command:

[:SOURce<hw>]:PULM:TTYPe on page 379

5.4.2 FM, PhiM and AM Modulation Settings

Option: R&S SMBB-K720

Access:

► Select "Modulation" > "Amplitude Modulation/Frequency Modulation/Phase Modulation".

Sources	**❙ FM**	O ΦM	❙ AM	O Output	Overview	✕

Path 1		Path 2	
State	❙	State	❙
Source	LF Generator 1	Source	External 1
Deviation	1.000 00 kHz	Deviation	1.000 00 kHz
Deviation Mode	Fixed Ratio	Ratio Path 2 / Path 1	100.00 %
Mode	High Bandwidth		

The "FM", "ΦM" and "AM" tabs contain the parameters per modulation type.

Source

State

Activates a modulation.

Note: Some modulations exclude each other and cannot be performed simultaneously. For more information, see data sheet.

Remote command:

`[:SOURce<hw>]:AM<ch>:STATe` on page 363
`[:SOURce<hw>]:FM<ch>:STATe` on page 367
`[:SOURce<hw>]:PM<ch>:STATe` on page 372

Source

Selects the LF signal source.

You can vary the signal sources for each of the modulations.

"LF Generator 1/2"

    Selects one or both of the internally generated LF signals.

    See Chapter 5.4.7.1, "Source > LF Generator Settings", on page 97.

"External"   Selects an externally supplied LF signal.

"Noise Generator"

    Selects the internally generated noise signal.

    See Chapter 5.4.7.3, "Source > Noise Generator Settings", on page 102.

Remote command:

[:SOURce<hw>]:AM<ch>:SOURce on page 363

[:SOURce<hw>]:FM<ch>:SOURce on page 368

[:SOURce<hw>]:PM<ch>:SOURce on page 372

FM settings

The following settings are dedicated to FM.

Deviation ← FM settings

Sets the frequency modulation deviation in Hz.

The maximal deviation depends on the RF frequency and the selected modulation mode (see data sheet).

Maximal possible deviation is selected automatically, if one of the following applies:
- The selected deviation is too high for the particular frequency
- The selected frequency is outside of the range where deviation is possible.

A warning message indicates this situation, too.

Remote command:

[:SOURce<hw>]:FM<ch>[:DEViation] on page 368

Deviation Mode ← FM settings

Enables you to couple the LF signal of both paths and determines the mode for fixing the total deviation.

The total deviation is the sum of both paths. When the sum is exceeded, the R&S SMB100B reports a settings conflict, but does not change the settings.

"Uncoupled"	Enables you to adjust the deviation for each path independently.
"Fixed Total"	Couples the deviation of both paths in per Hz. If you change the deviation of any path, the R&S SMB100B automatically adjusts the value of the other path. The sum always results in the set Total Deviation.
"Fixed Ratio"	Couples the deviation ratio of both paths. If you change the deviation of any path, the R&S SMB100B adjusts the value of the other path.

Remote command:

[:SOURce<hw>]:FM:DEViation:MODE on page 369

Total Deviation ← FM settings

Sets the sum of the signal deviation for path 1 and path 2 in Hz when using combined sources in Deviation Mode > Fixed Total.

Deviation of both paths always sum up to the value of the total deviation.

Behavior when changing any depth settings:
- Changing the total deviation adjusts the deviation of both paths proportionally.
- Changing the deviation of one path adjusts the deviation of the other path. The sum always results in the set total deviation.

Remote command:

[:SOURce<hw>]:FM:DEViation:SUM on page 369

Ratio Path2/Path1 ← FM settings

Sets the deviation ratio (path2 to path1) in percent.

Example:

If the deviation in path1 is 10 kHz and the ratio is 50%, the deviation in path 2 is automatically set to 5 kHz.

Remote command:

[:SOURce<hw>]:FM:RATio on page 369

Mode ← FM settings

Selects the mode of the frequency modulation.

"High Bandwidth"

           The maximum range for modulation bandwidth is available.

"Low Noise"   Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

Remote command:

[:SOURce<hw>]:FM:MODE on page 370

PhiM settings

The following settings are dedicated to PhiM.

Deviation ← PhiM settings

Sets the phase modulation deviation in radians or degrees.

The maximal deviation depends on the RF frequency and the selected modulation mode (see data sheet).

Maximal possible deviation is selected automatically, if one of the following applies:
- The selected deviation is too high for the particular frequency
- The selected frequency is outside of the range where deviation is possible.

A warning message indicates this situation, too.

Remote command:

[:SOURce]:PM<ch>[:DEViation] on page 374

Deviation Mode ← PhiM settings

Enables you to couple the LF signal of both paths and determines the mode for fixing the total deviation.

The deviation sum 2 rad at a maximum. When the sum is exceeded, the R&S SMB100B adjusts the settings automatically.

"Uncoupled"   Enables you to adjust the deviation for each path independently.

"Fixed Total"   Couples the deviation of both paths. If you change the deviation of any path, the R&S SMB100B automatically adjusts the value of the other path. The sum always results in the setTotal Deviation.

"Fixed Ratio"   Couples the deviation ratio of both paths. If you change the deviation of any path, the R&S SMB100B adjusts the value of the other path.

Remote command:

[:SOURce<hw>]:PM:DEViation:MODE on page 373

Total Deviation ← PhiM settings

In Deviation Mode = Fixed Total, sets the sum of the signal deviation for path 1 and path 2.

Deviation of both paths always sum up to the value of the total deviation.

Behavior when changing any depth settings:
- Changing the total deviation adjusts the deviations of both paths proportionally.
- Changing the deviation of one path adjusts the deviation of the other path. The sum always results in the set total deviation.

Remote command:

[:SOURce<hw>]:PM:DEViation:SUM on page 374

Ratio Path2/Path1 ← PhiM settings

Sets the deviation ratio (path2 to path1) in per cent.

Example:

If the deviation in path1 is 10 rad and the ratio is 50%, the deviation in path 2 is automatically set to 5 rad.

Remote command:

[:SOURce<hw>]:PM:RATio on page 374

Mode ← PhiM settings

Selects the mode of the phase modulation.

"High Bandwidth"

> The maximum range for modulation bandwidth and PhiM deviation is available.
> However, phase noise increases at low frequencies, and the range of PhiM deviation is limited. This mode is suitable if you process high frequencies.

"High Deviation"

> The maximum range for PhiM deviation is available.
> Phase noise is improved for low frequencies compared to the default mode. The range for modulation frequency is limited (see data sheet). This mode is suitable for low modulation frequencies and/or high PhiM deviation.

"Low Noise"   Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

Remote command:

[:SOURce<hw>]:PM:MODE on page 373

AM settings

The following settings are dedicated to AM.

Depth ← AM settings

Determines the depth of the modulation signal in percent.

The depth is limited by the maximum peak envelope power (PEP).

Remote command:
[:SOURce<hw>]:AM<ch>[:DEPTh] on page 364

Sensitivity ← AM settings

Sets the input sensitivity of the external modulation signal.

Remote command:
[:SOURce<hw>]:AM<ch>:SENSitivity on page 365

Deviation Mode ← AM settings

Enables you to couple the LF signal of both paths and determines the mode for fixing the total deviation.

The deviation sum of both paths is 100% in total. When the sum is exceeded, the R&S SMB100B reports a settings conflict, but does not change the settings.

"Uncoupled"   Enables you to adjust the deviation depth for each path independently.

"Fixed Total"   Couples the deviation depth of both paths in per cent. If you change the depth of any path, the R&S SMB100B automatically adjusts the value of the other path. The sum always results in the set Total Depth.

"Fixed Ratio"   Couples the deviation ratio of both paths. If you change the depth of any path, the R&S SMB100B adjusts the value of the other path.

Remote command:
[:SOURce<hw>]:AM:DEViation:MODE on page 365

Total Depth ← AM settings

Sets the sum of the signal Depth for path 1 and path 2 in per cent when using combined sources and Deviation Mode > Fixed Total.

Using external LF signals, the R&S SMB100B indicates the Sensitivity per Volts for the input signal.

Provided both signal paths are turned on, the depth of both paths always sum up to the value of the total depth.

Behavior when changing any depth settings:
- Changing the total depth adjusts the depths of both paths proportionally.
- Changing the depth of one path adjusts the depth of the other path. The sum always results in the set total depth.

Remote command:
[:SOURce<hw>]:AM:DEPTh:SUM on page 364

Ratio Path2/Path1 ← AM settings

Sets the deviaton ratio of the signal depth for path 2 to path 1 in per cent when using combined sources.

Using external LF signals, the R&S SMB100B indicates the Sensitivity per Volts for the input signal.

Remote command:
[:SOURce<hw>]:AM:RATio on page 365

5.4.3 Stereo Modulation

Option: see Chapter 5.1, "Required Options", on page 68.

Access:

► Select "Modulation" > "Stereo Modulation".

Option R&S SMBB-B5, Stereo/RDS Coder enables generation of stereo-modulated RF signals according to the standard. Beside the MPX (FM stereo multiplex) signal, also the radio traffic service ARI (Automotive Radio Information) and Radio Data System (RDS) are supported by the option.
Select an internal or external signal source. The analog [Stereo L/R] connections and the digital [S/P Dif] connection supply the signal of an external source. The LF generator acts as internal signal source.
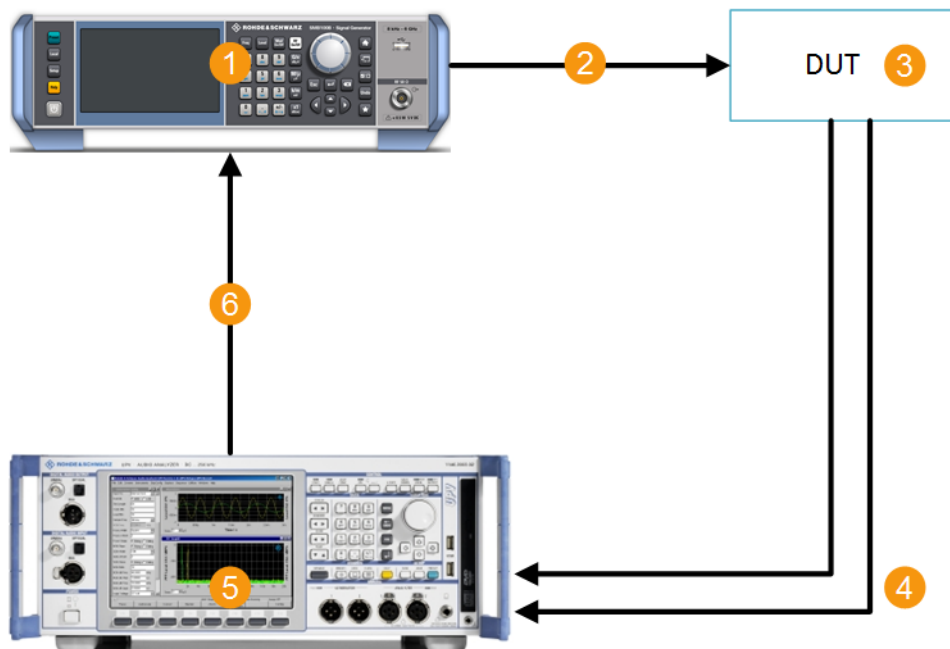
Figure 5-1: Example setup

1 = R&S SMB100B with Stereo/RDS Coder R&S SMBB-B5
2 = RF modulated test signal including ARI and RDS
3 = FM stereo tuner
4 = Analog audio signals
5 = Signal generation and analysis, for example with R&S®UPV Audio Analyzer
6 = Analog or digital audio signals

5.4.3.1 General Settings

Access:

► Select "Modulation" > "Stereo Modulation".

The "General" tab contains the settings for creating a stereo modulation signal.
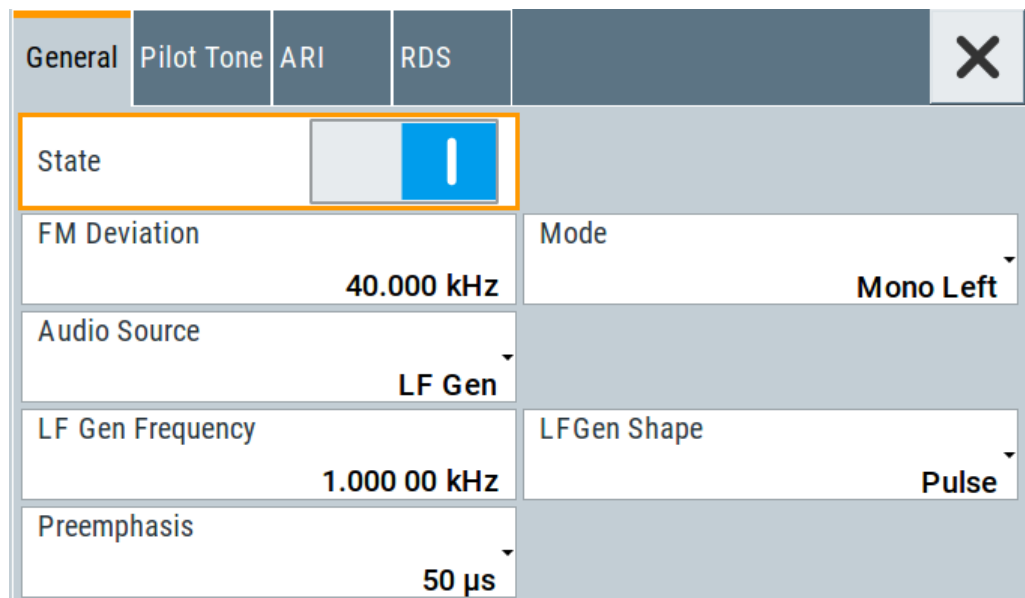
General	Pilot Tone	ARI	RDS		✕

State			

| FM Deviation | | Mode | |
| | 40.000 kHz | | Mono Left |

| Audio Source | | | |
| | LF Gen | | |

| LF Gen Frequency | | LFGen Shape | |
| | 1.000 00 kHz | | Pulse |

| Preemphasis | | | |
| | 50 µs | | |

Settings

State
Activates stereo modulation.

Remote command:
[:SOURce]:STEReo:STATe on page 387

FM Deviation
Sets the MPX (FM stereo multiplex) deviation.

Remote command:
[:SOURce]:STEReo[:DEViation] on page 387

Mode

Selects the mode for the audio signal.

"Mono Left"   A mono signal containing the left channel is generated/fed in.

"Mono Right"   A mono signal containing the right channel is generated/fed in.

"Stereo R = L"   A stereo signal with right and left chanel is generated/fed in. The channels have the same frequency and phase.

"Stereo R = -L"   The signal on the left external audio input is used for both channels. The right channel is inverted.

"Stereo R != L"   (External source only)
                    A stereo signal containing different, independent right and left channels is fed in.

Remote command:
[:SOURce]:STEReo:AUDio:MODE on page 388

Audio Source

Selects the source for the audio signal.

"Off"   No audio signal is provided, ARI and RDS signal can be generated separately.

"Ext L,R"   The external audio stereo signal is feed in via the analog [L] and [R] inputs.

"Ext S/P Diff"   The external audio signal is feed in via the digital [S/P Dif] input.

"LF Gen"   The audio stereo signal is generated by the internal LF1 generator.

Remote command:
[:SOURce]:STEReo:SOURce on page 388

LF Gen Frequency

If "Audio Source = LF Gen", sets the frequency of the LF generator signal.

This setting affects all analog modulations which use the LF1 generator as the internal modulation source.

Remote command:
[:SOURce]:LFOutput<ch>:FREQuency on page 411

LF Gen Shape

If "Audio Source = LF Gen", selects the shape of the LF generator signal.

This setting affects all analog modulations which use the LF1 generator as the internal modulation source.

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe on page 415

External R/L Impedance

(External analog audio signal input only)

Selects the input impedance for the external analog audio signal inputs [L] and [R].

Remote command:
[:SOURce]:STEReo:EXTernal:IMPedance on page 389

Preemphasis

Activates and sets the preemphasis used for signal generation.

Preemphasis increases the high-frequency portions of the signal in the level before the FM modulator is reached.

Remote command:

[:SOURce]:STEReo:AUDio:PREemphasis:STATe on page 390

[:SOURce]:STEReo:AUDio:PREemphasis on page 389

Max Modulation Frequency

Sets the maximum modulation frequency.

This parameter is valid/required only when preemphasis has been activated and an external modulation source is used.

For sinewave signals with full modulation, preemphasis can lead to an internal overload of the modulator. The MMF parameter reduces the internal full modulation, so that sinewave signals with nominal voltage can be transmitted with low distortion, even with active preemphasis up to the set frequency. This procedure reduces the S/N ratio at the set MMF, based on the level increase of the preemphasis.

The default value of this parameter works for normal modulation signals, such as voice or music, because the amplitude of the high-frequency portions of these signals normally decreases substantially.

Remote command:

[:SOURce]:STEReo:MMF on page 389

5.4.3.2 Pilot Tone

Access:

► Select "Modulation" > "Stereo Modulation > Pilot Tone".

General	Pilot Tone	ARI	RDS	✕
Pilot State			I	
Pilot Deviation			6.750 kHz	
Pilot Phase			0.0 deg	

The pilot tone supports the transmission of a signal to the receiver through adding a constant single-frequency signal. The signal receiver accepts the incoming signal only after the pilot tone is confirmed.

Settings

Pilot State

Activates the pilot tone generation.

Remote command:

[:SOURce]:STEReo:PILot:STATe on page 390

Pilot Deviation

Sets the deviation of the pilot tone.

Remote command:

[:SOURce]:STEReo:PILot[:DEViation] on page 390

Pilot Phase

Sets the phase of the pilot tone in relation to the 38 kHz carrier signal of the receiver. For a correct demodulation, the pilot tone must be in phase with the 38 kHz carrier.

Remote command:

[:SOURce]:STEReo:PILot:PHASe on page 390

5.4.3.3 ARI

Access:

► Select "Modulation" > "Stereo Modulation > ARI".
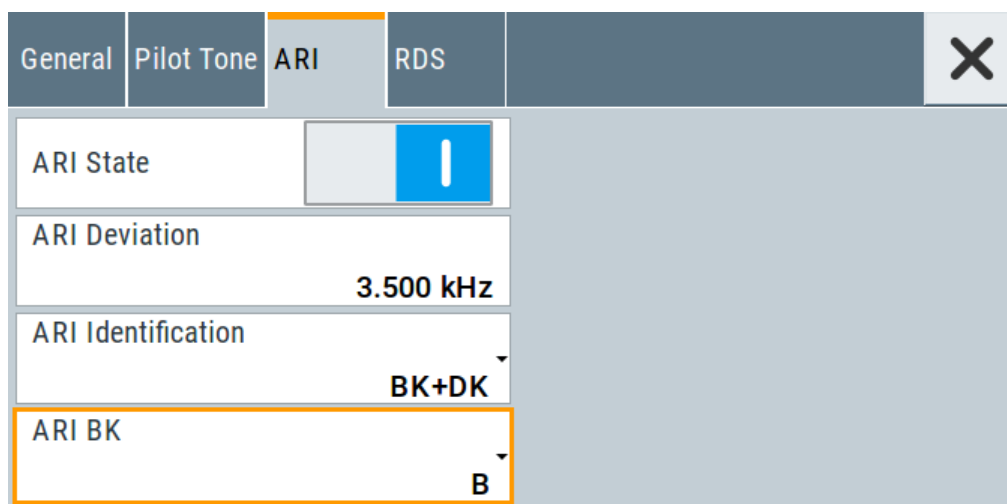
ARI (Automotive Radio Information) indicates the presence of traffic information in FM radio broadcasts.

Settings

ARI State

Activates the ARI signal generation. ARI signals can be generated simultaneously with MPX (FM stereo multiplex) and RDS signals.

Remote command:

[:SOURce]:STEReo:ARI:STATe on page 391

ARI Deviation

Sets the frequency deviation of the ARI subcarrier signal.

Remote command:

[:SOURce]:STEReo:ARI[:DEViation] on page 391

ARI Identification

Selects the generated identifiers of the ARI signal.

DK and BK are abbreviations of the German words Durchsagekennung and Bereichskennung.

"Off"	Only the 57 kHz subcarrier is generated. It marks the stations which broadcast traffic programs and enables the receiver to recognize the frequency as being ARI-capable.
"DK"	The message identification is generated in addition (low-frequency 30% AM). It signalizes that a traffic message is broadcasted.
"BK"	The area identification is generated in addition (60% AM). This code is used to identify the geographical region covered by the radio station. The specific code is selected below.
"DK+BK"	The area and message identification are generated in addition to the subcarrier.

Remote command:

[:SOURce]:STEReo:ARI:TYPE:STATe on page 391

[:SOURce]:STEReo:ARI:TYPE on page 391

ARI BK

Selects the specific area identification (BK) code of the ARI signal. The six letters (six different frequencies) identify a specific region in each country.

Remote command:

[:SOURce]:STEReo:ARI:BK[:CODE] on page 392

5.4.3.4 RDS

Access:

► Select "Modulation" > "Stereo Modulation > RDS".

General	Pilot Tone	ARI	**RDS**		✕

RDS State	▮

RDS Deviation	
	2.000 kHz

RDS Data Set	
	DS2

Program Service Name	⊘	Program Identification	⊘
·			

Traffic Program	▮	Traffic Announcement	▮
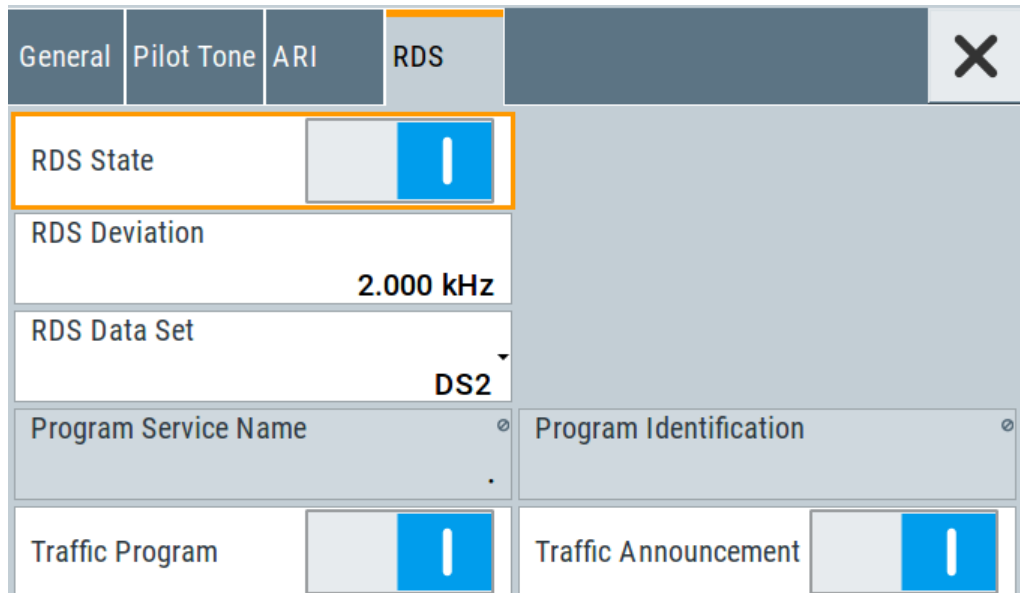
The RDS (Radio Data System) is configured in the RDS settings section. RDS is a communication protocol standard from the European Broadcasting Union for sending digital information embedded in conventional FM radio broadcasts. The RDS system standardizes several types of transmitted information, including time, track/artist info and station identification.

Settings

RDS State

Activates the RDS signal generation. RDS signals can be generated simultaneously with MPX (FM stereo multiplex) and ARI signals.

Remote command:
[:SOURce]:STEReo:RDS:STATe on page 392

RDS Deviation

Sets the deviation of the RDS subcarrier.

Remote command:

[:SOURce]:STEReo:RDS[:DEViation] on page 392

RDS Data Set
Selects the data set used in the RDS signal. Five data sets are provided on the instrument. The values of the data sets can be defined via remote control (command SOURce:STEReo:DIRect).

Each of these data sets contains predefined values for:
- PI (program identification, identifies the broadcast station)
- PS or scrolling PS (program service name, represents the station identity name)
- TP (traffic program, mark stations with regular traffic programs)
- TA (traffic announcement, marks the start of a traffic program)
- PTY (program type, predefined genres of broadcasting programs, e.g. news)
- PTYN (program type name)
- DI (decoder information)
- MS (music/speech)
- CT (clock time, used for synchronization)

The following values are empty:
- RT (radio text, two text blocks with 64 symbols each)
- AF (alternative frequencies, maximum of five lists with 25 frequencies each, enables the receiver to retune to a different frequency providing the same station when the first signal becomes too weak)
- TMC (traffic message channel)
- EON (enhanced other networks, eight PS with five EON AF lists each, enables the receiver to tune into these stations automatically if traffic programs are broadcasted)

The program identification and the program service name of the selected data set are indicated in the menu.

Remote command:

[:SOURce]:STEReo:RDS:DATaset on page 393

Program Service Name
Indicates the RDS program service name.

Remote command:

[:SOURce]:STEReo:DIRect on page 387

Program Identification
Indicates the RDS program identification.

Remote command:

[:SOURce]:STEReo:DIRect on page 387

Traffic Program
Activates the RDS traffic program (TP function). The receiver can recognize a frequency as being capable of traffic information only if the TP function is active.

Remote command:

[:SOURce]:STEReo:RDS:TRAFfic:PROGram[:STATe] on page 393

Traffic Announcement

Activates the RDS traffic announcement (TA function). If activated, the receiver switches from the current status, e.g. playing a CD, to the receive mode and enables the broadcast of a traffic announcement. The TP state has to be on.

Remote command:
[:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe] on page 393

5.4.4 Pulse Generator

Option: see Chapter 5.1, "Required Options", on page 68.

Access:

► Select "Modulation" > "Pulse Modulation > Pulse Generator".
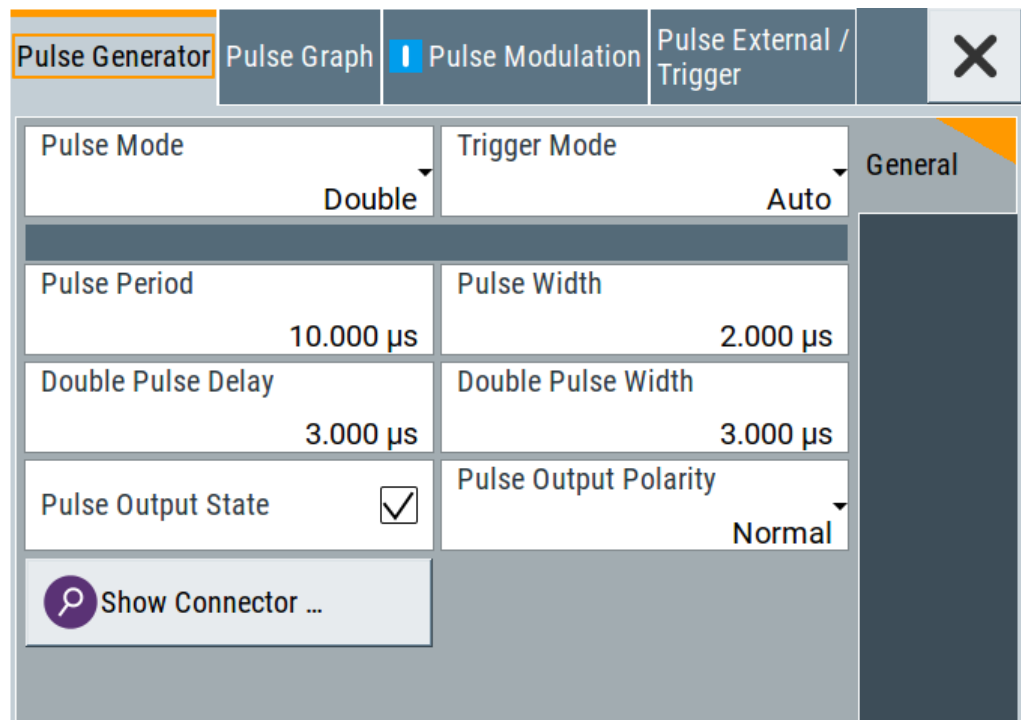
The "Pulse Generator" tab contains the settings for creating the pulse modulation signal internally.

5.4.4.1 Pulse Generator > General Settings

Access:

► Select "Modulation" > "Pulse Modulation > Pulse Generator".

Settings

Pulse Mode

Sets the operating mode of the pulse generator. Depending on the selection, the instrument displays the associated parameters.

"Single"   Generates a single pulse in one pulse period.

"Double"   Generates two pulses in one pulse period.

"Train"   Option: R&S SMBB-K27
                  Generates a user-defined pulse train.
                  See Chapter 5.4.4.2, "Pulse Generator > Pulse Train Settings",
                  on page 89.

Remote command:

`[:SOURce<hw>]:PULM:MODE` on page 376

Trigger Mode

Selects between continuous triggering or triggering initiated by a trigger event from an external signal.

See also "Input and output connectors" on page 69.

"Auto"   Generates the internal modulation signal continuously.

"Single"   The pulse generator is triggered by an internal trigger event, initiated
                  with Execute Single Trigger.
                  The pulse signal is generated once.

"Ext Single"   Generates a single pulse signal, triggered by an external signal.

"Ext Triggered" Generates the pulse signal each time an external trigger event
                  occurs.

"Ext Gated"   Generates the signal triggered by an external gate signal.

Remote command:

`[:SOURce<hw>]:PULM:TRIGger:MODE` on page 377

Pulse Period

Sets the repetition rate of the generated pulse signal.

Remote command:

[:SOURce<hw>]:PULM:PERiod on page 377

Pulse Width

Sets the pulse duration of the generated pulse signal.

Note: The pulse width must be at least 20 ns less than the set pulse period.

Remote command:

[:SOURce<hw>]:PULM:WIDTh on page 378

Double Pulse Width

Sets the width of the second pulse.

Remote command:

[:SOURce<hw>]:PULM:DOUBle:WIDTh on page 378

Pulse Delay

Sets the pulse delay. The pulse delay determines the time that elapses after a trigger event before pulse modulation starts. The pulse delay is not effective for double pulse generation.

Remote command:

[:SOURce<hw>]:PULM:DELay on page 378

Double Pulse Delay

Sets the delay from the start of the first pulse to the start of the second pulse.

Remote command:

[:SOURce<hw>]:PULM:DOUBle:DELay on page 378

Pulse Output State

Activates the output of the pulse modulation signal.

Remote command:

[:SOURce<hw>]:PGENerator:OUTPut[:STATe] on page 437

Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

Pulse Output Polarity

Sets the polarity of the pulse output signal.

Remote command:

[:SOURce<hw>]:PGENerator:OUTPut:POLarity on page 437

Execute Single Trigger

If "Trigger Mode = Single", initiates a single pulse sequence manually.

Remote command:

[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate on page 377

5.4.4.2 Pulse Generator > Pulse Train Settings

Option: see Chapter 5.1, "Required Options", on page 68.

Access:

1. Select "Modulation" > "Pulse Modulation > Pulse Generator" > **"Pulse Mode = Train"**.
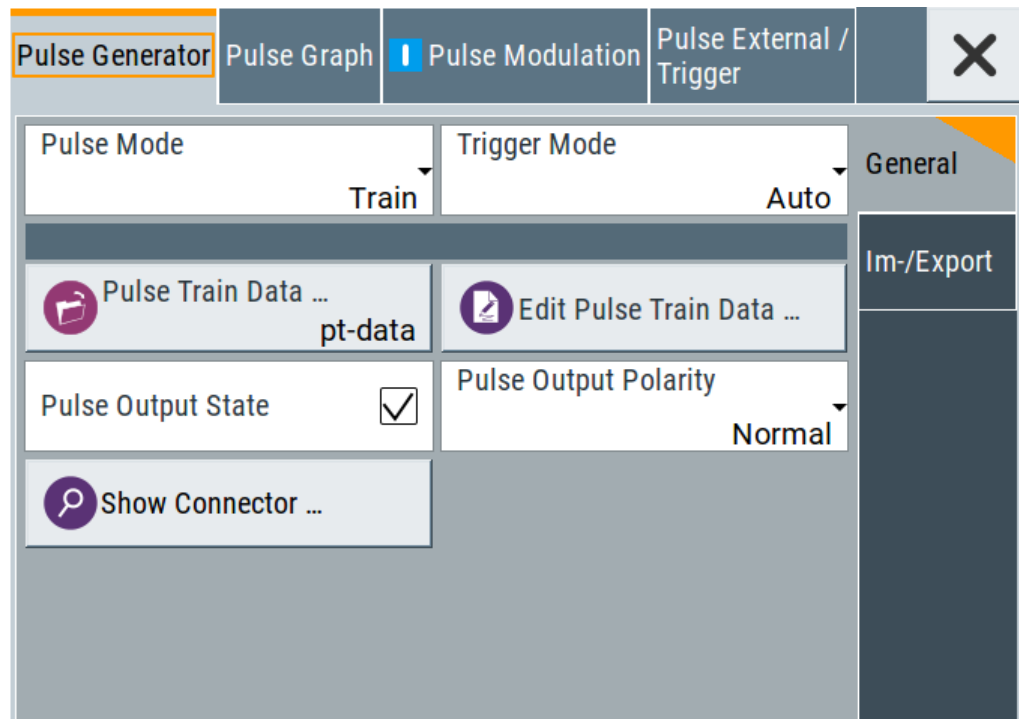
2. Select "Pulse Train Data".

3. Select an existing file or select "New" to create one.

4. Define the filename.
   Select "Edit Pulse Train Data", if the file is empty or to control and change the values.

5. In the "Edit Pulse Train Data" dialog, enter the pulse on/off times and pulse repetition values.

6. Select "Save".

   A pulse train is a sequence of pulses with user-defined repetition, and pulse on and off times. Once defined, pulse train settings can be saved in a file. The filename is user-definable; the file extension (`*.pulstrn`) is assigned automatically.
   When a file is selected, the filename is indicated.

Possible ways to configure a pulse train

You can configure a pulse train in the following ways:

- **Internally**

    – Use the built-in editor table editor, see in the "Pulse Generator > Pulse Train" dialog.
Once defined, pulse train settings can be saved in a file. For example, to exchange configuration between instruments or to modify the file content with an external program and reload them again.
The filename is user-definable; the file extension is `*.pulstrn`.

    – Using the corresponding remote-control commands.
Note that you have to create a pulse train file first.

- **Externally**
Create a pulse train sequence as a CSV file with Microsoft Excel, with a Notepad or a similar tool, save it with the predefined extension. Transfer the file to and load it into the instrument.

Pulse train ASCII file format

Files describing pulse trains are simple files in text or comma-separated value (CSV) file format. The filename is user-definable; the file extension is `*.csv` or `*.txt`.

The file contains a list of pulse definition values, one row per pulse; a new line indicator separates the pulses. Pulses are defined with their pulse on time, pulse off time given in us and number of repetitions.

Example: Pulse train file content (*.txt file)

```
0.0001,0.0005,2
0.00025,0.0005,1
0.0001,0.0003,3
```

For file handling, use the standard functions in the "File Manager", see Chapter 9.8, "Using the File Manager", on page 203.

Settings

Pulse Train Data
Accesses the standard "File Select" function of the instrument. The provided navigation possibilities in the dialog are self-explanatory.

Pulse train files are files with predefined file extension `*.pulstrn`. 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 *.pulstrn > Select"
- Use the general editor function to create internally new file or to edit an existing one.

- Use the standard file manager function to load externally created files to the instrument.

Remote command:

`[:SOURce<hw>]:PULM:TRAin:CATalog?` on page 381

`[:SOURce<hw>]:PULM:TRAin:SELect` on page 383

`[:SOURce<hw>]:PULM:TRAin:DELete` on page 382

Edit Pulse Train Data

Accesses the build-in table editor to define a new pulse train file or edit an existing one.

"On-Time, µs/Off-Time,µs"

Sets the pulse on and pulse off time.

"Count"   Sets the number of repetitions of an "On-/ Off-Time" value pair.

Pulses with "Count = 0" are ignored.

Use this method to skip value pairs temporarily, without deleting them from the table.

Remote command:

`[:SOURce<hw>]:PULM:TRAin:ONTime` on page 382

`[:SOURce<hw>]:PULM:TRAin:OFFTime` on page 382

`[:SOURce<hw>]:PULM:TRAin:REPetition` on page 382

`[:SOURce<hw>]:PULM:TRAin:DELete` on page 382

Data handling keys

Standard functions for file and data handling.
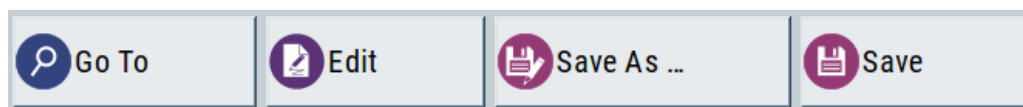
Note: Save a list only after filling both columns (frequency and level), otherwise the entries are lost.

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 a list, and provides access to a dialog for automatic filling.

See " Fill... " on page 91.

Save As/Save ← Data handling keys

Saves the list in a file with 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.

From		Range	
	0		1

Column To Fill	
	Frequency/Hz

Start Value		End Value	⌀
	2.000 000 000 000 GHz		2.000 000 000 000 GHz

Increment Value	
	200.000 000 000 MHz

✓ Fill

To fill the table, select "Fill".

Note: Once you enter a value or fill a column, the editor automatically adds preset values in the other columns. This functionality protects against data loss, otherwise incomplete rows will be lost when saving. You can simply override 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, levels in dBm or dwell times in s.

"Start Value / End Value"
Sets the start value for frequency, level or dwell time. 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".

5.4.4.3 Import/Export List Files

Access:

1. Select one of the following:
   - "Sweep" > "List mode".
   - "Level" > "User Correction".
   - "Modulation > Pulse Modulation > Pulse Generator > Pulse Mode = Train".

2. Select "Import/Export".
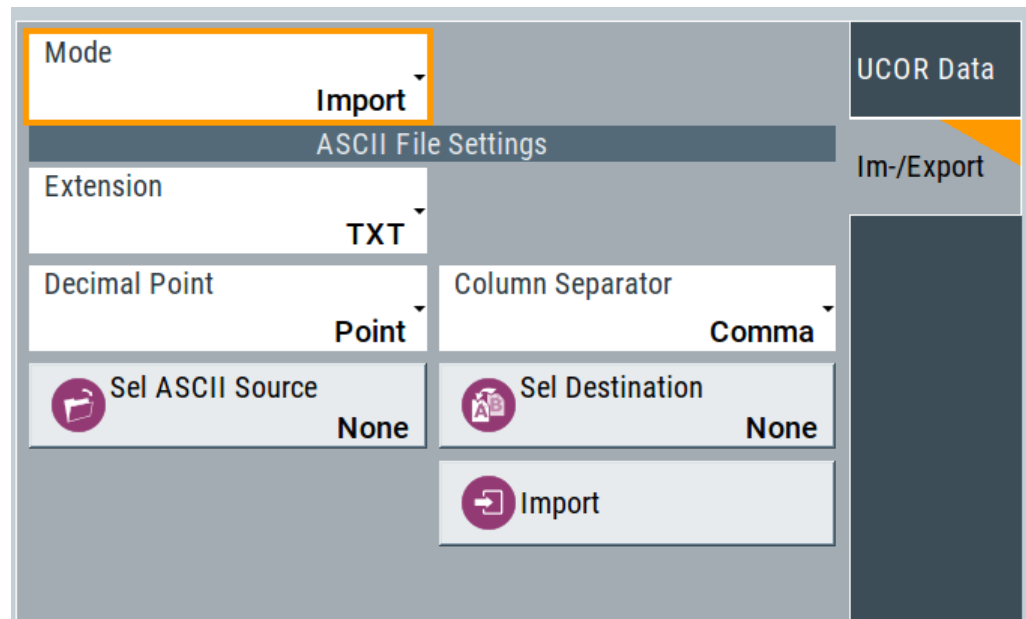
Figure 5-2: Im-/Export dialog (example with UCOR settings)

The "Import/Export" dialog contains all functions and settings to import externally created list 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.

Settings

Mode

Selects import or export of a data list file. The provided parameters vary according to the selected mode.

Remote command:

[:SOURce<hw>]:LIST:DEXChange:MODE on page 434

[:SOURce<hw>]:CORRection:DEXChange:MODE on page 401

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE on page 384

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>]:LIST:DEXChange:AFILe:EXTension` on page 433

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal` on page 433

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn` on page 433

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension` on page 399

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal`
on page 400

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn`
on page 400

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension` on page 384

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal`
on page 384

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn`
on page 384

Select (ASCII) Source/Select (ASCII) Destination
In "Mode > Import", access the file select dialog that provides standard file handling
functions.

Where:
- "Select ASCII Source": defines the file to be loaded (imported)
- "Select ASCII Destination": selects the filename under that the loaded file is saved

Remote command:

`[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog?` on page 432

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect` on page 433

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?` on page 399

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect` on page 400

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog?` on page 385

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect` on page 385

Select Source/Select ASCII Destination
In "Mode > Export", access the file select dialog that provides standard file handling
functions.

Where:
- "Select Source": selects the file to be exported
- "Select ASCII Destination": defines the filename and the file path for the exported
  file

Remote command:

`[:SOURce<hw>]:LIST:DEXChange:SELect` on page 434

`[:SOURce<hw>]:CORRection:DEXChange:SELect` on page 401

`[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect` on page 385

Import / Export
Imports or exports the selected data list file, depending on the current mode.

Remote command:

`[:SOURce<hw>]:LIST:DEXChange:EXECute` on page 432

`[:SOURce<hw>]:CORRection:DEXChange:EXECute` on page 400

`[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute` on page 385

5.4.5 Pulse Graph

Option: see Chapter 5.1, "Required Options", on page 68.

Access:

► Select "Modulation" > "Pulse Modulation > Pulse Graph".

The pulse graph is the graphical representation of the current pulse signal.
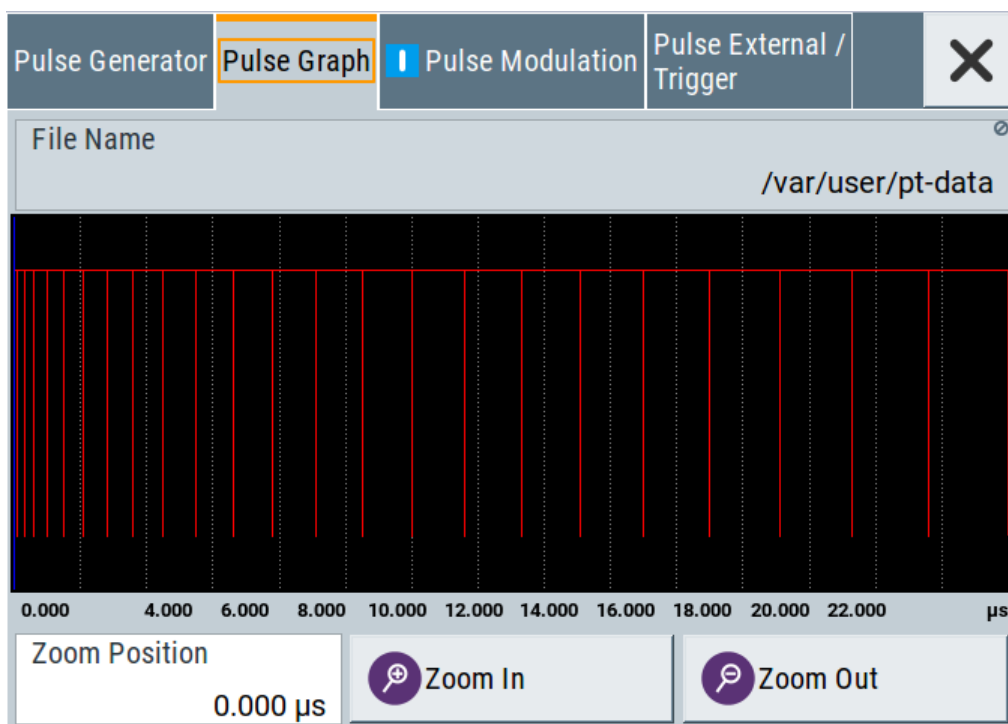
The height of the bars corresponds to the selected amplitude of the pulse signal.

File Name
Indicates the name of the pulse train data file.

To create or select a file, see "Pulse Train Data" on page 90.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 383

Zooming
You can zoom into the diagram to visualize the graph in more detail:
- "Zoom Position": Sets the focus on the time axis where to enlarge the graph.
- "Zoom In": Enlarges the graph at the selected position.

- "Zoom Out" for the reverse operation.

5.4.6 Pulse External / Trigger Settings

Access:

► Select "Modulation" > "Pulse Modulation > Pulse External / Trigger".
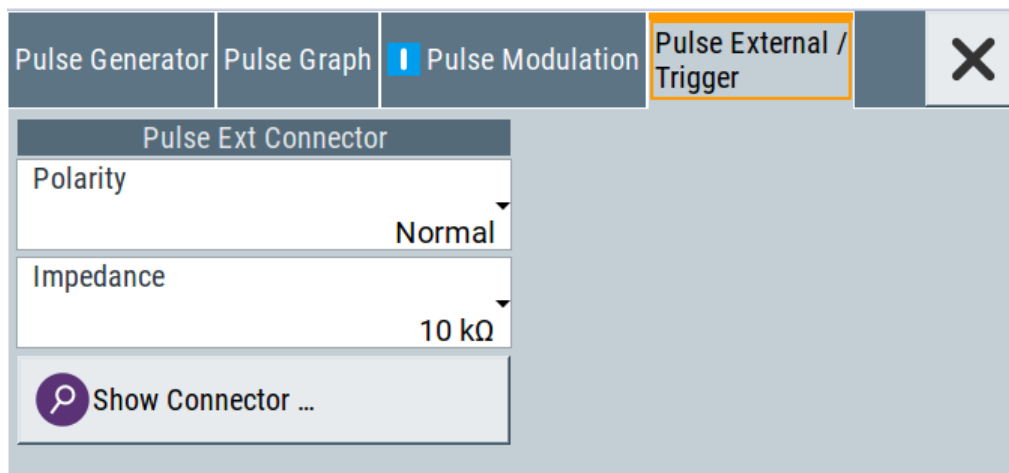
The dialog specifies some characteristics of the Pulse Ext. connector.
This connector is common for the pulse generator and the pulse modulator. For an overview, see "Input and output connectors" on page 69.

Settings

Polarity
Sets the polarity of the active slope of a pulse input signal, that is the external pulse modulation signal.

Remote command:
[:SOURce<hw>]:PULM:POLarity on page 380

Impedance
Sets the input impedance.

Remote command:
[:SOURce<hw>]:PULM:IMPedance on page 380

Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

5.4.7 FM, PhiM and AM Modulation Sources

Access:

► Select "Modulation > Modulation Sources".

In the "Sources" tab, you can configure an LF modulation signal for performing analog modulations. It includes the setting parameters of the internal LF-and multi-function generators, the noise generator, and an external signal source.

5.4.7.1 Source > LF Generator Settings

Access:

► Select "Modulation" > "Modulation Sources > LF Generator".
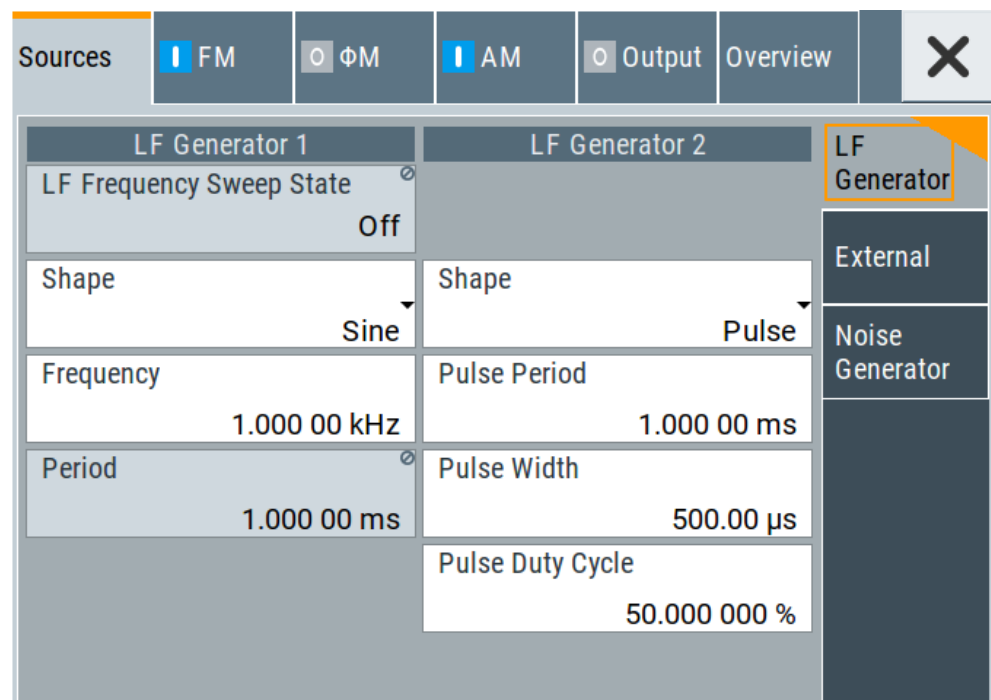
The internal LF signal can the modulation signal source for any of the analog modulations. The LF signal applies to all modulations which use the internal modulation signal. Therefore, any modification of the LF signal immediately affects all currently active modulations.

Settings

State (LF frequency sweep)

Status of the LF frequency sweep signal.

You find this parameter in two dialogs:
- "LF Frequency Sweep" turns on/off the signal generation.
  See Sweep Mode Settings for access.
- "Analog Modulation Sources" displays the current state (read-only). If it is turned on, this dialog provides the varying sweep frequency, see Current Frequency.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:

`[:SOURce<hw>]:LFOutput:FREQuency:MODE` on page 412

Shape

Selects the waveform shape of the LF signal.

The "Triangle" and "Trapezoid" waveforms require option R&S SMBB-K24.

"Sine"
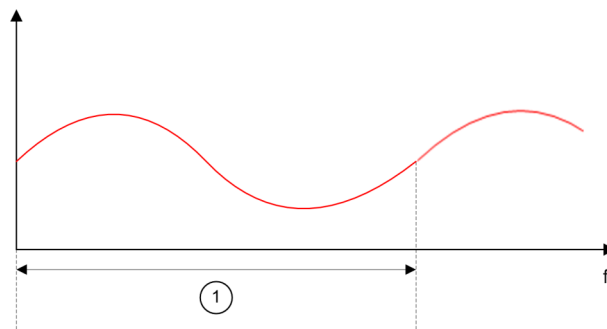
1 = Period

"Pulse"
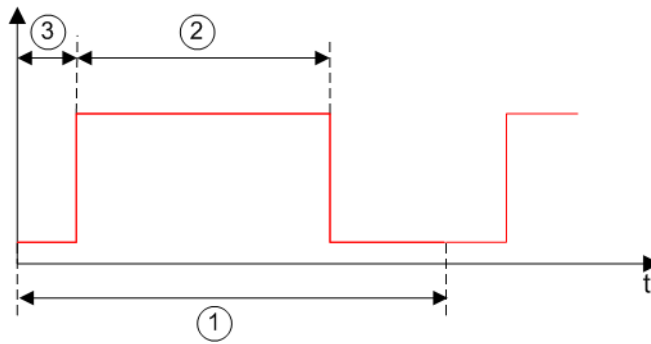
1 = Pulse period
2 = Pulse width
3 = Delay

"Triangle"
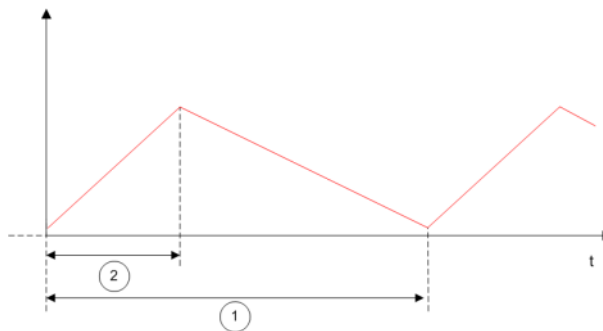
1 = Triangle period
2 = Triangle rise

"Trapezoid"
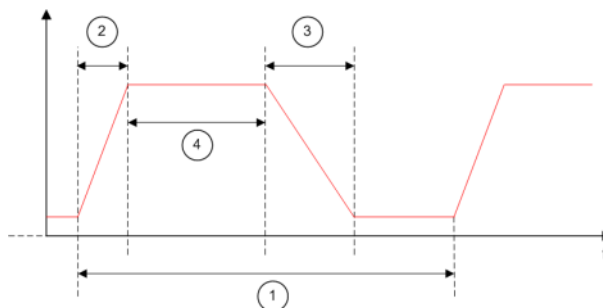
1 = Trapezoid period
2 = Trapezoid rise
3 = Trapezoid fall
4 = Trapezoid high

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe on page 415

Frequency
Sets the frequency of the LF generator for sine signals.

Set the signal shape with the parameter Shape.

Remote command:
[:SOURce]:LFOutput<ch>:FREQuency on page 411

Period

Sets the repetition rate of the generated LF signal for triangle, trapezoid or pulse shapes, see Shape.

The period of sine signals is calculated from the selected Frequency

Remote command:

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:PERiod on page 417

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:PERiod on page 417

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:PERiod on page 416

Pulse Width

Sets the pulse duration of the generated pulse signal.

Remote command:

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:WIDTh on page 416

Pulse Duty Cycle

Sets the ratio between the pulse duration and the pulse period in percent.

Remote command:

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:DCYCle on page 415

Triangle Rise

Sets the time required for the triangle signal to change from low level to high level.

Remote command:

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:RISE on page 418

Trapezoid Rise / Fall

Sets the time required for the trapezoid signal to change from low level to high level, and vice versa.

Remote command:

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:RISE on page 417

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL on page 416

Trapezoid High

Sets how long the trapezoid signal is at high level.

Remote command:

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH on page 416

5.4.7.2 Source > External Settings

Access:

► Select "Modulation" > "Modulation Sources > External".
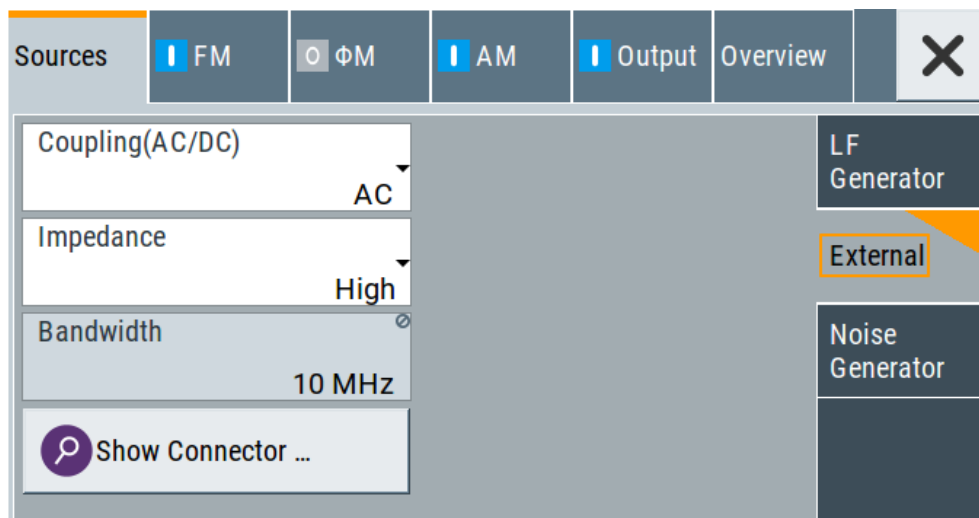
The "External" settings section contains all parameters required to configure the signal of an externally supplied LF signal.

Settings

Coupling (AC/DC)

Selects the coupling mode (AC or DC) for the external signal.

"AC"   Disconnects the DC voltage component and uses only the AC component of the modulation signal.

"DC"   Uses the modulation signal with both components, AC and DC.

Remote command:

[:SOURce<hw>]:INPut:MODext:COUPling on page 407

Impedance

Sets the impedance for the externally supplied signal.

Remote command:

[:SOURce<hw>]:INPut:MODext:IMPedance<ch> on page 408

Bandwidth

Displays the maximum bandwidth of the external LF signal.

Remote command:
[:SOURce]:LFOutput<ch>:BANDwidth? on page 411

Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

5.4.7.3 Source > Noise Generator Settings

Access:

► Select "Modulation" > "Modulation Sources > Noise Generator".
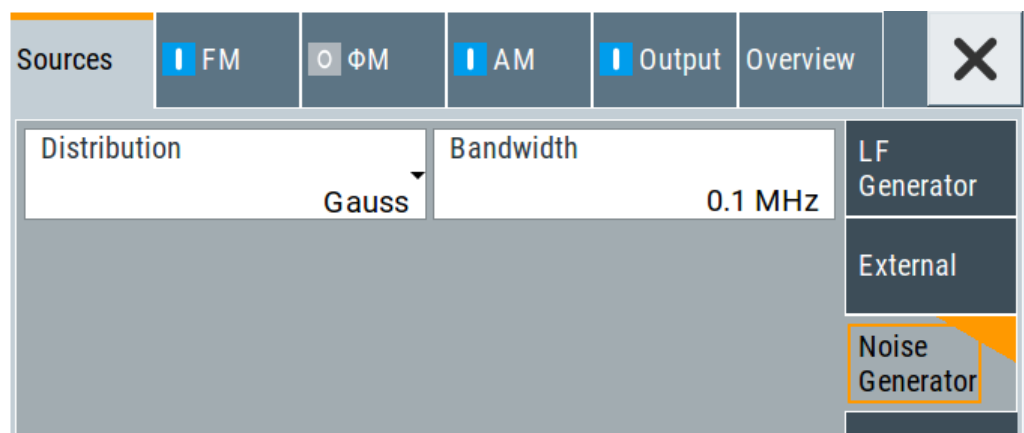
The "Noise Generator" settings contain all parameters to configure the signal of the internal noise generator.

Settings

Distribution
Selects the distribution of the noise power density.

"Gauss"   Generates the noise power according to a Gaussian distribution.

"Equal"   Generates an evenly distributed noise.

Remote command:
[:SOURce<hw>]:NOISe:DISTribution on page 435

Bandwidth
Sets the noise bandwidth as distinct value.

You can set the bandwidth between 100 kHz and 10 MHz in 100 KHz steps.

Remote command:
[:SOURce<hw>]:NOISe:BANDwidth|BWIDth on page 435
[:SOURce<hw>]:NOISe:BWIDth:STATe on page 435

5.4.8 LF Signal Output Settings

Access:

► Select "Modulation" > "LF Output".
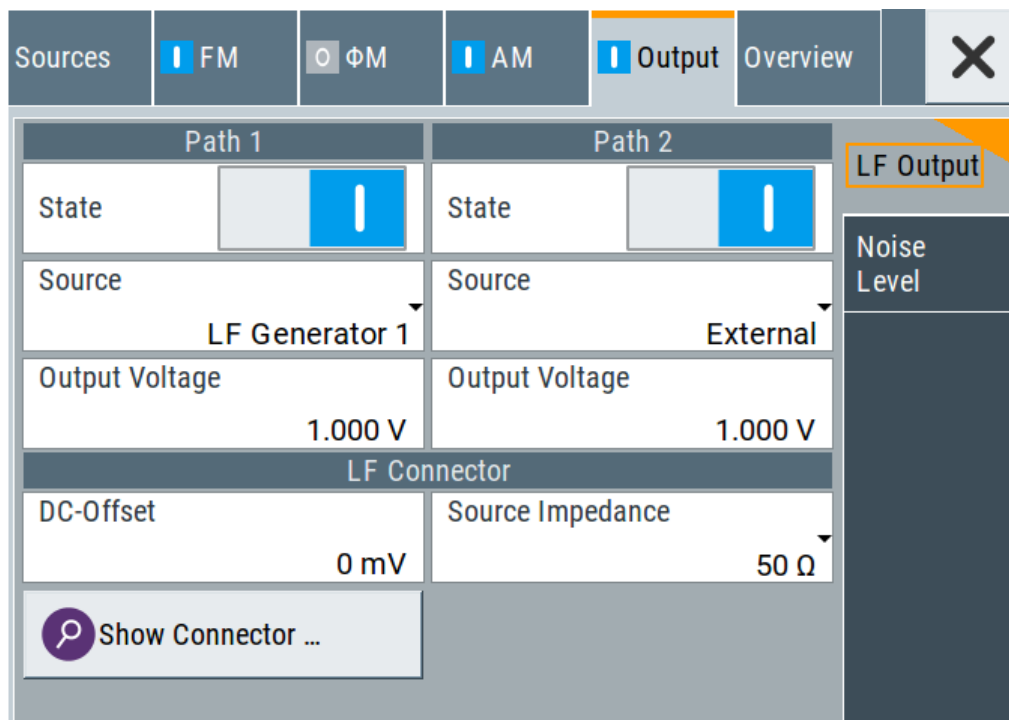
In the "LF Output" tab, you can configure the signal at the LF outputs, determine the output voltage or add a DC offset. Activate both paths to output the sum signal of the two sources.

Settings:

State

Activates the output of the LF signal.

Remote command:

[:SOURce]:LFOutput<ch>[:STATe] on page 413

Source

Select the sources for the signal output at the LF connector. If you activate path 1 *and* 2, those sources are added.

Use the "Show Connector" function to find out where this connector is located.

"LF Generator 1/2"

          Selects one of internally generated LF signals.

"AM"   Option: R&S SMBB-K720

          Selects the AM signal.

"FM/PhiM"   Option: R&S SMBB-K720

          Selects the signal also used by the frequency or phase modulations.

"Noise Generator"

          Selects the internally generated noise signal.

"External"   Selects an externally supplied LF signal.

Remote command:
[:SOURce]:LFOutput<ch>:SOURce on page 414

Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

Output Voltage

Sets the voltage (peak) of the selected LF output source.

Remote command:
[:SOURce]:LFOutput<ch>:INTernal:VOLTage on page 413

DC-Offset

Adds a DC offset to the LF output signal.

Remote command:
[:SOURce]:LFOutput:OFFSet on page 414

Source Impedance

Selects the output impedance of the LF generator.

"50 Ω"

          Selects an output impedance of 50 Ω.

"600 Ω"   Selects an output impedance of 600 Ω.

Remote command:
[:SOURce]:LFOutput:SIMPedance on page 414

Load Impedance

Sets the specification of the load impedance interconnected to the LF generator output.

This parameter is available in case of activated R&S SMB100A or R&S SML0x emulations only, see "Remote Access Settings" > "Instrument Emulations" > "Language" on page 268.

These signal generators come with an LF generator source impedance of 10 Ohm which is not available with the R&S SMB100B.

The set LF generator load impedance enables the R&S SMB100B to emulate the 10 Ohm LF generator source impedance of these generators by a corresponding increase of the open circuit LF generator output voltage.

The load impedance setting is not affected by an instrument preset ([Preset] key or `*RST`), restart or the "Save/Recall" function. It is reset to the default value of 1 MOhm by a factory preset only.

Remote command:
n.a.

Noise Level
Access:
● Select "Modulation" > "Output > Noise Level".
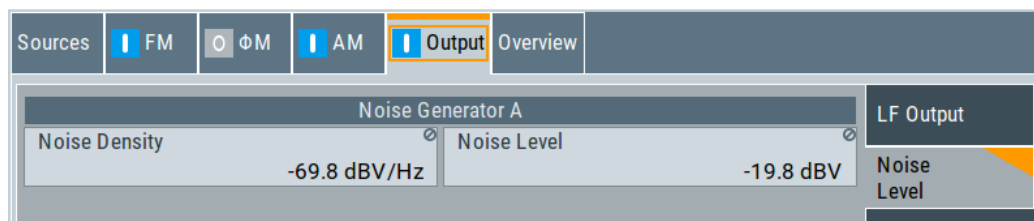
Noise Density ← Noise Level
Indicates the level of the noise signal for a bandwidth of 1 Hz (relative).

Remote command:
[:SOURce<hw>]:NOISe:LEVel:RELative? on page 435

Noise Level ← Noise Level
Indicates the level of the noise signal per Hz within the total bandwidth (absolute).

Remote command:
[:SOURce<hw>]:NOISe:LEVel[:ABSolute]? on page 436

5.4.9 Overview

Option: AM and FM/PM require R&S SMBB-K720

Access:

► Select "Modulation" > "Modulation Sources > Overview".
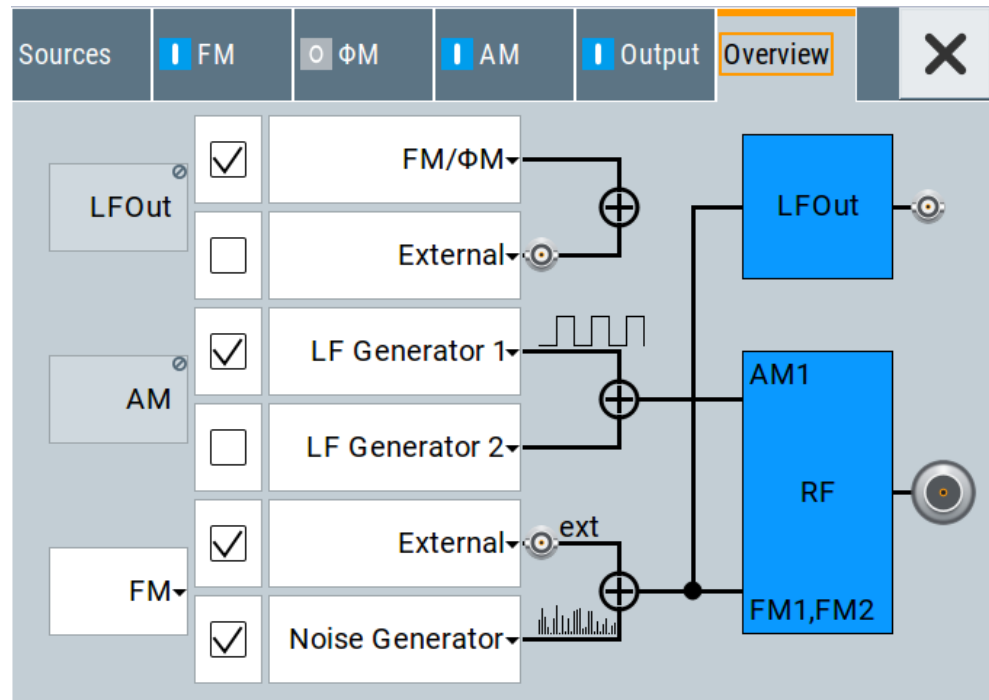
Blue color	= Active output signal (AM and FM)
Gray color	= Inactive output signal (LF Out)
Miniature graph	= Indicates an active source
Connectors	= Indicate a connector (e.g. external signal) is involved in the path of the signal

The "Overview" tab is an interactive diagram that indicates the active modulations and the signal being output.

Here you can:

● Select the output signal ("LF Out") in one or two paths; the setting acts as the parameter "LF Output Source"
● Select the source for each modulation and modulation path; the setting acts as the parameter "Source"
● Activate modulation in one or two paths; the setting acts as the parameter "State"
  To generate a two-tone signal composed form the two paths of the same modulation type, activate both paths.
● The "FM" box allows switching to "PhiM", but those modulations are mutually exclusive.

LFOut

Label for the LF output settings in the overview.

Remote command:
n.a.

AM

Label for the amplitude modulation settings in the overview.

Remote command:
n.a.

FM/PhiM

Selects the modulation signal to be assigned to the output. You can assign the frequency or phase modulated signal.

Remote command:
n.a.

5.5 How to Generate an Amplitude Modulated Signal

The following examples use the internal LF generator.

To set the frequency and level of the RF signal

1. Press [Preset] to start from a defined state.

2. In the status bar, set "Frequency = 2 GHz".

3. Set "Level = -20 dBm".

To configure the modulation signal (LF generator)

1. Select "Modulation" > "Modulation Source".

2. In the "Sources" tab, select "Shape > Sine".

3. Set "Frequency = 20 kHz".

    The period is calculated automatically and indicates "Period = 50.00 µs".

To configure the amplitude modulation settings

1. In "Modulation" dialog, select the "AM" tab.

2. Set "Source = LF Generator1"

3. Set "Depth = 30%"

4. Select "State = I" to activate the modulation.

5. Set "Level > RF ON" to enable signal output.

5.6 How to Generate a Pulse Modulated Signal

The following example uses the internal pulse generator.

To set the frequency and level of the RF signal

1. Press [Preset].

2. In the status bar, set "Frequency = 4 GHz".

3. Set "Level = -25 dBm".

To configure the pulse generator

1. Select "Modulation" > "Pulse Generator".

2. Select "Pulse Mode = Double".

3. Set "Pulse Period = 10 us".

4. Set "Pulse Width = 2 us".

5. Set "Double Pulse Width = 1.2 us".

6. Set "Double Pulse Delay = 4.5 us".

7. Activate "Pulse Output State".

8. Set "Trigger Mode = Auto".

   In the "Pulse Graph" tab, you can view the generated pulse signal graphically.

To enable pulse modulation

1. Select the "Pulse Modulation" tab.

2. Set "State = I" to activate pulse modulation.

3. Set "Level > RF ON" to enable signal output.

5.7 How to Generate a Pulse Train Modulated Signal

The following example uses the internal pulse generator.

To set the frequency and level of the RF signal

1. Press [Preset].

2. In the status bar, set "Frequency = 6 GHz".

3. Set "Level = -25 dBm".

To configure the pulse generator

1. Select "Modulation" > "Pulse Generator".

2. Select "Pulse Mode = Train".

3. Select "Pulse Train Data".
   Accesses the standard function for file handling.

4. Select an existing file or select "New" to create one.

5. Define the filename.
    Select "Edit Pulse Train Data", if the file is empty or to control and change the values.

6. In the "Edit Pulse Train Data" dialog, enter the pulse on/off times and pulse repetition values.

    For example:
    ● "On-Time = 500 us", "OFF-Time = 2 ms", "Count = 2"
    ● "On-Time = 100 us", "OFF-Time = 2.5 ms", "Count = 1"
    ● "On-Time = 10 us", "OFF-Time = 50 us", "Count = 10"

7. "Save" the file and close the dialog.
    The instrument returns to the /var/user/ where it has saved the file.

8. Select the file in the directory.

9. Confirm with "Select".

10. In the "Pulse Generator" dialog, select "Pulse Output State = On".

11. Set "Trigger Mode = Auto".

    In the "Pulse Graph" tab, you can view the generated pulse signal graphically.

To enable pulse train modulation

1. Select the "Pulse Modulation" tab.

2. Set "State = I".

3. Set "Level > RF ON" to enable signal output.

6 List and Sweep Mode

The operating modes "List" and "Sweep" allow you to generate an RF signal having periodically varying frequencies or amplitudes.

A signal generated with varying parameters scans a certain range of varying values of a parameter, with defined start and end points, and can be repeated cyclically.

The R&S SMB100B supports two basic methods:

- **Sweep** mode
  The instrument generates an RF signal which varies its frequency or level values in discrete steps between the start and end values. The values change according to a specific shape like sawtooth or triangle. The spacing is linear or logarithmmic.
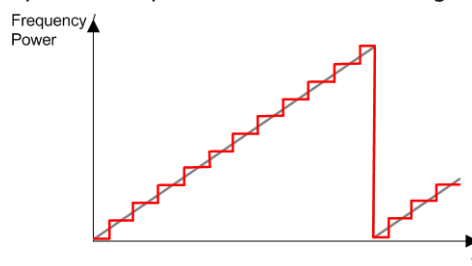
  Figure 6-1: Schematic representation of a signal generated in sweep mode

  The main application field of the "Sweep" mode is to determine the frequency response a DUT.

- **List** mode
  The instrument generates a varying output signal, based on a previously saved list with frequency, amplitude and step width values. While in sweep mode the frequency **or** the level values change, in list mode you can vary **both parameters simultaneously**. The frequency and level values do not need to have ascending or descending order, they can vary arbitrarily.
  You can use a global dwell time, which means that the time interval is constant for all steps of the list, or different dwell times for each value pair.
  Figure 6-2 represents the frequency and power value pairs, in this case with the dwell time set the same for all steps (global dwell time).
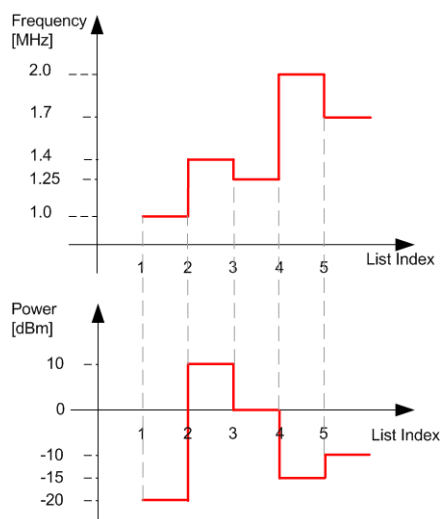
Figure 6-2: Schematic representation of a signal generated in list mode (global dwell time)

The list mode is especially useful in high-speed measurements with fast changing frequency and level settings.

Note that the shown diagrams represent the behaviour in theory. In real signal generation, the instruments usually have a blank time when the frequency or level changes.

Interactions and characteristics of list and sweep mode

- Activating the list mode automatically deactivates all RF and LF sweeps and vice versa.

- In list processing mode, the frequency and level display in the status bar is disabled.
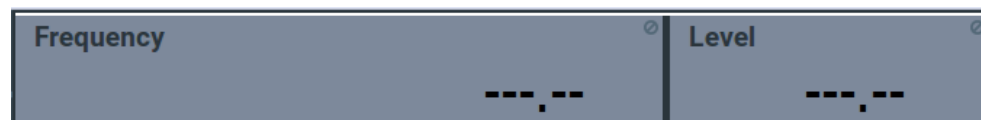
- The sweep modes only work with a *global* dwell time, that means the time intervals are constant during signal generation.

- If you want to hold a running sweep at a specific frequency or level value, enter the value in the status bar. The sweep stops immediately.

- We recommend that you switch off the display update for optimum sweep performance, especially with short dwell times
See

6.1 Signal Generation and Triggering in the Sweep and List Modes

In both operating modes "List" and "Sweep", triggering and signal generation follow the same principle. The instrument generates the signal continuously (that means triggered automatically) or in individual steps (controlled manually by an internal or external trigger signal).

The instrument expects the trigger signal at the Inst Trig connector.

If the dwell time in sweep or list mode is too short or external trigger signals come too fast, the signal generation delays. As the delay increases, the R&S SMB100B signals an overrun, or even stops sweep or list mode signal generation, if the delay gets too long.

The instrument diplays corresponding error messages.

The figures in this section give an overview on the signal generation in the sweep and list modes and the appropriate triggering. The figures show the signal state after activating the mode and the generation of the signal when a trigger event occurs. For each mode, the relevant parameters and settings are briefly explained.

Each "Sweep" and "List" mode dialog provides also a "Reset" function that sets the signal to the initial value or the beginning of the list. Depending on the selected trigger mode, the signal generation proceeds accordingly.

The naming of the selection parameters in manual control (GUI) sometimes deviates from the naming in the remote-control commands. In addition, the value names of the selection parameters used in the signal generator partly differ from the SCPI syntax. The instrument accepts all value names.

The correlation between the manual control and the corresponding remote control commands, including the SCPI conform syntax are explained for each mode (see the cross-reference tables).

See also the following programming examples on the sweep and list modes in remote control:

- Example "Setup an RF frequency or power sweep" on page 453
- Example "Setup an LF sweep" on page 408
- Example "Create an RF list and activate the list mode" on page 422

Auto mode (Sweep/List)
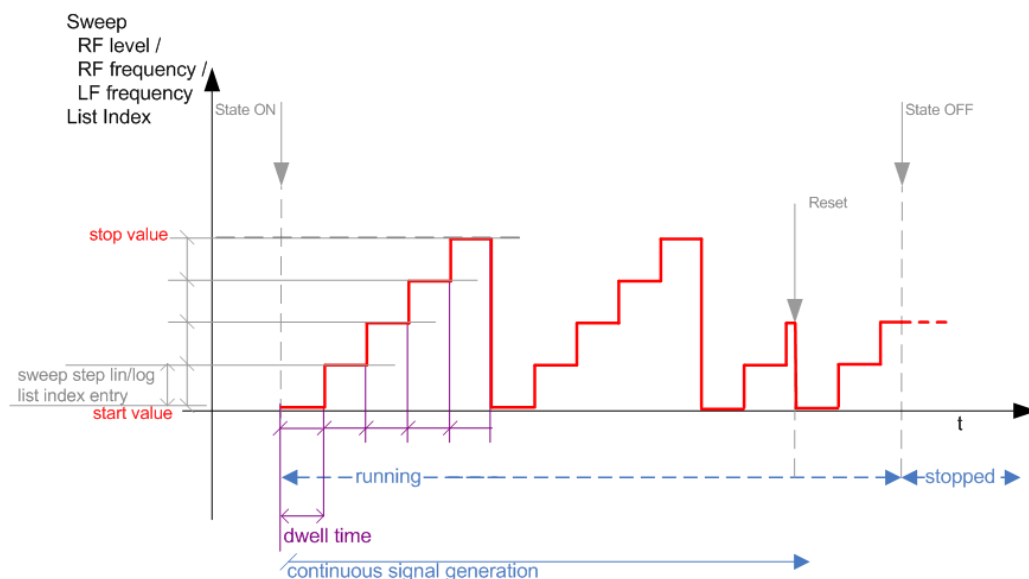
Figure 6-3: Auto mode (Sweep/List)

- The instrument generates the signal continuously.
- Trigger mode "Auto" is prerequisite (default). It causes the continuous generation of the sweep signal.
- Starts signal generation immediately with "State = On".
- Switches automatically to the next step when the Dwell time has elapsed.
- Stops signal generation with "State = Off".

Table 6-1: Cross-reference between manual and remote control in Auto mode (Sweep/List)

Manual control mode: "Auto"	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	:TRIGger<hw>:FSWeep:SOURce AUTO [IMMediate] :SOURce<hw>:SWEep:FREQuency:MODE AUTO
RF level sweep	:TRIGger<hw>:PSWeep:SOURce AUTO [IMMediate] :SOURce<hw>:SWEep:POWer:MODE AUTO
LF frequency sweep	:TRIGger<hw>:LFFSweep:SOURce AUTO [IMMediate] :SOURce<hw>:LFOutput<ch>:SWEep:FREQuency:MODE AUTO
List	:SOURce<hw>:LIST:MODE AUTO :SOURce<hw>:LIST:TRIGger:SOURce AUTO

Single / Extern Single mode (Sweep/List)
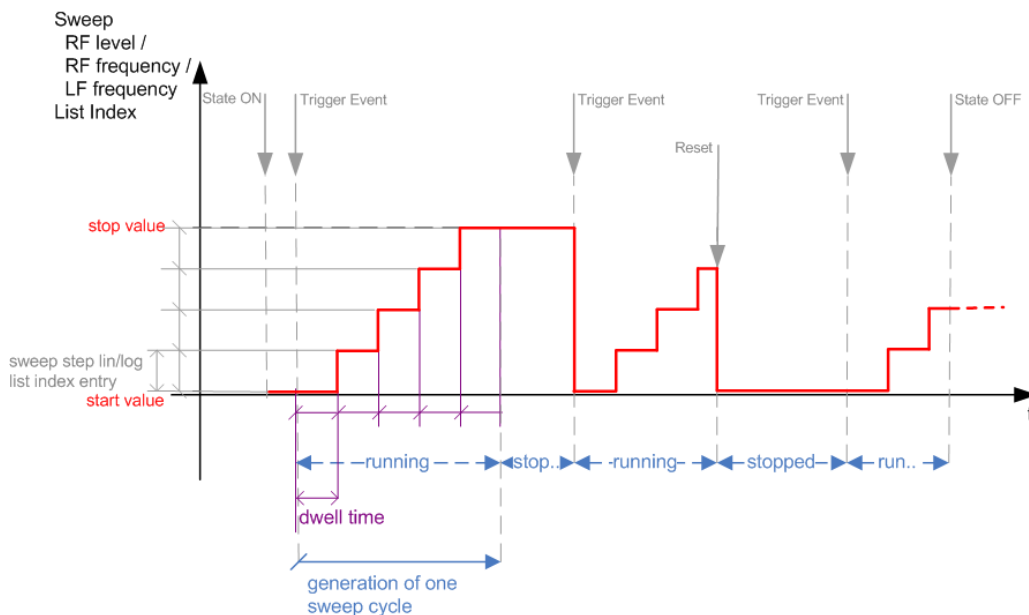
Figure 6-4: Single / Extern Single mode (sweep / list)

In single mode, you can specify, that the signal returns to the start value when a sweep cycle has been completed.

See "The Retrace function" on page 119 for details.

- The instrument generates a single sweep cycle.
- Trigger mode "Manual". A trigger event initiates one sweep from the start value to the end value.
- "State = On" sets the signal to the start value: the sweep start frequency, the sweep start power or the frequency-power value pair of the selected index in the list.
- Starts signal generation with a trigger event.
- Switches automatically to the next step when the Dwell time has elapsed.
- Stops signal generation at the set end value and waits for the subsequent trigger event.
- Trigger sources:
  – The "Execute Single Sweep" function.
  – The corresponding remote control command.
  – An externally applied trigger signal.
- "State = Off" stops the signal generation in sweep or list mode.

Table 6-2: Cross-reference between manual and remote control in Single / Extern Single modes (Sweep/List)

Manual control mode: "Single / Extern Single"	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	`:TRIGger<hw>:FSWeep:SOURce SINGle [BUS]` "Single" **or** `:TRIGger<hw>:FSWeep:SOURce EXTernal [EXTernal]` "Extern Single" `:SOURce<hw>:SWEep:FREQuency:MODE AUTO`
RF level sweep	`:TRIGger<hw>:PSWeep:SOURce SINGle [BUS]` for "Single" **or** `:TRIGger<hw>:PSWeep:SOURce EXTernal [EXTernal]` for "Extern Single" `:SOURce<hw>:SWEep:POWer:MODE AUTO`
LF frequency sweep	`:TRIGger<hw>:LFFSweep:SOURce SINGle [BUS]` "Single" **or** `:TRIGger<hw>:LFFSweep:SOURce EXTernal [EXTernal]` "Extern Single" `:SOURce<hw>:LFOutput<ch>:SWEep:FREQuency:MODE AUTO`
List	`:SOURce<hw>:LIST:TRIGger:SOURce SINGle` "Single" **or** `:SOURce<hw>:LIST:TRIGger:SOURce EXTernal` "Extern Single" `:SOURce<hw>:LIST:MODE AUTO`

Step / Extern Step mode (Sweep/List)
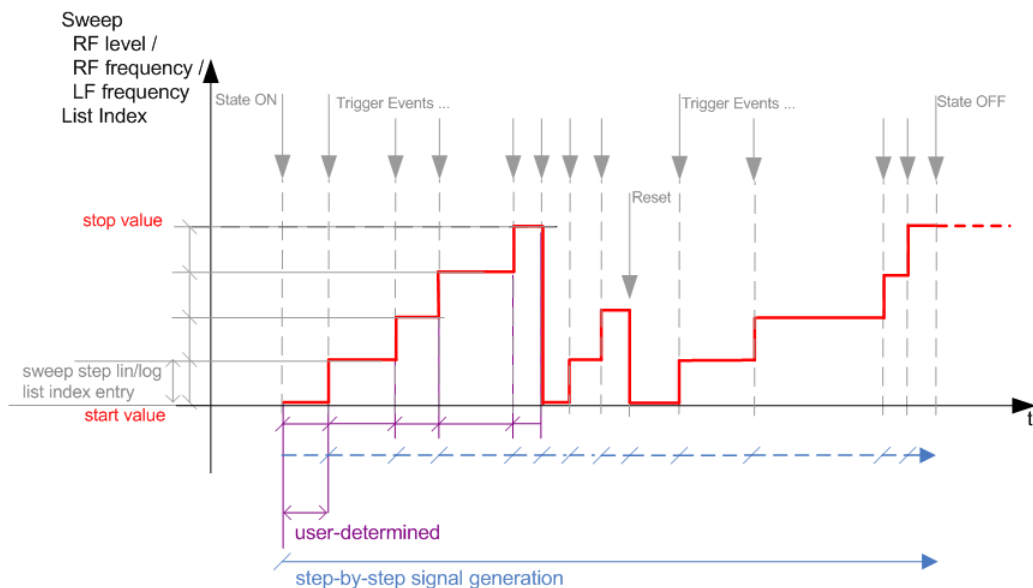
Figure 6-5: Step / Extern Step mode (sweep / list)

- The instrument generates the signal step-by-step.
- Starts signal generation with "State = On".
- Switches to the next step with a manual action.
  If the end value is reached, signal generation starts again from the beginning.
- Stops signal generation with "State = Off".

- Trigger sources:
  - The rotary knob at the front panel.
  - The [Arrow] keys at the front panel.
  - The corresponding remote control commands.
  - An externally applied trigger signal.

To step through the sweep frequencies or levels:

- In manual mode:
  - Set the Current Frequency or Current Level values
  - Use the [Up] and [Down] keys or the rotary knob
- In remote control mode:
  - Use the commands `[:SOURce<hw>]:FREQuency:MANual` or `[:SOURce<hw>]:POWer:MANual` with the UP or DOWN parameter

Steps that would exceed the sweep range are ignored.

Table 6-3: Cross-reference between manual and remote control in Step / Extern Step modes (Sweep/ List)

Manual control mode: "Step / Extern Step"	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	`:TRIGger<hw>:FSWeep:SOURce SINGle [BUS]` "Step" **or** `:TRIGger<hw>:FSWeep:SOURce EXTernal [EXTernal]` for "Extern Step" `:SOURce<hw>:SWEep:FREQuency:MODE STEP`
RF level sweep	`:TRIGger<hw>:PSWeep:SOURce SINGle [BUS]` "Step" **or** `:TRIGger<hw>:PSWeep:SOURce EXTernal [EXTenal]` "Extern Step" `:SOURce<hw>:SWEep:POWer:MODE STEP`
LF frequency sweep	`:TRIGger<hw>:LFFSweep:SOURce SINGle [BUS]` "Step" **or** `:TRIGger<hw>:LFFSweep:SOURce EXTernal [EXTenal]` "Extern Step" `:SOURce<hw>:LFOutput<ch>:SWEep:FREQuency:MODE STEP`
List	`:SOURce<hw>:LIST:TRIGger:SOURce SINGle` "Step" **or** `:SOURce<hw>:LIST:TRIGger:SOURce EXTernal` "Extern Step" `:SOURce<hw>:LIST:MODE STEP`

Extern Start/Stop mode (sweep)
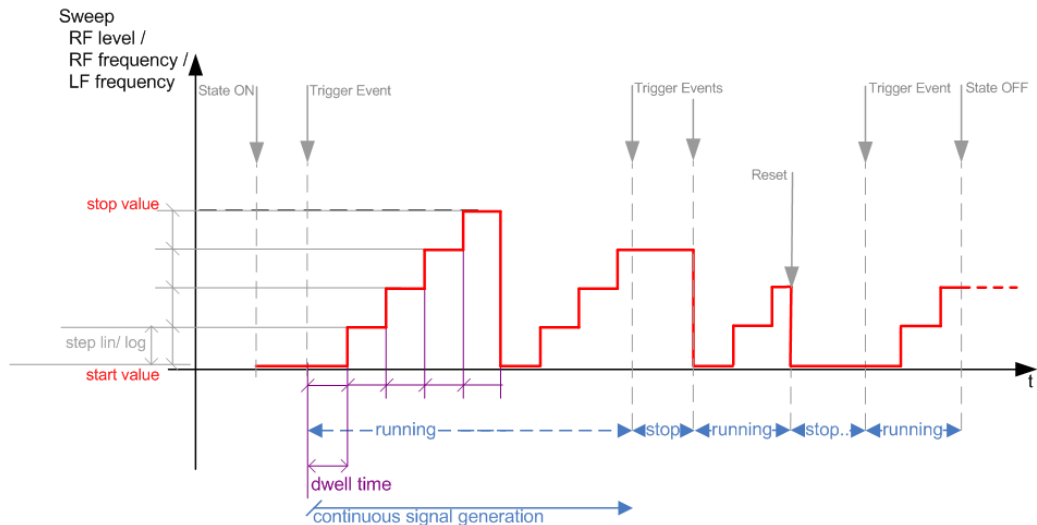
Figure 6-6: Extern Start/Stop mode (sweep)

- The instrument generates the signal continuously.
- Trigger mode "Auto" and "Sweep > State = On" are prerequisite.
- State "On" sets the signal to the start value, that is one of the following:
  – Sweep start frequency
  – Sweep start power
  – Frequency-power value pair of the selected index in the list
- Starts signal generation with a trigger event.
- Switches automatically to the next sweep step when the Dwell time has elapsed. If the end value is reached, signal generation continues with the next sweep cycle.
- Stops signal generation with the next external trigger event.
- Starts the signal generation again with the next trigger event, beginning at the start value.
- "State = Off" stops the signal generation in sweep or list mode.
- Trigger source: An externally applied trigger signal.

Table 6-4: Cross-reference between manual and remote control in Extern Start/Stop modes (sweep)

Manual control mode: "Extern Start/Stop"	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	`:TRIGger<hw>:FSWeep:SOURce EAUTo [-]` `:SOURce<hw>:SWEep:FREQuency:MODE AUTO`
RF level sweep	`:TRIGger<hw>:PSWeep:SOURce EAUTo [-]` `:SOURce<hw>:SWEep:POWer:MODE AUTO`
LF frequency sweep	`:TRIGger<hw>:LFFSweep:SOURce EAUTo [-]` `:SOURce<hw>:LFOutput<ch>:SWEep:FREQuency:MODE AUTO`

Manual mode (Sweep/List)

The **manual** mode only applies to remote control. It is not visible in the graphical user interface of the instrument and is described here for completeness.
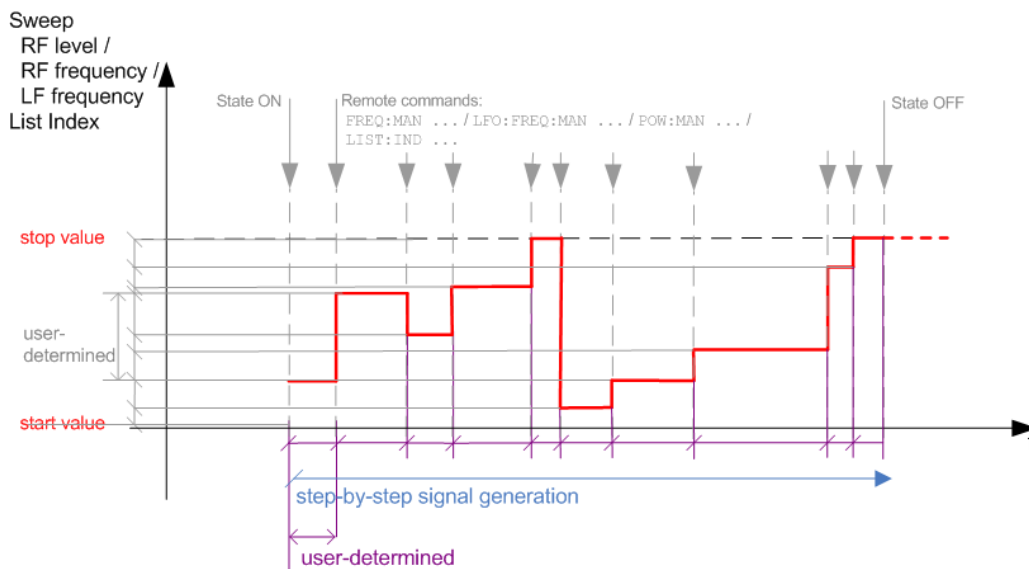
Figure 6-7: Manual mode in remote control (sweep / list)

- The instrument generates the signal in steps.
- Starts signal generation with "State = On".
- Switches to the next step with a user defined setting via remote control.
  You can arbitrarily select a value within the range of the start and stop values by setting the frequency, power or index using the corresponding remote control command. There is no ascending or descending order.
- Stops signal generation with "State = Off".

Table 6-5: Remote control commands in manual mode (Sweep/List)

Remote control mode: Manual	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	:SOURce<hw>:FREQuency:MANUal <Manual>
RF level sweep	:SOURce<hw>:POWer:MANual <Manual>
LF frequency sweep	:SOURce<hw>:LFOUTput:FREQuency:MANual <Manual>
List	:SOURce<hw>:LIST:INDex <Index>

The Retrace function
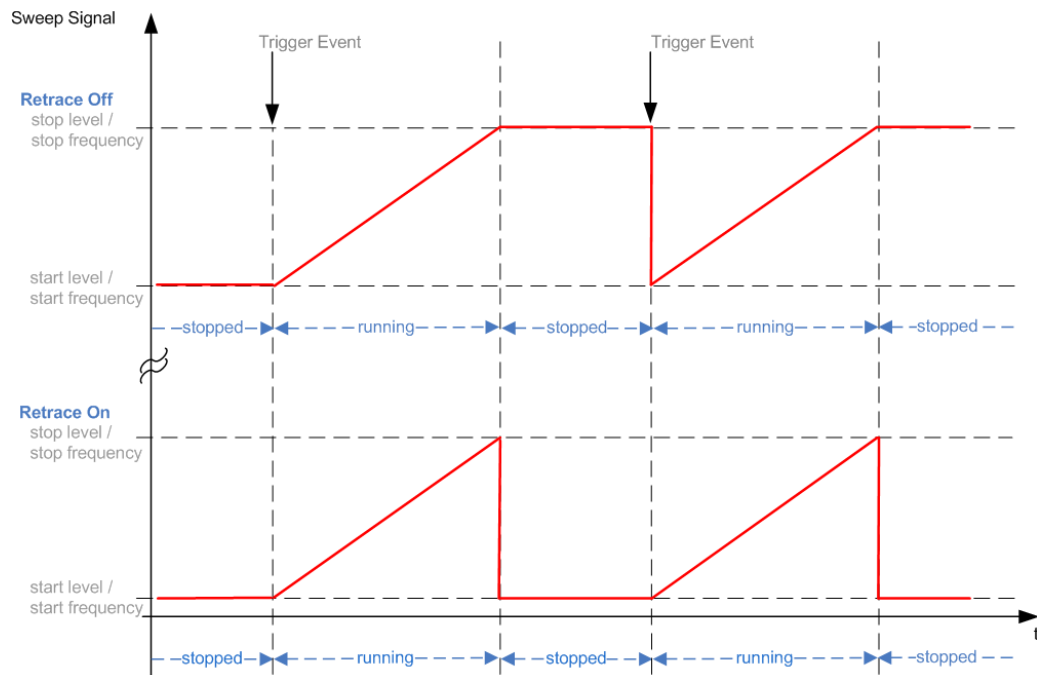
Retrace is a function especially designed for "Single" sweep modes, when the sweep signal follows a sawtooth shape. Working in this mode, the instrument performs a single sweep cycle when a trigger event occurs. The signal generation stops at the set end point (stop frequency or stop level), and waits for the next trigger event.

In this state, the upper value of the signal remains at the output until the next cycle starts. In particular, if you generate a level sweep signal, the high amplitude of the signal is output for a certain time. To protect the DUT from overload, the retrace function immediately resets the signal value to the start value at the end of a sweep cycle. It returns to the start level or start frequency until the next trigger is applied.

You can use the "Retrace" function if "Sweep > Mode = Single/External Single" and "Shape = Sawtooth", see:

● " Shape" on page 128
● "Mode" on page 127

6.2 About Sweep Mode

In sweep mode, the signal generator scans the sweep range gradually from one point to another, using a defined step size and following a triangle or sawtooth shape. This mode also enables you to change direction, that means, it is possible to step backwards.

See Chapter 6.2.2, "Sweep Signal Shapes", on page 122.

Configuration and operation of sweep mode signals

- The R&S SMB100B generates a sweep signal by varying one of the following parameters: the *RF frequency*, the *LF frequency* or the *RF level*.
- In all sweep modes, you can perform a complete sweep cycle once, repeat the cycle continuously or step through it gradually.
- The instrument generates the sweep signal according to the sweep settings.
- The "Reset Sweep" function, provided in the sweep settings dialogs enables you to reset the sweep to its initial value and restart it.

> **Impact of changing the sweep mode during performance**
>
> If you change the sweep mode during the execution, the signal generator stops the sweep and starts with the next trigger event at the initial value.

6.2.1 Correlating Parameters in Sweep Mode

A sweep signal is a periodic signal that changes its frequency or level from a starting value to an ending value in a defined time.

The R&S SMB100B provides various possibilities to configure a sweep signal. For example, you can determine the sweep range by the start and end values, or based on the start value and span. In any case, related parameters are adjusted accordingly.

The formulas below show how the sweep parameters correlate and the corresponding calculation basis, by the frequency and offset settings. Apart from "Center Frequency", "Span" and "Step_lin", the values apply accordingly to the level settings.

Table 6-6: Variables that are used in the following formulas

Variable	Description
Sweep range	Defined frequency or level value range
f_{CENTer}	Defined center frequency
f_{SPAN}	Defined extend of the sweep range
f_{OFFSet}	Frequency offset
f_{STARt}	Start frequency of the sweep range
f_{STOP}	End frequency of the sweep range
f_1	Current sweep frequency
f_2	Next, subsequent sweep frequency
step_lin	Step size in linear scaling
step_log	Step size in logarithmic scaling
POINts	Number of steps within the sweep range

Sweep range

The sweep range is defined by a start and an end value. How the remaining parameters correlate is shown below.

Offset = 0

Sweep Range = f_{STARt} to f_{STOP}

$f_{CENTer} = (f_{STARt} + f_{STOP})/2$

$f_{SPAN} = (f_{STOP} - f_{STARt})$

Where:

$f_{STARt} = f_{CENTer} - (f_{SPAN}/2)$

$f_{STOP} = f_{CENTer} + (f_{SPAN}/2)$

Offset≠0

A defined offset also affects the sweep range and the center frequency. Therefore, the set frequencies are only absolute values, if the Offset = 0. Offset ≠ 0 shifts the frequencies with the offset value:

Sweep Range = $f_{STARt} + f_{OFFSet}$ to $f_{STOP} + f_{OFFSet}$

$f_{CENTer} = f_{CENTer} + f_{OFFSet}$

$f_{SPAN} = f_{SPAN} + f_{OFFSet}$

The value range of the instrument is calculated as follows:

$RF_{min} + f_{OFFSet}$ to $RF_{max} + f_{OFFSet}$

It is possible to set $f_{STARt} > f_{STOP}$ and $f_{STARt} < f_{STOP}$, so that even a negative value is permitted for the "Span".

If you change the start and/or stop frequency, the span and center frequency change accordingly, and vice versa.

Sweep steps

In the following, you see how the sweep steps are calculated depending on the defined spacing mode. The formulas show a frequency sweep, but apply to the level settings in the same way.

The step size is added to the current value, to get the subsequent sweep step.

With **linear** scaling, the next frequency is calculated according to:

$f_2 = f_1 + step\_lin$

In the **logarithmic** scaling, the step size is determined in per cent, as a constant fraction of the current frequency.

Successive frequencies are calculated as follows:

- For $f_{STARt} < f_{STOP}$
  $f_2 = f_1*(1 + step\_log/100)$

If $f_2 > f_{STOP}$, then $f_2 = f_{STOP}$

- For $f_{STARt} > f_{STOP}$
  $f_2 = f_1/(1 + step\_log/100)$
  If $f_2 < f_{STOP}$, then $f_2 = f_{STOP}$

With "Shape = Triangle", the frequency values on the slope from f_{STOP} to f_{STARt} are the same as on the slope from f_{STARt} to f_{STOP}.

If you specify the number of steps within the sweep range, the step size is adjusted according to the following correlation:

- For **linear** sweeps and $f_{STARt} < f_{STOP}$
  $POINts_{frequency} = ((f_{STARt} - f_{STOP})/step\_lin) +1 = (f_{SPAN}/step\_lin) + 1$

- For **logarithmic** sweeps and $f_{STARt} < f_{STOP}$
  $POINts_{frequency} = ((\log f_{STOP} - \log f_{STARt})/\log step\_log) +1$

If step_log changes, the value of POINts is adjusted. The f_{STARt} and f_{STOP} values are retained.

6.2.2 Sweep Signal Shapes

The R&S SMB100B supports the following sweep shapes:

- Sawtooth
  The sweep sequence resembles a sawtooth. One sweep runs from start to stop frequency, or level value respectively. Each subsequent sweep starts again at the start value.
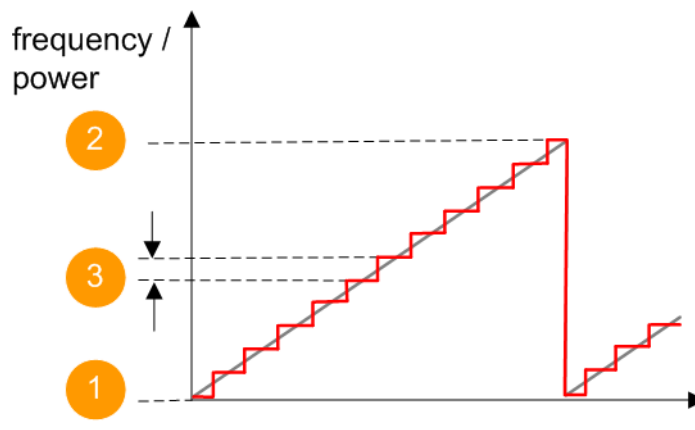
Figure 6-8: Sweep signal sawtooth shape

1 = Start value
2 = Stop value
3 = Step size

- Triangle
  The sweep sequence resembles a triangle. One sweep runs from start to stop value frequency and back. Each subsequent sweep starts at the start value.
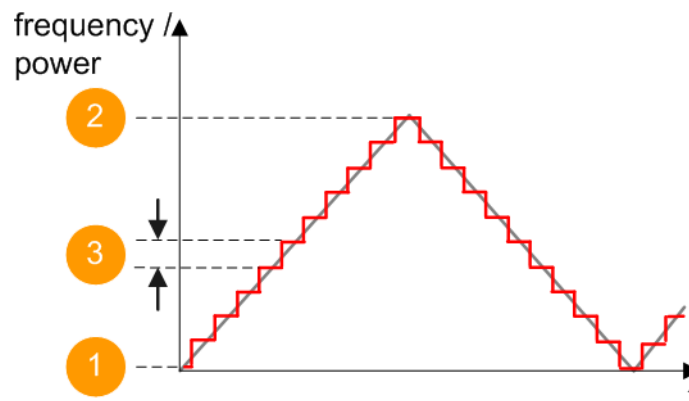
Figure 6-9: Sweep signal triangle shape

1 = Start value
2 = Stop value
3 = Step size

The current frequency or level of an RF frequency, level or LF frequency sweep is determined by the shape (e.g. sawtooth or triangle) and the spacing (linear or logarithmic), and the step size.

6.3 About List Mode

The list mode is used to generate the RF signal based on a set of predefined frequency and amplitude value pairs, with individual step times. You can define the values arbitrarily, in any order and varying step sizes, within the entire configurable value range of the instrument.

Configuration and operation of list mode signals

The parameters configuring the RF signal are defined in a list (table) and stored in a file.

Creating and handling lists

List files can be created in the following ways:

- **Internally**
  Use the build-in table editor with columns for the frequency-level values pairs and the dwell time.
  Define the values manually (row by row) or automatically, based on value range and step size.
  (See Chapter 6.7, "List Editor", on page 141)
  Lists are saved as files with user-definable filename and the predefined file extension `*.lsw`. To load a saved file, use the "File Manager".
  (See Chapter 9.8, "Using the File Manager", on page 203)
- Lists can be exported, too. For example, to exchange configuration between instruments or to modify the file content with an external program and reload them again.

- **Externally**
  Create a list file 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.

Dwell time mode

You can choose whether you want to use different dwell times or a fixed value for all steps in the list mode:

- "From List"
  This mode uses the values from the data table.
  See Edit List Mode Data
- "Global"
  This mode processes the list with a fixed time interval you can set with Global Dwell Time.

List processing mode

See:

- "Live list processing mode" on page 125

6.4 Significant Parameters and Functions

This section provides some basic parameters, settings and functions that affect the operating modes CW, list and sweep, that means at all frequency and level transitions of the RF signal.

Dwell time

Dwell time is the length of time that elapses from the beginning until the end of a step in list or sweep mode.
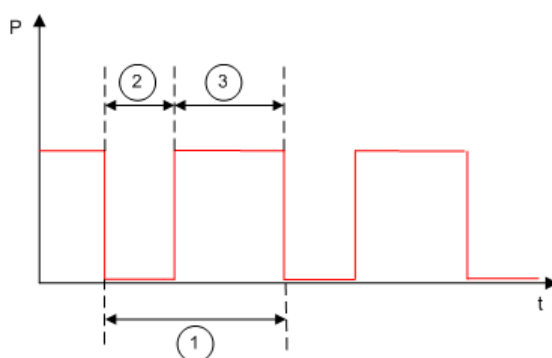
Figure 6-10: Dwell Time vs. settling time

1 = "Dwell Time" (as set with the parameter)
2 = Settling time
3 = Dwell time (effective)

However, the time the instrument requires for the signal to settle reduces the set dwell time:

$t_{dwell(effective)} = t_{dwell} - t_{setlting}$

If the dwell time in sweep or list mode is too short or external trigger signals come too fast, the signal generation delays. As the delay increases, the R&S SMB100B signals an overrun, or even stops sweep or list mode signal generation, if the delay gets too long.

The instrument diplays corresponding error messages.

Hardware adjustments

The first time a list (new or modified) is processed, the instrument automatically calculates the necessary hardware settings. It can be performed during list processing, but delays the first cycle, especially with short dwell times.

With long dwell times, you can perform this calculation while the list is being processed; the entered dwell times are observed. With short dwell times, calculation of the hardware settings increases the dwell time for the initial processing cycle; the entered value is only observed from the second processing cycle onwards. In this case, a message indicates that there is a deviation between the current and set dwell times. After the first cycle, you do not need to perform additional calculations. The current dwell times do not deviate from the set dwell times.

Blanking

The instrument applies *blanking*, which temporarily turns off the RF signal when the frequency or level changes, until the signal has settled to a stable state.

Temporary blanking applies to all operating modes.

Live list processing mode

The R&S SMB100B generates the signal directly from the value pairs in the database, and adjusts the hardware settings accordingly. The current instrument state and thus any change during the signal generation directly affects the RF signal. The temporary memory is not used.

You can conveniently modify parameters like modulation settings during run-time. Learning list mode data is not required. Impacts like temperature drift are also considered immediately.

This mode is optimized for **maximum signal quality**, and is useful if dwell times higher than 2 ms are sufficient.

6.5 Sweep Mode Settings

This section lists the settings of **all** available sweep modes.

Access:

1. Select "Sweep" > "RF Frequency Sweep"

2. Select "Sweep" > "RF Level Sweep"

3. Select "Sweep" > "LF Frequency Sweep"

The remote commands required to define these settings are described in:
- Chapter 12.14.3, "SOURce:FREQuency Subsystem", on page 401
- Chapter 12.14.12, "SOURce:SWEep Subsystem", on page 452
- Chapter 12.14.5, "SOURce:LFOutput Subsystem", on page 408

Settings

6.5.1 General Sweep Settings

Access:

► Select for example "Sweep" > "RF Frequency Sweep".

State	▯	Current Frequency	⊘
		259.000 000 000 MHz	
Mode	Single ▾	Retrace	☑
Shape	Sawtooth ▾		
Spacing	Linear ▾	Dwell Time	10.0 ms
◄ Reset Sweep		▶ Execute Single Sweep	
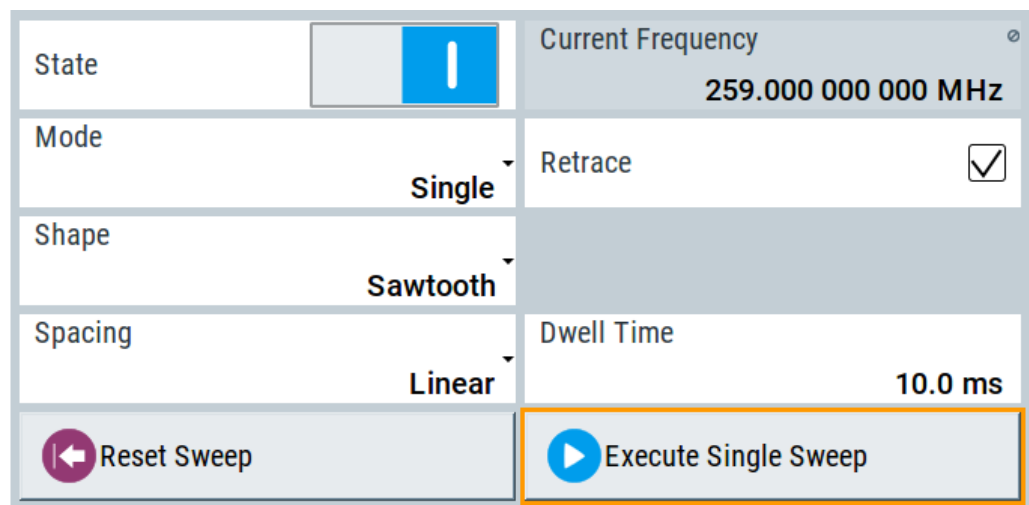
Settings

State (RF frequency sweep)
Activates RF frequency sweep signal generation.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:
[:SOURce<hw>]:FREQuency:MODE on page 402

State (RF level sweep)
Activates RF level sweep signal generation.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:
[:SOURce<hw>]:POWer:MODE on page 442

State (LF frequency sweep)
Status of the LF frequency sweep signal.

You find this parameter in two dialogs:
● "LF Frequency Sweep" turns on/off the signal generation.
   See Sweep Mode Settings for access.
● "Analog Modulation Sources" displays the current state (read-only). If it is turned
   on, this dialog provides the varying sweep frequency, see Current Frequency.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:
[:SOURce<hw>]:LFOutput:FREQuency:MODE on page 412

Current Frequency
In "RF/LF Frequency Sweep" mode, displays the current frequency.

In Mode = "Step", the parameter is editable and you can enter the next frequency step.

Remote command:
[:SOURce<hw>]:FREQuency:MANual on page 404
[:SOURce<hw>]:LFOutput:FREQuency:MANual on page 412

Current Level
Applies to "RF Level Sweep" mode.

Displays the current level value.

In Mode = "Step", the parameter is editable and you can enter the next level step.

Remote command:
[:SOURce<hw>]:POWer:MANual on page 442

Mode
Selects the sweep mode.

For detailed information on the sweep modes and the triggering, see Chapter 6.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 112.

"Auto"   Generates a continuously repeating sweep signal directly after activating the sweep mode.
The sweep steps are performed automatically, controlled by the dwell time.

"Single / Extern Single"
Generates a single sweep cycle after a trigger event.
The sweep steps within the cycle are performed automatically, controlled by the dwell time. If one cycle is completed, the instrument waits for the next trigger event.

"Step / Extern Step"
Generates the sweep signal step-by-step, manually triggered.

"Extern Start/Stop"
Generates a continuously repeating sweep signal that is started, stopped, and restarted by subsequent external trigger events.
The sweep steps are performed automatically, controlled by the dwell time.

Remote command:

[:SOURce<hw>]:SWEep[:FREQuency]:MODE on page 457

[:SOURce<hw>]:SWEep:POWer:MODE on page 455

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE on page 419

:TRIGger<hw>[:SWEep]:SOURce on page 490

:TRIGger<hw>:FSWeep:SOURce on page 490

:TRIGger<hw>:PSWeep:SOURce on page 490

:TRIGger<hw>:LFFSweep:SOURce on page 490

Retrace
For "Shape = Sawtooth" and "Mode = Single/External Single", enables changing the signal to the start value while it is waiting for the next trigger event. It returns to the start level or start frequency until the next trigger is applied.

Remote command:

[:SOURce<hw>]:SWEep[:FREQuency]:RETRace on page 458

[:SOURce<hw>]:SWEep:POWer:RETRace on page 458

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace on page 420

Shape
Selects the waveform shape of the sweep signal.

"Sawtooth" The sweep runs from start to stop frequency. The subsequent sweep starts at the start value, i.e. the shape of the sweep sequence resembles a sawtooth.
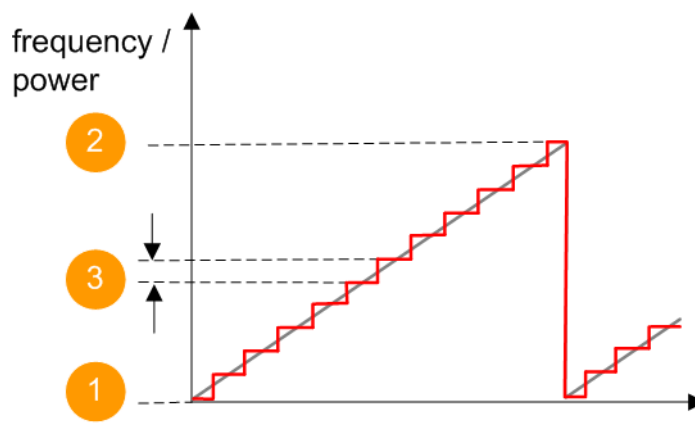
Figure 6-11: Sweep signal sawtooth shape

1 = Start value
2 = Stop value
3 = Step width

"Triangle" The sweep runs from start to stop value and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.
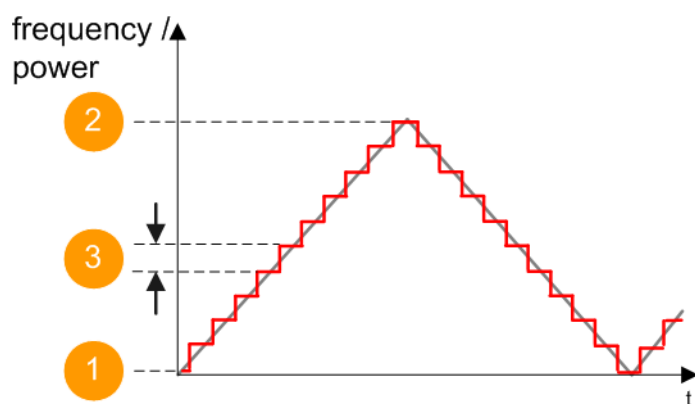
Figure 6-12: Sweep signal triangle shape

1 = Start value
2 = Stop value
3 = Step width

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe on page 458
[:SOURce<hw>]:SWEep:POWer:SHAPe on page 458
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe on page 420

Spacing

In "RF and LF Frequency Sweep" modes, selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

Enter the step size with the parameter Step Linear/Step Logarithmic .

"Linear" Takes the frequency value entered as absolute value in Hz.

"Logarithmic" Takes the value entered as a logarithmic value, i.e. as a constant fraction of the current frequency in %.

Remote command:

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 457

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing on page 420

Dwell Time

Defines the duration of the individual sweep steps.

Note: In case of considerable overrun conditions, the R&S SMB100B turns off the sweep mode.

See also Chapter 6.4, "Significant Parameters and Functions", on page 124.

Remote command:

[:SOURce<hw>]:SWEep[:FREQuency]:DWELl on page 456

[:SOURce<hw>]:SWEep:POWer:DWELl on page 455

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl on page 418

Trigger Slope

For "Mode = Extern Step/Single", selects the polarity of the active slope of an applied instrument trigger.

Trigger signal is expected at the Inst Trig connector.

"Positive" The rising edge of the trigger signal triggers the instrument.

"Negative" The falling edge of the trigger signal triggers the instrument.

Remote command:

[:SOURce]:INPut:TRIGger:SLOPe on page 408

Reset Sweep

Resets a sweep.

With the next trigger event, the sweep starts at the initial value.

Remote command:

[:SOURce<hw>]:SWEep:RESet[:ALL] on page 460

Execute Single Sweep

In "Mode = Single", starts a sweep manually.

Remote command:

[:SOURce<hw>]:SWEep[:FREQuency]:EXECute on page 458

[:SOURce<hw>]:SWEep:POWer:EXECute on page 458

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute on page 418

:TRIGger<hw>[:SWEep][:IMMediate] on page 491

:TRIGger<hw>:FSWeep[:IMMediate] on page 491

`:TRIGger<hw>:PSWeep[:IMMediate]` on page 491

`:TRIGger<hw>:LFFSweep:IMMediate` on page 491

6.5.2 Frequency Range Settings

Access:

1. Select for example "Sweep" > "RF Frequency Sweep"

2. Select "Frequency Range".

Start Frequency	Stop Frequency
200.000 000 000 MHz	600.000 000 000 MHz
Center Frequency	**Span**
400.000 000 000 MHz	400.000 000 000 MHz
Spacing	**Step Linear**
Linear ▾	10.000 000 000 MHz

Settings

Start Frequency/Stop Frequency
Defines the frequency sweep range by setting the start and end values.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Remote command:
`[:SOURce<hw>]:FREQuency:STARt` on page 406
`[:SOURce<hw>]:FREQuency:STOP` on page 406
`[:SOURce<hw>]:LFOutput:FREQuency:STARt` on page 413
`[:SOURce<hw>]:LFOutput:FREQuency:STOP` on page 413

Center Frequency
In "RF Frequency Sweep" mode, sets the RF center frequency.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Remote command:
`[:SOURce<hw>]:FREQuency:CENTer` on page 405

Span
In "RF Frequency Sweep" mode, sets the span of the frequency sweep range.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Remote command:

[:SOURce<hw>]:FREQuency:SPAN on page 405

Spacing

In "RF and LF Frequency Sweep" modes, selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

Enter the step size with the parameter Step Linear/Step Logarithmic .

"Linear"   Takes the frequency value entered as absolute value in Hz.

"Logarithmic" Takes the value entered as a logarithmic value, i.e. as a constant fraction of the current frequency in %.

Remote command:

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 457

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing on page 420

Step Linear/Step Logarithmic

In "RF/LF Frequency Sweep" mode, sets the step width for the individual frequency sweep steps. The value is added at each sweep step to the current frequency.

Depending on the current Spacing, you can enter either an absolute or logarithmic step width.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

"Step Linear"   The step width is a constant value in Hz.

"Step Logarithmic"

The step width is determined logarithmically in %, i.e. as a constant fraction of the current frequency.

Remote command:

[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] on page 459

[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic on page 459

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] on page 421

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic on page 421

6.5.3 Level Range Settings

Access:

1. Select "Sweep" > "RF Level Sweep"

2. Select "Level Range".

Settings

Start Level / Stop Level
Defines the RF level sweep range by setting the start and end values.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Remote command:
[:SOURce<hw>]:POWer:STARt on page 443
[:SOURce<hw>]:POWer:STOP on page 443

Spacing
Indicates that the level step intervals are linearly (straight proportional) distributed, i.e. intervals are of equal size.

Set the step size with the parameter "Step".

Remote command:
n.a.

Step
Applies to "RF Level Sweep" mode.

Sets the step width for the RF level sweep steps logarithmically in dB.

Remote command:
[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic] on page 456

Setting Characteristics
Selects additional quality characteristics to optimize the behavior of the RF signal level for the corresponding 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, as specified in the data sheet.
                   The RF signal is shortly blanked when the step attenuator is switch-
                   ing.

"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.

"Strictly Monotone"

                   Executes signal level changes monotonically increasing or decreas-
                   ing.
                   The setting makes sure that increasing the level value exclusively
                   results in an increased output level, and vice versa.
                   All electronic switches, which might affect the monotonicity are fixed.
                   The operation mode is useful for applications using level searching
                   algorithms which rely on a strictly monotonous behavior.

"Constant-VSWR"

                   Suppresses output impedance variations at the RF output connector,
                   due to changed level settings.

"User"   Indicates that a setting has been modified in the expert mode. The
                   expert mode is a protected function, that requires protection level 2
                   password.

Remote command:
[:SOURce<hw>]:POWer:LBEHaviour on page 441

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 446
[:SOURce<hw>]:POWer:RANGe:UPPer? on page 446

6.6 List Mode Settings

The "List Mode" dialog contains all the functions and settings for creating and handling
lists with RF frequency/level pairs including the corresponding dwell times for generat-
ing the RF signal based on these values.

Access:

► Select "Sweep" > "List mode".

The dialog contains parameters for configuring the list mode processing, entering list mode data and transferring data files from or to the instrument.
The remote commands required to define these settings are described in Chapter 12.14.6, "SOURce:LIST Subsystem", on page 421.

6.6.1 General Settings

Access:

► Select "Sweep" > "List mode".
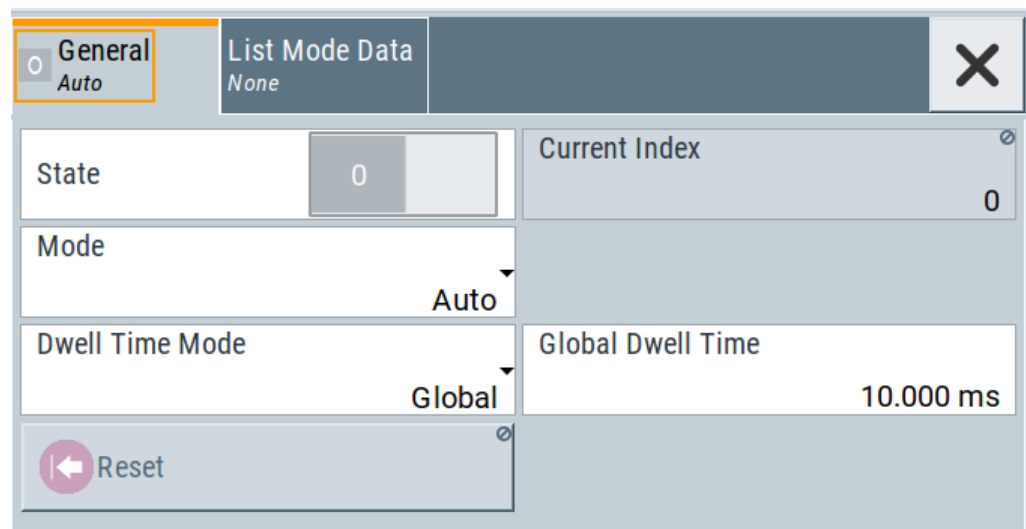
In the "General" tab, you can configure the trigger and dwell time modes for list processing and activate signal generation.

Settings

State

Activates the list mode and processes the currently selected list.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:

[:SOURce<hw>]:FREQuency:MODE on page 402

Current Index

Sets the list index for list processing in "Step" mode. In the other modes, the index indicates the current step.

Remote command:

[:SOURce<hw>]:LIST:INDex on page 426

Mode

Selects the mode for list processing.

For detailed information on the sweep modes and the triggering, see Chapter 6.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 112.

"Auto"   Generates the signal by processing the frequency/level value pairs of
                          the list from the beginning to the end.
                          The list steps are performed automatically, controlled by the dwell
                          time. If you switch from any mode to "Auto", signal generation always
                          starts at the top of the list.

"Single / Extern Single"
                          Generates the signal by processing the frequency/level value pairs of
                          the list once from the beginning to the end after a trigger event.
                          The list steps are performed automatically, controlled by the dwell
                          time. If one cycle is completed, the instrument waits for the next trigger event.

"Step / Extern Step"
                          Generates the signal by processing the frequency/level value pairs of
                          the list step-by-step, manually triggered.

Remote command:

[:SOURce<hw>]:LIST:TRIGger:SOURce on page 428

[:SOURce<hw>]:LIST:MODE on page 427

Dwell Time Mode

Selects either variable dwell times or a fixed dwell time to perform signal generation in list mode.

"Global"   Uses the same dwell time for all lists steps, set with Global Dwell
                          Time.

"From List"   Uses the dwell times from the list.
                          You can define the dwell time for each frequency/level value pair individually, see Chapter 6.7, "List Editor", on page 141.

Remote command:

[:SOURce<hw>]:LIST:DWELl:MODE on page 425

Global Dwell Time

Sets the dwell time for Dwell Time Mode > "Global".

Note: In case of considerable overrun conditions, the R&S SMB100B turns off the list mode.

See also "Dwell time" on page 124.

Remote command:
[:SOURce<hw>]:LIST:DWELl on page 424

Trigger Slope

For "Mode = Extern Step/Single", selects the polarity of the active slope of an applied instrument trigger.

Trigger signal is expected at the Inst Trig connector.

"Positive"   The rising edge of the trigger signal triggers the instrument.

"Negative"   The falling edge of the trigger signal triggers the instrument.

Remote command:
[:SOURce]:INPut:TRIGger:SLOPe on page 408

Reset

Resets the list to the starting point.

Remote command:
[:SOURce<hw>]:LIST:RESet on page 431

Execute Single

Manually starts list processing in "Single" mode.

Remote command:
[:SOURce<hw>]:LIST:TRIGger:EXECute on page 428

6.6.2 List Mode Data Settings

Access:

1. Select "Sweep" > "List mode".

2. Select "List Mode Data".
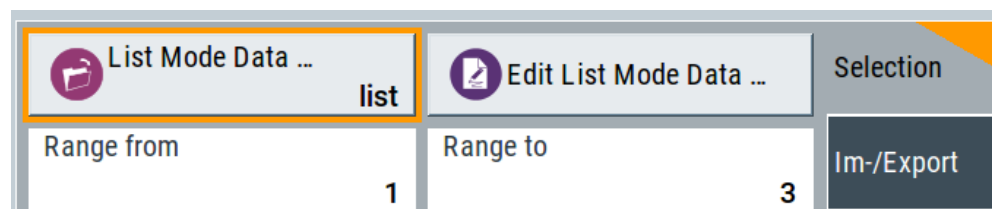
This dialog contains the parameters required for creating and editing lists, activating the learning function and selecting the list processing mode.

Settings

List Mode Data

Accesses the standard "Select List" dialog for selecting, creating and editing a list file. The currently loaded file is indicated.

You can create data lists with the internal editor or import externally created files, see "Creating and handling lists" on page 123.

Remote command:

`[:SOURce<hw>]:LIST:CATalog?` on page 430

`[:SOURce<hw>]:LIST:SELect` on page 431

`[:SOURce<hw>]:LIST:DELete` on page 430

`[:SOURce<hw>]:LIST:DELete:ALL` on page 430

Edit List Mode Data

Opens the editor to insert and save data lists with RF frequency, power and dwell time values, see Chapter 6.7, "List Editor", on page 141.

You find this function also in standard file select dialog, accessed via List Mode Data .

List Range from/to

Defines an index range in the current list by setting the start and stop index.

The instrument generates the signal with the values of the selected index range and ignores all other list entries.

Remote command:

`[:SOURce<hw>]:LIST:INDex:STARt` on page 427

`[:SOURce<hw>]:LIST:INDex:STOP` on page 427

6.6.3 Import/Export Settings

Access:

1. Select "Sweep" > "List Mode".

2. Select "List Mode Data" > "Im-/Export".
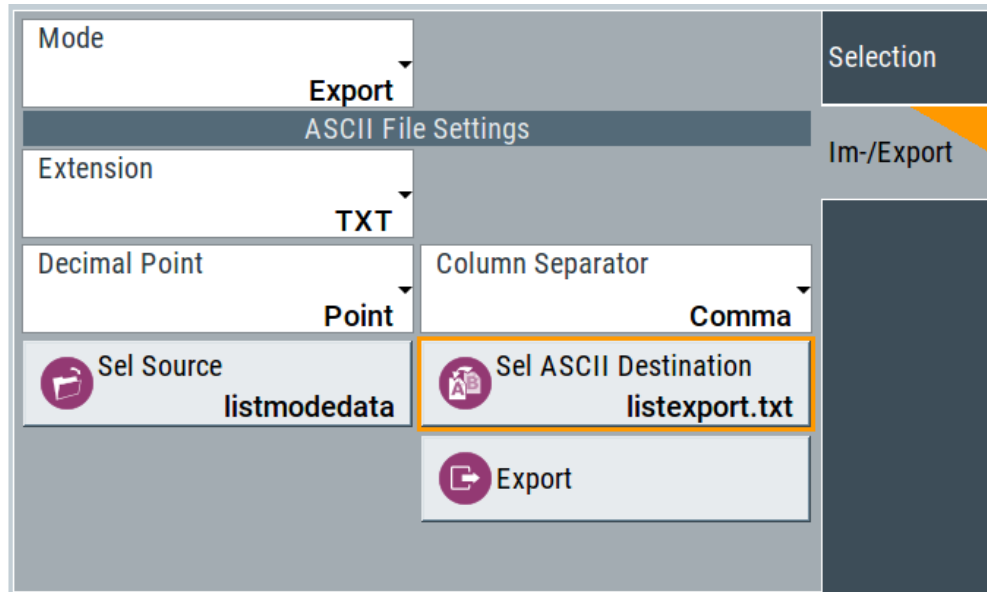
The "Im-/Export" dialog provides the parameters for importing or exporting files with user data in standard ASCII `*.txt` or `*.csv` file format.
The table separators and the decimal floating point numbers are customizable.

Settings

Mode
Selects import or export of a data list file. The provided parameters vary according to the selected mode.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:MODE` on page 434
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 401
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 384

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>]:LIST:DEXChange:AFILe:EXTension` on page 433

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal` on page 433

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn` on page 433

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension` on page 399

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal`
on page 400

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn`
on page 400

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension` on page 384

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal`
on page 384

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn`
on page 384

Select (ASCII) Source/Select (ASCII) Destination
In "Mode > Import", access the file select dialog that provides standard file handling functions.

Where:
- "Select ASCII Source": defines the file to be loaded (imported)
- "Select ASCII Destination": selects the filename under that the loaded file is saved

Remote command:

`[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog?` on page 432

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect` on page 433

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?` on page 399

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect` on page 400

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog?` on page 385

`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect` on page 385

Select Source/Select ASCII Destination
In "Mode > Export", access the file select dialog that provides standard file handling functions.

Where:
- "Select Source": selects the file to be exported
- "Select ASCII Destination": defines the filename and the file path for the exported file

Remote command:

`[:SOURce<hw>]:LIST:DEXChange:SELect` on page 434

`[:SOURce<hw>]:CORRection:DEXChange:SELect` on page 401

`[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect` on page 385

Import / Export
Imports or exports the selected data list file, depending on the current mode.

Remote command:

`[:SOURce<hw>]:LIST:DEXChange:EXECute` on page 432

`[:SOURce<hw>]:CORRection:DEXChange:EXECute` on page 400

`[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute` on page 385

6.7 List Editor

The "User Correction" and "List Mode" dialogs provide a build-in list editor for defining the corresponding value pairs.

The table and navigation functions of the UCOR and list mode editors have the same structure and are therefore summarized below. The access is specified for both modes, the fields and functions are explained using the example of the list mode.

Access to "Edit List Mode Data":

► "Sweep" > "List Mode" > "List Mode Data" > "Edit List Mode Data"

	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	10.55
3	1 563 000 000.00	10.07
4	1 564 000 000.00	9.59
5	1 565 000 000.00	9.11
6	1 566 000 000.00	8.63
7	1 567 000 000.00	8.15
8	1 568 000 000.00	7.67
9	1 569 000 000.00	7.19
10	1 570 000 000.00	6.71
11	1 571 000 000.00	6.23

Go To   Edit   Fill with Sensor …   Save As …   Save

The editor for list mode data provides a table with RF frequency and power values and standard navigation functions.

Access to "Edit User Correction Data":

► "Level" > "User Correction" > "Edit User Cor. Data"

	Frequency /Hz	Power /dBm	Dwell Time /s
0	1 000 000 000.000	-20.00	0.010 000
1	1 500 000 000.000	-25.00	0.010 000
2	3 000 000.000	-10.00	0.050 000
3	2 000 000 000.000	-30.00	0.100 000
4			

🔍 Go To   📝 Edit   💾 Save As …   💾 Save

The editor for user correction provides a table with RF frequency and power values, an extra column for defining variable dwell times, and standard navigation functions.

All columns in a row must contain values. Cells with missing values are therefore filled automatically, using the value of the previous row.

If you use **global dwell time in list mode**, consider also that the instrument uses the value set with Global Dwell Time for all list steps and not the values from the list.

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 "List Data Editor". If a function relates to a particular dialog, it is explicitly stated.

Settings

Edit List Mode Data
Table with values for list or user correction processing.

Note: Once you enter a value, the editor automatically adds preset values in the other columns. This functionality protects against data loss, otherwise incomplete rows will be lost when saving. You can simply override these values.

"Frequency /Hz"

Sets the frequency values.

Remote command:

[:SOURce<hw>]:LIST:FREQuency on page 426

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency on page 396

"Power /dBm"   Sets the level values.

Remote command:

[:SOURce<hw>]:LIST:POWer on page 428

[:SOURce<hw>]:CORRection:CSET:DATA:POWer on page 396

"Dwell /s"   In list mode, sets the dwell time values.

Remote command:

[:SOURce<hw>]:LIST:DWELl:LIST on page 425

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 a list, and provides access to a dialog for automatic filling, see " Fill... " on page 91.

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. Available in UCOR mode only.

See Chapter 7.3.3, "Fill with Sensor", on page 160

Save As/Save ← Data handling keys
Stores the list in a file with 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.

From		Range	
	0		1

Column To Fill		
	Frequency/Hz ▾	

Start Value	End Value ⊘
2.000 000 000 000 GHz	2.000 000 000 000 GHz

Increment Value
200.000 000 000 MHz

✓ Fill

To fill the table, select "Fill".

Note: Once you enter a value or fill a column, the editor automatically adds preset values in the other columns. This functionality protects against data loss, otherwise incomplete rows will be lost when saving. You can simply override 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, levels in dBm or dwell times in s.

"Start Value / End Value"
　　　　　Sets the start value for frequency, level or dwell time. 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".

6.8 How to Generate a Signal in List or Sweep Mode

This section shows you how to configure a varying RF output signal for both, the list and sweep modes.

To configure the frequency sweep signal

► For a step-by-step description, see Chapter 3.3.2, "Generating an RF Frequency Sweep Signal", on page 41.

Example: Fast changing frequency and level settings in list mode

The following example shows you how to generate an amplitude modulated RF signal based on list mode data.

General workflow

Since any change of the hardware settings or list entries can affect the RF signal characteristics directly, we recommend that you proceed as follows:

1. Configure the modulation settings.
   Activate the RF signal.

2. Wait until the hardware settings have settled.

3. Create a list file.

4. Configure the list mode.

5. Activate list mode.

To configure amplitude modulation and switch RF on

1. Press [Preset] to start from an initial state.

2. Select "Modulation" > "Amplitude Modulation > On".

3. Select "Level" > "RF ON" to activate RF signal generation.

To create list mode data

1. Select "Sweep" > "List Mode".

2. In the "List Mode Data" tab, select "List Mode Data > New"

3. Enter the filename `ListMode_Test` for the data list and confirm with "Ok".

   The instrument creates a file and stores it in the `/var/user/` directory.

4. Select "Edit List Mode Data".

5. Enter the first values "Frequency > 2", "Power > 0" and "Dwell > 2".

6. Enter further frequency, power and dwell time values in the same way.

7. Select "Save" and close the dialog.

To configure the list mode and start signal generation

1. In the "General" tab, select "List Mode > Auto".

2. Select "Dwell Time Mode > From List".

3. Switch state to "On".

4. Select "General > State > On".

   The instrument continuously generates an amplitude-modulated RF signal whose frequency and level values change according to the dwell times, as defined in the list.

   With active list mode, the generator displays no frequency and level values in the status bar, but you can check the following parameters.
   - In the list mode dialog, the current index indicates the steps of the signal generation.

● In remote control mode, you can query:
  – The current state with `[:SOURce<hw>]:LIST:RUNNing?`
  – Current parameters with the commands `FREQ?`, `POW?` and `LIST:DWEL?`.

7 Improving Level Performance

To adapt the RF output signal to specific needs in your application, the R&S SMB100B offers different functions:

- **Attenuator**
  The R&S SMB100B is equipped with a step attenuator that enables you to vary the amplitude of the RF signal in a wide range. It is characterized by low VSWR (voltage standing wave ratio) over the full level and frequency range, and provides highest level accuracy and noise suppression.
  See "About the attenuator" on page 147.

- **Automatic Level Control (ALC)**
  The automatic level control system ensures stable RF signals with highest absolute level accuracy over temperature and time.
  See "About ALC" on page 150.

- **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 153.

- **Power sensors**
  The R&S SMB100B has excellent absolute level accuracy. Since a DUT is rarely connected directly to the generator, but with cables or other components, the reference level shifts from the RF output to the DUT. To calibrate this level with high accuracy, i.e. in the tenth dB range, you can connect an R&S NRP power sensor to the generator. The power sensor transmits its readings to the generator, which indicates these measurement results in the display. Thus you can adjust the RF output power of the generator until you reach the target level at the DUT.
  See Chapter 7.4, "Using Power Sensors", on page 164

7.1 Attenuator

About the attenuator

The step attenuator is an electronic device without mechanical components, providing fast and wear free level settings.

According to the requirements of your application, you can select different attenuator characteristics.

The following are examples of test requirements and the corresponding configuration:

- Automatic configuration
  Select standard operation mode ("Auto"), in which the generator adjusts the attenuation of the RF output signal automatically.

- DUT tests under low signal to noise conditions
  Low output power is suitable to test the behavior of a DUT under low signal to noise conditions.

- Uninterrupted level settings with constant VSWR
  A fix attenuation value is required for obtaining uninterrupted level settings with constant VSWR.
  The configuration "RF Off Mode > Unchanged" ensures that constant VSWR is maintained if you turn the signal off and on again.

- Noise sensitive applications
  The parameter "RF OFF Mode > Full Attenuation" sets maximum attenuation and thus suppresses noise when you turn off the RF signal.

7.1.1 Attenuator Settings

Access:

► Select "Level" > "Level > Attenuator".
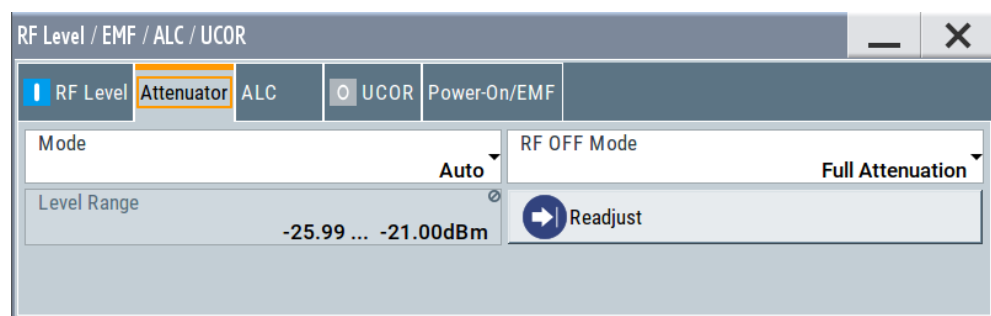
In the "Attenuator" dialog, you can select the operating mode of the electronic step attenuator.

The remote commands required to define these settings are described in Chapter 12.12, "OUTPut Subsystem", on page 344 and Chapter 12.14.10, "SOURce:POWer Subsystem", on page 438.

Settings

Mode

Determines the operating mode of the step attenuator.

"Auto"   Adjusts the attenuator settings automatically.

"Fixed"   Fixes the attenuator and amplifier paths for the current RF level and provides signal output with constant output VSWR. The resulting level range is indicated under " Level Range " on page 149.

Remote command:
:OUTPut<hw>:AMODe on page 346

Level Range

Shows the interruption-free range of the level that you can use in the selected mode.

Remote command:

:OUTPut<hw>:AFIXed:RANGe:LOWer? on page 346

:OUTPut<hw>:AFIXed:RANGe:UPPer? on page 346

RF OFF Mode

Determines the state of the step attenuator, when the RF signal is switched off.

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.

"Unchanged" Freezes the setting of the step attenuator.
        Use this mode if a constant VSWR (Voltage Standing Wave Ratio) is required.

"Full Attenuation"
        Switches to the maximum attenuation.
        Use this mode for applications that require a high level of noise suppression.

Remote command:

[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE on page 440

7.1.2 Reverse Power Protection

The R&S SMB100B is equipped with a reverse power protection circuit.

The reverse power protection is tripped when the power of signals reflected from the load or external signals applied to the RF output get too high. A relay opens and interrupts the internal connection to the RF output. This condition is indicated in the status bar by the "Overload" status message.

Overload

If an "Overload" status message is indicated in the status bar, perform the following:
- Remove the cause for the overload
- Press the [RF on/off] key to reset the overload protection

The RF input is activated when the overload protection is reset.

Remote command:

:OUTPut<hw>:PROTection:TRIPped? on page 347

:OUTPut<hw>:PROTection:CLEar on page 347

7.2 Automatic Level Control (ALC)

The R&S SMB100B is equipped with an automatic level control (ALC) unit to obtain best RF level accuracy.

About ALC

ALC is an adaptive control system to stabilize the RF output level. It continuously moni-tors the current level and adjusts it to keep a steady state over temperature and time.

ALC is active in almost all applications by default.

However, when **pulse modulation** with short pulses is used, the ALC uses table-based level settings with table values depending on the pulse width.

Also note that ALC can detect incorrect values in **multi-transmitter** test setups. If mul-tiple generators are coupled, reverse power can affect the ALC readings, which can lead to an incorrect RF output power.

ALC States and their effects

The following description basically explains the ALC states and their principle of opera-tion:

- "Auto"
  Adjusts the output level to the operating conditions automatically. ALC is active in almost all operating modes.
- "On"
  Activates the internal level control permanently, regardless of the operating condi-tions. This setting provides the highest level accuracy.
- "Off (Sample & Hold)"
  Deactivates ALC, but still allows you to maintain a constant output level.
  The R&S SMB100B switches briefly in the CW mode and enables ALC to adjust the level to the set target value. The instrument freezes this setting, turns off ALC again, and switches back to the operating mode.
- "Off (Table)"
  Deactivates internal level control loop. The instrument calculates every level setting using the attenuation values from the internal (ALC) table. Level attenuation between two table values is done with linear interpolation. This mode enables you to perform a strictly monotonic, but not quite as precise level adjustment.
- "Table & On"
  Starts with the associated value of the internal level table and then activates the automatic level control. This mode achieves maximum level accuracy and fast set-ting times.
  If pulse modulation is applied, this mode ensures fast level setting even with nar-row pulses at low repetition rate.

The R&S SMB100B displays the level control setting as a status message in the info line.

7.2.1 ALC Settings

Access:

► Select "Level" > "Automatic Level Control".
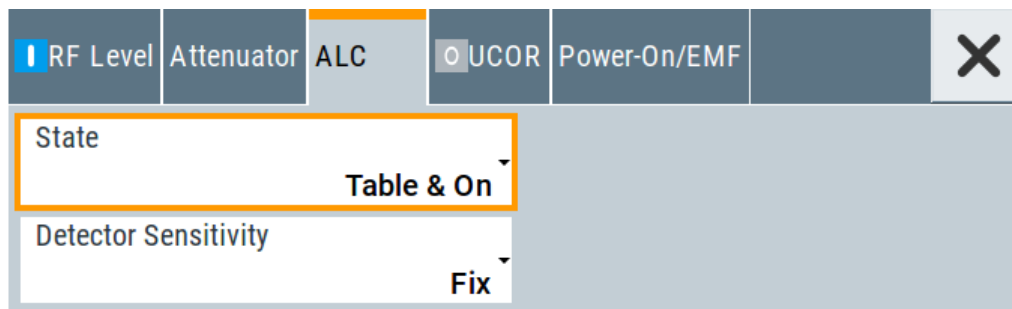
In the "ALC" dialog, you can configure the settings for the automatic level control of the RF signal to achieve optimal accuracy.

The remote commands required to define these settings are described in Chapter 12.14.10, "SOURce:POWer Subsystem", on page 438.

Settings

State
Selects the internal level control mode.

Find further details about the individual settings in "ALC States and their effects" on page 150. It covers an overview of the functionality and indicates what is to be considered.

"Auto"　　　　Selects the most appropriate ALC mode automatically.

"On"　　　　Activates ALC permanently.

"Off (Sample & Hold)"

Deactivates the ALC, but allows you to recalibrate the level at each frequency and level change. The value remains up to the next change.

"Off (Table)"

Controls the level using the attenuation values of the internal ALC table.

"Table & On"

Starts with the attenuation setting from the table and continues with automatic level control.

Remote command:
[:SOURce<hw>]:POWer:ALC[:STATe] on page 439

Detector Sensitivity

Determines the path of the internal level detector.

The level detector of the ALC has multiple paths distinguished by their sensitivity.

"Auto"   Selects the detector path automatically, according to the given level. This mode is the recommended operation mode.

"Low"   Selects the detector path with low sensitivity. This setting is intended for signals with high internal electronic levels.

"Med"   Selects the path with medium sensitivity. This setting corresponds to normal mode. It is intended for signals with medium internal electronic levels.

"High"   Selects the detector path with high sensitivity, intended for signals with low internal electronic levels.

"Fix"   Fixes the last set sensitivity setting.

Remote command:
[:SOURce<hw>]:POWer:ALC:DSENsitivity on page 440

7.3 User Correction

The R&S SMB100B 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 SMB100B 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.
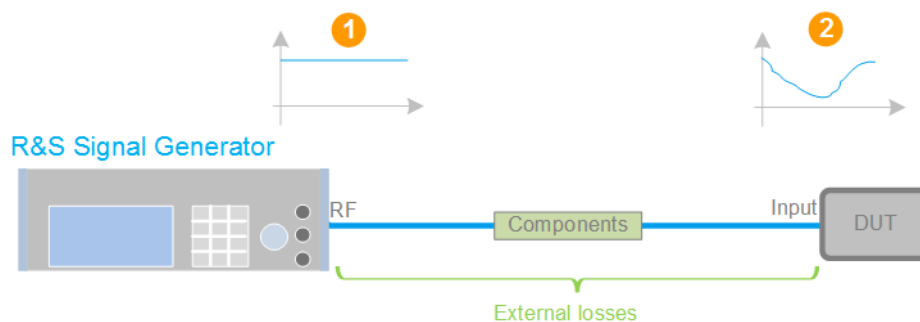
Figure 7-1: Effect of external losses on the signal flatness at the DUT input

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 SMB100B
2   = Signal received at the DUT, incl. the external losses

About UCOR

User correction (UCOR) is a method that determines the external level loss over a frequency range in advance, see Figure 7-2.

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 data sheet.
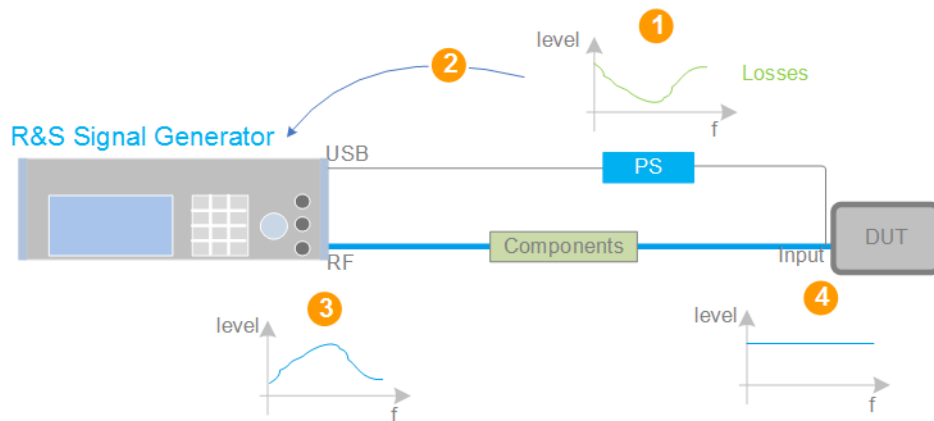
Figure 7-2: Understanding the principle of user correction

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 SMB100B
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 SMB100B and the DUT
2	= Obtain the correction data by inverting the collected data; load the correction parameters in the R&S SMB100B
3	= In the R&S SMB100B, 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 if 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 Note-pad 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 9.8, "Using the File Manager", on page 203.

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 based on 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.

Interactions and characteristics

Activated user correction is effective 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$_{RF}$ = "Status bar > Level" + "UCOR"

Activated user correction is indicated by the status indication "Lev Ucor" in the "Level" tile.

7.3.1 User Correction Settings

Access:

1. Select "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, proceed as described in Chapter 6.7, "List Editor", on page 141.

4. Select "RF Level > RF State > On".

5. Select "User Cor. Data > State > On".
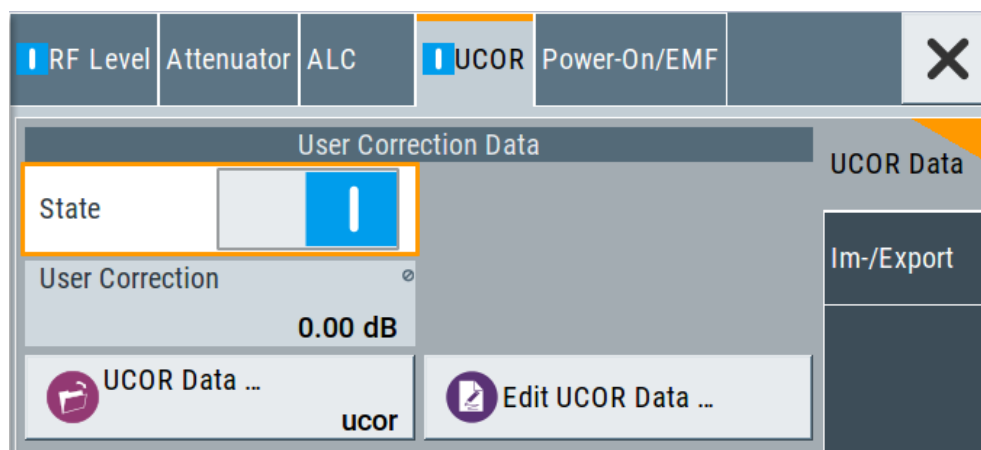
The "UCOR" dialog contains all settings for creating and handling files with user-defined level correction values.

The remote commands required to define these settings are described in Chapter 12.14.2, "SOURce:CORRection Subsystem", on page 393.

Settings

State

Activates user correction.

The R&S SMB100B displays the status icon "Lev Ucor" in the "Level" panel.

Remote command:

[:SOURce<hw>]:CORRection[:STATe] on page 398

User Correction

Indicates the corrected level value for a specific frequency point.

Remote command:

[:SOURce<hw>]:CORRection:VALue? on page 397

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 internally new 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 398

[:SOURce<hw>]:CORRection:CSET[:SELect] on page 397

[:SOURce]:CORRection:CSET:DELete on page 399

Edit UCOR Data

Opens the build-in table editor to define a new correction table or edit an existing one.

See also:
- Chapter 6.7, "List Editor", on page 141
- " Fill... " on page 91
- Chapter 7.3.3, "Fill with Sensor", on page 160

7.3.2 List Editor

The "User Correction" and "List Mode" dialogs provide a build-in list editor for defining the corresponding value pairs.

The table and navigation functions of the UCOR and list mode editors have the same structure and are therefore summarized below. The access is specified for both modes, the fields and functions are explained using the example of the list mode.

Access to "Edit List Mode Data":

► "Sweep" > "List Mode" > "List Mode Data" > "Edit List Mode Data"

	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	10.55
3	1 563 000 000.00	10.07
4	1 564 000 000.00	9.59
5	1 565 000 000.00	9.11
6	1 566 000 000.00	8.63
7	1 567 000 000.00	8.15
8	1 568 000 000.00	7.67
9	1 569 000 000.00	7.19
10	1 570 000 000.00	6.71
11	1 571 000 000.00	6.23

Go To   Edit   Fill with Sensor …   Save As …   Save

The editor for list mode data provides a table with RF frequency and power values and standard navigation functions.

Access to "Edit User Correction Data":

► "Level" > "User Correction" > "Edit User Cor. Data"

	Frequency /Hz	Power /dBm	Dwell Time /s
0	1 000 000 000.000	-20.00	0.010 000
1	1 500 000 000.000	-25.00	0.010 000
2	3 000 000.000	-10.00	0.050 000
3	2 000 000 000.000	-30.00	0.100 000
4			

Go To   Edit   Save As …   Save

The editor for user correction provides a table with RF frequency and power values, an extra column for defining variable dwell times, and standard navigation functions.

All columns in a row must contain values. Cells with missing values are therefore filled automatically, using the value of the previous row.

If you use **global dwell time in list mode**, consider also that the instrument uses the value set with Global Dwell Time for all list steps and not the values from the list.

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 "List Data Editor". If a function relates to a particular dialog, it is explicitly stated.

Settings

Edit List Mode Data
Table with values for list or user correction processing.

Note: Once you enter a value, the editor automatically adds preset values in the other columns. This functionality protects against data loss, otherwise incomplete rows will be lost when saving. You can simply override these values.

"Frequency /Hz"
              Sets the frequency values.

Remote command:
[:SOURce<hw>]:LIST:FREQuency on page 426
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency on page 396

"Power /dBm"   Sets the level values.

Remote command:
[:SOURce<hw>]:LIST:POWer on page 428
[:SOURce<hw>]:CORRection:CSET:DATA:POWer on page 396

"Dwell /s"   In list mode, sets the dwell time values.

Remote command:
[:SOURce<hw>]:LIST:DWELl:LIST on page 425

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 a list, and provides access to a dialog for automatic filling, see " Fill... " on page 91.

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. Available in UCOR mode only.

See Chapter 7.3.3, "Fill with Sensor", on page 160

Save As/Save ← Data handling keys

Stores the list in a file with 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.

From	Range
0	1

Column To Fill	
Frequency/Hz	

Start Value	End Value ⊘
2.000 000 000 000 GHz	2.000 000 000 000 GHz

Increment Value	
200.000 000 000 MHz	

| ✓ Fill | |

To fill the table, select "Fill".

Note: Once you enter a value or fill a column, the editor automatically adds preset values in the other columns. This functionality protects against data loss, otherwise incomplete rows will be lost when saving. You can simply override 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, levels in dBm or dwell times in s.

"Start Value / End Value"

Sets the start value for frequency, level or dwell time. 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".

7.3.3 Fill with Sensor

Access:

1. Select "Level" > "User Correction".

2. Select "UCOR Data > navigate to the file *.ucor > Select".

3. Select "Edit UCOR Data > Fill With Sensor...".

Sensor	List To Fill
2: NRP18S S/N 100654	ucor

Use SParameter	☐	Include Zeroing	☑

Execute

Used	Settings for Measurement

Modulation	Amplitude
Off (CW)	-30.00 dBm

This dialog contains parameters for filling a table automatically with sensor readings.

To fill the table, select "Execute".

For information on power sensors an how to use them, see Chapter 7.5, "How to Calibrate the Power Level with an R&S NRP Power Sensor", on page 174.

Settings

Fill User Correction Data with Sensor
- "Sensor"
  Displays connected sensors for selection.
- "List To Fill"
  Indicates the used list.
- "Use SParameter"
  Indicates whether SParameter correction in the R&S NRP power sensor is used.
- "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 might be blanked shortly. This setting is useful if blanking of RF is undesirable or the absence of power at the sensor cannot be guaranteed.

● "Execute"

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:ZERoing:STATe` on page 398

`[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` on page 397

Used SMB100B Settings For Measurement
Displays the settings relevant for the measurement.

"Modulation"   Indicates the modulation state

"Amplitude"   Shows the currently set level.

Remote command:
n.a.

7.3.4 Import/Export List Files

Access:

1. Select one of the following:

    ● "Sweep" > "List mode".
    ● "Level" > "User Correction".
    ● "Modulation > Pulse Modulation > Pulse Generator > Pulse Mode = Train".

2. Select "Import/Export".
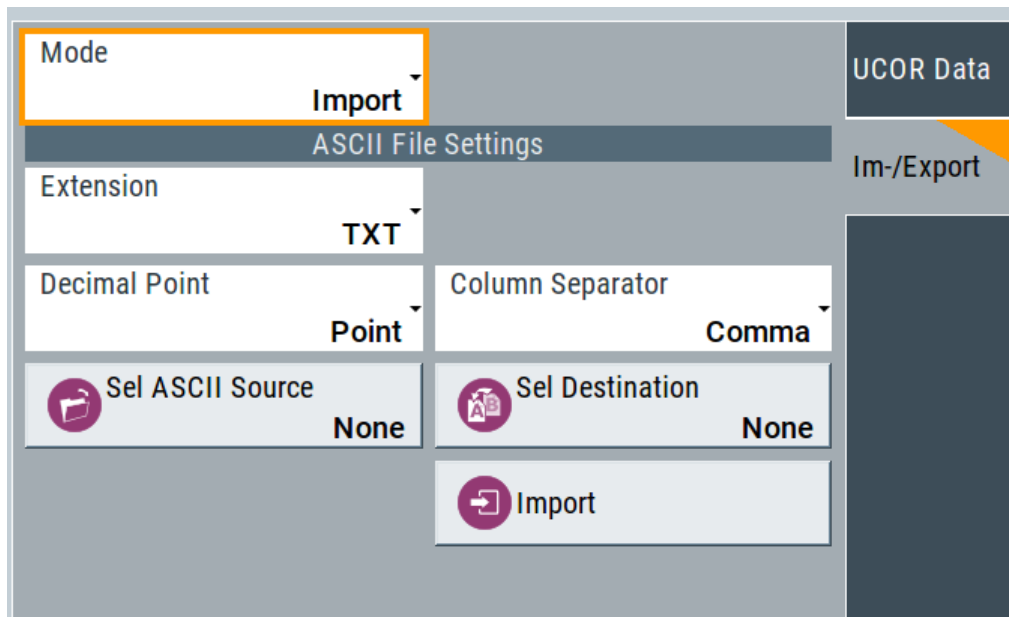
Figure 7-3: Im-/Export dialog (example with UCOR settings)

The "Import/Export" dialog contains all functions and settings to import externally created list 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.

Settings

Mode

Selects import or export of a data list file. The provided parameters vary according to the selected mode.

Remote command:

[:SOURce<hw>]:LIST:DEXChange:MODE on page 434

[:SOURce<hw>]:CORRection:DEXChange:MODE on page 401

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE on page 384

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>]:LIST:DEXChange:AFILe:EXTension on page 433

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal on page 433

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 433

[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 399

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal
on page 400

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn
on page 400

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 384

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal
on page 384

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn
on page 384

Select (ASCII) Source/Select (ASCII) Destination
In "Mode > Import", access the file select dialog that provides standard file handling
functions.

Where:
- "Select ASCII Source": defines the file to be loaded (imported)
- "Select ASCII Destination": selects the filename under that the loaded file is saved

Remote command:

[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog? on page 432

[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 433

[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 399

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 400

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 385

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 385

Select Source/Select ASCII Destination
In "Mode > Export", access the file select dialog that provides standard file handling
functions.

Where:
- "Select Source": selects the file to be exported
- "Select ASCII Destination": defines the filename and the file path for the exported
  file

Remote command:

[:SOURce<hw>]:LIST:DEXChange:SELect on page 434

[:SOURce<hw>]:CORRection:DEXChange:SELect on page 401

[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 385

Import / Export
Imports or exports the selected data list file, depending on the current mode.

Remote command:
[:SOURce<hw>]:LIST:DEXChange:EXECute on page 432
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 400
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 385

7.4 Using Power Sensors

The R&S SMB100B works with most 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.

R&S NRP sensors are highly accurate standalone measuring devices, suitable for a wide range of applications. The devices 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 SMB100B works with any sensor of the R&S NRP series and can perform 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 http://www.rohde-schwarz.com in section "Power Meters & Voltmeters".

7.4.1 Connecting R&S NRP Power Sensors to the R&S SMB100B

R&S NRP sensors are connected to the R&S SMB100B in the following ways:
● Connection to the USB connector
  Requires the following cables, depending on the used sensor type:
  – R&S NRP-ZKU (USB interface cable) for R&S NRPxx power sensors
  – R&S NRP-Z3 or R&S NRP-Z4 (USB adapter cables) for sensors of the R&S NRP-Zxx family
● Connection via R&S NRP-Z5 sensor hub
  The R&S NRP-Z5 USB sensor hub (high-speed USB 2.0) can host up to 4 R&S NRP sensors. It provides simultaneous internal and external triggering of all connected sensors.

Requires additional cables, depending on the used output connector of the hub. Choose one of the following:

– Short extension cable R&S NRP-Z2 for connection to the sensor connector. This six-pole connection provides the external trigger capability.

– Standard USB cable (USB type A to USB type B) to any USB type A connector of the R&S SMB100B. This connection does not support external triggering.

● Connection via USB hub with external power supply unit

Requires the following cables, depending on the used sensor type:

– R&S NRP-ZKU (USB interface cable) for R&S NRPxx power sensors

– R&S NRP-Z3 or R&S NRP-Z4 (USB adapter cables) for sensors of the R&S NRP-Zxx family

● Connection via LAN for R&S NRPxxxSN/xxxTN/xxxAN power sensors
Using the Ethernet interface requires PoE (Power over Ethernet) to provide the electrical power.

To establish the connection, you can use:

– 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.

For details, see the description R&S®NRP®Series Power Sensors Getting Started.

Detection and mapping

The R&S SMB100B automatically detects a connected R&S NRP power sensor and indicates it in the "NRP Power Viewer" and "NRP Sensor Mapping" dialogs.

By default, sensors 1 to 4 are assigned to the sensors at the USB connectors, according to their sequence of connection.

You can change the default mapping in the NRP Sensor Mapping dialog.

On connection, the R&S SMB100B immediately starts the measurement of a detected R&S NRP power sensor. If you perform an instrument preset ([Preset] key or `*RST`), the R&S SMB100B stops the measurements. The connection and the mapping of the power sensors remain, the measurements must be restarted.

7.4.2 NRP Sensor Mapping

The "NRP Sensor Mapping" lists all R&S NRP 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. Vice versa, the R&S SMB100B removes a sensor from the list, when it is disconnected.

R&S NRP sensors that are connected via LAN or use the USBTMC protocol are not automatically detected. They are detected by the scan search function.

Access:

► Select "Power Sens" > "NRP Sensor Mapping".

The dialog lists all detected R&S NRP sensors for selection and mapping. You can also browse the network for sensors.

The detected sensors are characterized by the used protocol and the corresponding connector icon. In the "Mapping" column, you can assign the sensor to one of the available sensor channels. The list can contain several entries but the R&S SMB100B can only use up to four sensors simultaneously.

The remote commands required to define these settings are described in Chapter 12.13, "SENSe, READ, INITiate and SLISt Subsystems", on page 347.

Settings

Sensor Mapping List

Displays a list of all sensor entries with information on the sensor name, the used protocol, the connector and the assigned mapping.

If a sensor is connected via LAN or uses the USBTMC protocol, its protocol is indicated as "Visa".

Remote command:

:SLISt[:LIST]? on page 350

:SLISt:ELEMent<ch>:MAPPing on page 350

:SLISt:SENSor:MAP on page 351

Scan

Scans the network and the USB connections for sensors connected via the VISA communication protocol, i.e. sensors that are addressed via LAN or USBTMC.

Sensors communicating via the USB legacy protocol are detected automatically.

Remote command:
`:SLISt:SCAN[:STATe]` on page 350

7.4.3 NRP Power Viewer

The R&S SMB100B features the power viewer function for measuring or monitoring signals with R&S NRP power sensors.

7.4.3.1 About

The R&S SMB100B 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 to much noise in your setup, by a bad supression 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.

Depending on the R&S NRP power sensor type, the manual setting of the filter length varies in resolution:

● Resolution = 1 for the R&S NRPxx power sensor family
● Resolution = 2^n for R&S NRP-Zxx power sensors, with n = 1 to 16

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.

- Different sensor types achieve the same filtering result with different filter and time window lengths.

  The time window length depends on the sensor type:

  – For most sensors, it is fixed to 20 ms.

  – For the R&S NRP-Z81 sensor, it is 10 µs.
     The R&S NRP-Z81 uses filter length that is 1000 times larger than the filter length for other sensors.

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 7.4.3.2, "NRP Power Viewer Settings", on page 169

- Software version of the connected power sensor:
  :SENSe<ch>[:POWer]:TYPE? on page 359

- Acquisition of level correction data:
  Chapter 7.3, "User Correction", on page 152

Additional information

See Rohde & Schwarz website http://www.rohde-schwarz.com in 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.

7.4.3.2 NRP Power Viewer Settings

Access:

► Select "Power Sens" > "NRP Power Viewer".
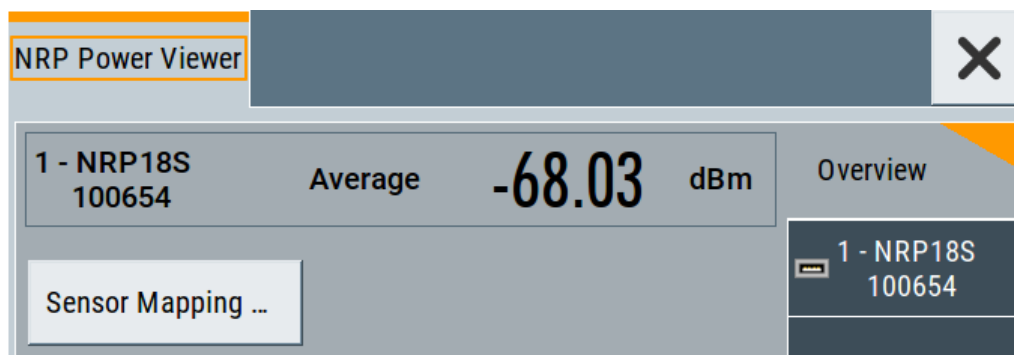
The "Overview" tab shows the list of detected sensors, and provides a separate tab per sensor.
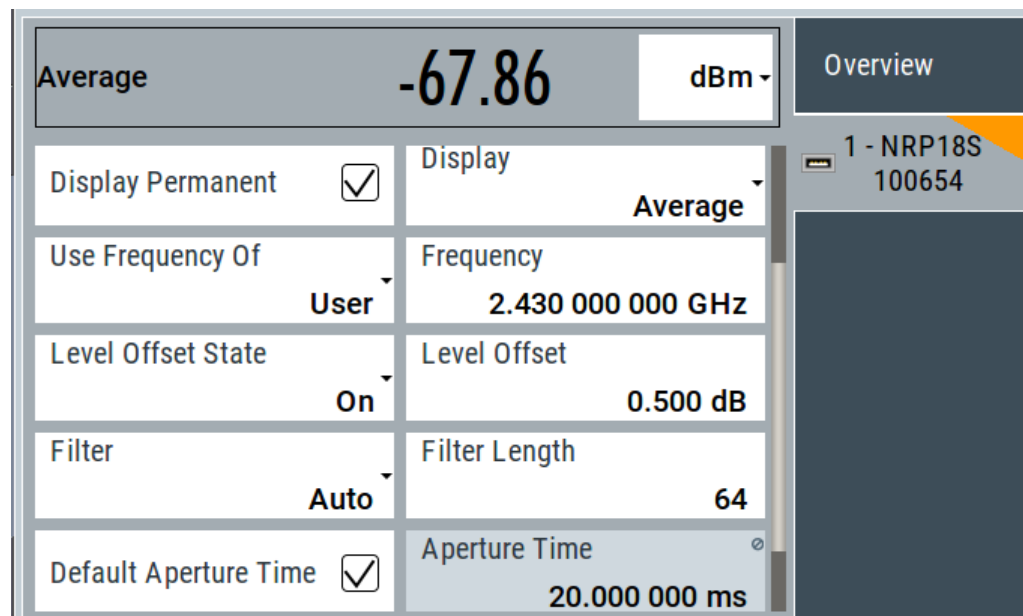
A sensor tab contains all parameters for configuring the sensor settings, like average or peak display, reference source, filter and level offset.

The remote commands required to define these settings are described in Chapter 12.13, "SENSe, READ, INITiate and SLISt Subsystems", on page 347, including the triggering of the measurement and the retrieval of measurement results. See also Chapter 7.5, "How to Calibrate the Power Level with an R&S NRP Power Sensor", on page 174.

Settings

Sensor type and serial number
Indicates the type and the serial number of a selected R&S NRP power sensor, and the channel the sensor is assigned to.

The displayed Level (Peak) / Level (Average) values correspond to the particular sensor.

Remote command:
:SENSe<ch>[:POWer]:TYPE? on page 359
:SENSe<ch>[:POWer]:SNUMber? on page 358

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 351
:SENSe<ch>:UNIT[:POWer] on page 352

Sensor Mapping
Accesses the NRP Sensor Mapping dialog.

Sensor settings

One tab per sensor provides the corresponding settings.

State ← Sensor settings

Activates level measurement.

Remote command:

`:INITiate<hw>[:POWer]:CONTinuous` on page 351

To query the availability of a sensor at a given connector, use the command `:SENSe<ch>[:POWer]:STATus[:DEVice]?` on page 358.

Zero ← Sensor settings

Activates the auto zeroing.

For details, see "About zeroing" on page 168.

Remote command:

`:SENSe<ch>[:POWer]:ZERO` on page 359

Display ← Sensor settings

Sets the display mode for power readings.

Permanent ← Display ← Sensor settings

Activates the permanent indication of the power measurement result on the left side of the home screen.

You can activate the permanent display for several sensors.

Remote command:

`:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe` on page 354

Use Frequency Of ← Sensor settings

Selects the source for measurement.

"RF"　　　　　The R&S SMB100B 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 SMB100B. 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 358

Frequency ← Sensor settings

Defines the frequency value if "Source > User" is used.

Remote command:
`:SENSe<ch>[:POWer]:FREQuency` on page 357

Level Offset State,Level Offset ← Sensor settings
Activates and defines a level offset which is considered in the power meassurement 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 357
`:SENSe<ch>[:POWer]:OFFSet:STATe` on page 357

Filter ← Sensor settings
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 167.

"Auto"   Selects the filter length automatically and adjusts it to the measured value. The value is indicated with the parameter Filter Length.
                When high output power is applied, the filter length and therefore the measurement time can be short.
                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.

"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 356

Filter Length ← Sensor settings
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 354
`:SENSe<ch>[:POWer]:FILTer:LENGth[:USER]` on page 354

Noise/Signal Ratio ← Sensor settings

For Filter > Fixed Noise, sets the noise content.

Remote command:

:SENSe<ch>[:POWer]:FILTer:NSRatio on page 355

Auto Once ← Sensor settings

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 167.

Remote command:

:SENSe<ch>[:POWer]:FILTer:SONCe on page 356

Timeout ← Sensor settings

For "Filter > Fixed Noise", sets a time limit for the averaging process.

Remote command:

:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe on page 355

Default Aperture Time ← Sensor settings

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 352

Aperture Time ← Sensor settings

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 353

S-Parameter ← Sensor settings

Lists the S-Parameter correction data files retrieved for the connected power sensor. To activate the correction data, select the corresponding file.

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 353
:SENSe<ch>[:POWer]:CORRection:SPDevice:LIST? on page 354
:SENSe<ch>[:POWer]:CORRection:SPDevice:SELect on page 353

Enable Logging ← Sensor settings

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 357

7.5 How to Calibrate the Power Level with an R&S NRP Power Sensor

Using a R&S NRP power sensor and the user correction function of the instrument, you can compensate external frequency responses. The R&S SMB100B utilizes the readings of the power sensor and creates a correction value table for controlling the output level during operation.

To connect the R&S NRP to the R&S SMB100B

1. Connect the power sensor.
   See Chapter 7.4.1, "Connecting R&S NRP Power Sensors to the R&S SMB100B", on page 164.

2. Select "Power Sens" > "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 7.4.2, "NRP Sensor Mapping", on page 165

5. Close the dialog.

To configure and calibrate the R&S NRP in the R&S SMB100B

Provided the power sensor is connected to the R&S SMB100B and is assigned to a sensor channel, we recommend that you calibrate and configure the power sensor in the "NRP Power Viewer" dialog.

1. Select "Level" > "RF ON > Off"

2. Select "Power Sens" > "NRP Power Viewer".
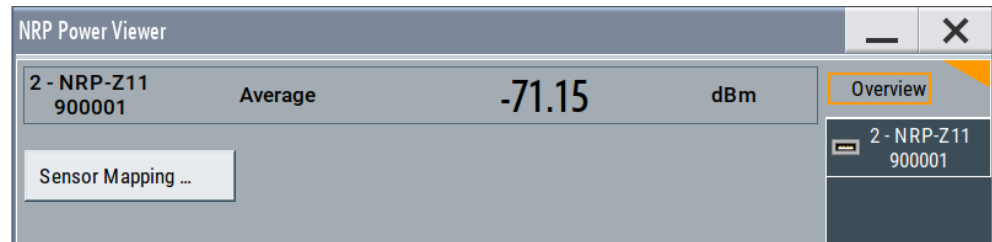
3. If the R&S SMB100B has detected several connected power sensors, select the tab of the sensor you want to use.

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 SMB100B

We assume, that the power sensor is connected, assigned and ready for operation.

1. Select "Level" > "User Correction".
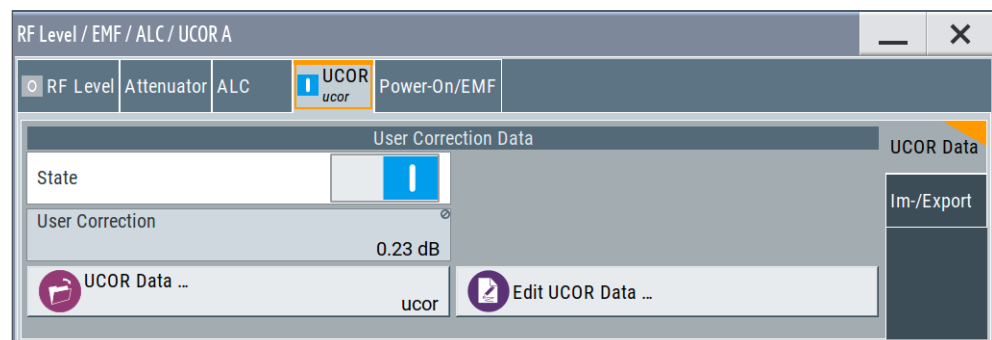
2. Select "UCOR Data > UCOR Data...".

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 SMB100B successively sets each frequency point, reads the measured power of the sensor and fills in the value in the correction table.

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 SMB100B 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 "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 SMB100B considers the user correction data and adjusts the signal level accordingly to compensate external frequency responses.

8 Reference Oscillator

The R&S SMB100B is equipped with an internal reference oscillator that generates a reference frequency of 10 MHz. It is used as internal reference source for the synthesizer. Alternatively, you can apply an external reference signal. If equipped with the required options, the R&S SMB100B can process external reference frequency in the range 1 MHz to 100 MHz and the 1 GHz reference frequency.

Regardless of the used reference source (internal or external), the R&S SMB100B always outputs the reference frequency at the output connector. You can use it, for example to synchronize further connected instruments.

See:

- **Data sheet**, for a comprehensive description of the possible reference frequency inputs and outputs, their characteristics and the required options
- Chapter 8.2, "Using the Reference Frequency for Instruments Synchronization", on page 178, for an overview of typical test situations

The reference oscillator settings are not affected by an instrument preset ([Preset] key or *RST) and the "Save/Recall" function. They are reset only by factory preset.

The remote commands required to define these settings are described in Chapter 12.14.11, "SOURce:ROSCillator Subsystem", on page 447.

8.1 Required Options

R&S SMB100B base unit equipped with the following options:

- Reference oscillator (R&S SMBB-B1/-B1H)
- 1 GHz reference (R&S SMBB-B3)
- Reference frequencies 1 MHz to 100 MHz (R&S SMBB-K704)

For more information, see data sheet.

8.2 Using the Reference Frequency for Instruments Synchronization

Test setups with two or more instruments often require that the instruments use a common reference frequency. Depending on the availability of external reference frequency source and its quality, the instruments are connected and configured in different ways.

This section gives an overview of the possible test setups and the related settings. The following situations are considered:

- External reference source is not available or the **built-in reference oscillator** is of better quality than the external source
(see "Distributing the internal 10 MHz reference signal to further instruments" on page 179)

- **Clean external reference source** with quality exceeding the quality of the built-in reference oscillator
  (see "Using external reference source" on page 180)
- **Interfered or noisy external reference signal**
  (see "Deriving 10 MHz from the external reference frequency" on page 180)
- **1 GHz reference coupling** for phase coherence of the RF signals with reasonable long-term phase stability
  (see "Sharing the 1 GHz reference frequency to obtain phase-coherent signals" on page 179)

Connectors overview

Use the "Show Connector" function to indicate the connector on the front/real panel:

- Ref In/Ref Out
- Ref In/Ref Out 1GHz

Distributing the internal 10 MHz reference signal to further instruments

The internal reference oscillator provides the reference frequency:

- Internal f_{ref} = 10 MHz (10 MHz at connector Ref Out)
- Source = "Internal"
- Reference Output/1GHz Reference Output = "10 MHz"
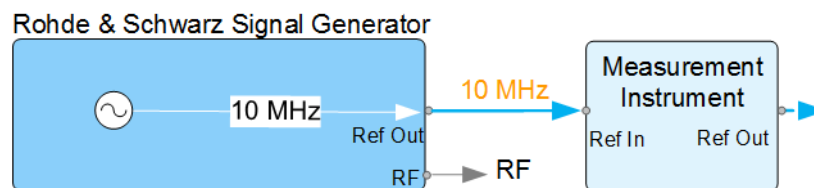
Figure 8-1: Synchronizing instruments using the internal 10 MHz reference signal of the R&S SMB100B

Ref In, Ref Out = Connectors

Sharing the 1 GHz reference frequency to obtain phase-coherent signals

Compared to 10 MHz, a 1 GHz reference signal significantly improves the achievable phase stability between two signal sources. Because the synchronization increases by a factor of 100, the relative phase fluctuations between the sources can be reduced.

1 GHz at connector Ref In 1GHz and 1 GHz at Ref Out 1GHz

- External f_{Ref} = 1 GHz
- Source = "External"
- External Reference Frequency = "1 GHz"
- 1GHz Reference Output = "1 GHz"

Using external reference source

If you have a clean external reference signal with 10 MHz or 100 MHz frequency, for example, you can **directly pass it to the output**. The signal quality remains the same.

10 MHz/100 MHz at connector Ref Out and Ref In

- External f_{Ref} = 10 MHz or 100 MHz

- Source = "External"

- Reference Output = "10 MHz/100 MHz" or "Input Signal (loop through)"

- Set the synchronization bandwidth according to the requirements of the application.
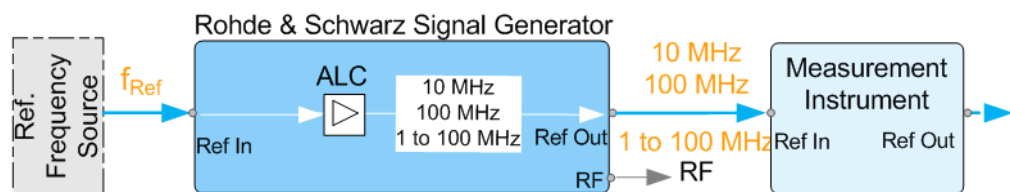
Figure 8-2: Synchronizing instruments with a 10 MHz external reference signal

Ref. Frequency Source = e.g. Rohde & Schwarz signal analyzer
f_{Ref} = 10 MHz/100 MHz/1 to 100 MHz external reference frequency
Ref In, Ref Out   = Connectors

You can forward reference frequency between 1 MHz and 100 MHz directly to the output in the same way.

Note: R&S SMB100B can forward only a defined range of external reference frequencies, see data sheet.

- External f_{Ref} = 1 MHz to 100 MHz
  (**1 MHz to 100 MHz at connector Ref In and Ref Out**)

- Source = "External"

- Variable Reference Frequency = "Variable"

- External Reference Frequency = current external frequency

- Reference Output = "Input Signal (loop through)" or specify the reference frequency the synchronized instrument supports

- Set the synchronization bandwidth according to the requirements of the application.

Deriving 10 MHz from the external reference frequency

10 MHz reference frequency can be derived from the following external reference signals:

- 10 MHz from internal oscillator locked to external input

- 100 MHz and 1 GHz external reference signals

- External reference signal between 1 MHz and 100 MHz

- If the external reference signal is interfered (noisy)
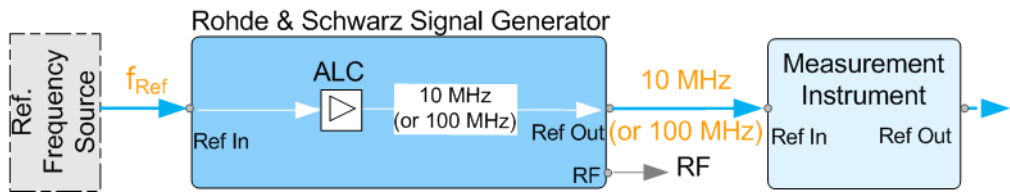
Figure 8-3: Synchronizing instruments with 10 MHz (derived from an external reference frequency)

Ref. Frequency Source = e.g., Rohde & Schwarz signal analyzer
f_{Ref} = 10 MHz/100 MHz/1 to 100 MHz/1GHz** external reference frequency
** = 1 GHz uses Ref In 1 GHz connector
Ref In, Ref Out = Connectors

1 GHz/1 to 100 MHz at connector Ref In 1 GHz/Ref In and 10 MHz at Ref Out

- E.g., External Ref. f_{ref} = 100 MHz

- Source = "External"

- External Reference Frequency = "100 MHz"

- Reference Output/1GHz Reference Output = "10 MHz"

- Synchronization Bandwidth = "Narrow"

8.3 Reference Frequency Settings

Access:

1. Select one of the following:
    - "Frequency" > "Reference Frequency"
    - "System Config" > "Setup" > "General" > "Reference Frequency"
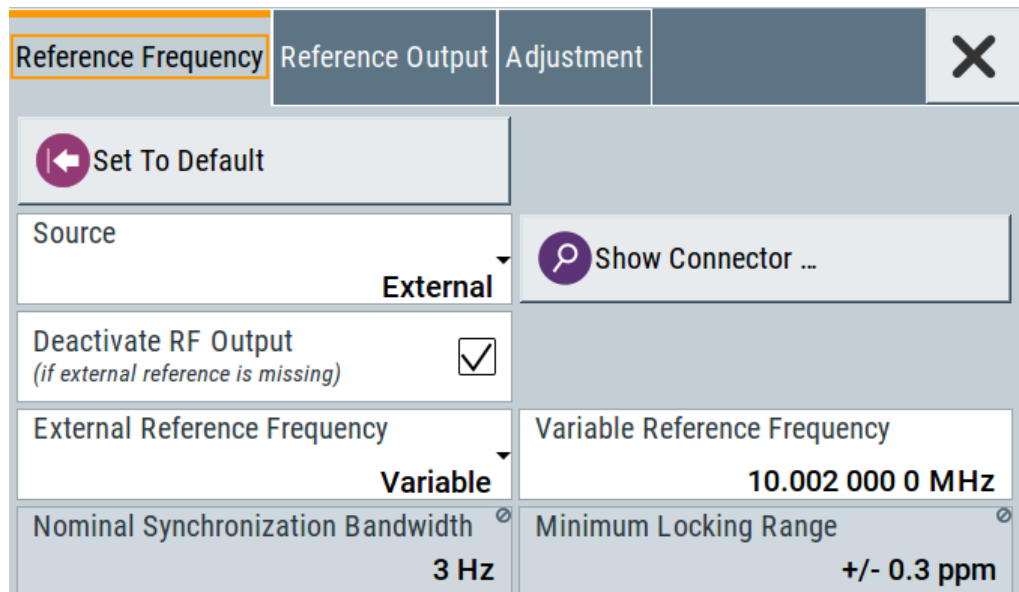
In the "Reference Frequency" tab, you can select the signal source of the reference frequency and define the frequency of an external reference signal.

2. Observe the information on the home screen, "Frequency" tile.

The "Frequency" tile indicates the current reference oscillator configuration, incl. the reference oscillator source, external reference frequency (rounded value) and output connector. A warning symbol in the "Frequency" tile indicates a missing external source.
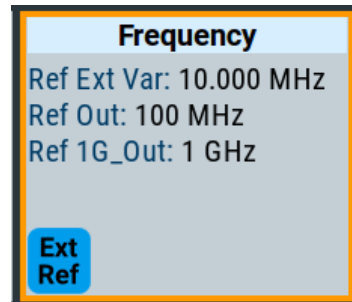
The remote commands required to define these settings are described in Chapter 12.14.11, "SOURce:ROSCillator Subsystem", on page 447.

Settings:

Set to Default
Calls the default settings.

Remote command:
[:SOURce]:ROSCillator:PRESet on page 449

Source
Selects the reference frequency source.

"Internal"   Uses the internal reference oscillator, either with calibrated or a user-defined adjustment value.

"External"   Uses an external reference signal.
                     The frequency of the external reference signal must be set with the
                     parameter "External Reference Frequency".

                     Note: If the external reference is missing, the R&S SMB100B issues
                     a warning message and indicates the icon ⚠ (external reference
                     missing).

                     See "External Reference Frequency" on page 183.

Remote command:
[:SOURce]:ROSCillator:SOURce on page 449

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 refer-
ence signal is used for measurements. A message indicates that the RF output is
deactivated.

Remote command:
[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] on page 449

External Reference Frequency
Sets the frequency of the external reference signal.

"Variable"   Option: R&S SMBB-K704
                     The external reference signal has an arbitrary frequency, within the
                     permissible range from 1 MHz to 100 MHz.
                     Set the output frequency with the parameters in the Reference Output
                     dialog.

"10 MHz, 100 MHz, 1GHz"
                     Selects the external reference frequency.
                     Option: R&S SMBB-B3 for 100 MHz and 1 GHz.
                     The R&S SMB100B locks its internal 500 MHz reference oscillator on
                     the 100 MHz or 1 GHz reference.

Remote command:
[:SOURce]:ROSCillator:EXTernal:FREQuency on page 449

Variable Reference Frequency
Option: R&S SMBB-K704

Sets the variably settable external reference frequency.

Remote command:
[:SOURce]:ROSCillator:EXTernal:FREQuency:VARiable on page 449

Synchronization Bandwidth
("External Reference Frequency = 10 MHz, 100 MHz or 1 GHz")

Selects the synchronization bandwidth for an external reference signal.

The resulting bandwidth is indicated with the parameter Nominal Synchronization Bandwidth.

"Narrow"   The internal reference oscillator is synchronized to the external signal with narrow bandwidth (< 1 Hz). This setting is recommended if the phase noise of the external signal is worse than the phase noise of the internal OCXO.

"Wide"   This mode is the recommended standard mode and for precise reference sources of high spectral purity.

Remote command:
[:SOURce]:ROSCillator:EXTernal:SBANdwidth on page 450

Nominal Synchronization Bandwidth
Indicates the nominal synchronization bandwidth for the selected external reference frequency and synchronization bandwidth.

Remote command:
[:SOURce]:ROSCillator:EXTernal:NSBandwidth? on page 450

Minimum Locking Range
Indicates the minimum locking range for the selected external reference frequency.

Remote command:
[:SOURce]:ROSCillator:EXTernal:MLRange? on page 450

8.4 Reference Output Settings

Access:

1. Select "Frequency" > "Reference Frequency"

2. Select "Reference Output".
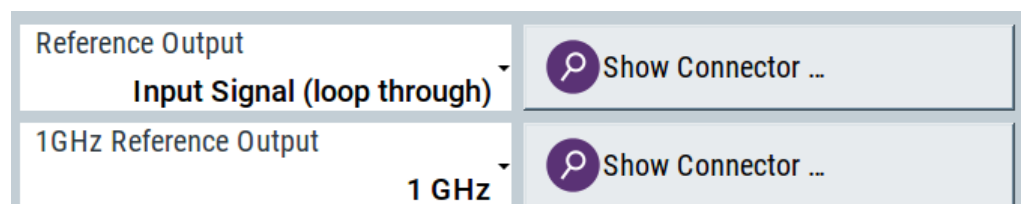
In the "Reference Output" tab, you can set the reference frequency value at the output connectors.
As a result of parameter dependencies, "Preset This Parameter" sometimes does not affect output dialogs.
The remote commands required to define these settings are described in Chapter 12.14.11, "SOURce:ROSCillator Subsystem", on page 447.

Settings:

Reference Output/1GHz Reference Output
Selects the signal that is to be output as frequency reference for downstream instruments.

"Off"   Disables the reference signal output.

"10 MHz"   Derives a signal with 10 MHz frequency from the internal reference oscillator and forwards this signal to the output.

"1 GHz"   Option: R&S SMBB-B3
Outputs a 1 GHz signal.

"Input Signal (loop through)"
                  Forwards the external reference frequency to the output directly.

Remote command:
`[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE` on page 451
`[:SOURce]:ROSCillator:OUTPut:ALTernate:FREQuency:MODE` on page 451

Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

8.5 Adjustment Settings

Access:

1. Select "Frequency" > "Reference Freq"

2. Select "Adjustment".
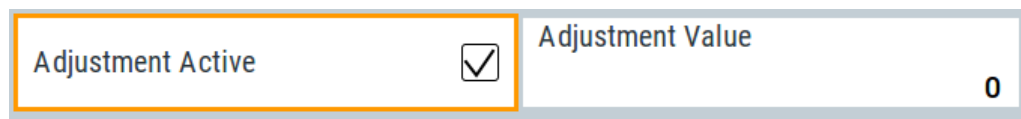
Settings:

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 452

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 452

9 File and Data Management

The R&S SMB100B uses files to save all instrument data. The instrument allows you to store 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 12.5, "MMEMory Subsystem", on page 317.

For information on how to save the displayed setting in a file, refer to Chapter 9.10, "Creating Screenshots of Current Settings", on page 216.

9.1 About the File System

Depending on the contained information, two file groups can be distinguished: system and user files.

> Due to security reasons, system files and the system directory are protected and therefore not accessible.
>
> The scope of this section is only the files with user data.

This section is an overview of the R&S SMB100B file system and covers the following topics:

- "Types of user data" on page 188
- "File storage location" on page 188
- "File handling" on page 188
- "File naming conventions" on page 189
- "File extensions" on page 189
- "File contents" on page 189

Types of user data

Depending on the **content**, the **user data** can be roughly divided into the following data types:

- *Settings*, e.g. the current instrument settings, can be saved and loaded later or used in other instrument of the same kind.
  See Chapter 9.4, "Saving and Recalling Instrument Settings", on page 195

- *SCPI scripts*, a series of commands that can be run to perform a task.
  See Chapter 9.6, "Exporting Remote Command Lists", on page 202

- Externally or internally generated *lists*, e.g. user correction lists, or data lists can be loaded in the instrument.
  See Chapter 9.7, "Loading, Importing and Exporting Lists", on page 203 and Chapter 9.5, "Accessing Files with User Data", on page 200

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 SMB100B is switched off.

File storage location

Without any additional measures, the R&S SMB100B stores user files on the internal memory or if connected, on a memory stick.

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 SMB100B 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 9.8, "Using the File Manager", on page 203. 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 9.8, "Using the File Manager", on page 203.

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 recognizes automatically 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 access the folder `/user`, that is the `/var/user/` folder on the instrument.
  For step-by-step description, see Chapter 9.9, "How to Transfer Files from and to the Instrument", on page 210.

- 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 step-by-step description, see Chapter 9.8.4, "How to Map a Network Folder", on page 207.

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 extensions

The R&S SMB100B distinguishes the files according to their extensions; each type of file is assigned a specific file content and also a specific file extension. The extension is usually of no consequence to you since access to the files occurs in the individual dialogs where only the relevant type of file is available. For example, files with user correction data can only be saved and loaded in the "UCOR" dialog.

See Chapter C, "Extensions for User Files", on page 567 for an overview of the supported file extensions.

File contents

To maintain the file size and to accelerate the loading and processing times, not all instrument settings but rather the settings in state different than the preset one are

stored. 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 stored, 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.

> Network settings and remote settings cannot be saved and restored.

9.2 Restoring the (Default) Instrument Configuration

The R&S SMB100B has various options to set default settings, see Figure 9-1. You can preset the R&S SMB100B to an initial state at any time as a known starting point for configurations. It is often useful as a first step in troubleshooting when unusual results arise.

The graph on Figure 9-1 shows the impact of the particular reset functions.
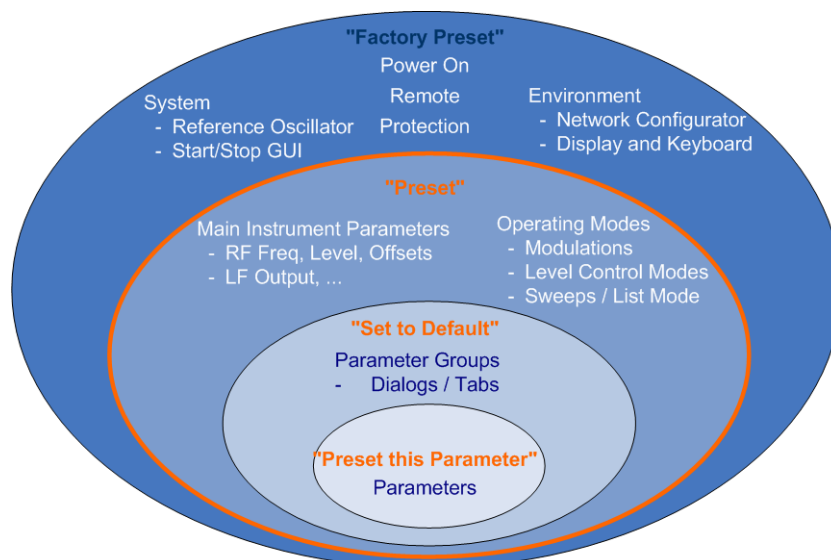
Figure 9-1: Parameter and operating modes, reset by the respective preset functions

Overview of the characteristics of the preset functions

Select the preset option that most fits to your particular application:

- [Preset]
  It is the most frequently used 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 also the states of inactive operating modes.
Network, remote access or system settings are retained.

► To execute a preset, press the [Preset] key at the front panel.
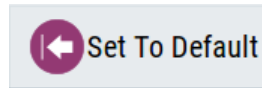
Set To Default

● "Set to Default"
Set To Default relates to individual dialogs or tabs and resets the associated settings of the corresponding dialog. All other settings are retained.

► To reset the grouped settings, click "Set To Default".

Preset This Parameter

● "Preset this parameter"
Sets a single parameter to its default value.

► To reset an individual parameter: Open its context-sensitive menu and select "Preset this parameter...".

Execute Factory Preset
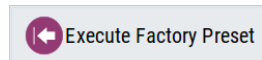
● "Factory Preset"
A factory preset is the most profound preset function that resets almost all instrument settings, including reference oscillator, network and remote access settings.
Retained are the following settings:

– 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.

► To restore the factory defaults, select System Config > Setup > Settings > Factory Preset.

Note: Perform a "Factory Preset" only if it is necessary. After a "Factory Preset", the network connection to the instrument no longer exists.

Presetting the instrument to a user-defined instrument state

The reset functions set the parameters and operating modes to default values predefined by the factory. Alternatively to these default settings, you can:

● Define user-specific recall settings to be restored after a preset
(see Chapter 9.2.3, "How to Recall User Settings Automatically after Preset", on page 193)

- Store and reload user-defined instrument states
  (see Chapter 9.4.2, "How to Save and Recall Instrument Settings", on page 199)

Mark / Do not mark parameters changed from preset

To survey the current state of the settings concerning default values, the R&S SMB100B offers a feature that visually identifies deviations from the default values.

For more information, see Chapter 9.2.2, "How to Identify Parameters Which Are Not in a Preset State", on page 193.

9.2.1 Preset, Set to Default and Factory Preset Settings

Preset

Resets all parameters and switching states, and closes all opened dialogs.

Consider also the following possibilities:
- You can define the settings that are restored when you preset the instrument
  (see Chapter 9.2.3, "How to Recall User Settings Automatically after Preset", on page 193)
- You can reset the instrument to the factory state
  (see "Execute Factory Preset" on page 192)

See also Table 9-1 that contains the key parameters that are reset by the corresponding preset functions.

Remote command:
*RST on page 314

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 9-1 that contains the key parameters that are reset by the corresponding preset functions.

Remote command:
:SYSTem:FPReset on page 317

9.2.2 How to Identify Parameters Which Are Not in a Preset State

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 activate this display:

1. Open the context-sensitive menu (touch and hold the screen anywhere in the GUI of the R&S SMB100B).

2. Select "Mark all parameters changed from preset".

If enabled, the corresponding settings are marked.

Example:

Figure 9-2: Labeled 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

9.2.3 How to Recall User Settings Automatically after Preset

You can define the settings that are restored when you preset the instrument.

1. Configure the settings as required. Save them as described in Chapter 9.4.2, "How to Save and Recall Instrument Settings", on page 199.

2. Save the settings as a file with the predefined filename **UserPreset.savrcltxt**. Save this file in the directory **/var/user/**.

   The filename UserPreset.savrcltxt and the directory /var/user/ are mandatory.

   Now when you press the [Preset] key or send the *RST command to the instrument, the defined settings are restored.

An "Info" message appears and confirms, that a file with user-defined preset setting is loaded.

9.2.4 Reference

See Table 9-1 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, refer to the description of the corresponding remote commands.

Table 9-1: 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
RF OFF mode	-	-	x
Modulation state	off	x	x
Uninterrupted level settings	off	x	x
Level attenuator mode	auto	x	x
Level ALC (internal level control)	auto	x	x
Level UCOR (user correction)	off	x	x
LF output state	off	x	x
Sweep state	off	x	x
List mode state	off	x	x
Reference frequency settings (reference oscillator)	-	-	x
Power on settings (Level/EMF)	-	-	x
Network settings	-	-	x
Hostname	-	-	x
GPIB address	-	-	x
Start/Stop display update	-	-	x
Display and keyboard settings	-	-	x
Password and settings protected by passwords (e.g. disabled LAN or USB)	-	-	-
Security settings	-	-	-
User files (setups[2)], data lists, etc.)	-	-	-

- [2] `UserPreset.savrcltxt` is renamed as `UserPresetInactive.savrcltxt`; an existing file with the same name is overwritten.

ⓘ If the default values in the "Remote Access" dialog had been changed, a factory preset via remote control (`:SYSTem:FPReset`) terminates the connection to the instrument.

Security settings are never reset.

Resets all parameters and switching states, and closes all opened dialogs.

9.3 Protecting Data

During operation, the R&S SMB100B saves user data permanently in the user directory, see "File storage location" on page 188.

To protect any classified data and to avoid saving any sensitive data on the R&S SMB100B permanently, you can:

- Store user files **temporarily in the `/var/volatile` directory**, which remains available only until the instrument is switched off.
  You can access data saved in volatile memory just as data stored permanently in the `/var/user/`.
  See also Chapter 9.8.3, "How to Display All Saved Files", on page 207.
- Activate the **volatile mode** so that no user data can be written to the internal memory permanently.
  Instead, you can only save user data:
  – Temporary in the volatile memory
  – On a connected external storage device, such as a memory stick
  See also:
  – "Default storage location" on page 188
  – "Volatile Mode" on page 241
  – Chapter 9.9.4, "Using a USB Storage Device for File Transfer", on page 215

9.4 Saving and Recalling Instrument Settings

Possibly you would like to restore or repeat a signal generation you performed under specific conditions on the instrument. Or, in a test setup with more than one signal generator, you want to transfer the used settings to another R&S SMB100B. In these cases, you can save and recall instrument and user settings, and possibly other related data.

Save/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 stored to a definable storage location. The file extension is `*.savrcltxt`.
  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 stored values.

Accessing and recalling instrument setups

For quick access to a stored instrument setup file, assign the appropriate action to the [★ (User)] key.

See Chapter 10.2.3, "Assigning Actions to the [★ (User)] Key", on page 231.

9.4.1 Save/Recall Settings

To access the dialog for storing and loading the complete instrument settings

1. Select "System Config > Save/Recall".

2. Select "Operation Mode > Save or Recall" to access the corresponding settings.

   The provided settings for both operations are similar and closely related.
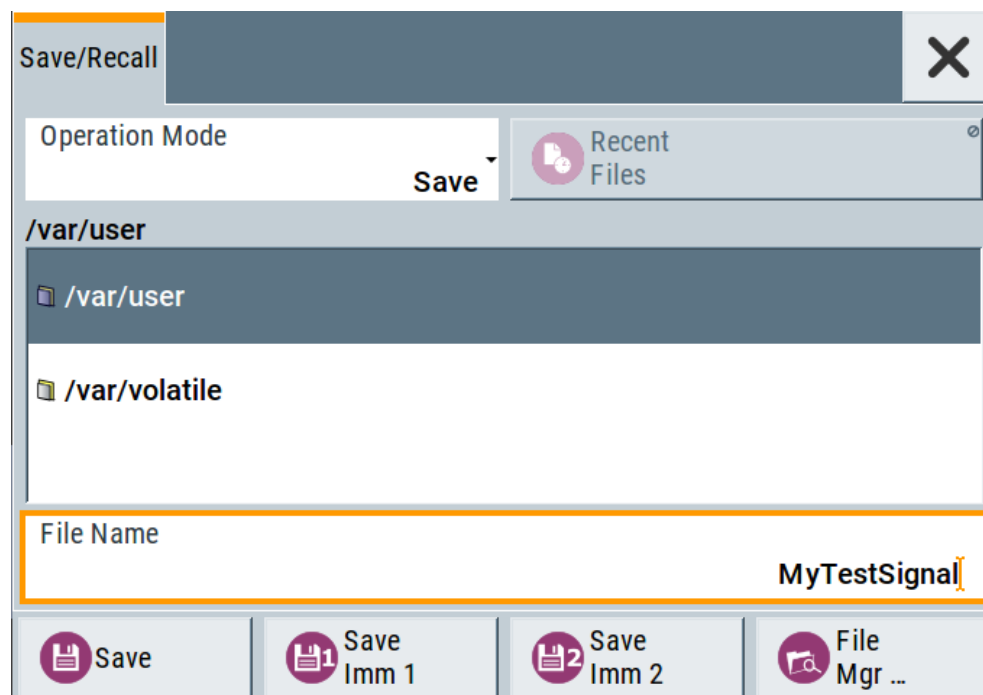
Settings:

Operation Mode

Accesses the settings for storing ("Save") and loading ("Recall") of the instrument settings, or for exporting created SCPI files ("SCPI-Export").

See Chapter 9.6, "Exporting Remote Command Lists", on page 202.

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 create a file, load and save files, use the dedicated functions "New", "Select", Save, and Recent files.
- To access the general data list editor, use the"Edit" button (see also Chapter 6.7, "List Editor", on page 141).
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see Chapter 9.8, "Using the File Manager", on page 203).

Remote command:

To list all files in a directory:

:MMEMory:CDIRectory on page 323

:MMEMory:CATalog? on page 322

[:SOURce]:CORRection:CSET:CATalog? on page 398

Recent files

Displays the files last used.

Show SCPI List

Opens the "SCPI List", which lists the current settings of the R&S SMB100B as SCPI commands.

The R&S SMB100B provides this function for Operation Mode > SCPI-Export.

SCPI List

Contains a list of all SCPI commands corresponding to the current instrument settings.

See also "How to create a SCPI list with the current instrument settings in one step" on page 298

Save

Saves the current instrument settings under the defined filename.

Remote command:

:MMEMory:STORe:STATe on page 326

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 314

Exclude Frequency

The current frequency is retained when a stored instrument setting is loaded.

Remote command:

[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL on page 403

Exclude Level

The current level is retained when a stored instrument setting is loaded.

Remote command:

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL on page 445

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 325

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 314

File Manager

Accesses the "File Manager" dialog, see Chapter 9.8, "Using the File Manager", on page 203.

9.4.2 How to Save and Recall 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.

Accessing and recalling instrument setups

For quick access to a stored instrument setup, assign the appropriate action to the [★ (User)] key.

See Chapter 10.2.3, "Assigning Actions to the [★ (User)] Key", on page 231.

To save and recall instrument settings quickly

1. Select "System Config > 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 stored in the second file.

To save complete instrument settings

1. Select "System Config > 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 `*.savrcltxt` is created.

To restore instrument's configuration

Save the configuration as described in "To save complete instrument settings" on page 200.

1. To restore settings, select "System Config > Save/Recall" > "Operation Mode > Recall".

2. To retain the current frequency and level settings, enable "Save/Recall > Exclude Frequency/Level"

3. In the file selection 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 9.2.3, "How to Recall User Settings Automatically after Preset", on page 193.

9.5 Accessing Files with User Data

Signal generation in list mode, the generation of pulse train signals or applying user correction values use data from list files. Whenever a list file is required as a data source, the instrument provides direct access to the standard "File Select" function. This function enables you to select, create and edit the list files.

9.5.1 File Select Settings

The "File Select" dialog opens automatically each time the signal generation requires list file as data source.

To access a loadable data list file

1. Select "Sweep" > List Mode Data > List Mode Data.

    A "File Select" dialog for loading, creating and modifying a file is displayed.
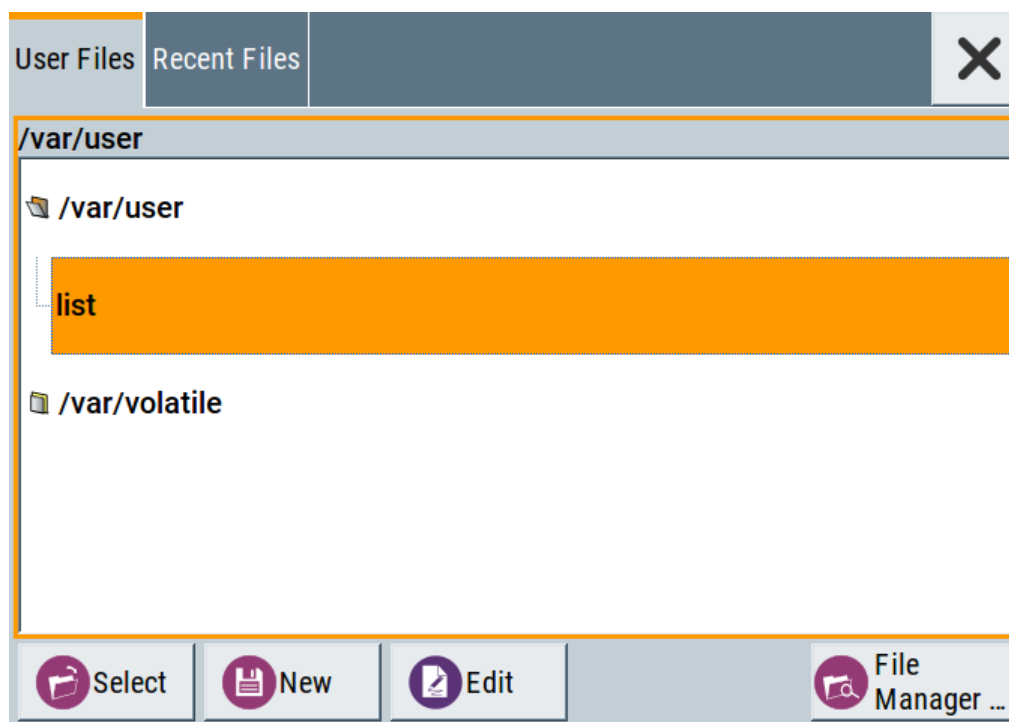
Tip: The name of the dialog is context-sensitive and differs depending on the particular function this dialog is from. However, the provided functions are similar.

2. To load an existing file:
   Navigate through the file system.
   Select the file and confirm with "Select".

3. To create a file, for example if there is no data list file specified:
   Navigate through the file system.
   Select "New" and specify the filename.

   A new empty file is created and saved in the selected folder.

4. To edit an existing or newly created file:
   Navigate through the file system.
   Select the file and select "Edit".

   The standard "Data List Editor" dialog opens

5. Edit the file content.
   Confirm with "Save".

Settings:

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 create a file, load and save files, use the dedicated functions "New", "Select", Save, and Recent files.
- To access the general data list editor, use the"Edit" button
  (see also Chapter 6.7, "List Editor", on page 141).
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see Chapter 9.8, "Using the File Manager", on page 203).

Remote command:
To list all files in a directory:
:MMEMory:CDIRectory on page 323
:MMEMory:CATalog? on page 322
[:SOURce]:CORRection:CSET:CATalog? on page 398

Functions for handling of data lists
Provided are the following standard functions for file handling:

"Select"   Select and load the file.

Remote command:
[:SOURce<hw>]:LIST:SELect on page 431
[:SOURce<hw>]:PULM:TRAin:SELect on page 383
[:SOURce<hw>]:CORRection:CSET[:SELect] on page 397

"New"   Creates file with the specified "Filename".
                  To confirm, select "OK"; use "Cancel" to undo the operation.
                  To edit the file content, select "File Select > Edit".

"Edit"   Accesses the "Data List Editor" and loads the selected file for editing

Recent files
Displays the files last used.

File Manager
Accesses the "File Manager" dialog, see Chapter 9.8, "Using the File Manager", on page 203.

9.6 Exporting Remote Command Lists

To set specific instrument settings or perform tasks automatically, you can create scripts that contain the settings in the form of remote control command sequences.

The R&S SMB100B also offers an SCPI macro recorder with code generator that is used to record manual settings and create an executable script, see Chapter 11.14, "How to Record / Create SCPI Lists", on page 296.

Completed scripts are stored in files and possibly converted to different formats, depending on the used language of the source code.

The R&S SMB100B supports the following commonly used languages:

- Plain SCPI: `*.txt`
- MATLAB: `*.m`
- NICVI: `*.c`

It is also possible to convert the SCPI command list to a user-specific language, see Chapter 11.15, "How to Convert and Save SCPI Lists", on page 299.

9.7 Loading, Importing and Exporting Lists

The R&S SMB100B provides built-in editors for creating list files, for example for the list mode or lists with user correction data. You can also create or evaluate them with an external application. The instrument provides interfaces with the following functionality:

- Import and export list files in a standard ASCII format file

Lists are saved and loaded in the corresponding dialogs. For example, the user correction data list is created and stored in the "User Correction" dialog.

9.8 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 stored on the R&S SMB100B.

You can perform the following tasks:

- Copying multiple files from disk to other media
  See Chapter 9.9, "How to Transfer Files from and to the Instrument", on page 210
- 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 9.8.4, "How to Map a Network Folder", on page 207
- Displaying saved files
  See Chapter 9.8.3, "How to Display All Saved Files", on page 207

Access:

► Select "System Config > Save/Recall" > "File Manager".

Tip: Each "Save/Recall" dialog and each "File Select" dialog provides a quick access to the "File Manger", i.e. whenever you select data lists or files with user data.
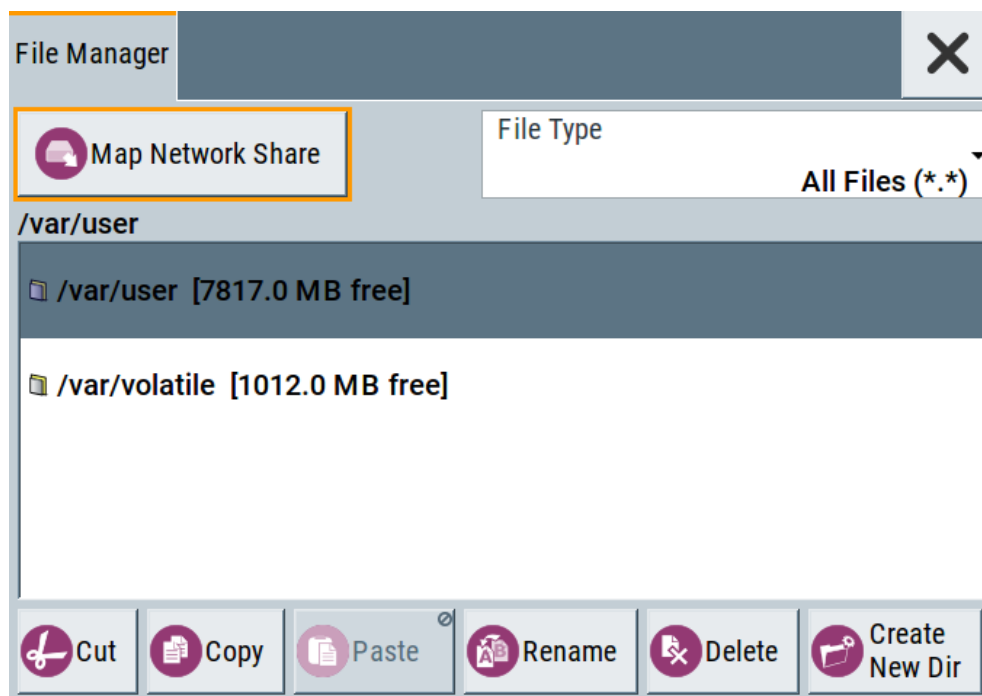
The "File Manager" dialog provides all standard functions required for file management. It displays the contents of the selected folder on the R&S SMB100B and provides functions to rename, delete, copy, or move individual files.

9.8.1 File Manager Settings

Access:

► Select "System Config > Save/Recall" > "File Manager".

Settings:

Map Network Share

Accesses the Map Network Share Settings dialog where you can map one or more network folders.

See also Chapter 9.8.4, "How to Map a Network Folder", on page 207.

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.

See Chapter C, "Extensions for User Files", on page 567 for an overview of the supported file extensions.

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 323

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 325

`:MMEMory:COPY` on page 323

Rename

Renames the selected file or directory.

Remote command:

`:MMEMory:MOVE` on page 326

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 325

9.8.2 Map Network Share Settings

Access:

► Select "System Config > 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

Settings:

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 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.

9.8.3 How to Display All Saved Files

To display all files on the internal memory

1. Select "System Config > Save/Recall" > "File Manager".

2. Navigate to `/var/user/`.

To display all files on a connected USB flash drive

1. Select "System Config > Save/Recall" > "File Manager".

2. Navigate to `/usb/`.

To display all files in the volatile memory

1. Select "System Config > Save/Recall" > "File Manager".

2. Navigate to `/var/volatile/`.

9.8.4 How to Map a Network Folder

Possibly you would like to transfer instrument or user settings to another
R&S SMB100B, distribute waveform files to several instruments or you have to access

frequently the same network drive. In these cases, on a R&S SMB100B connected to a LAN you can create a shortcut to this network folder or this computer.

For information on how to set up a LAN connection, refer to:

- Chapter 3.1.3, "Setting Up a Network (LAN) Connection", on page 27
- Chapter 11, "Network Operation and Remote Control", on page 251

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.
   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 SMB100B, enable file transfer via SMB (samba).

3. Select "System Config > Setup > Remote Access > Network".
   Select:

   a) "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.

Map Network Share			✕
Network Folder	**Local Folder**	**User Name**	**Reconnect at Startup**
//10.124.0.166/user	setups	instrument	Off

Network Folder
//10.124.0.166/user

Local Folder
setups

User Name
instrument

Password

Reconnect at Startup ☐

🔲 Connect   ➡ Change   🔀 Disconnect

6. Close the "Map Network Share" dialog.

   The navigation tree in the "File Manager" dialog displays the mapped network folder as `/shares/Setups`.

File Manager   ✕

🔴 Map Network Share

File Type
List Mode List (*.lsw)

/shares/Setups

📁 /var/user [7817.0 MB free]

📁 /shares/Setups [1012.0 MB free]

📁 /var/volatile [1012.0 MB free]

✂ Cut   📋 Copy   📄 Paste   🔤 Rename   🔀 Delete   📁 Create New Dir

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 9.9.5, "Using a File Server for Test Files Exchange", on page 215.

9.9 How to Transfer Files from and to the Instrument

As explained in "File handling" on page 188, you access the file system of the R&S SMB100B via one of the following ways:

- Via the built-in "File Manager"
  See Chapter 9.8, "Using the File Manager", on page 203.
- On an instrument connected to a LAN:
  - Via one of the standard functions ftp or SMB (samba)
    See Chapter 9.9.2, "Accessing the File System of the R&S SMB100B Via ftp", on page 212 and
    Chapter 9.9.3, "Accessing the R&S SMB100B File System Via SMB (Samba)", on page 213
  - Via mapped network drives
    See Chapter 9.8.4, "How to Map a Network Folder", on page 207.
- Via a connected USB storage device
  See Chapter 9.9.4, "Using a USB Storage Device for File Transfer", on page 215

Mainly because of security reasons, the access to the file system of your R&S SMB100B 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 9.9.1, "Removing File System Protection", on page 210 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.

9.9.1 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 > General"

2. Enable "Volatile Mode"

3. Enter the "Security Password".
   The default password is *123456*. For more information, see Chapter 10.4, "Using the Security Settings", on page 237.

4. Select "System Config > Setup > Maintenance > Shut Down"

5. Select "Reboot".

   The system reboots. The enabled settings are active.

To enable file transfer via ftp

1. Select "System Config > Setup > Security > Security > LAN Services".

2. Enable "LAN Interface"

3. Enable "FTP"

4. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 10.4, "Using the Security Settings", on page 237.

5. Select "Accept".

To enable file transfer via SMB (samba)

1. Select "System Config > Setup > Security > Security > LAN Services"

2. Enable "LAN Interface"

3. Enable "SMB (Samba)"

4. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 10.4, "Using the Security Settings", on page 237.

5. Select "Accept".

To enable file transfer via USB

1. Select "System Config > Setup > Security > Security > General"

2. Enable "USB Storage"

3. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 10.4, "Using the Security Settings", on page 237.

4. Select "Accept".

9.9.2 Accessing the File System of the R&S SMB100B Via ftp

If the R&S SMB100B 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.

For information on how to set up a LAN connection, refer to:
- Chapter 3.1.3, "Setting Up a Network (LAN) Connection", on page 27
- Chapter 11, "Network Operation and Remote Control", on page 251

To access the file system via 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 SMB100B indicates its IP address on the home screen.

   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 10.4.4, "Password Management", on page 246.

5. Enter the password to access the `user` directory.
   The `user` directory corresponds to the `/var/user/` directory of the instrument.
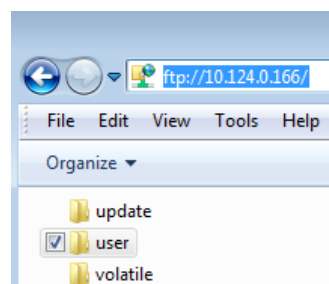
   There, you can perform standard functions like creating directory, or saving files.

6. In the `user` directory, create a directory, e.g. `test ftp`.

7. Select "System Config > Save/Recall".

Open the `/var/user/` directory.

The dialog displays the `/var/user/test ftp` directory.
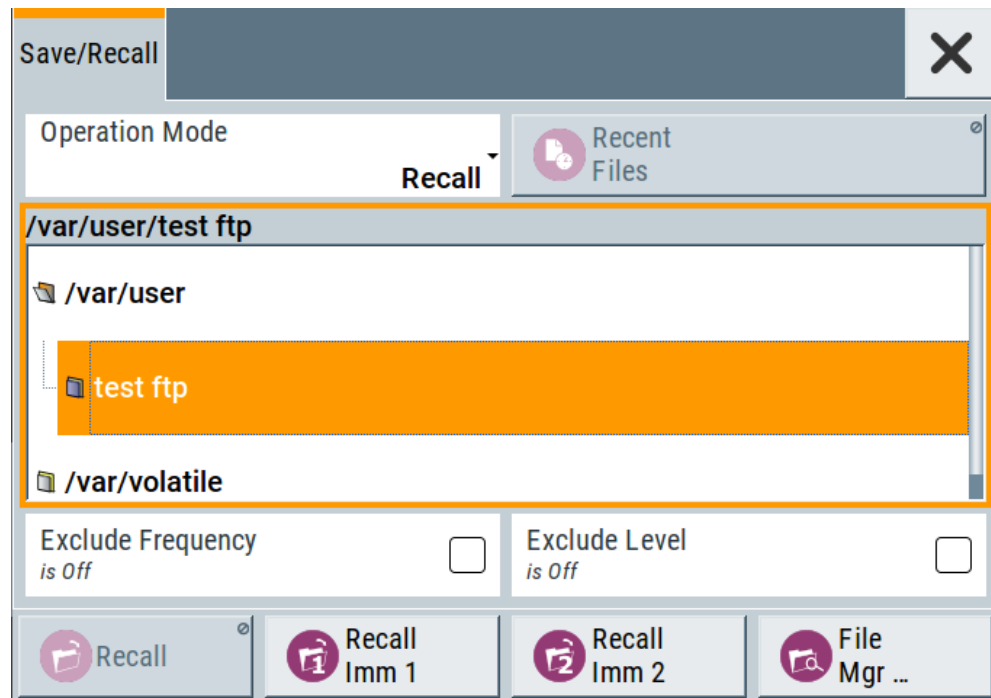
9.9.3 Accessing the R&S SMB100B File System Via SMB (Samba)

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.

For information on how to set up a LAN connection, refer to:

- Chapter 3.1.3, "Setting Up a Network (LAN) Connection", on page 27
- Chapter 11, "Network Operation and Remote Control", on page 251

To access the file system via 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 SMB100B indicates its IP address on the home screen.
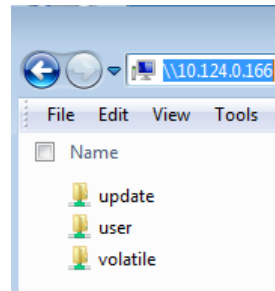
The `user` directory corresponds to the `/var/user/` directory of the instrument; the `volatile` directory - to the `/var/volatile` directory.

To map the R&S SMB100B 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 *//SMB100B-102030/user*.
      Tip: The R&S SMB100B indicates its IP address on the screen.
   c) Select "Finish".

   A log-on dialog opens and requests a user name and 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 10.4.4, "Password Management", on page 246.

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.
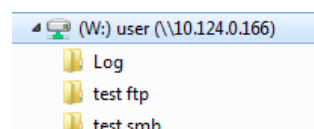
You can access the files in the `/var/user/` directory, perform standard function like creating directory, or storing files.

9.9.4 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 SMB100B 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 > 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.

9.9.5 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 store 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 SMB100Bs 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 SMB100B, map the required directory of the file server to the instrument.
    Perform the steps described in Chapter 9.8.4, "How to Map a Network Folder", on page 207.

2. On each R&S SMB100B, 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 SMB100B, 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 `MMEMory:CDIRectory "/shares/Setups"` to set the default directory for mass storage.

9.10 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 hard-copy of the current display.

9.10.1 Hardcopy Settings

Access:

► Select "System Config > Setup > User Interface > Hardcopy".
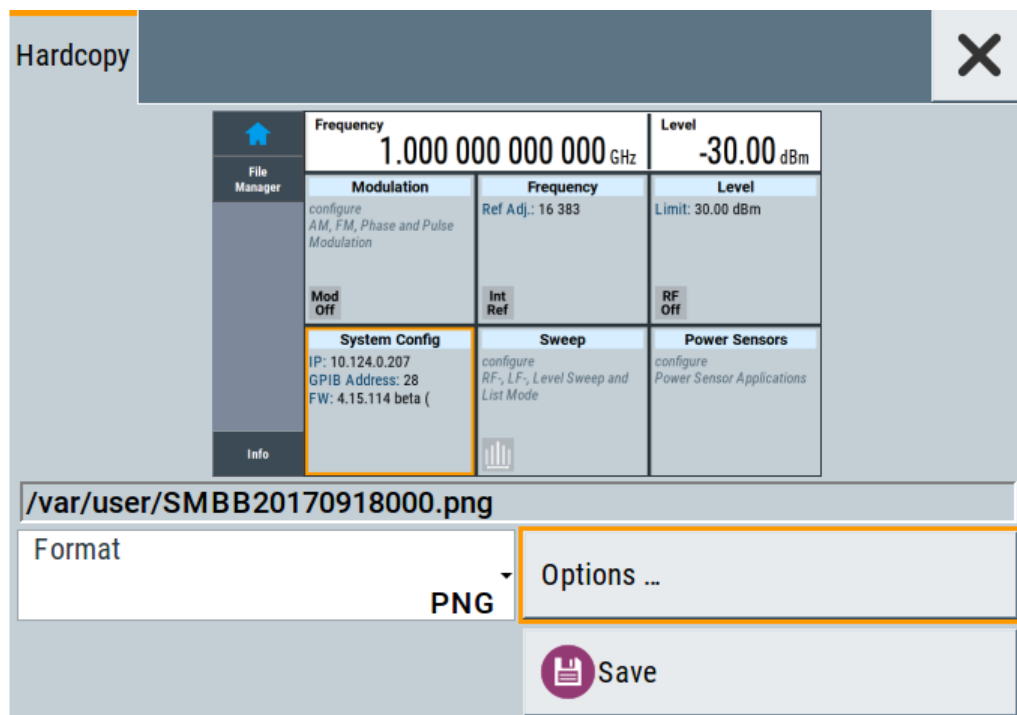
The remote commands required to define these settings are described in Chapter 12.10, "HCOPy Subsystem", on page 339.

Settings:

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 341

Format

Selects the output file format, for example `*.bmp`, `*.jpg` `*.xpm` and `*.png`.

Remote command:
`:HCOPy:IMAGe:FORMat` on page 340
`:HCOPy:DEVice:LANGuage` on page 340

Options...

Accesses Hardcopy Options dialog.

Save

Saves a hardcopy of the current display as a file.

Remote command:
`:HCOPy[:EXECute]` on page 341

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.
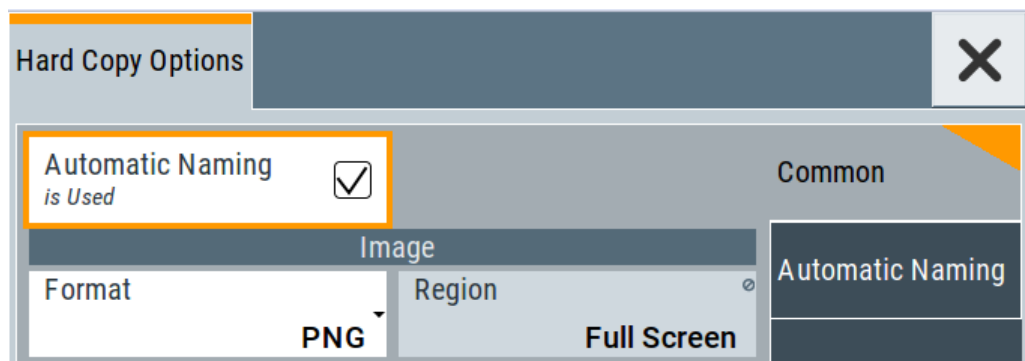
Automatic Naming ← Hardcopy Options > Common
If enabled, creates the output filenames automatically according to the rules set with the Hardcopy Options > Automatic Naming settings.

Remote command:
:HCOPy:FILE[:NAME]:AUTO:STATe on page 343

Format ← Hardcopy Options > Common
Selects the output file format, for example *.bmp, *.jpg*.xpm and *.png.

Remote command:
:HCOPy:IMAGe:FORMat on page 340
:HCOPy:DEVice:LANGuage on page 340

Region ← Hardcopy Options > Common
Displays the snapshot area.

Remote command:
:HCOPy:REGion on page 341

Hardcopy Options > Automatic Naming
Access: select "Hardcopy > Options... > Automatic Naming".
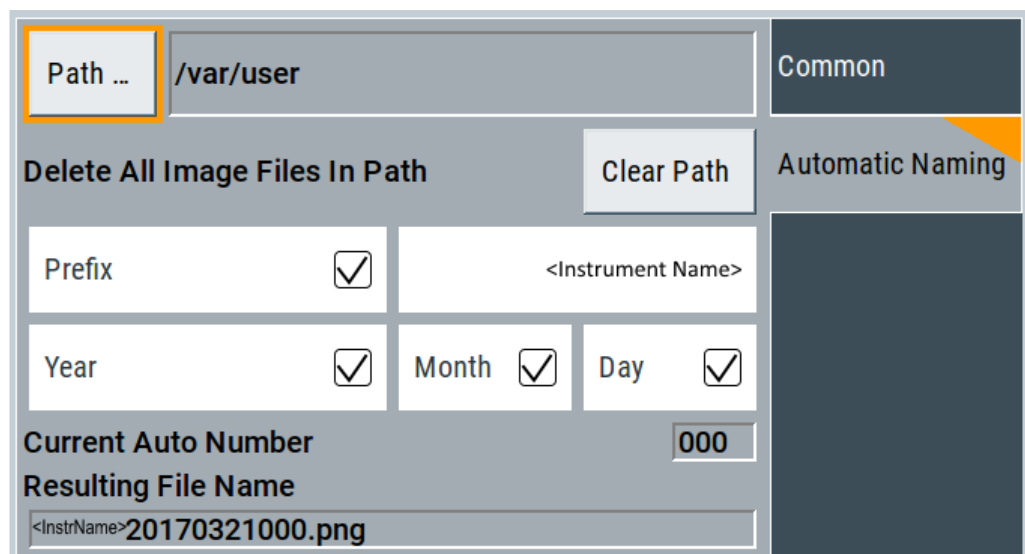
Provided are the following settings:

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 342

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 342

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 344
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe on page 344
:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe on page 343
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe on page 343
:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe on page 343

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 343

9.10.2 How to Save a Hardcopy of the Display

1. Select "System Config > Setup > User Interface > Hardcopy".
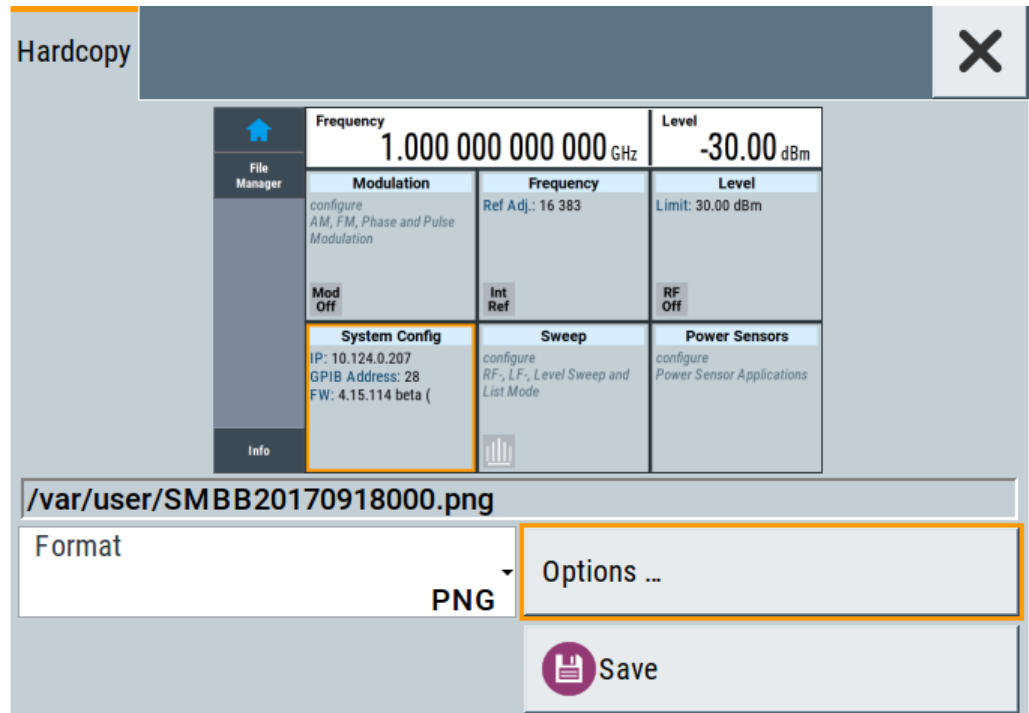
2. To define the output format, select "Format > JPG".

3. To enable the instrument to create output filenames, select "Automatic Naming > On".

4. Select "Options...".

5. In the "Hardcopy Options" dialog:

   a) To change the default directory the file is saved in, select "Automatic Naming Settings > Path" and define a path and a filename. For example, select the default directory `/var/user`.

   b) If necessary, disable or change some of the parameters in the "Automatic Naming Settings".

   c) Close the "Hardcopy Options" dialog.

6. In the "Hardcopy" dialog, select "Save".

   The instrument saves a hardcopy of the current instrument display as a `*.jpg` file. The filename is automatically created.

7. To print the hardcopy, connect the instrument to a LAN and:

   a) Transfer the file to a remote computer as described in Chapter 9.9, "How to Transfer Files from and to the Instrument", on page 210.

   b) On the remote computer, navigate through the file system.

c) Print the selected file.
For more information, refer to the online help of the operating system.

10 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, if necessary for specific applications.

The following special functions help you in service and basic system configuration:

- Chapter 10.1, "Customizing the User Interface", on page 222
  Allows you to adjust the display and keyboard language settings.
- Chapter 10.3, "Managing Licenses and License Keys", on page 233
  If you have purchased an additional option for the R&S SMB100B, you can enable it using a license key.
- Chapter 9.2, "Restoring the (Default) Instrument Configuration", on page 190
  At any time, you can restore a default configuration to start a measurement at a defined instrument state, or set the instrument to factory preset.
- Chapter 13.3, "Performing Maintenance Tasks", on page 517
  Special functions like calibration routines and self-tests put your instrument to an initial state.
- Chapter 10.4, "Using the Security Settings", on page 237
  Special security and protection functions protect your instrument from unauthorized use or activate specific test routines.

10.1 Customizing the User Interface

The R&S SMB100B provides basic alignments of instrument settings regarding the user interface, that means the touch panel (screen), the appearance of the displayed dialogs and graphics, and an external keyboard.

Start / stop display update

The operating system of the R&S SMB100B refreshes the displayed settings by default in almost real-time, to keep the display updated with the internally used values. However, you can turn off this function to reduce settling times when the instrument is remote controlled.

We recommend that you switch off the display update for optimum sweep performance with short dwell times and for fast settling times.

Consider that in this case the displayed values can differ from the operated values.

In detail described in the following paragraphs, you can:

- Set display and keyboard language, see Chapter 10.1.1, "Display and Keyboard Settings", on page 223

- Set date and time for the system clock, see Chapter 13.3.1, "Date and Time Settings", on page 517

- Configure and activate a Screen Saver

- Deactivate display update to improve performance, see Chapter 10.1.2, "Display Update Settings", on page 224

- Determine the state of the RF signal, and the level display in the status bar when you turn on the R&S SMB100B, see Chapter 10.1.3, "Defining the RF Signal State On Power On ", on page 225.

10.1.1 Display and Keyboard Settings

Access:

1. Select "System Config > Setup > User Interface > Display/Keyboard > Display".

Display	USB Keyboard	
Screen Saver *is Active* ☑	**Wait time** 10 Min
Brightness		
Display 14	RF Hardkey 14
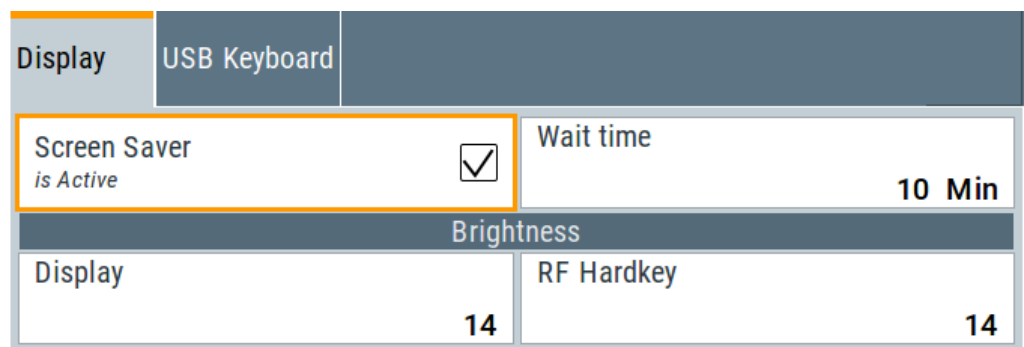
2. Select "Display/Keyboard > USB Keyboard".

Display	USB Keyboard	
Layout English (US) ▾	
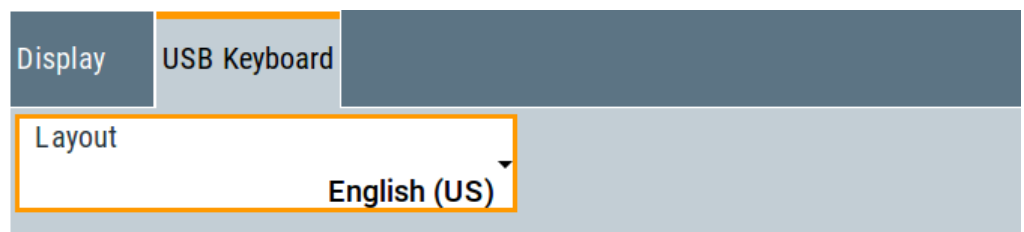
In the "Display/Keyboard" dialog, you can change regional and language options for the GUI and an external keyboard, and define the screen saver settings.

The remote commands required to configure the display and keyboard are described in Chapter 12.8, "DISPlay Subsystem", on page 332 and Chapter 12.11, "KBOard Subsystem", on page 344.

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 334

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 334

Display

Adjusts the brightness of the display.

Increase the value to turn up the display brightness.

Remote command:

`:DISPlay:BRIGhtness` on page 334

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 334

USB Keyboard > Layout

Selects the language of an externally connected keyboard via USB. The function assigns the corresponding keys automatically.

Remote command:

`:KBOard:LAYout` on page 344

10.1.2 Display Update Settings

Access:

► Select "System Config > Setup > User Interface > Start/Stop Display Update".
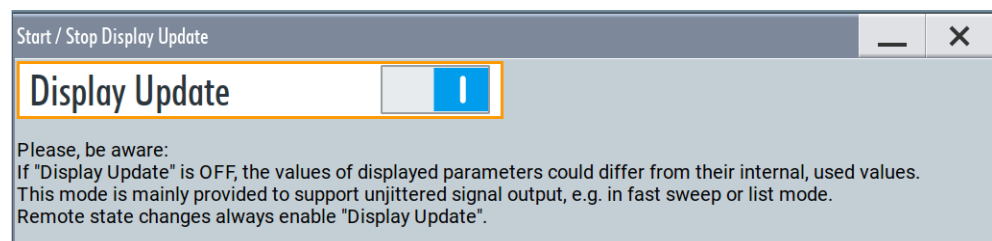
This dialog enables you, to deactivate updating the display.

The remote command to switch off the display update is described in Chapter 12.8, "DISPlay Subsystem", on page 332.

Display Update is
Disables the automatic refreshing of the displayed values.

Remote command:
`:DISPlay:UPDate` on page 335

10.1.3 Defining the RF Signal State On Power On

As additional functions for the level settings, you can determine the state of the RF signal, and the level display in the status bar when you turn on the R&S SMB100B.

Power-On/EMF settings

Access:

► Select "Level" > "Power-On / EMF".
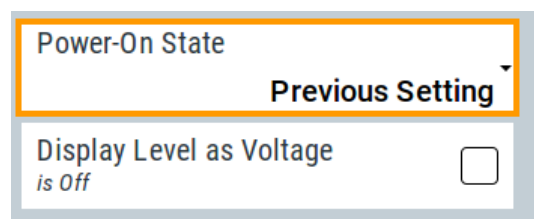
The "Power-On/EMF" dialog contains all settings for configuring the power-on behavior and the level display.

Settings:

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 345

Display Level as Voltage of EMF
Activates display of the signal level as voltage of the EMF (no-load voltage).

If disabled, the level is displayed as a voltage over a 50 Ohm load.

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<hw>]:POWer:EMF:STATe` on page 441

10.1.4 How to Set the Initial Instrument Settings

This section describes how to set up the R&S SMB100B initially.

10.1.4.1 Setting the Keyboard Language

You can select the language of the external keyboard connected to the instrument.

To adjust the keyboard settings

1. Press the [Setup] key.

2. Select "User Interface > Keyboard".
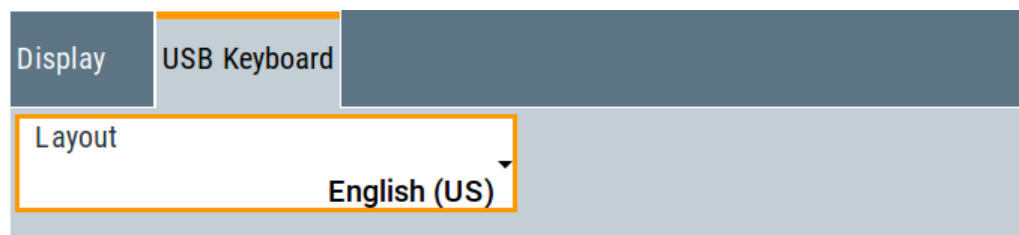
3. Select the "Layout".

   The dialog closes and the changes take effect immediately.

10.1.4.2 Setting the Screen Saver

You can enable a screen saver that automatically turns off the display after a user-defined period of time. The screen saver is activated if no settings are made on the touch screen, or via keys or the rotary knob during the selected wait time.

To activate the screen saver

1. Press the [Setup] key.

2. Select "User Interface > Display"

3. Activate the "Screen Saver".
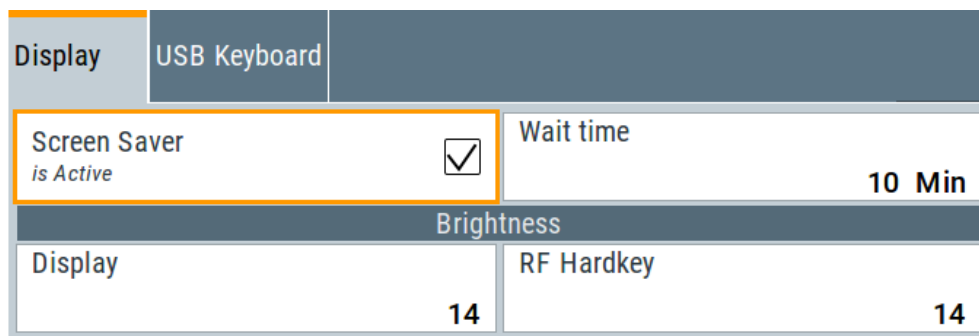
4. Define the "Wait Time" in minutes.

   The instrument turns off the display after the defined period of time.

5. To reactivate the display, tap the screen or press any key on the front panel.

To deactivate the screen saver

1. Press the [Setup] key.

2. Select "User Interface > Display"

3. Disable the "Screen Saver" state.

10.2 Organizing Frequently Used Settings as Favorites

The [★ (User)] key is a key with customizable function. Per default, pressing the key opens the "User Menu" but you can add or remove actions, too. You can add actions to be executed or function to be accessed upon pressing this key.

User menu and [★ (User)] key

These two functions work similar to the favorites function of browser or other programs. They allow you to create a list of frequently used actions or to group frequently used settings in one single dialog.

Possible applications

The ★ (User) key is useful in the following situations:

● There are functions or tasks you have to perform in a defined order but they are distributed among several dialogs

● There are functions or tasks you have to perform more frequently than others but they are not accessible via a front panel key.

● The required functions are grouped in a dialog that is not directly accessible from the blocks on the home screen.

● Your task involves the frequently loading and executing of certain SCPI scripts. Refer to Chapter 11.14, "How to Record / Create SCPI Lists", on page 296 for information on how to create an SCPI script.

● A quick access to saved setups is required.

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

Sometimes, you would like to restore a specific signal generation setup and perform further configurations based on this particular instrument state. The R&S SMB100B provides two ways to achieve this, by the "Save/Recall" function and by the "Recall Setup" function.

- "Save/Recall"
  For a detailed description, refer to Chapter 9.4, "Saving and Recalling Instrument Settings", on page 195.
- "Recall Setup"
  If the "Recall Setup" is the only one user action assigned to the [★ (User)] key, pressing this key triggers the R&S SMB100B to load *immediately* the user-defined preset file.

10.2.1 Using the User Menu for Fast Adjustments

By default, there is one predefined action assigned to the [★ (User)] key.

1. Press the [★ (User)] key.

   The "User Menu" dialog opens.
   If you execute this action for the first time, the dialog is empty.

2. Follow the instructions displayed in the "User Menu" dialog to build your own dialog with settings.

3. Alternatively, proceed as follows:

   a) Open a dialog with settings you frequently use.
   b) Select a parameter.

c) Open the context menu and select "Add to User Menu".
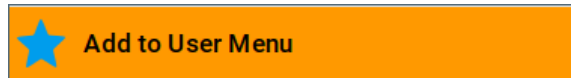
A favorites icon ★ indicates that the parameter is used in the "User Menu".
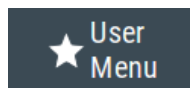
The "User Menu" indication in the task bar confirms that "User Menu" with favorites is created.

d) Press the [★ (User)] key.

The "User Menu" dialog shows all parameters that you have added to the list.
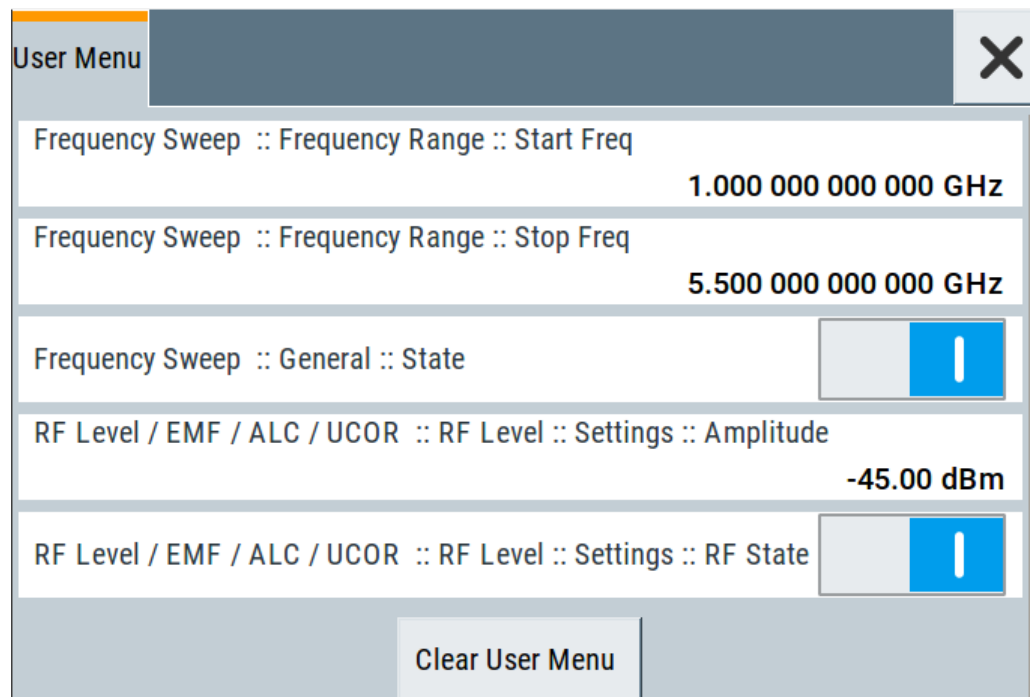
You can configure them, e.g .change state or set values, as you do in the particular dialog the entry originally appears.

4. To remove an entry, in select it (in the "User Menu" or in the particular dialog the entry originally appears.
    Open the context menu and select "Remove from User Menu".

5. In the "User Menu", select "Clear User Menu" to remove all entries at once.

Settings

Clear User Menu
Removes all entries from the "User Menu" at once.

10.2.2 Define User Key Actions Settings

Access:

► Select "System Configuration > Setup > User Interface > Define User Key".
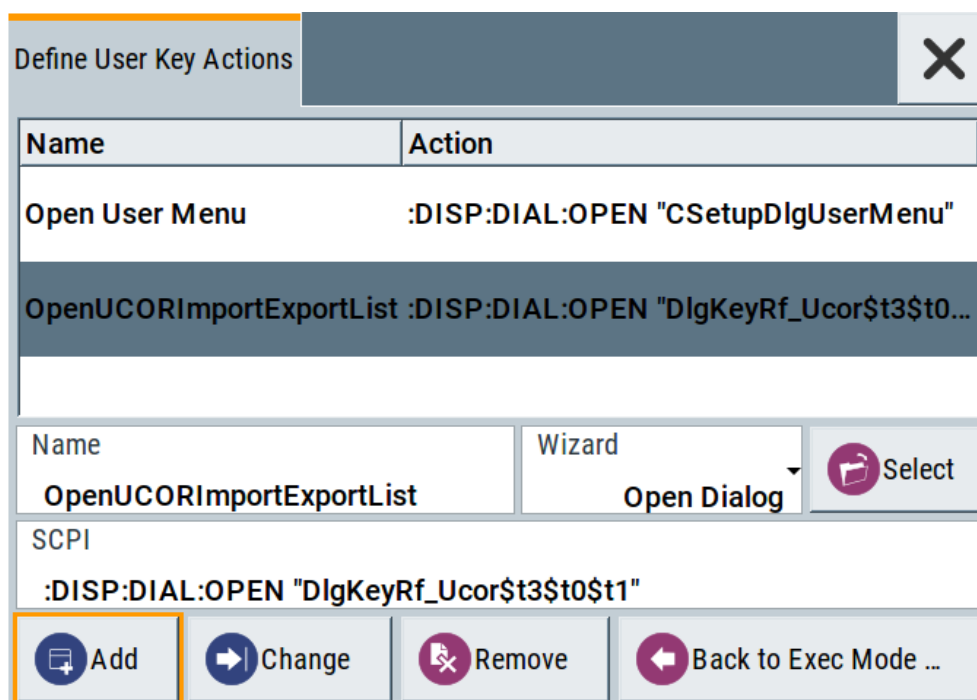
The dialog displays a list of the currently enabled actions and provides functions to define new, edit or remove existing actions. If no actions have been defined, the list is empty.
See Chapter 10.2.3, "Assigning Actions to the [★ (User)] Key", on page 231.

The remote commands required to define these settings are described in Chapter 12.8, "DISPlay Subsystem", on page 332.

Name
Enters a user-defined name for the action.

Wizard
Defines the action to be executed.
"Load SCPI Script"
                Selecting the action load and executes the SCPI script.
"Recall Setup"   Load a setup for quick access to the user-defined settings.

"Open Dialog"

Quick access to the selected dialog.

Select

Depending on the selected "Wizard", provides access to:

- The standard "File Select" function for loading of an SCPI script or setup file
- A list of the dialog IDs of all currently opened dialogs. The dialog ID is used for dialog identification in the remote control.
  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 336
See also :DISPlay:DIALog:ID? on page 336

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

Name	Action
Open User Menu	:DISP:DIAL:OPEN "CSetupDlgUserMenu"
Open	:DISP:DIAL:OPEN "CSetupFrontPanelKe...
➡ Define Actions ...	

Accesses the "Define User Key Actions" dialog.

10.2.3 Assigning Actions to the [★ (User)] Key

1. Open the dialog for that you are creating a quick access.
   For example, select "Level > UCOR > Import/Export"

2. Select "System Configuration > Setup > User Interface > Define User Key".

3. To create an action:

   a) Specify the "Name".
   b) Select "Wizard > Open Dialog"
   c) Select "Select" and select the dialog ID from the list

   The corresponding SCPI command is automatically displayed and can be later modified.

4. Select "Add" to store the new action in the list of user key actions.

Define User Key Actions

Name	Action
Open User Menu	:DISP:DIAL:OPEN "CSetupDlgUserMenu"
OpenUCORImportExportList	:DISP:DIAL:OPEN "DlgKeyRf_Ucor$t3$t0...

Name: OpenUCORImportExportList

Wizard: Open Dialog Select

SCPI: :DISP:DIAL:OPEN "DlgKeyRf_Ucor$t3$t0$t1"

Add   Change   Remove   Back to Exec Mode ...

5. To execute the created action, press ★ (User).
   In the list of actions ("Select Action to Execute" dialog), navigate to the required action.
   In this example, this is "OpenUCORImportExportList".

Define User Key Actions

Name	Action
OpenUCORImportExportList	:DISP:DIAL:OPEN "DlgKeyRf_Ucor$t3$t0...
Open User Menu	:DISP:DIAL:OPEN "CSetupDlgUserMenu"

The action is executed. The dialog opens.

10.3 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 R&S SMB100B service manual.

10.3.1 Manage License Keys Settings

This dialog is the central dialog for licenses registration and performing the required instrument-related steps during the process of unregistration.

Access:

1. Select "System Config > Setup > Instrument Assembly > Manage License Keys > New License".

2. Select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys".

New License	Installed License Keys					
Show Inactive ☐	Show Deactivated ☐					
Export License Key To File			Option	License Count	License Type	Registra-tions
1 0...			<InstrName>-<Opt>	1	Permanent	
2 0...			<InstrName>-<Opt>	1	Permanent	

In the "New License" tab, you can activate licenses for newly purchased or newly registered options. The "Installed License Keys" tab enables you to cancel already registered options, or move licenses.

Settings

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 manage-ment 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 instru-ment (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 option short designation.
　　　　　　　　　Tip: Open the Hardware Options/Software Options dialog to retrieve more information about the installed options.

"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)

10.3.2　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 > New License > Device ID".
   b) On the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New License > Device ID".
   c) In the browser, select "Manage Licenses > Move Portable License > Select Devices" and enter the Device IDs.

3. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys > License Keys Table".
   Navigate to the portable license you want to move.
   Select the "Export License to File" column.

   A standard file manager dialog opens.

4. Enter a filename. Save the exported license key, e.g.
   `k123_portable_key_to_move.xml`.

5. In the browser, select "Manage Licenses > Move Portable License > Select License (from file)" and select the exported license key.
   Check the selection. Create the deactivation key. Save it to file.

6. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New Licences > Import License Keys from File".
   Select the transferred deactivation key.

7. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New Licences > Export Deactivation Response to File".

8. In the browser, go to "Manage Licenses > Move Portable License > Install Deactivation Key (from file)".
   Enter the deactivation response of the instrument.

   The license is deactivated for the source instrument.

9. 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.
   Download the license key as a file. Transfer it to the target instrument.

10. In the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New License > Import License Keys from File".
    Select the created license key file.

    The portable option is installed on the target instrument.

10.4 Using the Security Settings

The protection function of the R&S SMB100B offers 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, the protection levels, that means all protected functions are locked.

To unlock a protection level:

► In the "System Config > Setup > Security > Protection", 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 factory internal use.

Security

The security concept of the R&S SMB100B 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 firmware package to be installed.

To access the settings of these topics, see Setting Security Parameters > "Secure Update Policy" on page 240.

- **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 also Chapter 10.4.4, "Password Management", on page 246.

- **LAN services** secure controlled network access
  You can individually lock and unlock the supported LAN interface services, see Chapter 10.4.3, "Configuring LAN Services", on page 245.
  Remote control via LAN interface requires that the interface is activated, but you can enable the required services specifically.

- **User interface** prevents front panel operation and/or reading the display.

For more information, see the document R&S SMB100B Instrument Security Procedures.

10.4.1 Protection Level Settings

Access:

► Select "System Config > Setup > Security > Protection".

Protection Level 1	☑	Password ******
Protection Level 2	☑	Password ******
Protection Level 3	☑	Password ******
Protection Level 4	☑	Password ******
Protection Level 5	☑	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 237.

The remote commands required to unlock a protected stage are described in Chapter 12.15, "SYSTem Subsystem", on page 460.

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 468

10.4.2 Setting Security Parameters

Access:

► Select "System Config > Setup > Security > Security > General".
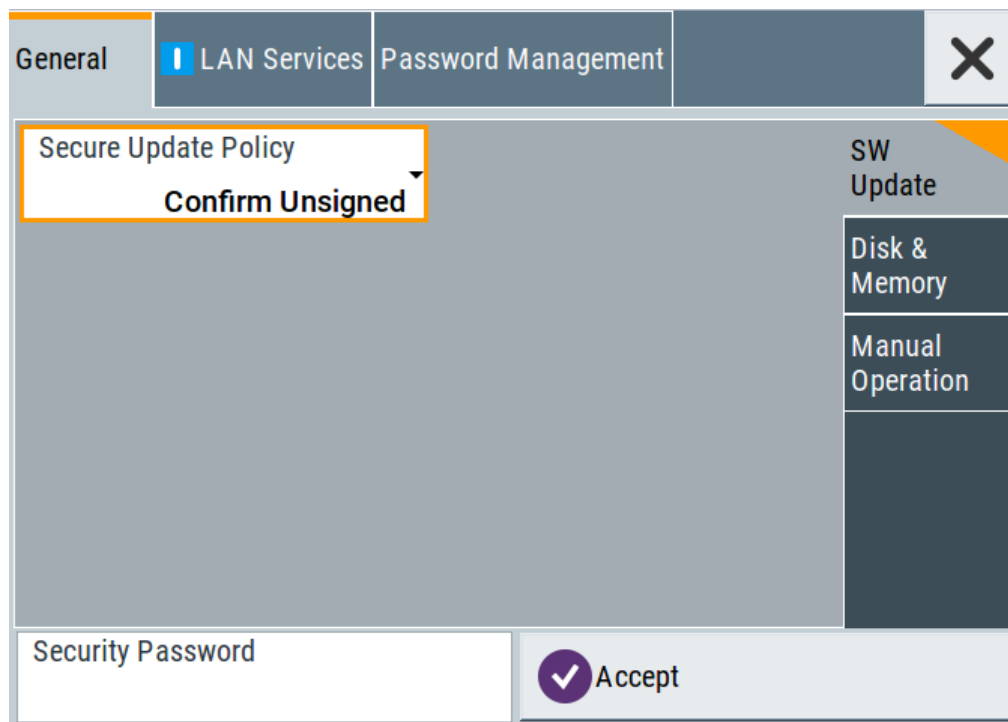
In the "General" tab, you can determine the security level for firmware updates, and configure the security settings for the mass memory and manual operation.

All modified settings in this dialog are not applied until you enter the Security Password and confirm with Accept.

10.4.2.1 Update Policy Security Settings

Access:

► Select "System Config > Setup > Security > Security > General > SW Update".
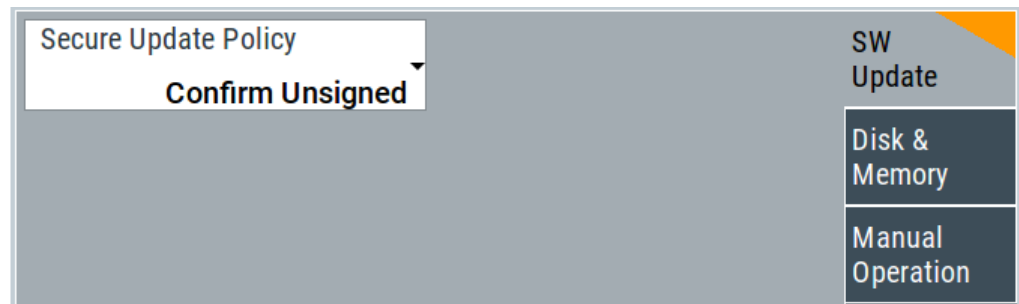
The SW Update tab enables you to select the security mode for firmware updates.

The remote commands available to control security settings are described in Chapter 12.15, "SYSTem Subsystem", on page 460.

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 10.4, "Using the Security Settings", on page 237 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/smb100b.

"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 477

10.4.2.2 Disk & Memory Security Settings

Access:

► Select "System Config > Setup > Security > Security > General > Disk & Memory".
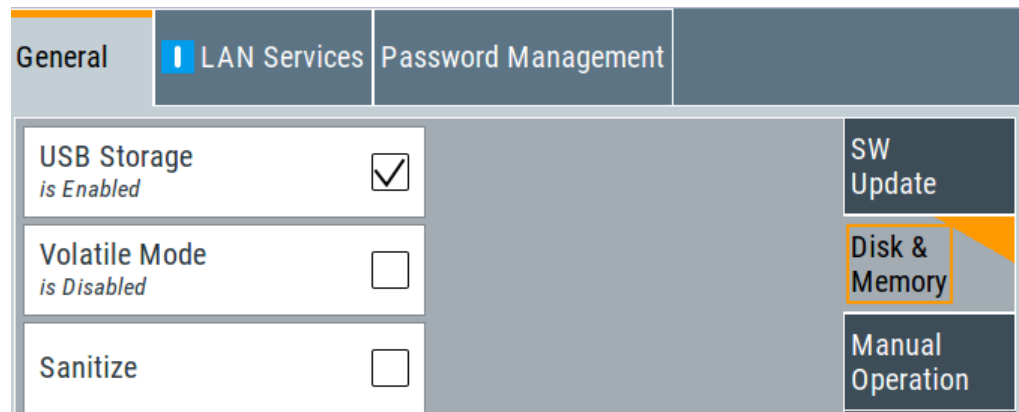
The "Disk & Memory" tab secures controlled access to the mass memory and prevents information from leaving a secure environment.

The remote commands available to control security settings are described in Chapter 12.15, "SYSTem Subsystem", on page 460.

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 also Chapter 9.9.4, "Using a USB Storage Device for File Transfer", on page 215.

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 9.3, "Protecting Data", on page 195.
- 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 an icon.

Remote command:
:SYSTem:SECurity:VOLMode[:STATe] on page 469

Sanitize

Executes the erase procedure that sanitizes the internal memory.

If the instrument is subject to high security, and you have not enabled the volatile mode, the internal flash memory holds user-data, i.e. id poses a security risk. 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.

See also Chapter 10.4, "Using the Security Settings", on page 237 for more information on the security concept.

Remote command:
:SYSTem:SECurity:SANitize[:STATe] on page 477

10.4.2.3 Manual Operation Security Settings

Access:

► Select "System Config > Setup > Security > Security > General > Manual Operation".
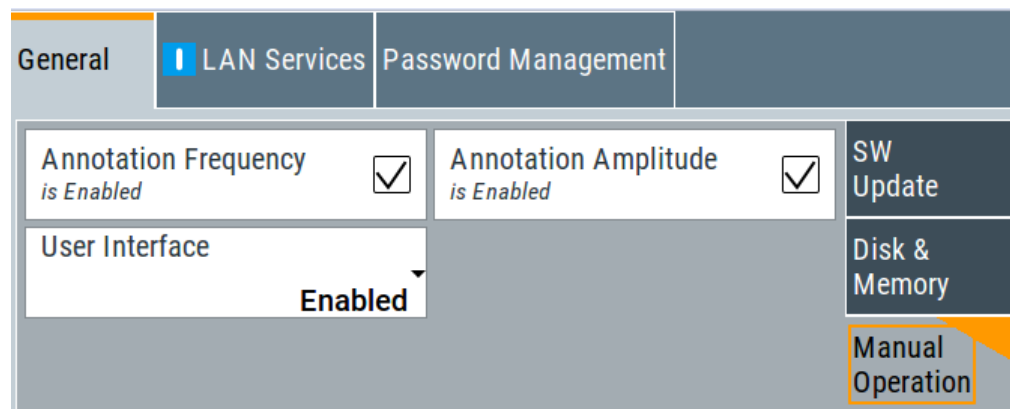
The "SW Update" tab enables you to lock front panel operation and/or reading the display.

The remote commands available to control security settings are described in Chapter 12.8, "DISPlay Subsystem", on page 332, and the Chapter 12.15, "SYSTem Subsystem", on page 460.

Annotation Frequency

Enables the display of the currently used frequency in the status bar.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

Remote command:
:DISPlay:ANNotation:FREQuency on page 335

Annotation Amplitude

Enables the display of the currently selected level in the status bar.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

Remote command:
`:DISPlay:ANNotation:AMPLitude` on page 335

User Interface

Allows you to lock the controls for manual operation and the display individually.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See also Chapter 10.4, "Using the Security Settings", on page 237 for more information on the security concept.

"Enabled"   Enables the display and all controls for the manual operation of the instrument.

"Touchscreen Off"

      Locks the touch sensitivity of the screen.
      This security feature protects the instrument against unintentional change of settings by accidentally touching of the screen.

      Still available controls for manual operation are:
- The keys at the front panel, including the rotary knob
- The external mouse and keyboard
- Remote operation over VNC

      The instrument indicates the locked touchscreen by an icon 🔒.
      Unlocking is possible via VNC, external controls or remote control.

"VNC Only"   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.

"Display Only"   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.

      The function disables:
- The touchscreen functionality of the display
- The keys at the front panel of the instrument
- The external mouse and keyboard

      The instrument indicates the locked controls by a padlock 🔒 softkey.
      Unlocking is possible by entering the security password, see Enabling a locked user interface for manual operation.

"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.
                  Unlocking is possible by entering the security password, see also
                  Enabling a locked user interface for manual operation.

Remote command:

`:SYSTem:ULOCk` on page 466

`:SYSTem:DLOCk` on page 466

`:SYSTem:KLOCk` on page 466

Enabling a locked user interface for manual operation
To unlock the user interface for manual operation, use one of the following:
● On the instrument's keypad or external keyboard, press any key.
  The instrument prompts you to enter the security password for unlocking.

Security password to unlock
******
[OK]   [Cancel]
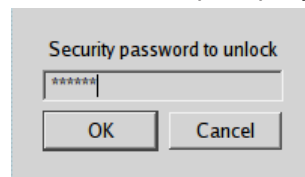
Note: The character of the first key you pressed is immediately added in the input
field. Delete the entry before inserting the password.
Enter the security password *123456*.
● In remote control mode, send the command `SYST:ULOC ENABled` to release all
  locks at once.
  Alternatively:
  – Send the command `SYST:KLOC OFF` to unlock the keyboard and touchscreen
  – Send the command `SYST:DLOC OFF` to release all locks.

  Via remote control, there is no password required.

Remote command:

`:SYSTem:ULOCk` on page 466

`:SYSTem:DLOCk` on page 466

`:SYSTem:KLOCk` on page 466

10.4.3   Configuring LAN Services

Access:

► Select "System Config > Setup > Security > Security > LAN Services".
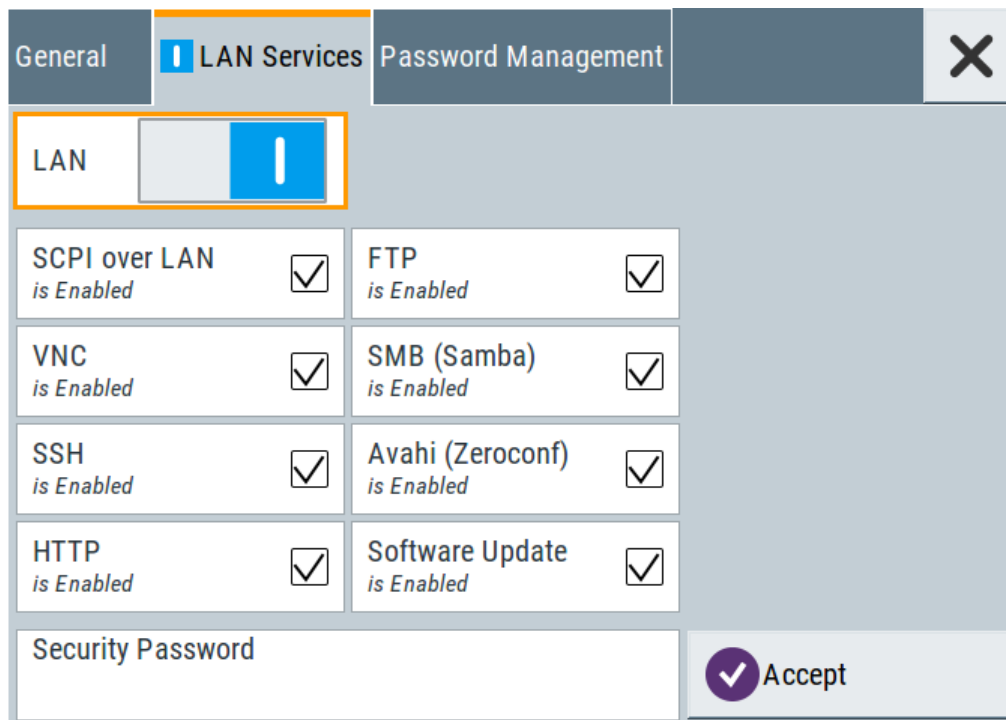
In the "LAN Services" dialog, you can individually enable or disable the supported LAN interface services.

> The activated LAN services are not activated until you enter the "Security Password" on page 246 and confirm with Accept.

LAN
Enables the LAN interface in general, and thus provides remote access via all unlocked services.

Enable LAN Services individually
Enables or disables the following interface services individually.

"SCPI over LAN"

Activates access over LAN to control the instrument remotely, by using SCPI (Standard Commands for Programmable Instruments) commands.
See also "Starting a remote control session over LAN with R&S VISA" on page 285.

"VNC" Activates access via VNC (Virtual Network Computing) interface, a graphical desktop sharing system that uses RFB protocol to control the instrument remotely.
See also Chapter 11.16, "How to Set Up Remote Operation via VNC", on page 300.

"SSH" Activates access via SSH (Secure Shell), a network protocol for secure data communication.

"HTTP" Activates access via HTTP (Hyper Text Transfer Protocol), the application protocol for hypermedia information systems.

"FTP" Activates access via FTP (File Transfer Protocol), used to transfer files from a host to the instrument and vice versa.
See also Chapter 9.9.2, "Accessing the File System of the R&S SMB100B Via ftp", on page 212.

"SMB (Samba)"

Activates access to SMB (Server Message Block), used for providing shared access to files, printers and serial ports of a network.
See also Chapter 9.9.3, "Accessing the R&S SMB100B File System Via SMB (Samba)", on page 213.

"Avahi (Zeroconf)"

Activates Avahi, a service for automatic configuration of the instrument in a network environment.

"Software Update"

Allows updating the software.

Security Password
Enters the password that is required to enable or to disable the settings protected by a security password. Default is *123456*.

Note:
- We recommend that you change the default security password before connecting the instrument to the network.
- The security settings are not assigned until you select the "Accept" button.
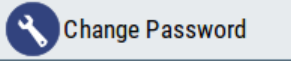
Accept
Applies the modified settings, provided the security password is entered and correct.

10.4.4 Password Management
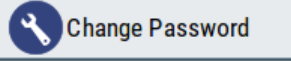
Access:

1. Select "System Config > Setup > Security > Security > Password Management > User 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".

A new password does not take effect until you confirm it with the corresponding "Change Password" button.

To confirm the new password, always press:

- "User Password" > Change Password
  Or

- "Security Password" > Change Password

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.

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.

Note: The new password is not assigned until you select the Change Password button.

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.

The security password is required when changing the status of the USB and LAN interface.

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.

Note: The new password is not assigned until you select Change Password button.

Change Password ← Security Password

Changes the password accordingly.

10.5 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".

State	I
device state after power on	
08:34:52 :OUTPut1:STATe 1	
08:34:55 :SOURce1:FREQuency:CW 3000000000	
08:35:05 :SOURce1:MODulation:ALL:STATe 1	

Clear History	Apply
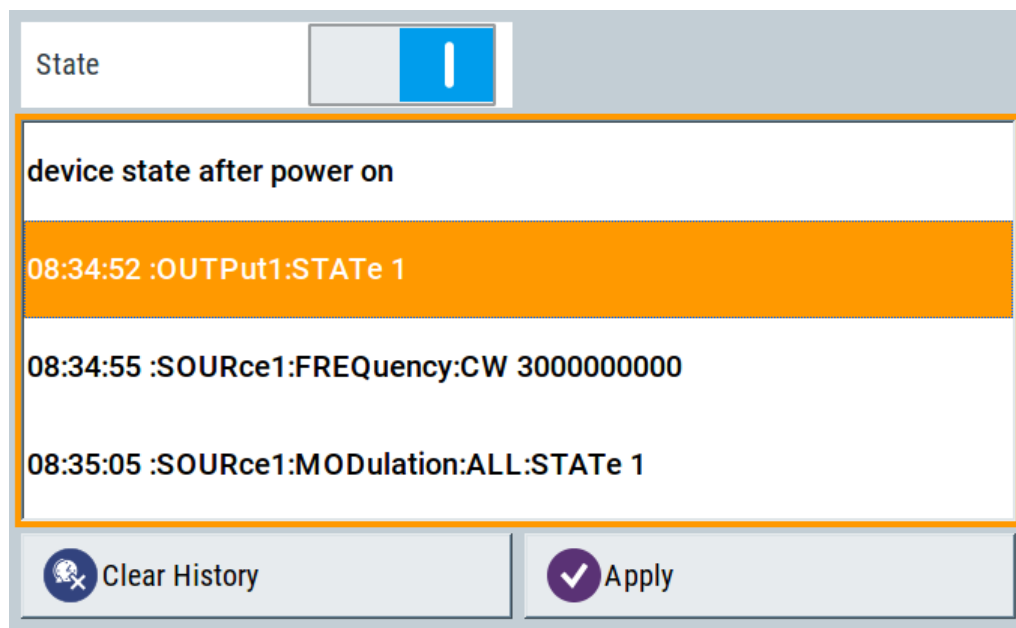
The dialog contains all functions for enabling the "Undo/Redo" functionality.

Settings:

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.

10.6 Shutting Down and Rebooting the Instrument

The [Power On/Standby] front panel 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".
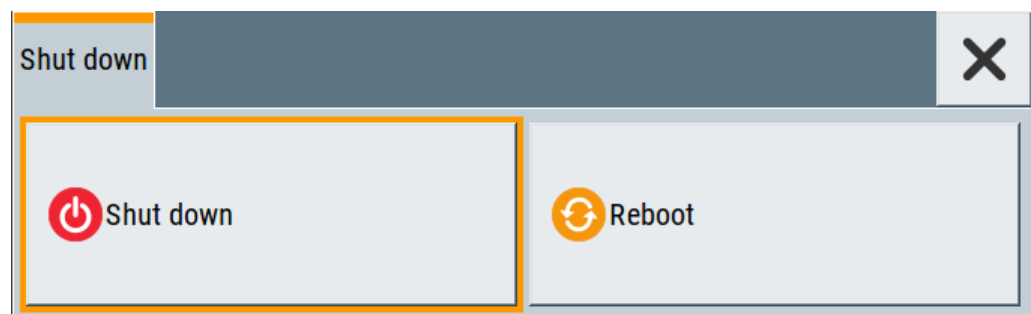
Remote command:

- :SYSTem:REBoot on page 484
- :SYSTem:SHUTdown on page 484

11 Network Operation and Remote Control

ⓘ The description in this section requires basic knowledge of the remote control operation. Definitions specified in the SCPI standard are not provided.

You find some basic information to the SCPI syntax, command lists, and general programming recommendations in Chapter A.1, "Additional Basics on Remote Control", on page 538. See also Chapter A.1.5, "Status Reporting System", on page 550 for information on the status reporting system of the instrument.

As an alternative to the interactive operation directly at the instrument, you can operate the R&S SMB100B also from a remote location.

The Figure 11-1 shows the possibilities of the physical connection (interfaces) for the remote access.
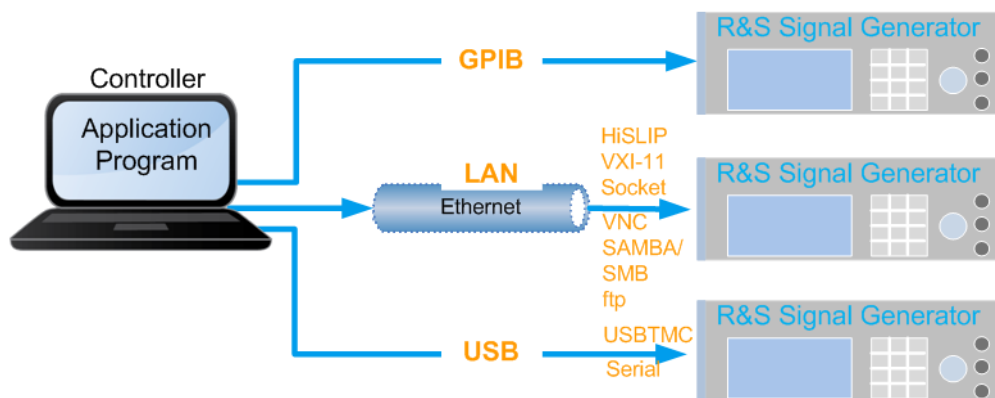
Figure 11-1: Supported remote connections

ⓘ For information on how to configure a network, see the Chapter 3.1.3, "Setting Up a Network (LAN) Connection", on page 27.

The various interfaces provide flexible access to the instrument, such as *remote control*, *remote operation* or *remote file access*. These remote access modes are fundamentally different, although they are often considered interchangeable. Refer to Overview of Remote Access Modes for details on these modes.

For comprehensive information on these topics, refer to the application note 1GP72: Connectivity of Rohde&Schwarz Signal Generators.

11.1 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)

NOTICE

Risk of unauthorized access

If the VNC service is enabled on the instrument, any user in the network who knows the computer name and password can access it.

Disable the VNC service on the instrument to prevent unauthorized access.

- 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.
- Clients supporting remote operation depend on the used remote device, see Table 11-1.

Table 11-1: Supported VNC operation modes

Remote device	VNC client	Requirements	Characteristics
Desktop (Windows, Linux, Mac™OS)	• Ultr@VNC • Other dedicated client software	*Ultr@VNC or Client Software* must be installed.	Fast, supports several options like full screen mode or auto-login.
	• Any web browser	*Java Runtime* 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.
	• Web browser with HTML5	*Web sockets* must be supported.	Slower than the other modes. No additional installation or activation required. No security concern.

Remote device	VNC client	Requirements	Characteristics
Smart device (Tablet/ smartphone)	• Dedicated client App	*App* must be installed.	Fast, supports several options like full screen mode or auto-login.
	• Web browser with HTML5	*Web sockets* 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`.

For more information, refer to Chapter 9.9, "How to Transfer Files from and to the Instrument", on page 210.

11.2 Remote Control Interfaces and Protocols

The instrument supports various interfaces for remote control. The table gives an overview on the connectivity:

Table 11-2: Remote control interfaces and protocols

Interface	Protocols, VISA*) address string and library	Remarks

Local area network (LAN)	• **HiSLIP** High-Speed LAN Instrument Protocol (IVI-6.1)
	`TCPIP::host address::hislip0[::INSTR]`
	VISA
	• **VXI-11**
	`TCPIP::host address[::`
	`LAN device name][::INSTR]`
	VISA
	• **Socket communication** (Raw Ethernet, simple Telnet)
	`TCPIP::host address[::`
	`LAN device name]::<port>::SOCKET`
	VISA or socket controller
		The LAN connector is on the rear panel of the instrument.
		The interface is based on TCP/IP and supports various protocols.
		For a description of the protocols, refer to:
		• Chapter 11.2.1.2, "HiSLIP Protocol", on page 256
		• Chapter 11.2.1.3, "VXI-11 Protocol", on page 256
		• Chapter 11.2.1.4, "Socket Communication", on page 256

USB	• **USBTMC**
	`USB::<vendor ID>::<product ID>::`
	`<serial number>[::INSTR]`
	VISA
		The USB In connector is located at the rear panel of the instrument.
		For a description of the interface, refer to Chapter 11.2.2, "USB Interface", on page 257

GPIB (IEC/IEEE Bus Interface)	• – `GPIB::<address>[::INSTR]` (no secondary address) VISA	Optional GPIB bus interfaces according to standard IEC 625.1/IEEE 488.1 are located on the rear panel of the instrument. For a description of the interface, refer to Chapter 11.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 258.
*) 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 a prerequisite for remote control over LAN (when using VXI-11 or HiSLIP protocol), USB and serial interface. For remote control via socket communication VISA installation is optional. For more information, see Chapter 11.3.1, "VISA Library", on page 259.	

Rohde & Schwarz provides the standardized I/O software library R&S VISA for communication with the instruments via TCP/IP (LAN: HiSLIP, VXI-11 and raw socket) or USB (USBTMC) interfaces.

R&S VISA is available for download at the Rohde & Schwarz website http://www.rohde-schwarz.com/rsvisa.

How to configure the remote control interfaces is described in Chapter 11.8, "How to Set Up a Remote Control Connection", on page 280.

SCPI (Standard Commands for Programmable Instruments)

SCPI commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers. The tutorial "Automatic Measurement Control - A tutorial on SCPI and IEEE 488.2" from John M. Pieper (Rohde & Schwarz order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

For more information, see also Chapter A.1, "Additional Basics on Remote Control", on page 538.

11.2.1 LAN Interface

To be integrated in a LAN, the instrument is equipped with a LAN interface, consisting of a connector, a network interface card and protocols.

For remote control via a network, the PC and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol. The TCP/IP network protocol and the associated network services are preconfigured on the instrument. Software for instrument control and (for specified protocols only) the VISA program library must be installed on the controller.

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.

11.2.1.1 VISA Resource Strings

The VISA resource string is required to establish a communication session between the controller and the instrument in a 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 on the network. Alternatively, you can also assign its **LAN device name**.

If assigned, the IP address is displayed on home screen. You can adjust it manually with the parameter the "System Config > Remote Access > Network" > IP AddressEnabling a locked user interface for manual operation.

The following section lists the characteristics of the VISA resource strings for the corresponding interface protocols. The highlighted characters are crucial.

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.

For details of the HiSLIP protocol, refer to Chapter 11.2.1.2, "HiSLIP Protocol", on page 256.

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.

For details of the VXI-11 protocol, refer to Chapter 11.2.1.2, "HiSLIP Protocol", on page 256.

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 VISA resource string with the associated protocol used.

The registered port for socket communication is port 5025.

11.2.1.2 HiSLIP Protocol

The HiSLIP (**Hi**gh **S**peed **L**AN **I**nstrument **P**rotocol) is the successor protocol for VXI-11 for TCP-based instruments specified by the IVI foundation. The protocol uses two TCP sockets for a single connection - one for fast data transfer, the other for non-sequential control commands (e.g. `Device Clear` or `SRQ`).

HiSLIP has the following characteristics:

- High performance as with raw socket network connections
- Compatible IEEE 488.2 support for Message Exchange Protocol, Device Clear, Serial Poll, Remote/Local, Trigger, and Service Request
- Uses a single IANA registered port (4880), which simplifies the configuration of fire-walls
- Supports simultaneous access of multiple users by providing versatile locking mechanisms
- Usable for IPv6 or IPv4 networks

Using VXI-11, each operation is blocked until a VXI-11 device handshake returns. However, using HiSLIP, data is sent to the device using the "fire and forget" method with immediate return. Thus, a successful return of a VISA operation such as `viWrite()` does not guarantee that the instrument has finished or started the requested command, but is delivered to the TCP/IP buffers.

For more information see also the application note:

1MA208: Fast Remote Instrument Control with HiSLIP

11.2.1.3 VXI-11 Protocol

The VXI-11 standard is based on the ONC RPC (Open Network Computing Remote Procedure Call) protocol which in turn relies on TCP/IP as the network/transport layer. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection-oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

11.2.1.4 Socket Communication

An alternative way for remote control of the software is to establish a simple network communication using sockets. The socket communication, also referred to as "Raw Ethernet communication", does not necessarily require a VISA installation on the remote controller side. It is available by default on all operating systems.

The simplest way to establish socket communication is to use the built-in telnet program. The telnet program is part of every operating system and supports a communi-

cation with the software on a command-by-command basis. For more convenience and to enable automation by means of programs, user-defined sockets can be programmed.

Socket connections are established on a specially defined port. The socket address is a combination of the IP address or the host name of the instrument and the number of the port configured for remote-control. All R&S SMB100B use port number 5025 for this purpose. The port is configured for communication on a command-to-command basis and for remote control from a program.

11.2.2 USB Interface

For remote control via the USB connection, the PC and the instrument must be connected via the USB type B interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S instrument automatically when the USB connection is established. You do not have to install a separate driver.

USBTMC (USB Test & Measurement Cass Specification) is a protocol that is built on top of USB for communication with USB devices, like GPIB. It defines class code information of the instrument, that identifies its functionality to load the respective device driver. Using VISA library, it supports service request, triggers, and other specific operations, similar to GPIB.

11.2.2.1 USB Resource String

The resource string represents an addressing scheme that is used to establish a communication session with the instrument. It is based on the instrument address and some instrument- and vendor-specific information.

The USB resource string syntax is as follows:

USB::**<vendor ID>::<product ID>::<serial number>**[::INSTR]

USB	= denotes the used interface
<vendor ID>	= is the manufacturer ID for Rohde & Schwarz
<product ID>	= is the product identification of the instrument
<serial number>	= is the individual serial number on the rear of the instrument
[::INSTR]	= indicates the instrument resource class (optional)

To set the USB resource string, see Remote Access Settings.

Example:

```
USB::0x0AAD::0x01DE::100001
```

0x0AAD is the vendor ID for Rohde & Schwarz.

0x01DE is the product ID for the R&S SMB100B

100001 is the serial number of the particular instrument.

11.2.3   GPIB Interface (IEC/IEEE Bus Interface)

To be able to control the instrument via the GPIB bus, the instrument and the controller must be linked by a GPIB bus cable. A GPIB bus card, the card drivers and the program libraries for the programming language used must be provided in the controller.

GPIB address

The controller must address the instrument with the GPIB bus channel (see Chapter 11.4.3, "GPIB Address Settings", on page 267). GPIB provides channel addresses from 0 to 30.

The GPIB resource string syntax is as follows:

GPIB::**<address>**[::INSTR]

GPIB   = denotes the used interface
<channel address> = the used channel
[::INSTR]   = indicates the instrument resource class (optional)

Note: If the VISA implementation supports the GPIB interface, you can optionally define the VISA Instrument Control Resource (INSTR). It is used to define the basic operations and attributes for a device, such as reading, writing, or triggering.

Notes and characteristics

In connection with the GPIB interface, note the following:

- Up to 15 instruments can be connected.
- The total cable length is restricted to a maximum of 15 m, or 2 m times the number of devices, whichever is less. The maximum recommended cable length between two instruments is 2 m.
- A wired "OR"-connection is used if several instruments are connected in parallel, since the slowest instrument determines the speed.

Any connected IEC bus cable must be terminated by an instrument or controller.

11.2.4   LXI Browser Interface

The LXI browser interface allows easy configuration of the LAN and remote control of the R&S SMB100B without additional installation requirements. The instrument's LXI browser interface works correctly with all W3C compliant browsers.

See Chapter 11.17.1, "LXI Functionality", on page 306 for more about LXI.

The LAN settings are configured using the instrument's LXI browser interface described in Chapter 11.5.2.1, "LAN Configuration", on page 275. The LXI status settings in the R&S SMB100B are described in Chapter 11.5.1, "LXI Status Settings", on page 272.

11.3 Remote Control Programs and Libraries

This section shows how the remote-control programs access the instrument, and the libraries they require for the appropriate interface protocols.
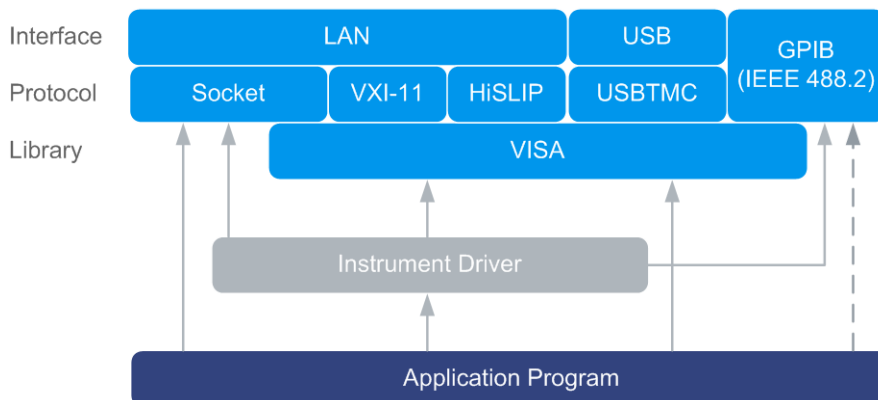
Figure 11-2: Overview of remote control interfaces, protocols and libraries

11.3.1 VISA Library

VISA is a standardized software interface library providing input and output functions to communicate with instruments. Thus, you can configure the interface without having to adjust the application program to the used interface. The I/O channel (LAN or TCP/IP, USB, GPIB,...) is selected at initialization time with the channel–specific address string ("VISA resource string"), or by an appropriately defined VISA alias (short name). See also Table 11-2 for an overview.

Instrument access via VXI-11 or HiSLIP protocols is achieved from high level programming platforms using VISA as an intermediate abstraction layer. VISA encapsulates the low-level VXI or GPIB function calls and thus makes the transport interface transparent for the user.

A VISA installation is a prerequisite for remote control using the following interfaces:

- LAN interface using HiSLIP Protocol
- LAN interface using VXI-11 Protocol
- USB Interface

Instrument access via the LAN socket protocol or GPIB connections can be operated both, with or without the VISA library. See also Chapter 11.2.1.4, "Socket Communication", on page 256 and Chapter 11.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 258.

For more information about VISA library, refer to the user documentation.

11.3.2 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. The involved parts are **highlighted**. For more information, see the application note 1GP72: Connectivity of Rohde&Schwarz Signal Generators.

- Remote control (application) program using VISA
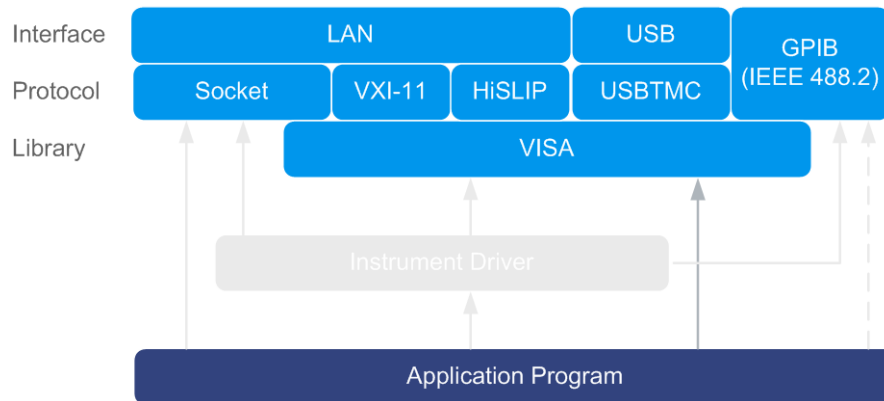
Figure 11-3: Application program using VISA

Protocol	Remote control program
Socket	`viOpen (..., "TCPIP:SMB100B-102030::5025::SOCKET", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
VXI-11	`viOpen (..., "TCPIP:SMB100B-102030::inst0::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
HiSLIP	`viOpen (..., "TCPIP:SMB100B-102030::hislip0::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
USBTMC	`viOpen (..., "USB::0x0AAD::0x01DE::100001::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
GPIB	`viOpen (..., "GPIB::28::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`

- Remote control program using instrument driver (VISA available)
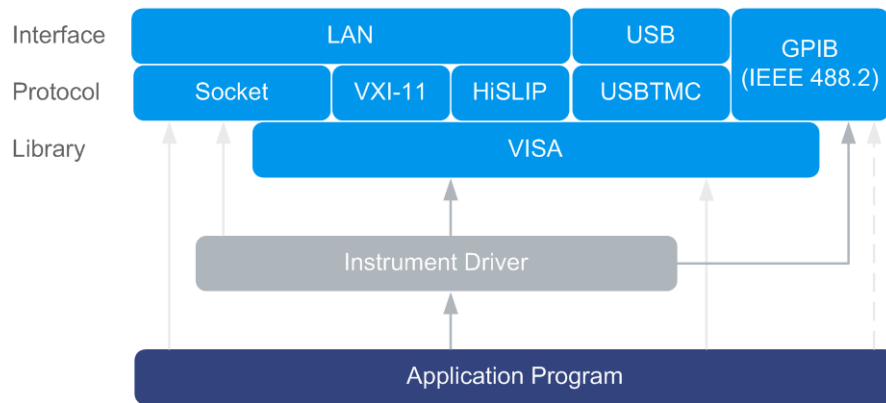
Figure 11-4: Application using instrument driver (VISA available)

Protocol	Remote control program
Socket	rssmb_init ("TCPIP:SMB100B-102030::5025::SOCKET", ...) rssmb_SetFrequency (..., 2e9)
VXI-11	rssmb_init ("TCPIP:SMB100B-102030::inst0::INSTR", ...) rssmb_SetFrequency (..., 2e9)
HiSLIP	rssmb_init ("TCPIP:SMB100B-102030::hislip0::INSTR", ...) rssmb_SetFrequency (..., 2e9)
USBTMC	rssmb_init ("USB::0x0AAD::0x01DE::100001::INSTR", ...) rssmb_SetFrequency (..., 2e9)
GPIB	rssmb_init ("GPIB::28::INSTR", ...) rssmb_SetFrequency (..., 2e9)

- Remote control program using instrument driver (VISA **not** available)
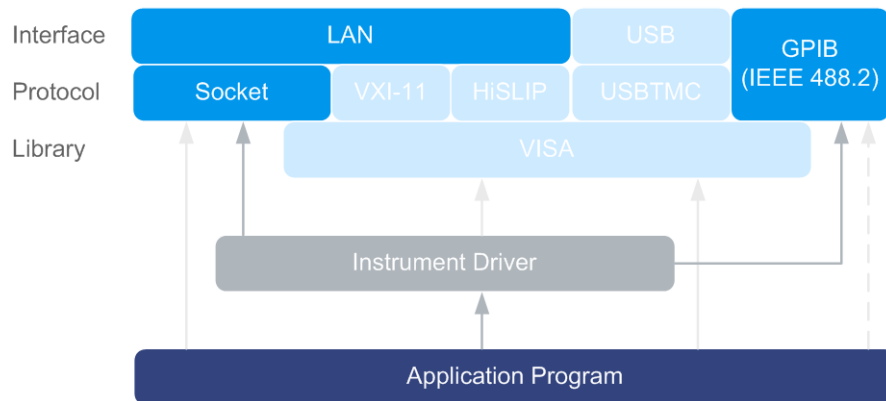
Figure 11-5: Remote control program using instrument driver (VISA not available)

Protocol	Remote control program
Socket	`rssmb_init ("TCPIP:SMB100B-102030::5025::SOCKET", ...)` `rssmb_SetFrequency (..., 2e9)`
GPIB	`rssmb_init ("GPIB::28::INSTR", ...)` `rssmb_SetFrequency (..., 2e9)`

11.4 Remote Access Settings

This section outlines 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 via smart devices.

About instrument emulations

You can also remotely control the R&S SMB100B via the command set of another signal generator, as, for example, of an HP generator. With this function you can, for example, replace a signal generator with an R&S SMB100B in an automated test setup, without adjusting the command scripts used.

The R&S SMB100B 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 all the remote control command sets supported by the R&S SMB100B 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 SMB100B specific command set is disabled and the SCPI command `:SYSTem:LANGuage` is discarded.

To return to the SCPI command set of the R&S SMB100B, use the appropriate command of the selected command set. If for example an HP generator is emulated, the HP command `EX` returns to the instrument-specific GPIB command set.

11.4.1 Network Settings

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses

Errors can affect the entire network.

Access:

► Select "System Config > Remote Access > Network".

In the "Network" dialog, you can configure the settings of the general network environment and specific identification parameters of the instrument in the network.

The remote commands required to configure the network remotely are described in Chapter 12.15, "SYSTem Subsystem", on page 460.

How to connect the signal generator to the network is described in the Chapter 3.1.3, "Setting Up a Network (LAN) Connection", on page 27.

Network Status
Indicates that the instrument is connected to the network.

R&S®SMB100B   **Network Operation and Remote Control**

Remote Access Settings

Remote command:

`:SYSTem:COMMunicate:NETWork:STATus?` on page 472

Restart Network

Terminates the network connection of the instrument and subsequently 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 472

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 host-name 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 472

Workgroup

Sets the individual windows workgroup name of the R&S SMB100B. 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 473

Address Mode

Selects the mode for assigning the IP address.

NOTICE! Risk of network failure.
Consult your network administrator before performing the following tasks:
● Connecting the instrument to the network
● Configuring the network
● Changing IP addresses

Errors can affect the entire network.

"Auto (DCHP)"
      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 471

IP Address

Displays the IP address of the instrument in the network.

By default, the R&S SMB100B 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 instrument 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.
See Chapter 14.5, "Resolving Network Connection Failures", on page 534.

To assign the IP address manually, select Address Mode > "Static".

Remote command:
`:SYSTem:COMMunicate:NETWork:IPADdress` on page 470

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:
`:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK` on page 473

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 473

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 472

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 473

MAC Address

Indicates the MAC (Media Access Control) address, a unique identifier of the network adapter in the R&S SMB100B.

Remote command:

:SYSTem:COMMunicate:NETWork:MACaddress on page 471

11.4.2 VISA Resource Strings

Access:

► Select "System Config > Remote Access > Visa Resource Strings".
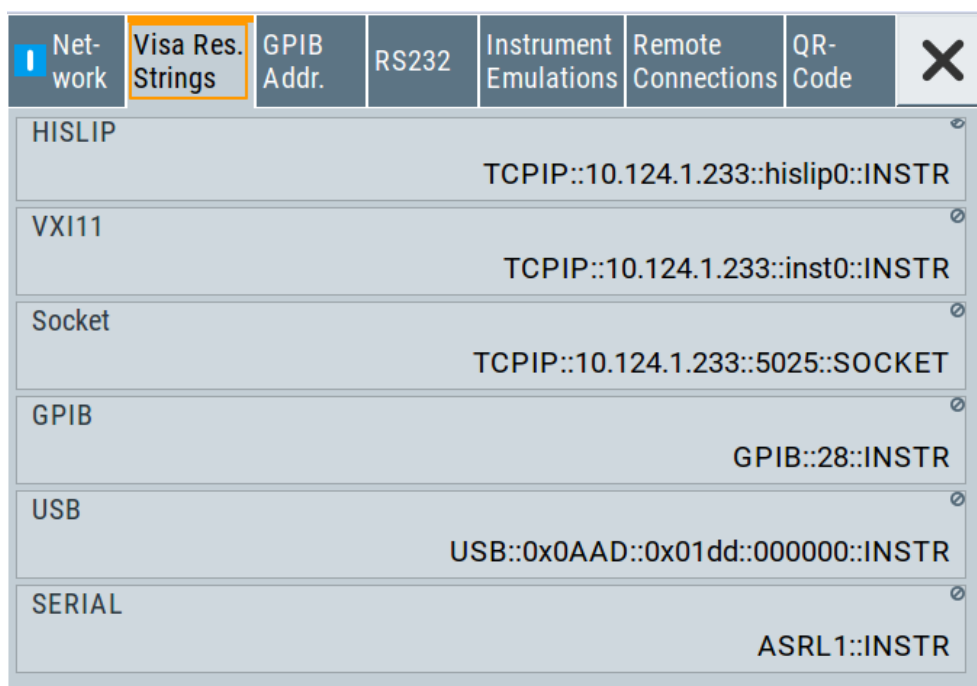
The "Visa Resource String" dialog displays the Visa resource strings provided for remote control via the different interfaces.

Remote command:

:SYSTem:COMMunicate:HISLip:RESource? on page 470

:SYSTem:COMMunicate:NETWork:RESource? on page 471

:SYSTem:COMMunicate:SOCKet:RESource? on page 474

:SYSTem:COMMunicate:GPIB:RESource? on page 470

:SYSTem:COMMunicate:USB:RESource? on page 475

:SYSTem:COMMunicate:SERial:RESource? on page 474

11.4.3 GPIB Address Settings

Access:

1. Select "System Config > Remote Access > GPIB Address".

2. Set the GPIB channel address of the connected instrument.

Remote command:

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess on page 470

11.4.4 RS232 Settings

Remote control via a serial interface is possible via a USB. The controller and the instrument must be connected with the external USB/serial-adapter R&S TS1-USB (see recommended extras in the data sheet) and a serial crossover (null modem) cable. A USB connection requires the Visa library to be installed on the controller. Visa detects and configures the R&S SMB100B automatically when the USB connection is established.

Access:

► Select "System Config > Remote Access > RS232".

In the "RS232" dialog, you can configure the settings of the serial interface.

The remote commands required to configure the settings remotely are described in Chapter 12.15, "SYSTem Subsystem", on page 460.

Baud Rate
Sets the baudrate for the serial remote control interface.

Remote command:
:SYSTem:COMMunicate:SERial:BAUD on page 473

Parity

Sets the parity for the serial remote control interface.

Remote command:
:SYSTem:COMMunicate:SERial:PARity on page 474

Stop Bits

Sets the number of stop bits for the serial remote control interface.

Remote command:
:SYSTem:COMMunicate:SERial:SBITs on page 474

11.4.5 Instrument Emulations Settings

Access:

► Select "System Config > Remote Access > Instrument Emulations".
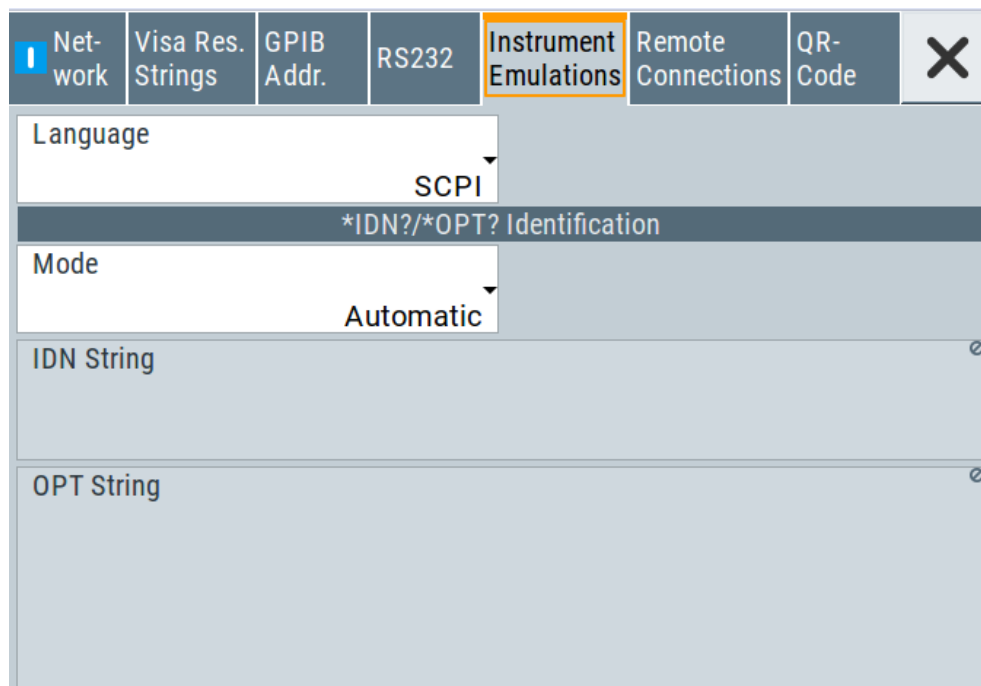
The "Instrument Emulations" dialog enables you to emulate a remote control command set of another signal generator.

The remote commands required to configure the emulation settings remotely are described in Chapter 12.15, "SYSTem Subsystem", on page 460.

Language

Selects the instrument whose remote command set is emulated by the R&S SMB100B.

Remote command:
:SYSTem:LANGuage on page 477

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 475

Set to Default

In "Mode > User Defined", resets the *IDN and *OPT strings.

Remote command:
:SYSTem:IDENtification:PRESet on page 476

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 312
:SYSTem:IRESponse on page 476

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, additionally to the automatically created one.

Remote command:
*OPT? on page 313
:SYSTem:ORESponse on page 476

11.4.6 Remote Connections Settings

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.

11.4.6.1 Active Connections

Access:

► Select "System Config > Remote Access > Remote Connections > Active".
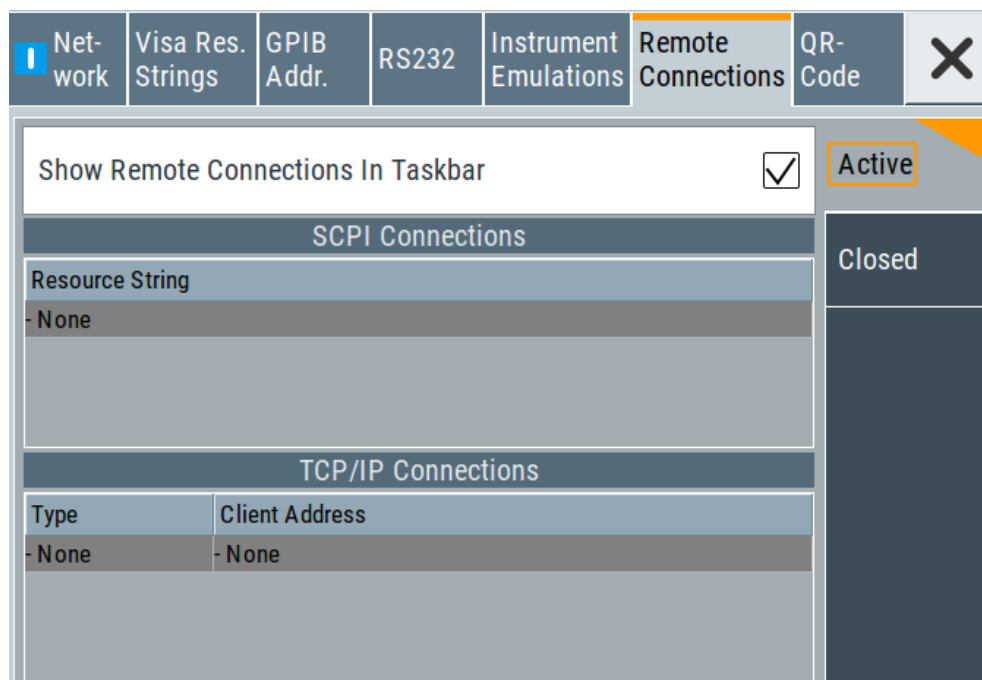
The "Active " tab shows the currently active remote connections, and you can enable the display of the active connections in the task bar.

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 curently controlling the instrument via the LAN interface.

Remote command:

n.a.

11.4.6.2 Closed Connections

Access:

► Select "System Config > Remote Access > Remote Connections > Closed".
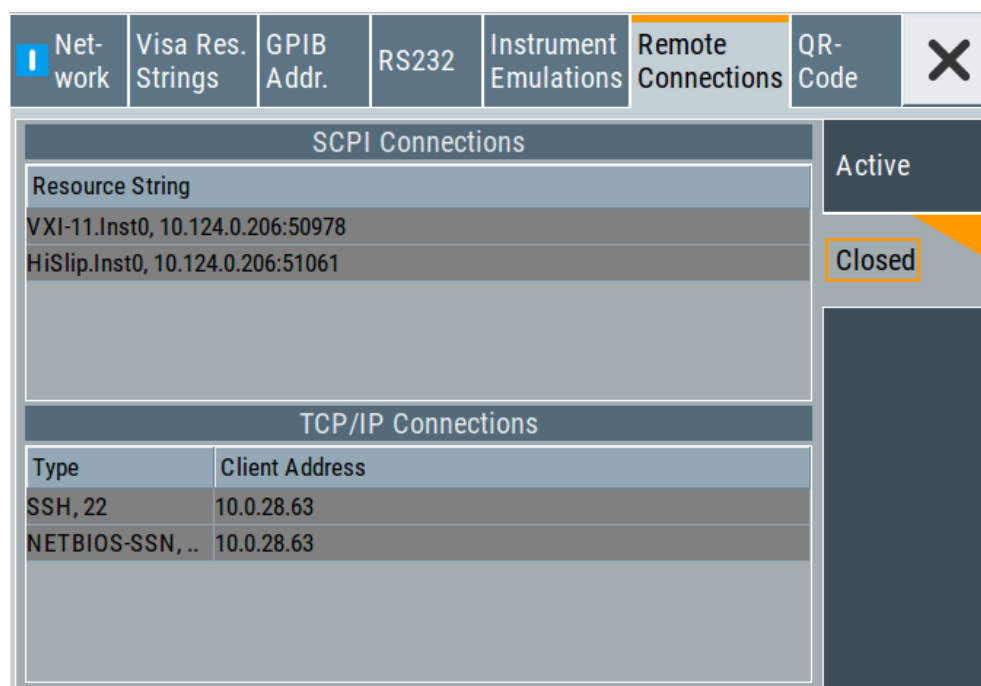
The "Closed" tab shows the currently active remote connections, and you can enable the display of the active connections in the task bar.

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.

11.4.7 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 11.16.2, "Setting Up a Remote Operation from a Smart Device", on page 303.

11.5 LXI Settings

On the R&S SMB100B the LXI functionality is already installed and enabled, see LXI Status Settings. Thus, the instrument can be accessed via any web browser (like the Microsoft Internet Explorer) to perform the following tasks:

● Modifying network configurations
● Remote control the instrument
● Performing SCPI remote diagnostics

The LAN settings are configured using the instrument's LXI browser interface described in Chapter 11.5.2.1, "LAN Configuration", on page 275.

11.5.1 LXI Status Settings

Access:

► Select "System Config > Setup > Remote Access > LXI Status...".
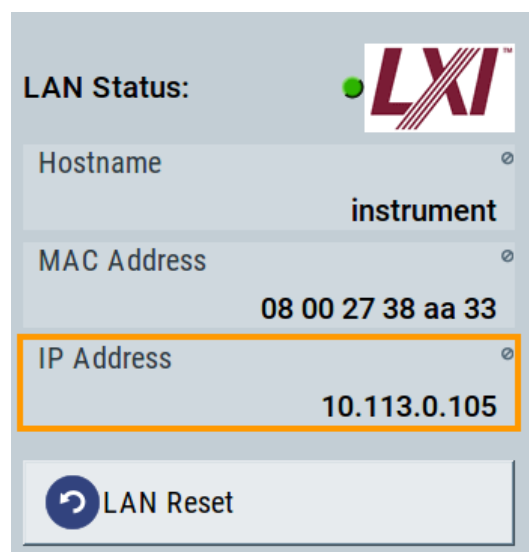
The "LXI - Status" dialog shows the parameters of the LAN connection.

Alternatively, you can change the LAN settings using the LXI web browser interface, see Chapter 11.5.2.1, "LAN Configuration", on page 275.

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 264.

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 place the following network settings 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 RF signal generator:

Parameter	
Hostname	`Instrument-specific hostname`
Description	Vector signal generator
Negotiation	Auto detect
VXI-11 discovery	Enabled

11.5.2 LXI Browser Settings

To access the instrument via the web browser:

► In the address field of the browser on your PC, type the instrument's host name or IP address, 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 LEDs flash, both in the browser dialog and in the LXI dialog of the connected instrument, see LAN Status. 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 "Ping Client" on page 276.
  – "Status" displays information about the LXI status of the instrument.
  – "Utilities" provides access to the LXI event log functionality required by the LXI standard.
● "Instrument Control"
  – "Web Control" provides remote access to the instrument, see "Starting a remote control via the LXI web browser" on page 281.
● "Diagnostics"
  – "SCPI Remote Trace" records messages exchanged via the remote control interface, see "SCPI Remote Trace" on page 277.
● "Help"
  – "Glossary" explains terms related to the LXI standard.
  – www.rohde-schwarz.com opens the Rohde & Schwarz homepage.
● "Data Sheet"
  Provides the data sheet with the specification data of the instrument at the time of delivery, see "Data Sheet" on page 278.

11.5.2.1 LAN Configuration

The "LAN Configuration" web page displays all mandatory LAN parameters and allows their modification.

It comprises the following navigation entries.

IP Configuration

The "IP configuration" web page displays all mandatory LAN parameters and allows their modification.

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.

See Chapter 10.4.4, "Password Management", on page 246.

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.

See Chapter 10.4.4, "Password Management", on page 246.

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".

SCPI Remote Trace

The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S SMB100B, see Chapter 11.9, "Tracing SCPI Commands and Messages Exchanged via the LXI Web Browser Interface", on page 289.

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
- **I**: number of the subinstrument
- "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.
- "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

Data Sheet

The data sheet functionality allows you to retrieve the specification data of the instrument at the time of delivery.

The document contains all specified value ranges and information of the data sheet, for example important as reference values for recalibration.
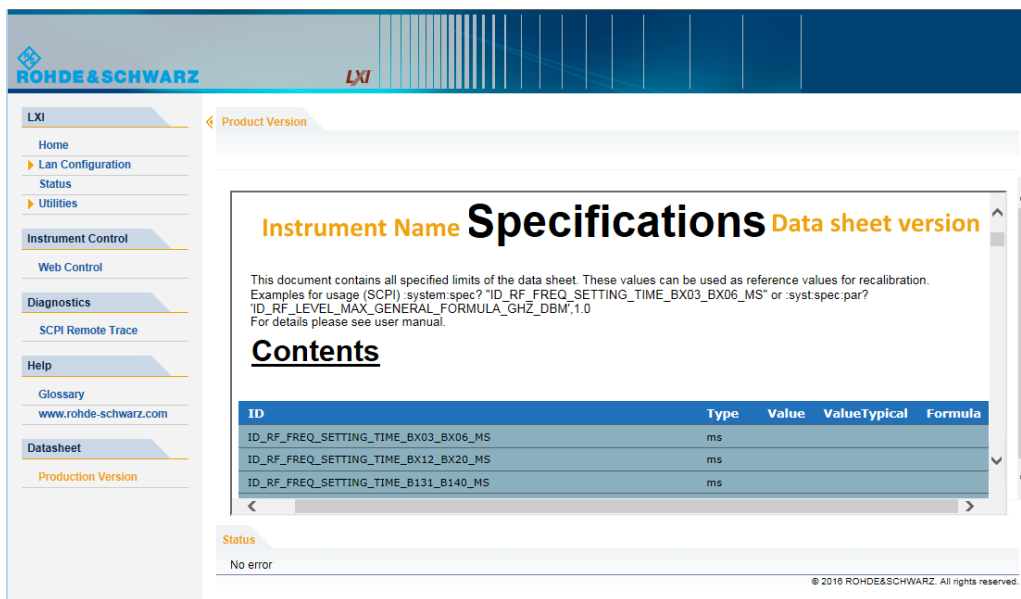
11.6 How to Find the VISA Resource String

► Select "System Config > Remote Access > VISA Resource Strings".

The dialog shows all specified resource strings of the supported remote control interfaces.

- For information on how to assign the IP address manually, see Chapter 3.1.3.3, "Assigning the IP Address", on page 29.
- Also note that using the RS232 serial interface via USB requires the USB serial adapter R&S TS-USB1.

11.7 How to Change the GPIB Instrument Address

To control the instrument remotely via the GPIB bus, it must be addressed using the GPIB address. The remote control address is factory-set to 28, but it can be changed if it does not fit in the network environment. For remote control, addresses 0 through 30 are allowed. The GPIB address is maintained after a reset of the instrument settings.

To set the GPIB address:

1. Select "System Config > Remote Access > GPIB Address".

2. Select "GPIB Channel Address" and enter a value between 0 and 30.

ⓘ **Risk of losing remote connection**

If the remote access and network settings had been configured to values different to the default, executing a factory preset via remote control terminates the connection to the instrument.

11.8 How to Set Up a Remote Control Connection

This section guides you through the steps required to set up remote control connections of the available interfaces.

- Chapter 11.8.1, "Establishing a Remote Control Connection over the LXI Browser Interface", on page 281
- Establishing a Remote Control Connection over LAN Using VXI-11 Protocol
- Setting Up a Remote Control Connection over LAN Using Socket Communication
- Setting Up a Remote Control Connection over GPIB
- Setting Up a Remote Control Connection over USB

The instrument and the controller have to be connected with the suitable cable and switched on.

A remote control program must open a connection to the instrument, before it can send commands to and receive device responses from the instrument.

ⓘ **Instrument address**

To operate the instrument via remote control, it must be addressed using the defined interface address.

See:

- Chapter 11.2.1, "LAN Interface", on page 254
- Chapter 11.2.2, "USB Interface", on page 257
- Chapter 11.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 258

You find the VISA resource strings in the "System Config > Remote Access > VISA Resource Strings" dialog.

> **Securing the display**
>
> To prevent unauthorized personnel from reading the display, you can disable the frequency and level display explicitly. This is useful when you remotely control the instrument from a different location.
>
> For more information, see:
>
> - "Annotation Frequency" on page 242
> - "Annotation Amplitude" on page 243

11.8.1 Establishing a Remote Control Connection over the LXI Browser Interface

Via the LXI browser interface to the R&S SMB100B one or more users can control the instrument remotely from another PC without additional installation. Most instrument controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available.

Starting a remote control via the LXI web browser

This section assumes that the instrument and the controller PC are connected in the LAN.

1. Start a web browser that supports HTML5 (W3C compliant).

2. Enter the IP address of the R&S SMB100B in the browser's address bar.

   The R&S SMB100B's welcome page is displayed.

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 and confirm with the [Enter] key.

   After the connection is established, the current screen of the R&S SMB100B is displayed in the browser window.

5. Use the mouse cursor and keyboard to access the functionality of the instrument as you would directly perform on the instruments touchscreen and front panel.

11.8.2 Establishing a Remote Control Connection over LAN Using VXI-11 Protocol

In this example, the I/O software library R&S VISA from Rohde & Schwarz is used to set up a LAN remote control link and remotely control the R&S SMB100B. R&S VISA is running on a controller PC with Windows operating system. When the connection is set up, you can send commands to the instrument and receive the responses.

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) is used to replace the complete resource string. The host address is the R&S SMB100B's hostname or its IP address.

See also Chapter 11.2.1, "LAN Interface", on page 254.

In the following, we assume that:

● A LAN remote control link between the controller and the R&S SMB100B is set up.

● The R&S VISA program is installed on the remote PC
See http://www.rohde-schwarz.com/rsvisa > "RS VISA Release Notes".

Setting up the controller with R&S VISA

To remote control the R&S SMB100B, we use the R&S VISA Tester application. The application communicates via TCP/IP protocol.

The instrument is preconfigured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, enter the computer name in the position of the IP address.

1. Connect the controller and the instrument in the same network (network cable). Switch them on.

2. On the controller, start "R&S VISA > Tester 32bit" or "R&S VISA > Tester 64bit".

3. In the menu bar, select "Choose VISA Implementation > Rohde & Schwarz Visa" and confirm with "OK".

4. In the menu bar, select "Find Resource" to search for the instrument in the LAN.
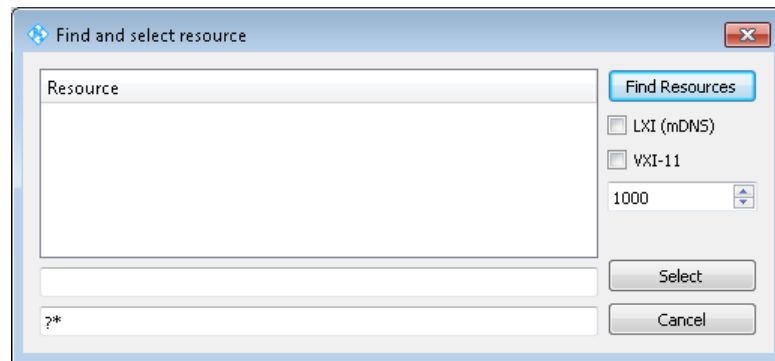
5. Select "VXI-11" and "Find Resources".

   R&S VISA scans the network for connected instruments and lists all detected instruments in the "Resource" list.
   Note: The search may take some time, particularly in large networks.

6. Select the required instrument and confirm with "Select".
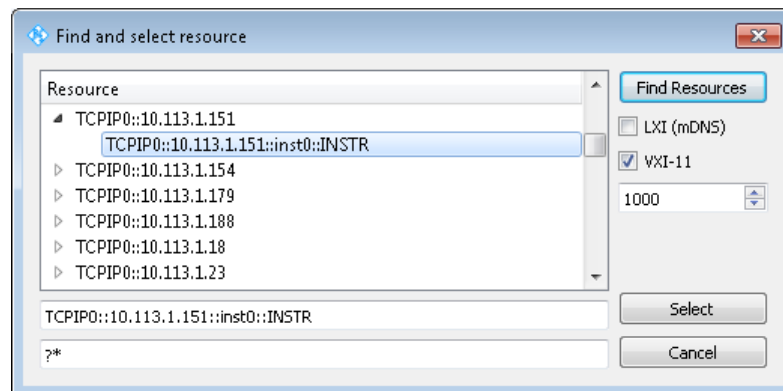
   The "Find and select resource" dialog closes and R&S VISA indicates the IP address in the "Resource" field of the main application window.

7. As an alternative to the IP address, you can assign an alias name to the R&S SMB100B:

a) In the menu bar, select "RsVisaConfig".
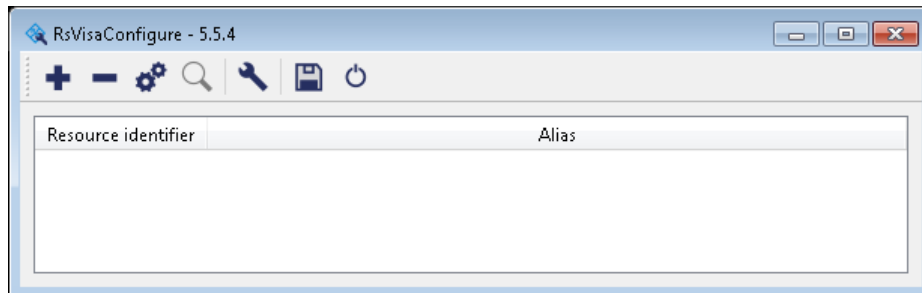
b) In the toolbar, select "+" to access the "VISA Resource String Composer".
c) Fill in the "Alias" name, the "VISA Resource String" and the "Device IP Address or host name" as shown in the figure, and confirm with "OK".
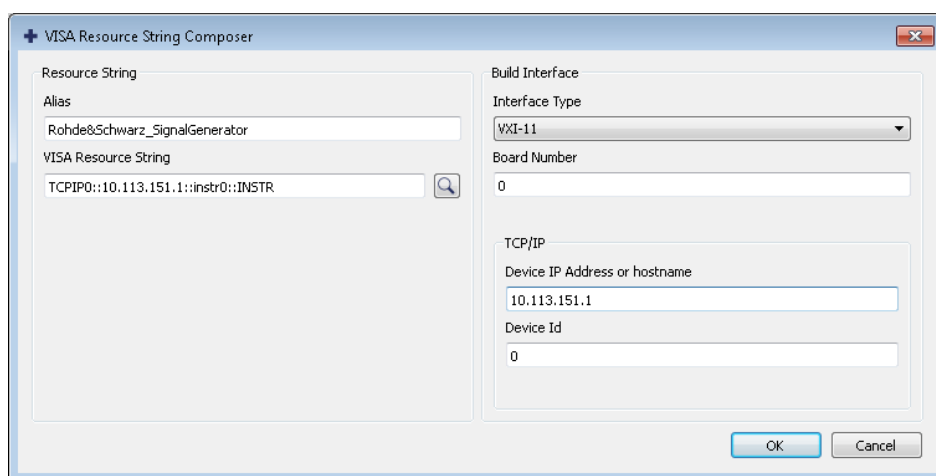
The "Alias" name is assigned.
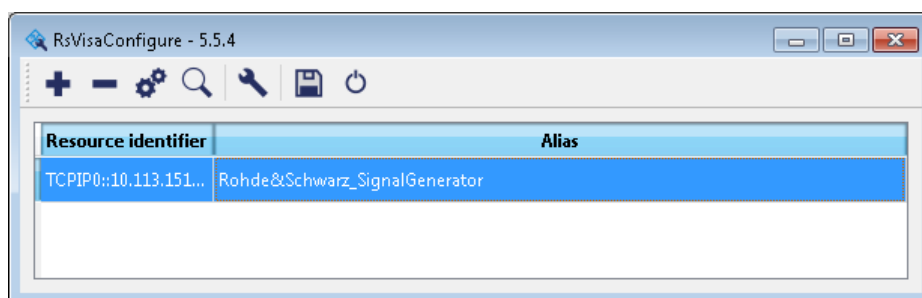
d) Close the dialog.
   The R&S SMB100B is registered in the program. It can be addressed via the resource string or alias name.

8. In the main window, select "Connect".

R&S VISA establishes the connection to the R&S SMB100B.

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.

For information on how to proceed when network failures occur, see Chapter 14.5, "Resolving Network Connection Failures", on page 534.

For further information on the functions to read and write to an open session, and the utility applications the software provides, see the R&S VISA user manual.

Starting a remote control session over LAN with R&S VISA

To set the instrument to remote control, you can use the addressed command `&GTR` or send any command from the controller.

1. Start the R&S VISA Tester. Establish the connection to the R&S SMB100B.
   See "Setting up the controller with R&S VISA" on page 282.

2. In the R&S VISA "Basics" tab, enter an SCPI command, e.g. "*IDN?". Confirm with "Query".

   The instrument is switched to remote control when it receives a command from the controller.

3. Select "Read" to obtain the instrument response.
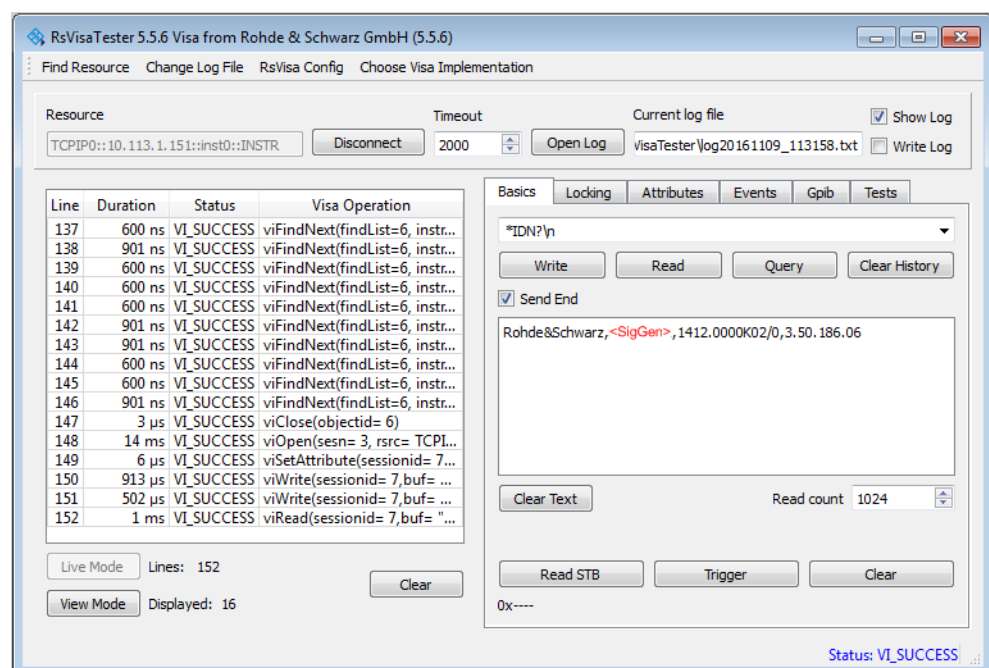
Tip: If the "Show Log" checkbox is checked, R&S VISA displays each VISA function call in the log-view on the left. If you check the "Write Log" checkbox, the log-view entry is written to the log file as well. You can operate the log-view in two modes: the "Live Mode" shows only the most recent messages whereas the "View Mode" allows you to scroll the history.

4. To set, e.g. the frequency, enter `SOUR1:FREQ 4 GHz` and select "Write".
   To check the performed setting, `SOUR1:FREQ?` and select "Query".
   The instrument response is `4000000000`. The value corresponds to the frequency in Hz.

While remote control is active, the "Remote" icon in the status bar indicates that the instrument is in remote control mode. Currently ongoing communication (data transfer) is indicated by green colored arrows in the icon.
Operating via the front and touch panel or via mouse and keyboard are locked, allowing a remote control program to be performed without interruption. On the display, keys and entry fields are grayed out and cannot be activated or modified, but you can still open dialogs, for example to verify settings.

5. To disable the access to the dialogs, use the command SYST:KLOC ON.

6. To prevent unintentional return to manual operation, use the command &LLO.
   See also Chapter A.1.2, "LAN Interface Messages", on page 539.

   The instrument switches to "Remote LLO" state. The [Setup] key is disabled.

7. To enable the [Setup] key, use the command &GTR.

8. To return to manual operation, see Chapter 11.10, "How to Return to Manual Operation", on page 289.

   Tip: Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

11.8.3 Setting Up a Remote Control Connection over LAN Using 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 (see also Chapter A.2, "Telnet program examples", on page 559).

The telnet client transmits information unencrypted. Therefore, for sensitive information we recommend that you use a client which supports secure protocols, like SSH.

In the following example, we assume basic knowledge of programming and operation of the controller. You can find information on the interface commands in the corresponding manuals.

Setting up a Telnet connection

To control the software, only a Telnet program is required. The Telnet program is part of every operating system.

1. To establish a Telnet connection with the R&S SMB100B, start the Telnet program. Enter the socket address.
   The socket address is a combination of the IP address or the hostname of the R&S SMB100B and the number of the port configured for remote-control via Telnet.
   Tip: The R&S SMB100B uses the port number 5025 for remote connection via Telnet.
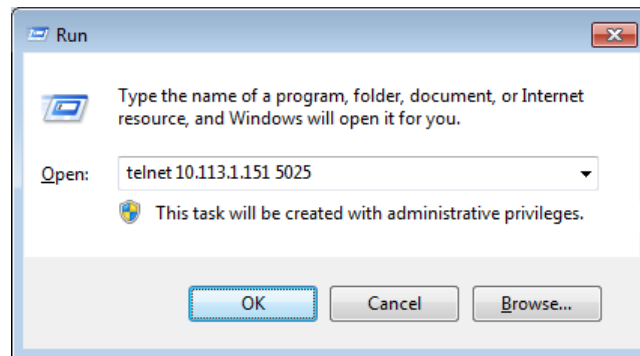
The connection to the instrument is set up and you can send remote-control commands.
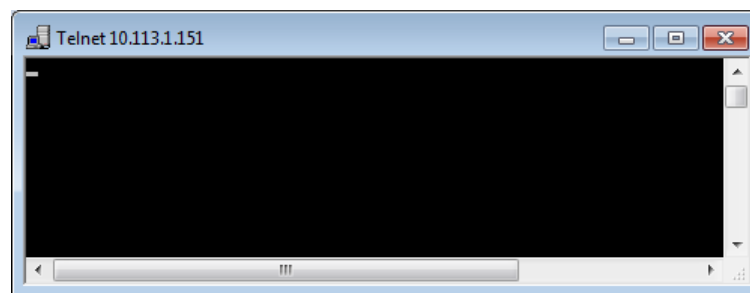
2. Note that Telnet does not reflect your first entry. Insert a command, e.g. `*IDN` and confirm with "Enter".

3. Observe the screen.

   A response on the query confirms that the connection is working. The client displays all subsequent inputs and responses.

4. Even if the cursor is not visible on the screen, blindly enter a remote-control command. Confirm with Enter.
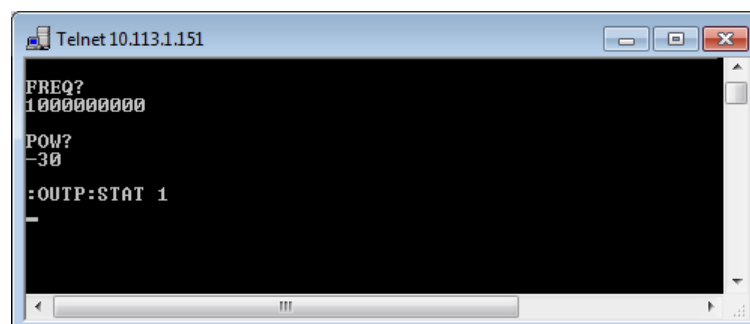
11.8.4 Setting Up a Remote Control Connection over GPIB

The program example in this section is written in VISUAL BASIC. A condition for programming in VISUAL BASIC is that the modules NIGLOBAL (`Niglobal.bas`) and VBIB32 (`Vbib_32.bas`) are added to the projects.

Drivers for instrument, for example IVI-COM and LabVIEW drivers, are available for download area on the product page at:

https://www.rohde-schwarz.com/driver/smb100b/

Starting a remote control session over GPIB

As a prerequisite, the GPIB address of the instrument must be the default value, which is factory-set to 28.

1. Connect instrument and controller using a GPIB cable. Switch them on.

2. Execute the following commands on the controller:

   a) Open the port to the instrument.
      ```
      CALL IBFIND("DEV1", generator%)
      ```
   b) Inform the controller about instrument address.
      ```
      CALL IBPAD(generator%, 28)
      ```
   c) Reset the instrument.
      ```
      CALL IBWRT(generator%, "*RST;*CLS")
      ```
   d) Set the instrument to new address.
      ```
      CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 18")
      ```
   e) Inform the controller about new address.
      ```
      CALL IBPAD(generator%, 18)
      ```

   The GPIB address of the instrument is changed.

3. To return to manual operation, press the Local key at the front panel.

11.8.5 Setting Up a Remote Control Connection over USB

For remote control via the USB connection, the PC and the instrument must be connected via the USB type B interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S instrument automatically when the USB connection is established. You do not have to enter an address string or install a separate driver.

Starting a remote control session over USB

1. Connect instrument and controller using USB cable. Switch them on.

2. Execute the following commands on the controller:

   a) Open the port to the instrument.
      ```
      viOpen (..., "USB::0x0AAD::0x01DE::100001::INSTR", ...)
      ```
   b) Reset the instrument.
      ```
      viRST (generator%, "*RST;*CLS")
      ```
   c) Set 2 GHz frequency
      ```
      viPrintf (..., "SOUR:FREQ 2GHz\n")
      ```
   d) Set 20 dBm output level
      ```
      viPrintf (..., "SOUR:POW -20dBm\n")
      ```

   The RF frequency and signal level of the instrument are changed.

3. To return to manual operation, press the [Local] key.

11.9 Tracing SCPI Commands and Messages Exchanged via the LXI Web Browser Interface

The remote trace functionality allows you to trace commands and messages exchanged via a remote control interface of the R&S SMB100B.

To activate the SCPI remote trace:

1. Start a web browser that supports HTML5 (W3C compliant).

2. Enter the IP address of the R&S SMB100B in the browser's address bar.

   The R&S SMB100B's welcome page is displayed.

3. In the navigation pane, select "Diagnostics > SCPI Remote Trace".

4. In the toolbar bar of the "SCPI Remote Trace" page, select "live mode > on" and "logging > on".

   "live mode > on" displays all commands and responses, and "logging > on" also traces messages.

   If you now control the R&S SMB100B with SCPI commands, using an appropriate tool, the LXI function records the information sent and received.
   The 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 upon request, using the "refresh" button. You can also save the log in a file.
   Note: The diagnostics functionality will be extended in later releases, e.g. to download or upload SCPI command files from / to the instrument.

11.10 How to Return to Manual Operation

Before returning to manual control, command processing must be completed. Otherwise, the instrument switches back to remote control immediately.

1. To return from "Remote" state to manual state, perform one of the following:
   - On the controller, use the command `&GTL`
     Note: If `&NREN` has been set before `&GTL` is locked. Use `&GTR` instead.
   - In the status bar, select the "Remote" icon.
   - On the front panel, press the [Local] key.
   - In the block diagram, select "Context sensitive menu > Key Emulation > Local"

2. To return from "Remote LLO" state to manual or to "Remote" state, perform one of the following:

   Note: In the local lockout state, the command `&GTL` and the [Local] key are locked. You can unlock this state only via remote control.

   - On the controller, use the command `&LOCS`.

     This command switches directly to manual operation.
   - Send the command `&REMS`.

     This command changes the remote control state from "Remote LLO" to "Remote".
   - Use the Visual Basic command `CALL IBLOC (generator%)`.

     The command switches directly to manual operation.
   - VISA function `viGpibControlREN()`

     This function switches directly to manual operation.

11.11 Automating Tasks with Remote Command Scripts

To achieve fast configuration, make complex test setups or repeating measurements reproducible, you can automate the required settings with scripts. A script contains a series of SCPI commands corresponding to the settings. When completed, it is converted to an executable format, saved in a file and can be run whenever needed.

> If you frequently need to load and run a script, assign the script to the [★ (User)], and you can quickly and easily perform the task.
>
> See Chapter 10.2.3, "Assigning Actions to the [★ (User)] Key", on page 231.
>
> **Note:** In contrast to "Recall Setup" via the [★ (User)] key, an assigned script execution does not close active dialogs and windows. On the contrary, even active window control (open / close) is possible.
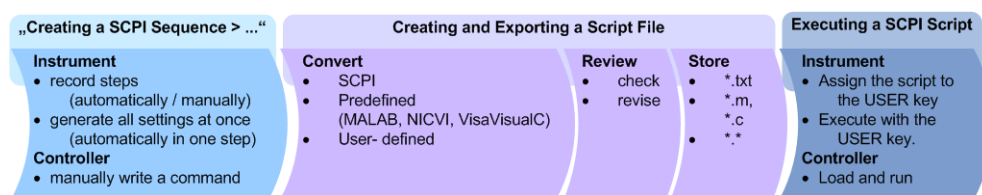
Figure 11-6: Steps for performing SCPI Scripts

In the graph, you can see the main steps required to work with an SCPI script.

Creating a SCPI list

With the SCPI record functions, you can create a SCPI command list directly in the instrument and then export the list to the controller. If you want to edit or write a script manually, use a suitable editor on the controller. Even for manually creating, the instrument supports you by showing the corresponding command syntax and the current settings value.

Directly in the instrument, you can create a SCPI list at any time of operation, in the following ways:

● Recording steps

Both, automatic and manual SCPI recording of settings is possible. You can start, stop and resume automatic recording, and also record individual commands manually.

– Manually record the steps selectively
In manual recording mode, you can deliberately record a SCPI command with the "Add CPI Command to Recording List" function, see How to record SCPI lists manually.

– Automatically record all performed steps
The instrument records the SCPI command and settings value of each step you perform, and then writes the commands to the file system, see How to record SCPI lists automatically.
You can also add a SCPI command manually to the recording list during automatic SCPI recording.

Note: The RF signal generator clears the SCPI list after booting automatically.

● Generating all settings at once
Generates the SCPI commands of the current instrument settings in one step, and writes the command list in a temporary list, see How to create a SCPI list with the current instrument settings in one step.
Note: This function lists all commands in alphabetical order, in contrast to the recording or manual creation, which consider the order the settings are configured. Using this function can slow down the runtime or cause errors during execution. Therefore, always check and revise a script if necessary, see "How to check an SCPI list" on page 299.

● Manually create a command script with "Copy" and paste
Enables you to copy the SCPI command and the current setting, see Chapter 11.11.1, "Show SCPI Command", on page 293.

Some parameters cannot be set by an SCPI command.

If so, *no SCPI command found* is entered instead of a command when you record or generate all settings at once.

The difference between "Show SCPI Command" and the provided cross-reference

If you want to enter your settings in a script, or use a remote control program, you must know the corresponding SCPI command and the exact syntax.

If you need to look up the SCPI command, the instrument offers two ways to figure it out quickly.

- "Show SCPI command" (context-sensitive menu)
  Displays the SCPI command syntax of a selected parameter including the current setting value, see Chapter 11.12, "How to Find Out the SCPI Command Corresponding to the Manual Operation via Show SCPI Command", on page 295. The "Copy" function enables you to write an SCPI script conveniently by hand.

- Instrument help ([Help] key)
  Opens a help topic that describes the selected parameter or instrument function, including a cross-reference to the corresponding SCPI command. The reference leads you to the description of the SCPI command comprising the complete SCPI syntax, all available setting values, value ranges, etc., see Chapter 11.13, "How to Find Out the SCPI Command Corresponding to the Manual Operation Using the Online Help", on page 296.

Creating and exporting a script file

When the script list is completed, a code generator translates the SCPI commands into the source code of a proprietary programming language, using a code template. Therefore, each language requires an appropriate code template. When converted, you can save the script in a file with an extension corresponding to the programming language.

The R&S SMB100B 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: MATLAB Toolkit for R&S Signal Generators.

- NICVI
  An ANSI C programming environment designed for measurements and tests (`*.c`).
  You can directly use this format with National Instruments LabWindows CVI.

You can also convert a script to a user-specific format. In this case, you need a code template with the extension `*.expcodetmpl`.

For information on how to select the code template and save the script in a file, see Chapter 11.11.3, "SCPI Recording Export Settings", on page 294.

Executing an SCPI script

An SCPI script primarily runs on the controller PC. In addition, you can execute a script directly on the instrument, by assigning the script to the [★ (User)] key.

See Chapter 10.2.3, "Assigning Actions to the [★ (User)] Key", on page 231.

11.11.1 Show SCPI Command

Access:

1. Select the parameter.

2. Open the context-sensitive menu (tap and hold).

3. Select "Show SCPI Command".

This function provides the syntax of the remote command with the current setting.

Copy
Copies the command and the current setting.

Close
Exits the "SCPI Command" dialog.

11.11.2 Displaying an SCPI List

The instrument displays a recorded SCPI list and thus provides viewing the recorded results before exporting.

► Depending on the starting point, you can access the "SCPI Recording List" dialog as follows:

- During recording
  Select "Show SCPI Recording List" in the context-sensitive menu.
- At any time outside recording
  Select "Show SCPI Recording List" in the context-sensitive menu.
  This function assumes that at least one recording has been executed after power-on.
- At the end of the recording
  Select "Stop automatic SCPI recording". The dialog opens automatically.
- After you have exported the script to a file.
  Select "SCPI Recording Export > Show file content"
  See Chapter 11.11.3, "SCPI Recording Export Settings", on page 294.
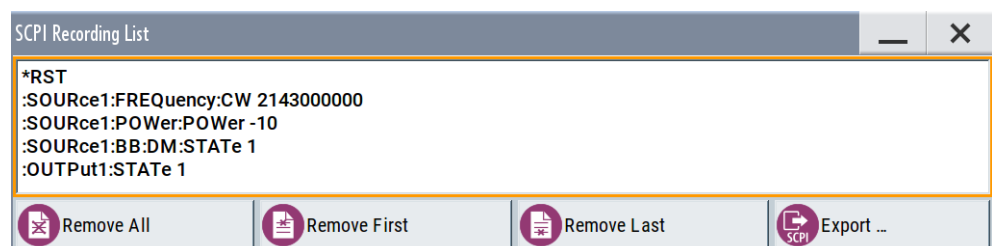
The "SCPI Recording List" shows the last recorded and exported commands.

SCPI Recording List

Lists the automatically or manually recorded recorded SCPI commands.

Export

Opens the SCPI Recording Export dialog for configuring the file parameters for export.

Remove All, Remove First, Remove Last

Deletes either the first, the last or all recorded SCPI commands.

To remove several recorded commands, repeat the removing.

For post processing, export the SCPI command list in a file, see Chapter 11.15, "How to Convert and Save SCPI Lists", on page 299.

11.11.3 SCPI Recording Export Settings

Scripts are configured and saved in the "SCPI Recording Export" dialog. This dialog opens automatically, when you stop recording.

Access:

1. Select "Show SCPI Recording List" in the context-sensitive menu.

   The "SCPI Recording List" dialog opens.

2. Select "Export".
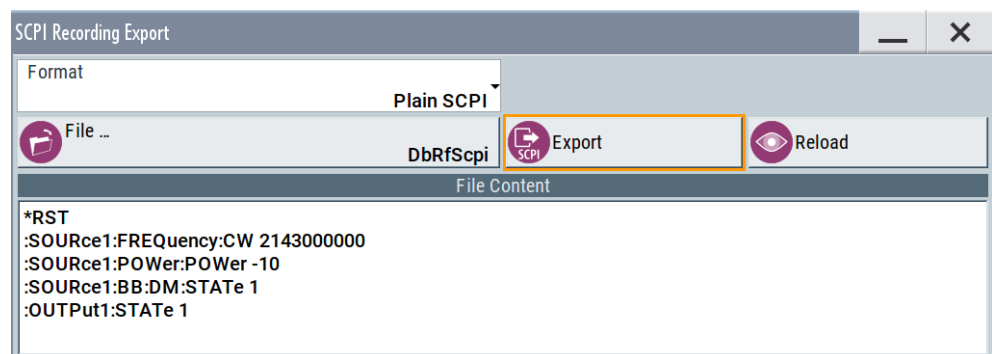
The "SCPI Recording Export" dialog contains all functions required for export of command lists to a file. It enables you to select the source code format, assign an individual filename and display the file content.

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.

"User Code Generator"

Provides the ability to convert a script by a user-specific code generator.

Select Code Template

Opens the standard "File Select" dialog and lists the predefined or user-defined code templates.

See Chapter 9.5.1, "File Select Settings", on page 200.

File

Opens the standard file select dialog "Select Output File", see Chapter 9.5.1, "File Select Settings", on page 200.

Export

Executes data export.

The SCPI list is saved in as file with the selected filename and in the selected directory, see File.

Reload

Reloads a SCPI list from a file.

You can export recorded SCPI lists to files (see File and Export), that can be modified.

File content

Displays the content of the script in the selected format and code template.

11.12 How to Find Out the SCPI Command Corresponding to the Manual Operation via Show SCPI Command

1. To find out the SCPI command of a parameter in manual operation, select the respective parameter.

2. Open the context-sensitive menu and select "Show SCPI command"

You get the detailed command syntax, including the currently set value.
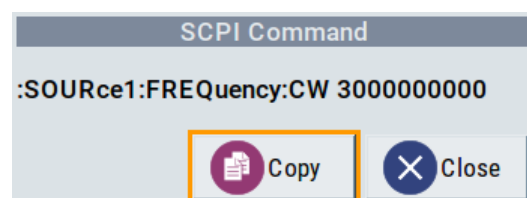
With the "Copy" function, you can conveniently paste the command including the current setting, e.g., in a command script.

11.13 How to Find Out the SCPI Command Corresponding to the Manual Operation Using the Online Help

If you are looking for the remote command to a function in manual operation, you find it in the description of the online help.

1. To find out the SCPI command of a parameter in manual operation, select the respective parameter.

2. To open the corresponding help topic, select one of the following:
   - In the display, select "context-sensitive menu > Help".

     ? **Help**

   - On the front panel, press the [Help] key.

   The help topic opens. Apart from the function description, it contains the SCPI command in detailed syntax.

How to find the corresponding GUI function to a command

Conversely, if you are looking for a function in the GUI, which belongs to a SCPI, you find it via a cross-reference in the online help and in the user manual.

11.14 How to Record / Create SCPI Lists

How to record SCPI lists automatically

The following example briefly explains how to proceed when you want to record SCPI lists.

For comprehensive information on this topic, refer to the application note 1GP98: SCPI Recorder Test Automation on a Fingertip.

1. On the screen, open the context-sensitive menu (touch and hold, or right mouse click) and select "Start SCPI recording".

   ⚙ **Start SCPI Recording**

   Starting from now, all steps you perform are recorded.

2. To stop SCPI recording, select "context-sensitive menu > Stop SCPI recording".

	Stop SCPI Recording

The "SCPI Recording List" dialog opens automatically.

3. Proceed with How to check an SCPI list.

How to record SCPI lists manually

We recommend that you activate the "Mark All Parameters Changed from Preset". This function facilitates to track the changes.

1. To retrace your settings, open the context-sensitive menu and select "Mark all Parameters Changed from Preset".

	Mark All Parameters Changed from Preset

This function identifies and highlights all settings you have changed, both in the block diagram, and in the dialogs.

Frequency		
	4.000 000 000 000 GHz	
Offset	Multiplier	
10.000 000 kHz	**1.000**	
User Variation		
Variation Active ☑	Variation Step	
	1.000 000 000 MHz	

2. For selectively recording your steps:
    a) Set the parameter.
    b) Open the context-sensitive menu.
    c) Select "Add SCPI Command to Recording List"

	Add SCPI Command to Recording List

Tip: You cannot see "Add SCPI ..." in the menu?
A possible reason is opening the menu outside of a dialog or input field, for example in a block diagram. Open the context-sensitive menu within the corresponding dialog or input field, and the feature is available.

d) Continue with the next setting, and repeat steps *a to b* whenever needed.

Each time you select "Add SCPI ...", the SCPI command is appended to a temporary list.

3. To check the progress of the recording, select "Context-Sensitive > Show SCPI Recording List".

Show SCPI Recording List (4)

The "SCPI Recording List" dialog opens, displaying all recorded settings so far.

4. Proceed with How to check an SCPI list.

How to create a SCPI list with the current instrument settings in one step

You can also generate a SCPI list from a manually created instrument state at any time, in only one step.

To generate an SCPI list with commands for all settings performed:

1. Select "Save/Recall > SCPI Export".
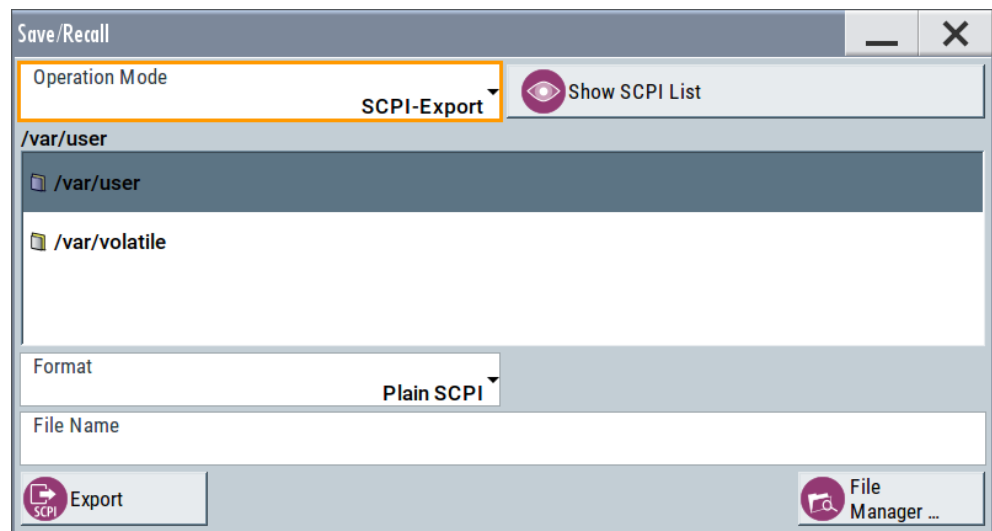
The instrument opens the standard file select dialog, see Chapter 9.4.1, "Save/Recall Settings", on page 196.

2. In the "Format" entry field, select the source code.

3. Depending on the selected format, convert the script as described in Chapter 11.15, "How to Convert and Save SCPI Lists", on page 299

4. Enter a filename.

5. Select "Export".
   The instrument writes all SCPI commands of the key parameters and the modified settings in the file. Also assigns the file extension automatically according to the source code format.

6. To preview the content of the SCPI list:
   a) Select "System Config > Save/Recall".
   b) Select "Operation Mode > SCPI-Export".
   c) In the /var/user/ directory, select a previously saved file.
   d) Select "Show SCPI List".

The list of all SCPI commands is displayed, for example, for a final check.

Exporting the SCPI list of the instrument state in one step is a fast and convenient method. Nevertheless, it usually requires postprocessing on an external PC.

How to check an SCPI list

The easiest way to check a list, is to execute it. The generator returns a warning if a setting could not be performed.

However, we recommend that you check the list and possibly rework. It can be that ...

- A parameter has not assigned an 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 subsequently perform some internal settings that are also assigned to the list with "SCPI Export".
- After a preset still some settings are defined, which are then written to the list generated with "SCPI Export."

Some suggestions on how you can check and revise a list:

1. Search and remove missing command entries.

2. Remove unnecessary content written after a preset.

3. Rearrange the commands to a reasonable order. If you, for example, set a `STATe` command to the last position of a list, you can avoid intermediate calculations of the signal.

4. Preview the list for completeness by comparing it with the modified settings in the manual mode.
   a) To retrace your settings in manual operation, open the context-sensitive menu and select "Mark all parameters changed from preset".
      The function identifies all settings you have changed, both in the block diagram, and in the dialogs. They appear orange.
   b) Check whether there is a command in the list for all modified settings.

5. To perform modifications, export the list to a PC, using for example a USB flash drive.

11.15 How to Convert and Save SCPI Lists

After completing the recording, the "SCPI Recording Export" dialog opens.

1. Select the "Format" for the command syntax in which you want to save the list.

2. "Select Code Template"
   Depending on the selected format, proceed accordingly:
   Note: Select the code template **before** exporting.

   a) Plain SCPI
      Continue with the next step.
   b) Predefined code generator
      The "SCPI Recording Export - Select Predefined Code Template" dialog opens.
      Select one of the predefined code templates.
   c) User code generator
      A file system ("SCPI Recording Export - Select User Code Template") dialog opens.
      Select your user-defined code template. The code template must have file extension `*.expcodetmpl`.

3. Select "File..."
   The "SCPI Recording Export - Select Output File" dialog opens.

4. Select "New" and assign a filename for saving the recorded list.

5. In the "SCPI Recording Export" dialog, select "Export".
   Saves the recorded data either in ASCII format (plain SCPI), or in the corresponding format of the used code template, and shows the SCPI list in the "File Content" section.

11.16 How to Set Up Remote Operation via VNC

This section shows you some examples of the various possibilities to set up remote operation.

- Using a desktop system
- Using a smart device

Enabled direct control

The direct control of the instrument is not disabled and the instrument can be controlled from the front panel and via the remote computer alternately.

11.16.1 Setting Up a Remote Operation from a Desktop System

11.16.1.1 Using a Web Browser

The R&S SMB100B supports remote operation via VNC with any web browser, like Windows Internet Explorer or Mozilla Firefox for instance, or alternatively, an HTML5 web browser.

To operate the instrument via a web browser remotely:

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. Type the instruments' IP address in the address field of the web browser on your PC, e.g. *http://10.113.1.151*

   The VNC authentication screen appears.

3. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

11.16.1.2 Using a VNC Client Software

A VNC client software is an application which can be used to access and control the instrument from a remote computer through a LAN connection.

The VNC client software for setting up the connection is included in the operating system Linux/Unix per default. For Windows operating systems, 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.

Setting up the VNC connection on a Linux/Unix desktop client

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 password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

Setting up the VNC connection on a Windows desktop client

1. Install the VNC viewer program component on the remote computer.

   a) On the Internet, select a VNC client program and download it onto your PC. 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.
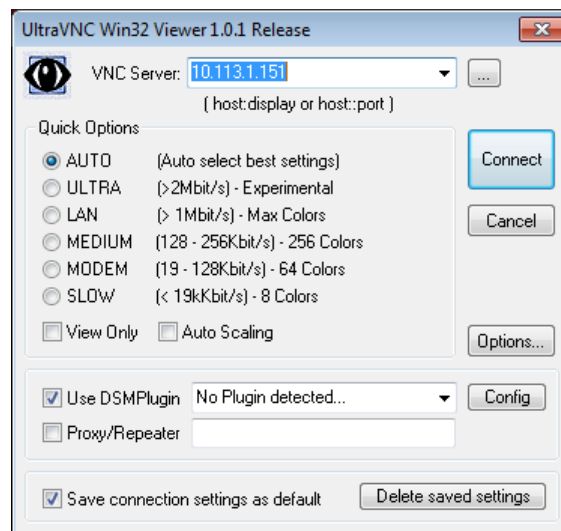
3. Select "VNC Server" and enter the IP address of the instrument.

4. To initialize the connection, select "Connect".

   A dialog opens requesting the password.

5. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

Terminating VNC connection

► Perform one of the following:

   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.

The connection is terminated but not disabled. It can be established again any time.
In the "Active Connections" tab, the displayed TCP/IP connection disappears. Consider, however, the note concerning unauthorized access due to VNC connection ("Risk of unauthorized access" on page 252).

11.16.2 Setting Up a Remote Operation from a Smart Device

The R&S SMB100B supports remote operation via VNC from a smart device (remote client), like a tablet (tablet computer) or a smartphone. The smart device accesses the instrument via WLAN, either by a suitable App, or an HTML5 web browser, that means with embedded *javascript*.

There are several possibilities to establish a WLAN connection between the smart device and the R&S SMB100B, which are, however, not all described here. This section gives an example of how a network environment can be built up, and some essential configuration steps.

For comprehensive information on this topic refer to the application notes:

- 1MA216: Remote Operation of Windows Based Instruments with Apple iPad
- 7BM82: Apple iPad Remote Control of Broadcasting T&M Instruments

Example:
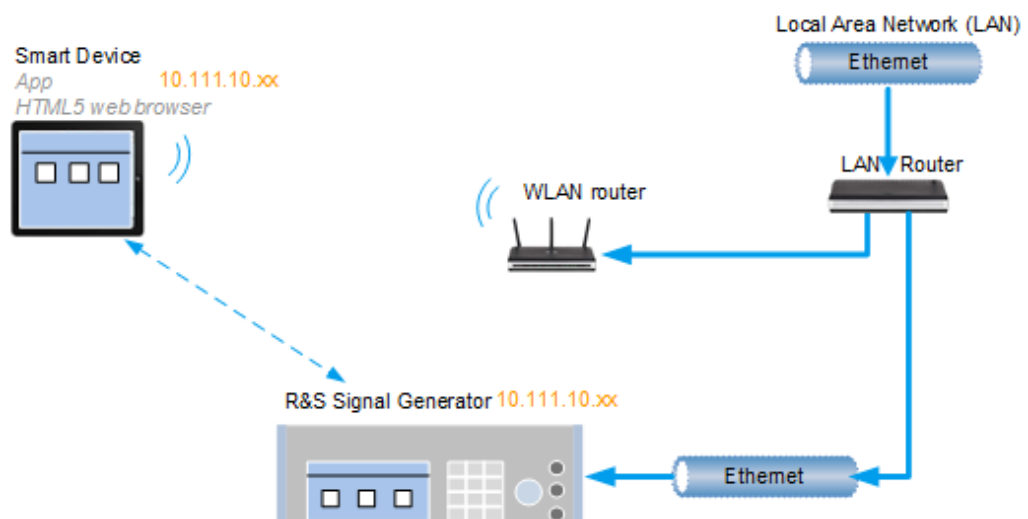
Figure 11-7: Example of a network configuration for remote operation with a smart device

As shown in the figure, the R&S SMB100B and the WLAN router are connected to the LAN router. The smart device accesses the Rohde & Schwarz instrument via the WLAN router.

Prerequisites

For this network configuration, the following prerequisites must be met:

- The required equipment is:
  – A LAN router
  – A WLAN router (hot spot)
    Required for accessing the R&S SMB100B
- The smart device must be known and accepted in the network of the R&S SMB100B.
- The *App* or web browser implements the VNC functionality on the smart device for remote operation.

It is recommended that all components in the network use DHCP, which automatically assigns the relevant address information.

With the configuration in the example, you can reach the instrument from a great distance, since the WLAN router acts as an additional access point.

11.16.2.1 Using a VNC App

Using a *VNC App* enables the smart device to access the R&S SMB100B via WLAN.

The VNC Apps are available from various manufacturers of the smart devices. The list of supported devices is different according to the smart device. Refer to the manufacturer's website to find out whether a VNC App is available for your device, and how it is installed.

1. In the network, establish the connection of the WLAN router to the LAN router. We assume the connection of the LAN router and the R&S SMB100B and their configuration in the LAN.

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*.

5. In the address field, enter the IP address of the instrument.
   Tip: The R&S SMB100B indicates IP address on the screen.

   A log-on dialog opens and requests the password for the VNC connection.

   The default user name and password is *instrument*.

   Tip: Default password. Remote access via VNC uses the user name "instrument" with default user password "instrument".
   Note: We recommend that you change the default password before connecting the instrument to a network.

   See Chapter 10.4.4, "Password Management", on page 246.

6.   Enter the password to establish the remote access.

After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

11.16.2.2 Using a Web Browser with HTML5

The R&S SMB100B supports remote operation from a smart device via VNC with any HTML5 compliant web browser, like Internet Explorer, Firefox, Google Chrome, or Safari for instance.

To operate the instrument remotely via a web browser, proceed as follows:

1.   In the web browser enter the IP address of the instrument, e.g. *http://10.113.1.151*.

2.   Type the instrument IP address in the address field of the web browser on your PC, e.g. *http://10.113.1.151*
     Tip: The R&S SMB100B indicates IP address on the screen.

     The VNC authentication screen appears.

3.   Enter the password and confirm with "OK".
     The default password is *instrument*.

     After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

11.16.2.3 Special Mode 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.

QR code readers are available from various manufacturers of the smart devices. The list of supported devices is different according to the smart device. Refer to the manufacturer's website to find out whether a reader is available for your device, and how it is installed.

1.   Install the required QR code reader software on your device.

2.   Start the reader.

3.   On the R&S SMB100B, select "System Config > Remote Access".

4.   In the "Remote Access" dialog, select the "QR-Code" tab.

5.   Scan the QR code of the instrument with your smart device.

6.   On the device, decode the scanned QR code and pass it to the web browser.

     A dialog opens requesting the password for the VNC connection.

7.   Enter the password and confirm with "OK".
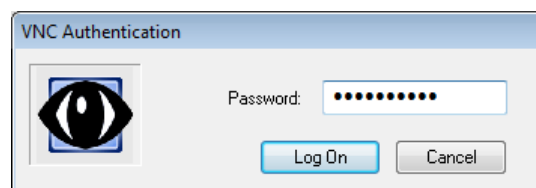
The default password is *instrument*.

After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

11.17 References

11.17.1 LXI Functionality

LAN Extensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology. LXI is intended to be the LAN-based successor to GPIB, combining the advantages of Ethernet with the simplicity and familiarity of GPIB.

Like GPIB, LXI determines and standardizes the way the instrument behaves in a LAN. The LXI implementation in the R&S SMB100B 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 http://www.lxistandard.org.
See also "News from Rohde & Schwarz, article 2006/II - 190".

The LXI functionality in the R&S SMB100B is characterized by a common LAN implementation, including an ICMP ping responder for diagnostics. The instrument can be configured via a web browser. 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 SMB100B provides the following LXI-related functionality:

- Integrated "LXI Status" dialog for LXI status indication and reset of the LAN configuration, see Chapter 11.5.1, "LXI Status Settings", on page 272.
- "LXI Browser Interface", as described in Chapter 11.5.2.1, "LAN Configuration", on page 275.
- "SCPI Remote Trace" utility, see "SCPI Remote Trace" on page 277.

Firmware update
To enable the full LXI functionality after a firmware update, shut down and restart the instrument.

11.17.2 Code Generator Templates

This section describes the main structure of the code generator templates, and shows the method by means of 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 an 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.expcodetmpl`:

```
#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
```

11.17.3 Remote Control States

How to I recognize if there is an active remote connection to the instrument?

► Observe 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 11.4.6, "Remote Connections Settings", on page 269.

The following table shows the different remote control states and the associated commands or actions to return to manual control.

Table 11-3: Remote control status icons

GUI symbol	Transition to remote control state...	Transition to manual operation...(local state)
	`&GTR` (controller) Remote control, but usable front panel keys. The parameters are in read-only mode.	• `&GTL` (controller) • Tap the "Remote" icon (display) • [Local] (front panel or key emulation) A currently performed setting is indicated by the green arrows. The setting must be completed (white arrows), otherwise the instrument remains in remote state.
	`&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 via remote control.	• `&LOCS` (controller) • `CALL IBLOC (generator%)` (controller) **Note:** The command `&REMS` returns to "Remote" state.

12 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, refer to:

- Chapter 11, "Network Operation and Remote Control", on page 251
- Chapter A.1, "Additional Basics on Remote Control", on page 538

12.1 Conventions used in SCPI Command Descriptions

Note the following conventions 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 SMB100B 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.

12.2 Programming Examples

The corresponding sections of the same title provide simple programming examples for the R&S SMB100B. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

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 (for example comments) start with two // characters.

At the beginning of the most remote control program, an instrument (p)reset is recommended to set the R&S SMB100B 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 that:

- 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.

12.3 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 devices. 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

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>"

Example: Rohde&Schwarz,SMB100B,11400.1000K02/0,4.00.033

Usage: Query only

Manual operation: See "IDN String" on page 269
                       See "Hardware Options/Software Options" on page 528

*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 data sheet.

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 269
                        See "Hardware Options/Software Options" on page 528

*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 199

---

*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 192

---

*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 198

*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.

Usage: Event

*TST?

Self-test query

Initiates self-tests of the instrument and returns an error code.

Return values:

<ErrorCode>   **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

12.4 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 314). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. GPIB address or reference oscillator source settings.
- Activating the preset state of the parameters related to the selected signal path (`:SOURce<hw>:PRESet` on page 316)
- Activating the preset state of all parameters that are not related to the signal path (`:DEVice:PRESet` on page 316)
- Activating the original state of delivery (factory reset, `:SYSTem:FPReset` on page 317). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

: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 [Preset] key
- The *RST command

For an overview of the settings affected by the preset function, see Table 9-1

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 192

12.5 MMEMory Subsystem

The MMEMory subsystem (Mass MEMory) contains the commands for managing files and directories as well as for loading and storing complete instrument settings in files.

Mass storage location

Without any additional measures, the R&S SMB100B stores user files on the internal memory or if connected, on a memory stick.

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 SMB100B 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 9.8, "Using the File Manager", on page 203. 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`.

12.5.1 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.

File extension

The file and the optional file *extension* are separated by a period sign. The R&S SMB100B distinguishes the files according to their extensions; each type of file is assigned a specific file content and hence a specific file extension. Refer to Chapter C, "Extensions for User Files", on page 567 for an overview of the supported file extensions.

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.

12.5.2 Accessing 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 rater 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 stored 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 SMB100B filters out the relevant files.

- Define the **absolute file path**, including the user directory /var/user, created subdirectories and filename (see Example "Load file with user data from a specific directory" on page 319).
  As a rule, whenever an absolute 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 12.5.3, "Programming Examples", on page 320 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 321.

Example: Load file with user data from a specific directory

This example shows the principle of file handling in remote environment by using list commands. Working with the files of other subsystems is analogical. We assume that the directory /var/user/my_files is existing and contains the files list_test.lsw and list_2.lsw.

```
//Query files in the user diectory
SOURce1:LIST:CATalog?
// -
// no files

// Set the default directory
MMEMory:CDIRectory "/var/user/my_files"
SOURce1:LIST:CATalog?
// "list_test","list_2"

// Specify the complete path to select a list file (*.lsw)
// in the specific directory
SOURce1:LIST:SELect "/var/user/my_files/list_test"
SOURce1:LIST:DELete "/var/user/my_files/list_2"
```

12.5.3 Programming Examples

Example: Storing and loading current settings

This example shows two ways of how to store the current instrument setting in the file `settings.savrcltxt` in the directory `/var/user/savrcl`.

Before the instrument settings can be stored in a file, they have to be stored 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>`.

```
// Store the current settings in an intermediate memory with number 4
*SAV 4

// store the settings in a file in a specific directory;
// the complete path has to be specyfied
MMEMory:STORe:STATe 4,"/var/user/savrcl/settings.savrcltxt"

// store 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 stored 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.savrcltxt" into the new directory
MMEMory:COPY "/var/user/settings.savrcltxt","/var/user/new/settings.savrcltxt"

// Rename the file "settings.savrcltxt" into the new directory
// and read out the files in this specific directory
MMEMory:CDIRectory  "/var/user/new"
MMEMory:MOVE "settings.savrcltxt","settings_new.savrcltxt"
MMEMory:CATalog? "/var/user/new"
// 25141,8102789120,".,DIR,4096","..,DIR,4096","settings_new.savrcltxt,BIN,16949"

// Delete the "test" directory
MMEMory:RDIRectory "/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"

:SOURce1:LIST:SELect "/var/volatile/list"
:SOURce1:FREQuency:MODE LIST
:OUTPut1:STATe 1
```

12.5.4 Remote Control Commands

:MMEMory:CATalog? <path>

Returns the content of a particular directory.

Query parameters:

<path>	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.

Return values:

<UsedDiskSpace>	Byte size of all files in the directory.
<FreeDiskSpace>	Remaining disk space in bytes.
<FileInfo>	<NameFileN>,<SuffixFileN>,<SizeFileN>
	List of files, separated by commas
	<NameFileN>
	Name of the file.
	<SuffixFileN>
	Type of the file. Possible suffixes are: ASCii, BINary, DIRectory
	<SizeFileN>
	Size of the file in bytes.
Usage:	Query only
Manual operation:	See "Directory, File List and Filename" on page 197

: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 '..' .

Usage: SCPI confirmed

Manual operation: See "Directory, File List and Filename" on page 197
See "Directory and Filename" on page 205

: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 `:MMEMory:CDIRectory` command.
Note: Existing files with the same name in the destination directory are overwritten without an error message.

Usage: Setting only
SCPI confirmed

Manual operation: See "Cut, Copy&Paste and Delete" on page 205

:MMEMory:DATA <Filename>, <BinaryBlock>
: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:
<BinaryBlock>   `#<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.

Parameters for setting and query:
<Filename>   string

String parameter to specify the name of the file.

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`

Usage: SCPI confirmed

:MMEMory:DCATalog? <path>

Returns the subdirectories of a particular directory.

Query parameters:
<path>   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:
<Catalog>   <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 parameter to specify the directory. If the directory is omit-
                  ted, 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: Event
                  SCPI confirmed

Manual operation: See "Cut, Copy&Paste and Delete" on page 205

: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
                   `*.savrcltxt`.

Usage: Setting only

Manual operation: See "Recall" on page 199

:MMEMory:MDIRectory <Directory>

Creates a subdirectory for mass memory storage in the specified directory. If no direc-
tory 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: Event

Manual operation: See "Create New Directory" on page 205

: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: Event
                    SCPI confirmed

Manual operation: See "Rename " on page 205

:MMEMory:MSIS <Msis>

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.

Usage: SCPI confirmed

:MMEMory:RDIRectory <Directory>

Removes an existing directory from the mass memory storage system. If no directory is specified, the subdirectory with the specified name is deleted in the default directory.

Setting parameters:

<Directory>	string
	String parameter to specify the directory to be deleted.

Usage: Event

:MMEMory:STORe:STATe <savrcl_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:

<savrcl_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 *.savrcltxt.
Usage:	Event
Manual operation:	See "Save" on page 198

: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

12.6 CALibration Subsystem

The CALibration subsystem contains the commands needed for performing internal adjustments. This procedure is triggered by the query commands.

Suffix <hw>

Suffix	Value range	Description
CALibration<hw>	[1]	Optional suffix

Understanding the query response

- 0: error-free execution of the adjustments
- 1: indicates that an error occurred; the process has been canceled

:CALibration:ALL[:MEASure]? [<Force>]

Starts all internal adjustments that do not need external measuring equipment.

Query parameters:

<Force>	string

Return values:

<Measure>	0 | 1 | OFF | ON

Example:	`CAL:ALL:MEAS?`
	0
	Executes the adjustments of all instrument functions. When completed, it indicates that the adjustment has been performed successfully.

Usage:	Query only

Manual operation:	See "Adjust All" on page 523

: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 524

:CALibration<hw>:ALL:INFormation?

Queries the current state of the internal adjustment.

Return values:

<CalInfoText>	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 524

: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?
	// "+39.00 K"

Usage:	Query only
Manual operation:	See "Temperature Offset Since Last Full Adjustment" on page 524

: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 Since Last Full Adjustment" on page 524

: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 527

: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>	0 | 1 | OFF | ON
	*RST: n.a. (factory preset: 0)

Example:	`CAL:CONT ON`
	`// Continues calibration after an error`

Manual operation:	See "Continue Adjustment on Error" on page 524

12.7 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 SMB100B 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 modules available in the instrument
// and variant and revision state of a certain assembly
DIAGnostic1:BGINfo:CATalog?
// FRONT_AF,PSU300,IFB.BV,MB2_AF,...
DIAGnostic1:BGINfo? "PSU300"
// PSU300 2118.2067.02 01.00 100000

// Query the test points available in the instrument
// and trigger the measurement in a selected test point
DIAGnostic1:POINt:CATalog?
// ATT6HP_AF_DET_N,ATT6HP_AF_DET_P,ATT6HP_AF_DET_TEMP...
DIAGnostic1:MEASure:POINt? "ATT6HP_AF_DET_N"
//  0.000000V
```

: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 331.

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 331.
Usage:	Query only
Manual operation:	See "Assembly" on page 527

:DIAGnostic\<hw\>:POINt:CATalog?

Queries the test points available in the instrument.

For more information, see R&S SMB100B Service Manual.

Return values:

\<Catalog\>	string
	List of comma-separated values, each representing a test point
Example:	See Example "Programming example" on page 331.
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 SMB100B 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 331.
Usage:	Query only

12.8 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 ON
// :DISPlay:ANNotation:AMPLitude ON

// Enable automatic update of the display at defined time intervals
:DISPlay:UPDate 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 10.2.3, "Assigning Actions to the [★ (User)] Key", on page 231.

```
// Query the dialog IDs of all open dialogs
:DISPlay:DIALog:ID?
// CEUtraDLGenSetDlg,_,$A DlgKeyRf_Rosc

// Open and close dialogs via remote control
:DISPlay:DIALog:OPEN "CEUtraDLGenSetDlg,_,$A"
:DISPlay:DIALog:OPEN "DlgKeyRf_Rosc"
:DISPlay:DIALog:CLOSe "DlgKeyRf_Rosc"
:DISPlay:DIALog:CLOSe:ALL
```

: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 333

Manual operation: See "Wait Time" on page 224

: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>   0 | 1 | OFF | ON
                        *RST: n.a. (factory preset: 0)

Example: See Example "Activating screen saver mode and display
                        update" on page 333

Manual operation: See "Screen Saver" on page 224

:DISPlay:BRIGhtness <BRIGhtness>

Sets the brightness of the dispaly.

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 224

:DISPlay:BUTTon:BRIGhtness <ButtonBrightnes>

Sets the brightness of the [RF on/off] key.

Parameters:

<ButtonBrightnes>	integer
	Range: 1 to 20
	*RST: n.a. (no preset. default: 14)

Example: `DISPlay:BUTTon:BRIGhtness 15`

Manual operation: See "RF Hardkey" on page 224

:DISPlay:UPDate <Update>

Activates the refresh mode of the display.

Parameters:

<Update>	0	1	OFF	ON
	*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 333

Manual operation: See "Display Update is" on page 225

:DISPlay:ANNotation:AMPLitude <State>

Indicates asterisks instead of the level values in the status bar.

Parameters:

<State>	0	1	OFF	ON
	*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 333

Manual operation: See "Annotation Amplitude" on page 243

:DISPlay:ANNotation:FREQuency <State>

Indicates asterisks instead of the frequency values in the status bar.

Parameters:

<State>	0	1	OFF	ON
	*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 333

Manual operation: See "Annotation Frequency" on page 242

: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> 0 | 1 | OFF | ON

 *RST: 1

Example: See Example "Activating screen saver mode and display update" on page 333

: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 336

`:DISPlay:DIALog:CLOSe` on page 337

<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 333

Usage: Query only

Manual operation: See "SCPI" on page 231

: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 333
Usage:	Setting only
Manual operation:	See "SCPI" on page 231

: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 333
Usage:	Setting only

:DISPlay:DIALog:CLOSe:ALL

Closes all open dialogs.

Example:	See Example "Querying the dialog IDs, opening and closing dialogs" on page 333
Usage:	Event

12.9　FORMat Subsystem

The commands in the `FORMat` subsystem determine the format of data returned by the R&S SMB100B 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 <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.

12.10 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"
```

12.10.1 Hard Copy Settings

With the following commands, you can configure the settings of a hard copy.

: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 339

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 339

Manual operation: See "Format" on page 217

: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 339

Manual operation: See "Region" on page 218

: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 12.10.2, "Automatic Naming", on page 341.

Parameters:

<Name>   string

Example: See Example "Store a hard copy of the display" on page 339

Manual operation: See "File..." on page 217

: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 339

Usage: Event

Manual operation: See "Save" on page 217

12.10.2 Automatic Naming

Use the following commands to automatically assign a file name.

: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 339

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 339

Manual operation: See "Path..." on page 219

: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 339

Usage: Event

Manual operation: See "Clear Path" on page 219

: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 339.

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO:STATe <State>

Activates automatic naming of the hard copy files.

Parameters:

<State>   0 | 1 | OFF | ON

*RST: 1

Example: See Example "Store a hard copy of the display" on page 339

Manual operation: See "Automatic Naming" on page 218

: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>   0 | 1 | OFF | ON

*RST: 1

Example: See Example "Store a hard copy of the display" on page 339

Manual operation: See "Prefix, Year, Month, Day" on page 219

: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 SMB100B 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 339

Usage: Query only

Manual operation: See "Current Auto Number" on page 219

: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>	0 | 1 | OFF | ON
	*RST: 1

Example: See Example "Store a hard copy of the display" on page 339

Manual operation: See "Prefix, Year, Month, Day" on page 219

12.11 KBOard Subsystem

The `KBOard` subsystem contains the commands to set a connected keyboard.

:KBOard:LAYout <Layout>

Selects the language for an external keyboard and assigns the keys acccordingly.

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 "USB Keyboard > Layout" on page 224

12.12 OUTPut Subsystem

In the `OUTPut` subsystem, you can configure the output signals.

The LF output signal is defined with the commands of the Chapter 12.14.5, "SOURce:LFOutput Subsystem", on page 408 system.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
OUTPut<hw>	[1]	Optional suffix

:OUTPut:ALL[:STATe] <State>

Activates the RF output signal of the instrument.

Parameters:

<State>   0 | 1 | OFF | ON

                 *RST: n.a. (factory preset: 0)

Example: OUTPut:ALL:STATe 0

:OUTPut<hw>[:STATe] <State>

Activates the RF output signal.

Parameters:

<State>   0 | 1 | OFF | ON

                 *RST: 0

Example: OUTP ON
                 Activates the RF output.

Manual operation: See "RF State/RF ON" on page 58

: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: OUTP:PON OFF
                 The RF output is deactivated when the instrument is switched
                 on.

Manual operation: See " Power-On State " on page 225

:OUTPut<hw>:AMODe <AMode>

Sets the step attenuator mode at the RF output.

Parameters:

<AMode>   AUTO | FIXed

AUTO
The step attenuator adjusts the level settings automatically, within the full variation range.

FIXed
The step attenuator and amplifier stages are fixed at the current position, providing level settings settings with constant output VSWR. The resulting variation range is calculated according to the position.

*RST: AUTO

Example: SOURce:POWer:ALC:STATe 1
OUTPut:AMODe FIXed

Manual operation: See " Mode " on page 148

:OUTPut<hw>:IMPedance?

Queries the impedance of the RF outputs.

Return values:

<Impedance>   G1K | G50 | G10K

*RST: G50

Example: OUTP: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 58

: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.

See :OUTPut<hw>:AMODe on page 346

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

Manual operation: See " Level Range " on page 149

: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: OUTP:PROT:CLE

Resets the protective circuit of the RF output.

Usage: Event

Manual operation: See "Overload" on page 149

:OUTPut<hw>:PROTection:TRIPped?

Queries the state of the protective circuit.

Return values:

<Tripped>   0 | 1 | OFF | ON

*RST: 0

Example: OUTP:PROT:TRIP

queries the state of the protective circuit of the RF output.

Response: 0

the protective circuit has not tripped.

Usage: Query only

Manual operation: See "Overload" on page 149

12.13 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 SMB100B.

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 :SLISt commands to change the sensor mapping
READ<ch>	[1] to 4	Sensor assignment
INIate<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"
// list of automatically detected sensors

SLISt:SCAN:STATe 1
// searches for sensors connected in the LAN or via the USBTMC protocol

SLISt:LIST?
// Response:
// "NRP33SN-V-900007-USB Legacy","NRP-Z211-900001-USB Legacy",
// "NRP33SN-V-900005-USBTMC","NRP33SN-V-900011-LAN"
// list of automatically detected sensors
// the list can contain more entries

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 directly to channel 3
```

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 continous 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 continous power measurement on

:READ?
//Triggers the measurement and displays the results
```

: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 348.

Usage: Query only

Manual operation: See " Sensor Mapping List " on page 166

:SLISt:SCAN[:STATe] <State>

Starts the search for R&S NRP power sensors, connected in the LAN or via the USBTMC protocol.

Parameters:

<State>   0 | 1 | OFF | ON
                   *RST: 0

Example: See Example "Detecting and assigning a power sensor" on page 348.

Manual operation: See " Scan " on page 166

: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 348.
Manual operation:	See " Sensor Mapping List " on page 166

: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 348.
Usage:	Setting only
Manual operation:	See " Sensor Mapping List " on page 166

: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>	0	1	OFF	ON
	*RST: 0
Example:	`INIT1:CONT ON`
	Switches local state of continuous power measurement on.
Manual operation:	See " State " on page 171

: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 " Level (Peak) / Level (Average) " on page 170

: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 " Level (Peak) / Level (Average) " on page 170

: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 353.

Parameters:

<UseDefAp>	0 | 1 | OFF | ON
	*RST: 1

Example:	See Example "Performing a power measurement with a fixed filter" on page 349.
Manual operation:	See "Default Aperture Time" on page 173

: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 349.
Manual operation:	See "Aperture Time" on page 173

: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 173

: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>	0 | 1 | OFF | ON
	*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 173

: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 173

: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> 0 | 1 | OFF | ON

*RST: 0

Example: SENS1:POW:DISP:PERM:STAT ON
The permanent viewer is switched on.

Manual operation: See " Permanent " on page 171

: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 65536

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 172

: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 167).

The R&S NRP power sensors provide different resolutions for setting the filter length, depending on the used sensor type:

- Resolution = 1 for R&S NRPxx power sensors
- Resolution = 2^n for sensors of the R&S NRP-Zxx family, with n = 1 to 16

Parameters:

<User>   float

                          Range: 1 to 65536
                          *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 172

: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 349.

Manual operation: See "Noise/Signal Ratio" on page 173

:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe <MTime>

Sets an upper limit for the settling time of the auto-averaging filter in the NSRatio mode and thus limits the length of the filter. The filter type is set with command :SENSe<ch>[:POWer]:FILTer:TYPE.

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 349.

Manual operation: See "Timeout" on page 173

: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 173

: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. **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`. **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`). *RST: AUTO
Example:	See Example "Performing a power measurement with a fixed filter" on page 349.
Manual operation:	See " Filter" on page 172

:SENSe\<ch>[:POWer]:FREQuency \<Frequency>

Sets the RF frequency of the signal, if signal source "USER" is selected (`:SENSe<ch>[:POWer]:SOURce`).

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 171

:SENSe\<ch>[:POWer]:LOGGing:STATe \<State>

Activates the recording of the power values, measured by a connected R&S NRP power sensor.

Parameters:

\<State>	0	1	OFF	ON
	*RST: 0

Example:	`SENS:LOGG:STAT ON`
	Activates recording of the power measurement of the first sensor.

Manual operation: See "Enable Logging" on page 174

: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 172

: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>	0 | 1 | OFF | ON
	*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 172

: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 170

: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 349.

Manual operation:	See " Use Frequency Of" on page 171

:SENSe<ch>[:POWer]:STATus[:DEVice]?

Queries if a sensor is connected to the instrument.

Return values:

<Status>	0 | 1 | OFF | ON
	*RST: 0

Example:	SENS1:STAT?
	Response: 1
	A sensor is connected.

Usage: Query only

Manual operation: See " State " on page 171

: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 170

: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 171

12.14 SOURce Subsystem

The SOURce subsystem contains the commands for configuring the digital and analog signals.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
SOURce\<hw>	[1]	• SOURce[1] = RF output (optional keyword) • LF output = SOURce:LFOutput (SOURce is optional keyword)

12.14.1 Analog Modulation Subsystems

Option: see Chapter 5.1, "Required Options", on page 68.

The subsystems in this section describe all commands for analog modulation of the RF signal. Divided in separate sections, you can configure amplitude modulation (AM), frequency modulation (FM) , phase modulation (PhiM) and pulse modulation (PULM).

You can perform each of the modulations either with an internally generated modulation signal or with an externally applied signal.

To configure the internal signal, use the commands listed in Chapter 12.14.5, "SOURce:LFOutput Subsystem", on page 408.

For more information:

See Chapter 5, "Analog Modulations", on page 68.

12.14.1.1 SOURce:MODulation Subsystem

The command in this subsytem allows you to disable all active modulations at once, and, vice versa, to restore the last active ones.

[:SOURce\<hw>]:MODulation[:ALL][:STATe] \<State>

Activates all modulations that were active before the last switching off.

Parameters:

\<State>   0 | 1 | OFF | ON

                             *RST: 0

Example:

```
SOURce1:AM1:DEPTh 30
SOURce1:AM1:SOURce LF1
SOURce1:AM1:STATe 1
SOURce1:FM1:DEViation 1000
SOURce1:FM1:STATe 1
// disable both modulation
SOURce1:MODulation:ALL:STATe 0
SOURce1:AM1:STATe?
// 0
SOURce1:FM1:STATe?
// 0
// enable both modulation
SOURce1:MODulation:ALL:STATe 1
SOURce1:AM1:STATe?
// 1
SOURce1:FM1:STATe?
// 1
```

Manual operation: See "[Mod on/off]" on page 70

12.14.1.2 SOURce:AM Subsystem

Option: R&S SMBB-K720

The AM subsystem contains the commands for setting the amplitude modulation and also the broadband amplitude modulation.

The following examples show some variants for generating AM signals.

Example: Creating an amplitude modulated RF signal

Using the internal LF generator, the following command sequence configures an amplitude modulated signal.

```
// Reset the instrument to start from a defined state
*RST

// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the modulation signal
SOURce1:LFOutput1:SHAPe SINE
SOURce1:LFOutput1:FREQuency 20000

// Configure the amplitude modulation settings and switch AM on
SOURce1:AM1:SOURce LF1
SOURce1:AM1:DEPTh 30
SOURce1:AM:RATio 40
SOURce1:AM1:DEViation:MODe UNC
SOURce1:AM1:STATe 1
```

Example: Using combined LF signals

Using the internal LF generators of both paths, the following command sequences configure an amplitude modulated signal with determined deviations depths.

```
// Configure the AM modulation settings with combined LF signal sources
SOURce1:AM1:SOURce LF1
SOURce1:AM1:DEPTh 32
// Select the modulation signal source for the second path
SOURce1:AM2:SOURce LF2
// Combine the signals of both paths with fixed total deviation depth
SOURce1:AM1:DEViation:MODe TOT
SOURce1:AM1:DEPTh:SUM 60

// Query the deviation depth of modulation signal in the second path
SOURce1:AM2:DEPTh?
// Response:  28

// Combine the signals of both paths with fixed ratio
SOURce1:AM1:DEViation:MODe RAT
SOURce1:AM1:RATio 100
SOURce1:AM2:DEPTh 25

// Query the deviation depth of modulation signal in the first path
SOURce1:AM1:DEPTh?
// Response:  25

SOURce1:AM1:STATe 1
SOURce1:AM2:STATe 1
```

Example: Using an external signal source

Using an external signal source, you can additionally determine whether you want to use only the AC component of the external modulation signal.

```
// Reset the instrument to start from a defined state
*RST

// Set frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the amplitude modulation settings and turn on AM
SOURce1:AM1:SOURce EXT1
SOURce1:AM1:DEPTh 40

// Query the input sensitivity at the external modulation input
SOURce1:AM1:SENSitivity?
// Response:  40
// Since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 50%/V.
```

```
// This value is assigned to the voltage value for full
// modulation of the input.


// Select the coupling mode AC for external amplitude modulation
SOURce1:INPut:MODext:COUPling1 AC


// For external AM signal input, adjust the sensitivity
SOURce1:AM1:SOURce EXT1
SOURce1:AM1:SENSitivity 25
SOURce1:AM1:SENSitivity?
Response: 25

// Switch on AM and RF signal output
SOURce1:AM1:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:AM<ch>:STATe <State>

Activates amplitude modulation.

Suffix:

<ch>   1 to 2
                       Modulation signal channel

Parameters:

<State>   0 | 1 | OFF | ON
                       *RST: 0

Example: See Example "Creating an amplitude modulated RF signal" on page 361.

Manual operation: See "State" on page 73

[:SOURce<hw>]:AM<ch>:SOURce <Source>

Selects the modulation source for amplitude modulation.

Suffix:

<ch>   1 to 2
                       Modulation signal channel

Parameters:

<Source>   EXT1 | NOISe | LF2 | LF1 | EXTernal | INTernal

LF1|LF2
Uses an internally generated LF signal.

EXT1
Uses an externally supplied LF signal.

NOISe
Uses the internally generated noise signal.

INTernal
Uses the internally generated signal of LF1.

EXTernal
Uses an external LF signal (EXT1).

Example:	See Example "Creating an amplitude modulated RF signal" on page 361.
Manual operation:	See "Source" on page 73

[:SOURce<hw>]:AM<ch>[:DEPTh] <Depth>

Sets the depth of the amplitude modulation in percent.

Suffix:

<ch>	1...2
	Modulation signal channel

Parameters:

<Depth>	float
	Range: 0 to 100
	Increment: 0.01
	*RST: 30

Example:	See Example "Creating an amplitude modulated RF signal" on page 361.
Manual operation:	See "Depth" on page 76

[:SOURce<hw>]:AM:DEPTh:SUM <AmDepthSum>

Sets the total depth of the LF signal when using combined signal sources in amplitude modulation.

Parameters:

<AmDepthSum>	float
	Range: 0 to 100
	Increment: 0.01
	*RST: 30

Example:	See Example "Using combined LF signals" on page 362.
Manual operation:	See "Total Depth" on page 77

[:SOURce<hw>]:AM:DEViation:MODE <AmDevMode>

Selects the coupling mode. The coupling mode parameter also determines the mode for fixing the total depth.

Parameters:

<AmDevMode>   UNCoupled | TOTal | RATio

UNCoupled
Does not couple the LF signals.
The deviation depth values of both paths are independent.

TOTal
Couples the deviation depth of both paths.

RATio
Couples the deviation depth ratio of both paths

*RST: UNCoupled

Example: See Example "Using combined LF signals" on page 362.

Manual operation: See "Deviation Mode" on page 77

[:SOURce<hw>]:AM:RATio <Ratio>

Sets the deviation ratio (path#2 to path#1) in percent.

Parameters:

<Ratio>   float

Range: 0 to 100
Increment: 0.01
*RST: 100

Example: See Example "Creating an amplitude modulated RF signal" on page 361.

Manual operation: See "Ratio Path2/Path1" on page 77

[:SOURce<hw>]:AM<ch>:SENSitivity <Sensitivity>

Sets the sensitivity of the external signal source for amplitude modulation in %/V.

Parameters:

<Sensitivity>   float

Range: 0 to 100
Increment: 0.1
*RST: 30

Example: See Example "Using an external signal source" on page 362.

Manual operation: See "Sensitivity" on page 77

12.14.1.3 SOURce:FM Subsystem

Option: R&S SMBB-K720

The FM subsystem contains the commands for setting the frequency modulation.

Example: Creating a frequency modulated RF signal

Using the internal LF generator, the following command sequence configures a frequency modulated signal.

```
// Reset the instrument to start from a defined state
*RST

// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the modulation signal
SOURce1:LFOutput1:SHAPe SINE
SOURce1:LFOutput1:FREQuency 20000

// Configure the frequency modulation settings and switch FM on
SOURce1:FM1:SOURce LF1
SOURce1:FM1:DEViation 1000
SOURce1:FM:RATio 40
SOURce1:FM:MODe LNOise
SOURce1:FM1:STATe 1

// Switch on LF and RF signal output
SOURce1:LFOutput1:STATe 1
OUTPut1:STATe 1
```

Example: Using combined LF signals

Using the internal LF generators of both paths, the following command sequences configure a frequency modulated signal with determined deviations.

```
// Configure the FM modulation settings with combined LF signal sources
SOURce1:FM1:SOURce LF1
SOURce1:FM1:DEViation 1000
// Select the modulation signal source for the second path
SOURce1:FM2:SOURce LF2
// Combine the signals of both paths with fixed total deviation depth
SOURce1:FM1:DEViation:MODe TOT
SOURce1:FM1:DEViation:SUM 5000

// Query the deviation depth of modulation signal in the second path
SOURce1:FM2:DEViation?
// Response:  4000

// Combine the signals of both paths with fixed ratio
```

```
SOURce1:FM1:DEViation:MODe RAT
SOURce1:FM1:RATio 100
SOURce1:FM2:DEVIation 10000

// Query the deviation depth of modulation signal in the first path
SOURce1:AM1:DEViation?
// Response:  1000

SOURce1:FM1:STATe 1
SOURce1:FM2:STATe 1
```

Example: Using an external signal source

Alternatively configure the frequency modulation settings with an external modulation signal.

```
// Reset the instrument to start from a defined state
*RST

// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the frequency modulation settings and switch FM on
SOURce1:FM1:SOURce EXT1
SOURce1:FM1:DEViation 5000

// Query the input sensitivity at the external modulation input
:SOURce1:FM1:SENSitivity?
// Response:  1000
// since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 5000 Hz/V.

// Switch on FM and RF signal output
SOURce1:FM1:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:FM<ch>:STATe <State>

Activates frequency modulation.

Suffix:

FM<ch>   1..2

determines the modulation signal channel.

Parameters:

<State>   0 | 1 | OFF | ON

                             *RST: 0

Example: See Example "Creating a frequency modulated RF signal" on page 366.

Manual operation: See "State" on page 73

[:SOURce<hw>]:FM<ch>[:DEViation] <Deviation>

Sets the modulation deviation of the frequency modulation in Hz.

Suffix:

FM<ch>   1|2

Modulation signal channel

Parameters:

<Deviation>   float

The maximum deviation depends on the RF frequency and the selected modulation mode (see data sheet).

Range: 0 to max
Increment: 0.01
*RST: 1E3

Example: See Example "Creating a frequency modulated RF signal" on page 366.

Manual operation: See "Deviation" on page 74

[:SOURce<hw>]:FM<ch>:SOURce <Source>

Selects the modulation source for frequency modulation.

Suffix:

FM<ch>   1|2

Modulation signal channel.

Parameters:

<Source>   EXT1 | NOISe | LF2 | LF1 | INTernal | EXTernal

LF1|LF2
Uses an internally generated LF signal.

INTernal
Uses the internally generated signal of LF1.

EXTernal
Uses an external LF signal (EXT1).

NOISe
Uses the internally generated noise signal.

*RST:	LF1 <FM1>; LF2 <FM2>

Example:	See Example "Creating a frequency modulated RF signal" on page 366.
Manual operation:	See "Source" on page 73

[:SOURce<hw>]:FM:DEViation:MODE <FmDevMode>

Selects the coupling mode. The coupling mode parameter also determines the mode for fixing the total deviation.

Parameters:

<FmDevMode>	UNCoupled | TOTal | RATio
	UNCoupled
	Does not couple the LF signals.
	The deviation values of both paths are independent.
	TOTal
	Couples the deviation of both paths.
	RATio
	Couples the deviation ratio of both paths
	*RST: UNCoupled

Example:	See Example "Using combined LF signals" on page 366.
Manual operation:	See "Deviation Mode" on page 74

[:SOURce<hw>]:FM:DEViation:SUM <FmDevSum>

Sets the total deviation of the LF signal when using combined signal sources in frequency modulation.

Parameters:

<FmDevSum>	float
	Range: 0 to 40E6
	Increment: 0.01
	*RST: 1E3

Example:	See Example "Using combined LF signals" on page 366.
Manual operation:	See "Total Deviation" on page 74

[:SOURce<hw>]:FM:RATio <Ratio>

Sets the deviation ratio (path2 to path1) in percent.

Parameters:

<Ratio>	float
	Range: 0 to 100
	Increment: 0.01
	*RST: 100

Example: See Example "Creating a frequency modulated RF signal"
                            on page 366.

Manual operation: See "Ratio Path2/Path1" on page 74

[:SOURce<hw>]:FM:MODE <Mode>

Selects the mode for the frequency modulation.

Parameters:
<Mode>   HBANdwidth | LNOise

                            HBANdwidth
                            Selects maximum range for modulation bandwidth.

                            LNOise
                            Selects optimized phase noise and spurious characteristics with
                            reduced modulation bandwidth and FM deviation.

                            *RST: HBANdwidth

Example: See Example "Creating a frequency modulated RF signal"
                            on page 366.

Manual operation: See "Mode" on page 75

[:SOURce<hw>]:FM:SENSitivity?

Queries the sensitivity of the externally supplied signal for frequency modulation. The
sensitivity depends on the set modulation deviation.

Return values:
<Sensitivity>   float

                            Sensitivity in Hz/V.
                            It is assigned to the voltage value for full modulation of the input.

                            Range: 0 to max
                            Increment: 0.01

Example: See Example "Using an external signal source" on page 367.

Usage: Query only

12.14.1.4 SOURce:PM Subsystem

Option: R&S SMBB-K720

The PM subsystem contains the commands for setting the phase modulation. You can
configure the internal modulation source (LF generator) with the commands listed in
Chapter 12.14.5, "SOURce:LFOutput Subsystem", on page 408 .

Example: Performing phase modulation
The following example shows a command sequence to perform phase modulation.

```
// Reset the instrument to start from an initial state
*RST; *CLS


// Set the RF signal frequency and level
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25


// Configure the phase modulation settings
SOURce1:LFOutput1:SHAPe SINE
SOURce1:LFOutput1:FREQuency 1000


// Select the LF signal generated by the internal modulation generator
// or the internally generated noise signal
SOURce1:PM1:DEViation 1
SOURce1:PM1:SOURce LF1
// SOURce1:PM1:SOURce INTernal
// SOURce1:PM1:SOURce NOISe
SOURce1:PM1:RATio 40
SOURce1:PM1:MODE HBAN


// Alternatively configure the phase modulation settings for an
// external modulation source and query the input sensitivity.
SOURce1:PM1:SOURce EXT1
// SOURce1:PM1:SOURce EXTernal
SOURce1:PM1:DEViation 1
SOURce1:PM1:SENSitivity?
// Response: 1
// since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 1RAD/V.


// Activate the signal output
SOURce1:PM1:STATe 1
OUTPut1:STATe 1
```

Example: Using combined LF signals

Using the internal LF generators of both paths, the following command sequences configure an phase modulated signal with determined deviations.

```
// Configure the Phase modulation settings with combined LF signal sources
SOURce1:PM1:SOURce LF1
SOURce1:PM1:DEViation 1.5
// Select the modulation signal source for the second path
SOURce1:PM2:SOURce LF2
// Combine the signals of both paths with fixed total deviation depth
SOURce1:PM1:DEViation:MODe TOT
SOURce1:PM1:DEViation:SUM 2


// Query the deviation depth of the modulation signal in the second path
SOURce1:PM2:DEViation?
// Response:  0.5
```

```
// Combine the signals of both paths with fixed ratio
SOURce1:PM1:DEViation:MODe RAT
SOURce1:PM1:RATio 80
SOURce1:PM2:DEViation?
// Response:  1.2

// Query the deviation depth of modulation signal in the first path
SOURce1:PM1:DEViation?
// Response:  1.5

SOURce1:FM1:STATe 1
SOURce1:FM2:STATe 1
```

The following commands are available:

[:SOURce<hw>]:PM<ch>:STATe <State>

Activates phase modulation.

Activation of phase modulation deactivates frequency modulation.

Suffix:

PM<ch>   1|2
                      Sets the modulation signal channel.

Parameters:

<State>   0 | 1 | OFF | ON
                      *RST: 0

Example: See Example "Performing phase modulation" on page 370.

Manual operation: See "State" on page 73

[:SOURce<hw>]:PM<ch>:SOURce <Source>

Selects the modulation source for phase modulation signal.

Suffix:

PM<ch>   1|2
                      Sets the modulation signal channel.

Parameters:

<Source>   EXT1 | NOISe | LF2 | LF1 | INTernal | EXTernal

LF1|LF2
Uses an internally generated LF signal.

EXT1
Uses an externally supplied LF signal.

NOISe
Uses the internally generated noise signal.

INTernal
Uses the internally generated signal of LF1.

EXTernal
Uses an external LF signal (EXT1).

Example: See Example "Performing phase modulation" on page 370.

Manual operation: See "Source" on page 73

[:SOURce<hw>]:PM:MODE <Mode>

Selects the mode for the phase modulation.

Parameters:
<Mode>   HBANdwidth | HDEViation | LNOise

                     HBANdwidth
                     Sets the maximum available bandwidth.

                     HDEViation
                     Sets the maximum range for ΦM deviation.

                     LNOise
                     Selects a phase modulation mode with phase noise and spuri-
                     ous characteristics close to CW mode.

                     *RST: HBANdwidth

Example: See Example "Performing phase modulation" on page 370.

Manual operation: See "Mode" on page 76

[:SOURce<hw>]:PM:DEViation:MODE <PmDevMode>

Selects the coupling mode. The coupling mode parameter also determines the mode
for fixing the total deviation.

Parameters:
<PmDevMode>   UNCoupled | TOTal | RATio

                     UNCoupled
                     Does not couple the LF signals.
                     The deviation values of both paths are independent.

                     TOTal
                     Couples the deviation of both paths.

                     RATio
                     Couples the deviation ratio of both paths

                     *RST: UNCoupled

Example: See Example "Using combined LF signals" on page 371

Manual operation: See "Deviation Mode" on page 75

[:SOURce<hw>]:PM:DEViation:SUM <PmDevSum>

Sets the total deviation of the LF signal when using combined signal sources in phase modulation.

Parameters:
<PmDevSum>   float

Range:	0 to 20
Increment:	1E-6
*RST:	1

Example: See Example "Using combined LF signals" on page 371

Manual operation: See "Total Deviation" on page 76

[:SOURce<hw>]:PM:RATio <Ratio>

Sets the deviation ratio (path2 to path1) in percent.

Parameters:
<Ratio>   float

Range:	0 to 100
Increment:	0.01
*RST:	100

Example: See Example "Performing phase modulation" on page 370.

Manual operation: See "Ratio Path2/Path1" on page 76

[:SOURce<hw>]:PM:SENSitivity?

Queries the sensitivity of the externally applied signal for phase modulation.

The returned value reports the sensitivity in RAD/V. It is assigned to the voltage value for full modulation of the input.

Return values:
<Sensitivity>   float

Example: See Example "Performing phase modulation" on page 370.

Usage: Query only

[:SOURce]:PM<ch>[:DEViation] <Deviation>

Sets the modulation deviation of the phase modulation in RAD.

Parameters:

<Deviation>	float

The maximal deviation depends on the RF frequency and the selected modulation mode (see data sheet).

Range: 0 to max
Increment: 1
*RST: 1
Default unit: RAD

Example: See Example "Performing phase modulation" on page 370.

Manual operation: See "Deviation" on page 75

12.14.1.5 SOURce:PULM Subsystem

Option: see Chapter 5.1, "Required Options", on page 68.

The PULM subsystem contains the commands for setting the pulse modulation.

Pulse Modulation Settings

With the commands described in this section, you can configure the settings for pulse modulation, select the trigger mode and determine delay times for the pulse modulation signal.

Example: Perform pulse modulation

The example shows a command sequence to perform pulse modulation.

```
// Reset the instrument to start from an initial state
*RST; *CLS

// Set the RF signal frequency and level
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the pulse modulation settings
// Select the internal modulation generator,
// set trigger mode, select pulse mode, transition type

// Trigger a single pulse

SOURce:PULM:SOURce INT
SOURce:PULM:TRIGger:MODE SING
SOURce:PULM:MODE DOUB
SOURce:PULM:TTYPe SMO

SOURce:PULM:TRIG:IMM
```

```
// Alternatively configure the pulse modulation settings for
// external modulation source
// Select the source, set the polarity of the external signal,
// select the impedance for the external pulse modulation input/
// for the external pulse modulation trigger input
SOURce:PULM:SOURce EXT
SOURce:PULM:POLarity NORMal
SOURce:PULM:IMPedance G1K

// Configure the pulse generator settings
// Set pulse period, width, and delay
SOURce:PULM:PERiod 10 us
SOURce:PULM:WIDth 8 us
SOURce:PULM:DOUBle:WIDTh 0.0000012
SOURce:PULM:DOUBle:DELay 0.0000045

// Activate the signal output
SOURce:PGENerator:OUTPut:STATe 1
SOURce:PULM:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:PULM:MODE <Mode>

Selects the mode for the pulse modulation.

Parameters:

<Mode>	SINGle | DOUBle | PTRain
	SINGle
	Generates a single pulse.
	DOUBle
	Generates two pulses within one pulse period.

PTRain

Generates a user-defined pulse train.

Specify the pulse sequence with the commands:

`[:SOURce<hw>]:PULM:TRAin:ONTime`

`[:SOURce<hw>]:PULM:TRAin:OFFTime`

`[:SOURce<hw>]:PULM:TRAin:REPetition`

*RST: SINGle

Example: See Example "Perform pulse modulation" on page 375.

Options: PTRain requires R&S SMBB-K27

Manual operation: See "Pulse Mode" on page 87

[:SOURce<hw>]:PULM:TRIGger:MODE <Mode>

Selects a trigger mode - auto, single, external, external single or external gated - for generating the modulation signal.

Parameters:

<Mode>   AUTO | EXTernal | EGATe | SINGle | ESINgle

                       *RST: AUTO

Example: See Example "Perform pulse modulation" on page 375.

Manual operation: See "Trigger Mode" on page 87

[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate

If `[:SOURce<hw>]:PULM:TRIGger:MODE` SINGle, triggers the pulse generator.

Example: See Example "Perform pulse modulation" on page 375.

Manual operation: See "Execute Single Trigger" on page 88

[:SOURce<hw>]:PULM:PERiod <Period>

Sets the period of the generated pulse, that means the repetition frequency of the internally generated modulation signal.

Parameters:

<Period>   float

                       The minimum value depends on the installed options
                       R&S SMBB-K22 or R&S SMBB-K23

                       Range: 20E-9 to 100
                       Increment: 5E-9
                       *RST: 10E-6

Example: See Example "Perform pulse modulation" on page 375.

Manual operation: See "Pulse Period" on page 88

[:SOURce<hw>]:PULM:WIDTh <Width>

Sets the width of the generated pulse, that means the pulse length. It must be at least 20ns less than the set pulse period.

Parameters:

<Width>   float

                Range: 20E-9 to 100
                Increment: 10E-9
                *RST: 2E-6

Example: See Example "Perform pulse modulation" on page 375.

Manual operation: See "Pulse Width" on page 88

[:SOURce<hw>]:PULM:DELay <Delay>

Sets the pulse delay.

Parameters:

<Delay>   float

                *RST: 1ms

Example: See Example "Perform pulse modulation" on page 375.

Manual operation: See "Pulse Delay" on page 88

[:SOURce<hw>]:PULM:DOUBle:DELay <Delay>

Sets the delay from the start of the first pulse to the start of the second pulse.

Parameters:

<Delay>   float

                *RST: 1E-6

Example: See Example "Perform pulse modulation" on page 375.

Manual operation: See "Double Pulse Delay" on page 88

[:SOURce<hw>]:PULM:DOUBle:WIDTh <Width>

Sets the width of the second pulse.

Parameters:

<Width>   float

                Increment: 5E-9

Example: See Example "Perform pulse modulation" on page 375.

Manual operation: See "Double Pulse Width" on page 88

[:SOURce<hw>]:PULM:DOUBle:STATe <State>

Provided for backward compatibility with former Rohde & Schwarz signal generators.

Works like the command `[:SOURce<hw>]:PULM:MODE` DOUBle.

Parameters:

<State>　　　　　　　　0 | 1 | OFF | ON

　　　　　　　　　　　*RST:　　　0

[:SOURce<hw>]:PULM:STATe <State>

Activates pulse modulation.

Parameters:

<State>　　　　　　　　0 | 1 | OFF | ON

　　　　　　　　　　　*RST:　　　0

Example:　　　　　　See Example "Perform pulse modulation" on page 375.

Manual operation:　See "State" on page 71

[:SOURce<hw>]:PULM:SOURce <Source>

Selects between the internal (pulse generator) or an external pulse signal for the modulation.

Parameters:

<Source>　　　　　　　INTernal | EXTernal

　　　　　　　　　　　*RST:　　　INTernal

Example:　　　　　　See Example "Perform pulse modulation" on page 375.

Manual operation:　See "Source" on page 71

[:SOURce<hw>]:PULM:TTYPe <Source>

Sets the transition mode for the pulse signal.

Parameters:

<Source>　　　　　　　SMOothed | FAST

　　　　　　　　　　　SMOothed
　　　　　　　　　　　flattens the slew rate, resulting in longer rise/fall times.

　　　　　　　　　　　FAST
　　　　　　　　　　　enables fast transitions with shortest rise and fall times.

　　　　　　　　　　　*RST:　　　FAST

Example:　　　　　　See Example "Perform pulse modulation" on page 375.

Manual operation:　See "Transition Type" on page 72

[:SOURce<hw>]:PULM:POLarity <Polarity>

Sets the polarity of the externally applied modulation signal.

Parameters:

<Polarity>　　　　　　　NORMal | INVerted

　　　　　　　　　　　　NORMal
　　　　　　　　　　　　Suppresses the RF signal during the pulse pause.

　　　　　　　　　　　　INVerted
　　　　　　　　　　　　Suppresses the RF signal during the pulse.

　　　　　　　　　　　　*RST:　　　NORMal

Example:　　　　　　　See Example "Perform pulse modulation" on page 375.

Manual operation:　　See "Polarity" on page 96

[:SOURce<hw>]:PULM:IMPedance <Impedance>

Sets the impedance for the external pulse trigger and pulse modulation input.

Parameters:

<Impedance>　　　　　　G50 | G10K

　　　　　　　　　　　　*RST:　　　G50

Example:　　　　　　　See Example "Perform pulse modulation" on page 375.

Manual operation:　　See "Impedance" on page 96

Pulse Train Settings

Option: R&S SMBB-K27

This section describes the commands for the pulse train modulation and the associated file handling. For background information, see Chapter 5.4.4.2, "Pulse Generator > Pulse Train Settings", on page 89.

Example: Generating a pulse train signal

The following settings are required to perform pulse train modulation.

Always create and select pulse train data list first before you activate the pulse train mode.

Otherwise, an error is displayed

```
*RST; *CLS

// Set the RF signal frequency and level
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// Create a pulse train data list
// Select the directory
```

```
MMEM:CDIR '/var/user/'
SOURce1:PULM:TRAin:CATalog?
// my_pt
// Create and7or select the pulse train data file
SOURce1:PULM:TRAin:SELect "/var/user/pt"
// Enter the pulse train data
SOURCe:PULM:TRAin:ONTime 0.0001,0.00025,0.0001
SOURCe:PULM:TRAin:OFFTime 500us,500us,300us
SOURCe:PULM:TRAin:REPetition 2,0,3
// the second pulse is ignored

// Select pulse train mode
// Select the internal modulation generator and the pulse mode
SOURce1:PULM:SOURce INT
SOURce1:PULM:MODE PTR
SOURce1:PULM:TRIGger:MODE EXT
SOURce1:PGENerator:OUTPut:STATe 1
SOURce1:PGENerator:OUTPut:POLarity NORM
SOURCe:PGENerator:OUTPut:STATe 1
SOURCe:PULM:STATe 1
OUTPut1:STATe 1

// SOURce1:PULM:TRAin:CATalog?
// my_pt, pt
// SOURce1:PULM:TRAin:DEL "/var/user/my_pt"
```

The following commands are available:

[:SOURce<hw>]:PULM:TRAin:CATalog?

Queries the available pulse train files in the specified directory.

Return values:

<Catalog>	string
	List of list filenames, separated by commas
Example:	See Example "Generating a pulse train signal" on page 380.
Usage:	Query only
Manual operation:	See "Pulse Train Data" on page 90

[:SOURce<hw>]:PULM:TRAin:DELete <Filename>

Deletes the specified pulse train file.

Setting parameters:

<Filename>	string
	Filename or complete file path; file extension is optional.
Example:	See Example "Generating a pulse train signal" on page 380.
Usage:	Setting only
Manual operation:	See "Pulse Train Data" on page 90 See "Edit Pulse Train Data" on page 91

[:SOURce<hw>]:PULM:TRAin:ONTime <OnTime>
[:SOURce<hw>]:PULM:TRAin:OFFTime <OffTime>

Enters the pulse on/off times values in the selected list.

Parameters:

<OffTime>	Offtime#1{, Offtime#2, ...} | binary block data
	List of comma-separated numeric values or binary block data, where: The list of numbers can be of any length. In binary block format, 8 (4) bytes are always interpreted as a floating-point number with double accuracy. See `:FORMat[:DATA]` on page 338 for details. The maximum length is 2047 values.
	Range: 0 ns to 5 ms
Example:	See Example "Generating a pulse train signal" on page 380.
Manual operation:	See "Edit Pulse Train Data" on page 91

[:SOURce<hw>]:PULM:TRAin:REPetition:POINts?
[:SOURce<hw>]:PULM:TRAin:ONTime:POINts?
[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts?

Queries the number of on and off time entries and repetitions in the selected list.

Return values:

<Points>	integer
	Range: 0 to INT_MAX *RST: 0
Example:	See Example "Generating a pulse train signal" on page 380.
Usage:	Query only

[:SOURce<hw>]:PULM:TRAin:REPetition <Repetition>

Sets the number of repetitions for each pulse on/off time value pair.

Parameters:

<Repetition>   Repetition#1{, Repetition#2, ...}

0 = ignore value pair
Set "Repetition = 0" to skip a particular pulse without deleting
the pulse on/off time value pair

Range: 0 to 65535

Example: See Example "Generating a pulse train signal" on page 380.

Manual operation: See "Edit Pulse Train Data" on page 91

[:SOURce<hw>]:PULM:TRAin:SELect <Filename>

Selects or creates a data list in pulse train mode.

If the list with the selected name does not exist, a new list is created.

Parameters:

<Filename>   string

Filename or complete file path; file extension can be omitted.

Example: See Example "Generating a pulse train signal" on page 380.

Manual operation: See "Pulse Train Data" on page 90
See "File Name" on page 95
See "Functions for handling of data lists" on page 202

Pulse Train Data Exchange

Option: R&S SMBB-K27

With the following commands, you can configure pulse trains in ASCII format and
export or import them accordingly.

```
SOURce1:PULM:SOURce INT
SOURce1:PULM:MODE PTR
SOURce1:PULM:TRAin:SELect "/var/user/pt"
SOURce1:PULM:STATe 1

SOURce1:PULM:TRAin:DEXChange:MODE EXP
SOURce1:PULM:TRAin:DEXChange:AFILe:EXTension TXT
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal DOT
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn SEM
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn COMM
SOURce1:PULM:TRAin:DEXChange:SELect "/var/user/pt.pulstrn"
SOURce1:PULM:TRAin:DEXChange:AFILe:SELect "/var/user/pt_script.txt"
SOURce1:PULM:TRAin:DEXChange:EXECute
```

The following commands are available:

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE <Mode>

Determines the import or export of a list.

Specify the source or destination file with the command `[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect`.

Parameters:

<Mode>	IMPort | EXPort	
	*RST:	IMPort

Example: See "Pulse Train Data Exchange" on page 383.

Manual operation: See " Mode " on page 93

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension <Extension>

Determines the extension of the ASCII file for import or export, or to query existing files.

Parameters:

<Extension>	TXT | CSV	
	*RST:	TXT

Example: See "Pulse Train Data Exchange" on page 383.

Manual operation: See "ASCII File Settings" on page 93

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal <Decimal>

Sets "." (decimal point) or "," (comma) as the decimal separator used in the ASCII data with floating-point numerals.

Parameters:

<Decimal>	DOT | COMMa	
	*RST:	DOT

Example: See "Pulse Train Data Exchange" on page 383.

Manual operation: See "ASCII File Settings" on page 93

[:SOURce<hw>]:PULM:TRAin: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 "Pulse Train Data Exchange" on page 383.

Manual operation: See "ASCII File Settings" on page 93

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog?

Queries the available ASCII files in the current or specified directory.

Return values:

<Catalog>   string

                        List of ASCII files *.txt or *.csv, separated by commas.

Example: See "Pulse Train Data Exchange" on page 383.

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination"
                        on page 94

[:SOURce<hw>]:PULM:TRAin: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 "Pulse Train Data Exchange" on page 383.

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination"
                        on page 94

[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect <Filename>

Selects the ASCII file for import or export, containing a pulse train list.

Parameters:

<Filename>   string

                        Filename or complete file path; file extension can be omitted.

Example: See "Pulse Train Data Exchange" on page 383.

Manual operation: See "Select Source/Select ASCII Destination" on page 94

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute

Usage: Event

Manual operation: See "Import / Export" on page 94

Executes the import or export of the selected list file, according to the transfer direction
set with command `[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE`.

12.14.1.6 SOURce:STEReo Subsystem

Option: R&S SMBB-B5

The `SOURce:STEReo` subsystem contains the commands for generating FM stereo multiplex signals, the radio traffic service ARI (Automotive Radio Information) and Radio Data System (RDS).

Additional functions are available using the `SOURce:STEReo:DIRect` commands, see Chapter 12.20, "Direct Commands for the Stereo/RDS Coder Option R&S SMBB-B5", on page 493.

Example: Activating stereo modulation

The following example shows a command sequence for stereo modulation.

```
// Reset the instrument to start from an initial state
*RST; *CLS
// Set the FM deviation, audio source, preemphasis
// and max modulation frequency

SOURce:STEReo:DEViation 25000
SOURce:STEReo:SOURce SPEX
SOURce:STEReo:AUDio:PREemphasis:STATe 1
SOURce:STEReo:AUDio:PREemphasis 75 us
SOURce:STEReo:AUDio:MODE RNEL
SOURce:STEReo:MMF 1500

// Configure the pilot tone
SOURce:STEReo:PILot:DEViation 5000
SOURce:STEReo:PILot:PHASe 3

// Configure and activate ARI
STEReo:ARI 2800
SOURce:STEReo:ARI:TYPE BK
STEReo:ARI:BK C
SOURce:Stereo:ARI:STATe 1

//Configure and activate RDS
STEReo:RDS 1200
SOURce:STEReo:RDS:DATaset DS3
SOURce:STEReo:RDS:TRAFfic:PROGram:STATe 1
SOURce:STEReo:RDS:TRAFfic:ANNouncement:STATe 1
STEReo:RDS:STATe 1

// Activate the signal output
SOURce:STEReo:STATe 1
```

[:SOURce]:STEReo:DIRect <Direct>

Sends a R&S SMB100B command string to the stereo coder.

The direct commands offer extended settings possibilities for the stereo coder, see Chapter 12.20, "Direct Commands for the Stereo/RDS Coder Option R&S SMBB-B5", on page 493.

Parameters:

<Direct>   string

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Program Service Name " on page 85
                         See " Program Identification " on page 85

[:SOURce]:STEReo:STATe <State>

Activates/deactivates stereo modulation.

Parameters:

<State>   0 | 1 | OFF | ON

                        *RST: 0

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See "State" on page 79

[:SOURce]:STEReo[:DEViation] <Deviation>

Sets the MPX (Multiplex stereo signal) deviation.

Parameters:

<Deviation>	integer

Range: 0 to depends on instrument hardware
*RST: 40 kHz

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See "FM Deviation" on page 79

[:SOURce]:STEReo:AUDio:MODE <Mode>

Selects the generated identifiers of the AUDio signal.

Parameters:

<Mode>   LEFT | RIGHt | RELeft | REMLeft | RNELeft

LEFT
A mono signal containing the left channel is generated/fed in.

RIGHt
A mono signal containing the right channel is generated/fed in.

RELeft
A stereo signal with right and left channel is generated/fed in. The channels have the same frequency and phase.

REMLeft
The signal on the left external audio input is used for both channels, left and right. The right channel is inverted.

RNELeft
(External source only)
A stereo signal containing different, independent right and left channels is feed in. It is possible, for example, to feed a fixed audio frequency to the first channel while a frequency sweep is being performed in the second channel.

*RST: LEFT

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See "Mode" on page 80

[:SOURce]:STEReo:SOURce <Source>

Selects the source for the audio signal.

Parameters:

<Source>   OFF | LREXt | SPEXt | LFGen

OFF
No audio signal is provided, ARI and RDS signal can be generated separately.

LREX
The external audio signal is feed in via the analog L and R inputs.

SPEX

The external audio signal is feed in via the digital S/P DIF interface

LFG

The audio stereo signal is internally generated by the LF generator.

*RST: LRExt

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See "Audio Source" on page 80

[:SOURce]:STEReo:EXTernal:IMPedance <Impedance>

For `[:SOURce]:STEReo:SOURce`LREX, selects the input impedance for the external analog audio signal inputs L and R.

Parameters:

<Impedance>   600 | 600Ohm | 100000 | 100kOhm | 100000Ohm

                    *RST: 100000

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " External R/L Impedance " on page 80

[:SOURce]:STEReo:MMF <Mmf>

For `[:SOURce]:STEReo:SOURce`LREX and `[:SOURce]:STEReo:AUDio:PREemphasis:STATe`1, sets the maximum modulation frequency. It prevents over modulation but decreases S/N ratio.

Parameters:

<Mmf>   integer

                    Range: 1000 to 18000
                    *RST: 1000

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Max Modulation Frequency " on page 81

[:SOURce]:STEReo:AUDio:PREemphasis <PreEmphasis>

If `[:SOURce]:STEReo:AUDio:PREemphasis:STATe`1, sets the preemphasis used for signal generation.

Parameters:

<PreEmphasis>   OFF | 50 | 75

                    Range: 50 us to 75 us

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Preemphasis " on page 81

[:SOURce]:STEReo:AUDio:PREemphasis:STATe <State>

Activates the use of preemphasis for signal generation.

Parameters:
<State>   0 | 1 | OFF | ON
                          *RST: 0

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Preemphasis " on page 81

[:SOURce]:STEReo:PILot:STATe <State>

Activates/deactivates the pilot tone generation.

Parameters:
<State>   0 | 1 | OFF | ON
                          *RST: 1

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Pilot State " on page 82

[:SOURce]:STEReo:PILot[:DEViation] <Deviation>

Sets the deviation of the pilot tone.

Parameters:
<Deviation>   integer
                          Range: 0 to 10 kHz
                          *RST: 6.75 kHz

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Pilot Deviation " on page 82

[:SOURce]:STEReo:PILot:PHASe <Phase>

Sets the phase of the pilot tone in degrees, in relation to the 38 kHz carrier signal of
the receiver. For a correct demodulation, the pilot tone must be in phase with the 38
kHz carrier.

Parameters:
<Phase>   float
                          Range: -5 to 5
                          Increment: 0.1
                          *RST: 0

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Pilot Phase " on page 82

[:SOURce]:STEReo:ARI:STATe <State>

Activates/deactivates the ARI signal generation. ARI signals can be generated simultaneously with MPX and RDS signals.

Parameters:

<State>   0 | 1 | OFF | ON

                         *RST: 0

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " ARI State " on page 83

[:SOURce]:STEReo:ARI[:DEViation] <Deviation>

Sets the frequency deviation of the ARI subcarrier signal.

Parameters:

<Deviation>   integer

                         Range: 0 to 10000
                         *RST: 3500

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " ARI Deviation " on page 83

[:SOURce]:STEReo:ARI:TYPE:STATe <State>

Activates/deactivates the Stereo ARI Identifier. Activating selects the previously selected identifier type.

Parameters:

<State>   0 | 1 | OFF | ON

                         *RST: 0

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " ARI Identification " on page 83

[:SOURce]:STEReo:ARI:TYPE <Type>

Selects the generated identifiers of the ARI signal.

DK and BK are abbreviations of the German words Durchsagekennung and Bereichskennung.

Parameters:

<Type>   OFF | DK | BK | BKDK

                         OFF
                         Only the 57 kHz subcarrier is generated.

                         DK
                         The message identification is generated in addition (low-frequency 30% AM).

BK

The area identification is generated in addition (60% AM). The specific code is selected in `[:SOURce]:STEReo:ARI:BK[:CODE]` on page 392.

BKDK

The area and message identification are generated in addition. The BK code is selected in `[:SOURce]:STEReo:ARI:BK[:CODE]` on page 392.

*RST: OFF

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " ARI Identification " on page 83

[:SOURce]:STEReo:ARI:BK[:CODE] <Code>

Selects the area identification (BK) code of the ARI signal. The code is generated if the BK or DK+BK identifier of the ARI signal is activated.

Parameters:

<Code>   A | B | C | D | E | F

                     The six letters (six different frequencies) identify a specific region in each country.

                     *RST: A

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " ARI BK " on page 83

[:SOURce]:STEReo:RDS:STATe <State>

Activates/deactivates the RDS signal generation. RDS signals can be generated simultaneously with MPX (FM stereo multiplex) and ARI signals.

Parameters:

<State>   0 | 1 | OFF | ON

                     *RST: 0

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " RDS State " on page 84

[:SOURce]:STEReo:RDS[:DEViation] <Deviation>

Sets the deviation of the RDS subcarrier.

Parameters:

<Deviation>   integer

                        Range: 0 to 10 kHz
                        *RST: 2 kHz

Example: See Chapter 12.14.1.6, "SOURce:STEReo Subsystem", on page 386.

Manual operation: See " RDS Deviation " on page 84

[:SOURce]:STEReo:RDS:DATaset <Dataset>

Selects one of the five data sets provided on the instrument for use in the RDS signal.

Parameters:

<Dataset>   DS1 | DS2 | DS3 | DS4 | DS5

                  *RST: DS1

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " RDS Data Set " on page 85

[:SOURce]:STEReo:RDS:TRAFfic:PROGram[:STATe] <State>

Activates the RDS traffic program. The receiver can recognize a frequency as being capable of traffic information only if the TP function is active.

Parameters:

<State>   0 | 1 | OFF | ON

                  *RST: 0

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Traffic Program " on page 85

[:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe] <State>

Activates the RDS traffic announcement.

If TP is on, this function switches the receiver from the current status, e.g. playing a CD, to the receive mode and enables the broadcast of a traffic announcement.

Parameters:

<State>   0 | 1 | OFF | ON

                  *RST: 0

Example: See Example "Activating stereo modulation" on page 386.

Manual operation: See " Traffic Announcement " on page 86

12.14.2 SOURce:CORRection Subsystem

The SOURce:CORRection subsystem contains the commands for defining correction values for external test assemblies.

You can acquire the correction values any time, regardless of the modulation settings of the generator. The correction is performed by adding 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.

Correction values can be stored in files with the predefined file extension `*.uco`.

Refer to Chapter 12.5.2, "Accessing Files in the Default or in a Specified Directory", on page 318 for general information on file handling in the default and in a specific directory.

Programming example

The examples in this section assume that:

- The files are stored in the default directory.
- `*RST` does not affect data lists.

Example: Create a table with user-defined correction values for the RF level

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 new one
// ****************************************************************
*RST; *CLS
SOURce1:CORRection:CSET:CATalog?
// Response: shows the name of available user correction files (if applicable)
// Select a file
SOURce1:CORRection:CSET:SELect "/var/user/ucor1"
// Create a new file (if not existing)
SOURce1:CORRection:CSET:SELect "/var/user/ucor2"

// Enter the frequency/level value pairs in the table;
// existing data is overwritten
// Query the number of frequency/power entries in the selected list
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: Fill user correction data with 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: User correction data exchange

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
```

12.14.2.1 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 "Create a table with user-defined correction values for the RF level" on page 394 .
Manual operation:	See "Edit List Mode Data" on page 142

[: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 "Create a table with user-defined correction values for the RF level" on page 394 .
Manual operation:	See "Edit List Mode Data" on page 142

[: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 "Create a table with user-defined correction values for the RF level" on page 394 .
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 "Fill user correction data with sensor" on page 395.
Usage:	Event
Manual operation:	See " Fill User Correction Data with Sensor" on page 160

[: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 "Create a table with user-defined correction values for the RF level" on page 394 .
Manual operation:	See "UCOR Data" on page 156
	See "Functions for handling of data lists" on page 202

[: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 "Create a table with user-defined correction values
                       for the RF level" on page 394 .

Usage: Query only

Manual operation: See "User Correction" on page 156

[:SOURce<hw>]:CORRection:ZERoing:STATe <State>

Activates the zeroing procedure before filling the user correction data acquired by a
sensor.

Parameters:
<State>   0 | 1 | OFF | ON
                       *RST: 1

Example: See Example "Fill user correction data with sensor"
                       on page 395.

Manual operation: See " Fill User Correction Data with Sensor" on page 160

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

Fills the selected user correction list with the level values measured by the power sen-
sor for the given frequencies.

Suffix:
SENSor<ch>   Defines the used power sensor, i.e. the sensor whose values are
                       used.

Example: See Example "Fill user correction data with sensor"
                       on page 395.

Usage: Event

[:SOURce<hw>]:CORRection[:STATe] <State>

Activates user correction with the currently selected table.

Parameters:
<State>   0 | 1 | OFF | ON
                       *RST: 0

Example: See Example "Create a table with user-defined correction values
                       for the RF level" on page 394 .

Manual operation: See "State" on page 156

[: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 "Create a table with user-defined correction values
                            for the RF level" on page 394 .

Usage: Query only

Manual operation: See "UCOR Data" on page 156
                            See "Directory, File List and Filename" on page 197

[: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 "Create a table with user-defined correction values
                            for the RF level" on page 394 .

Usage: Setting only

Manual operation: See "UCOR Data" on page 156

12.14.2.2 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 cur-
rent or specified directory.

Return values:

<Catalog>   string

                            List of ASCII files *.txt or *.csv, separated by commas.

Example: See Example "Create a table with user-defined correction values
                            for the RF level" on page 394 .

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination"
                            on page 94

[: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 "User correction data exchange" on page 395 .

Manual operation: See "ASCII File Settings" on page 93

[: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 "User correction data exchange" on page 395 .

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination"
                      on page 94

[: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 "User correction data exchange" on page 395 .

Manual operation: See "ASCII File Settings" on page 93

[: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 "User correction data exchange" on page 395 .

Manual operation: See "ASCII File Settings" on page 93

[: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 "User correction data exchange" on page 395 .

Usage: Event

Manual operation: See "Import / Export" on page 94

[: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 "User correction data exchange" on page 395 .

Manual operation: See " Mode " on page 93

[: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 "User correction data exchange" on page 395 .

Manual operation: See "Select Source/Select ASCII Destination" on page 94

12.14.3 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:MODE CW
SOURce1:FREQuency:CW 6000000000
SOURce1:FREQuency:OFFSet 2000000000
SOURce1:FREQuency:MULTiplier 1.5
SOURce1:FREQuency:CW?
// 11000000000

// SOURce1:FREQuency:STEP:MODE USER
// SOURce1:FREQuency:STEP:INCRement 1000000
// SOURce1:FREQuency:CW UP

SOURce1:PHASe 2
SOURce1:PHASe:REFerence
```

[:SOURce<hw>]:FREQuency:MODE <Mode>

Sets the frequency mode for generating the RF output signal. The selected mode determines the parameters to be used for further frequency settings.

Parameters:

<Mode>   CW | FIXed | SWEep | LIST

                  CW|FIXed
                  Sets the fixed frequency mode. CW and FIXed are synonyms.
                  The instrument operates at a defined frequency, set with command [:SOURce<hw>]:FREQuency[:CW|FIXed].

                  SWEep
                  Sets sweep mode.
                  The instrument processes frequency (and level) settings in defined sweep steps.
                  Set the range and current frequency with the commands:
                  [:SOURce<hw>]:FREQuency:STARt on page 406 and [:SOURce<hw>]:FREQuency:STOP on page 406,
                  [:SOURce<hw>]:FREQuency:CENTer on page 405,
                  [:SOURce<hw>]:FREQuency:SPAN on page 405,
                  [:SOURce<hw>]:FREQuency:MANual on page 404

                  LIST
                  Sets list mode.
                  The instrument processes frequency and level settings by means of values loaded from a list.
                  To configure list mode settings, use the commands of the Chapter 12.14.6, "SOURce:LIST Subsystem", on page 421.

                  *RST: CW

Example: See Example "Frequency configuration" on page 401

Example: See Example "Setup an RF frequency or power sweep" on page 453

Manual operation: See "State (RF frequency sweep)" on page 127
                  See " State " on page 136

[:SOURce<hw>]:FREQuency[:CW|FIXed] <Fixed>

Sets the frequency of the RF output signal in the selected path.

The effect depends on the selected mode:

- In CW mode (`FREQ:MODE CW | FIXed`), the instrument operates at a fixed frequency.
- In sweep mode (`FREQ:MODE SWE`), the value applies to the sweep frequency. The instrument processes the frequency settings in defined sweep steps.
- In user mode (`FREQ:STEP:MODE USER`), you can vary the current frequency step by step.

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: 100 MHz

Example: See Example "Frequency configuration" on page 401

Example: See Example "Setup an RF frequency or power sweep" on page 453

Options: RFmax depends on the installed options, for example 3 GHz with R&S SMBB-B103

Manual operation: See "Frequency" on page 61

[: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 198

[:SOURce<hw>]:FREQuency:MANual <Manual>

Sets the frequency and triggers a sweep step manually if `SWEep:MODE MAN`.

Parameters:

<Manual>	float
	You can select any frequency within the setting range, where:
	`STARt` is set with `[:SOURce<hw>]:FREQuency:STARt`
	`STOP` is set with `[:SOURce<hw>]:FREQuency:STOP`
	`OFFSet` is set with `[:SOURce<hw>]:FREQuency:OFFSet`
	Range: (STARt + OFFSet) to (STOP + OFFSet)
	Increment: 0.01Hz
	*RST: 100 MHz
	Default unit: Hz
Example:	See Example "Setup an RF frequency or power sweep" on page 453
Manual operation:	See " Current Frequency" on page 127

[:SOURce<hw>]:FREQuency:MULTiplier <Multiplier>

Sets the multiplication factor $N_{FREQ:MULT}$ of a subsequent downstream instrument.

The parameters offset $f_{FREQ:OFFSer}$ and multiplier $N_{FREQ:MULT}$ affect the frequency value set with the command `FREQ`.

The query `FREQ?` returns the value corresponding to the formula:

$f_{FREQ} = f_{RFout} * N_{FREQ:MULT} + f_{FREQ:OFFSer}$

See "RF frequency and level display with a downstream instrument" on page 59.

Parameters:

<Multiplier>	float
	Range: -10000 to 10000
	Increment: 0.001
	*RST: 1
Example:	See Example "Frequency configuration" on page 401
Manual operation:	See "Multiplier" on page 61

[:SOURce<hw>]:FREQuency:OFFSet <Offset>

Sets the frequency offset $f_{FREQ:OFFSet}$ of a downstream instrument.

The parameters offset $f_{FREQ:OFFSer}$ and multiplier $N_{FREQ:MULT}$ affect the frequency value set with the command `FREQ`.

The query `FREQ?` returns the value corresponding to the formula:

$f_{FREQ} = f_{RFout} * N_{FREQ:MULT} + f_{FREQ:OFFSer}$

See "RF frequency and level display with a downstream instrument" on page 59.

Note: The offset also affects RF frequency sweep.

Parameters:

<Offset>	float
	Increment: 0.01
	*RST: 0

Example: See Example "Frequency configuration" on page 401

Manual operation: See "Offset" on page 61

[:SOURce<hw>]:FREQuency:CENTer <Center>

Sets the center frequency of the sweep.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Parameters:

<Center>	float
	Range: 300 kHz to RFmax
	Increment: 0.01 Hz
	*RST: 300E6
	Default unit: Hz

Example: See Example "Setup an RF frequency or power sweep" on page 453

Manual operation: See " Center Frequency " on page 131

[:SOURce<hw>]:FREQuency:SPAN <Span>

Sets the sapn of the frequency sweep range.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Parameters:

<Span>	float
	Full freqeuncy range
	Increment: 0.01
	*RST: 400E6

Example: See Example "Setup an RF frequency or power sweep" on page 453

Manual operation: See "Span" on page 131

[:SOURce<hw>]:FREQuency:STARt <Start>

Sets the start frequency for the RF sweep.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Parameters:

<Start>	float
	Range:　　　300kHz to RFmax
	Increment:　0.01Hz
	*RST:　　　　100 MHz

Example:	See Example "Setup an RF frequency or power sweep" on page 453
Manual operation:	See " Start Frequency/Stop Frequency " on page 131

[:SOURce<hw>]:FREQuency:STOP <Stop>

Sets the stop frequency range for the RF sweep.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Parameters:

<Stop>	float
	Range:　　　300kHz to RFmax
	Increment:　0.01Hz
	*RST:　　　　500 MHz
	Default unit: Hz

Example:	See Example "Setup an RF frequency or power sweep" on page 453
Manual operation:	See " Start Frequency/Stop Frequency " on page 131

[: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.
	USER
	Increases or decreases the level in increments, set with the command FREQ:STEP[:INCR].
	*RST:　　　　DECimal

Example:	// increasing the RF frequency with a step size of 50 KHz
	SOURce1:FREQuency:STEP 50E3
	SOURce1:FREQuency:STEP:MODE USER
	SOURce1:FREQuency:CW UP

Manual operation: See "Variation Active" on page 62

[: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`, if you have activated `FREQ:STEP:MODE USER`.

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 401

Manual operation: See "Variation Step" on page 62

12.14.4 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).

[:SOURce<hw>]:INPut:MODext:COUPling <Coupling>

Selects the coupling mode for an externally applied modulation signal.

Parameters:

<Coupling>   AC | DC

AC
Passes the AC signal component of the modulation signal.

DC
Passes the modulation signal with both components, AC and DC.

*RST: AC

Example: `SOURce1:INPut:MODext:COUPling AC`

`SOURce1:INPut:MODext:IMPedance G50`

Manual operation: See "Coupling (AC/DC)" on page 101

[:SOURce<hw>]:INPut:MODext:IMPedance<ch> <Impedance>

Sets the impedance for the externally supplied modulation signal.

Parameters:

<Impedance>   G50 | G600 | HIGH

                           G50 = 50 Ohm to ground
                           G600 = 600 Ohm to ground
                           HIGH = 100 kOhm to ground

                           *RST: HIGH

Example: See [:SOURce<hw>]:INPut:MODext:COUPling
                           on page 407.

Manual operation: See "Impedance" on page 101

[:SOURce]:INPut:TRIGger:SLOPe <Slope>

Sets the polarity of the active slope of an applied instrument trigger.

Parameters:

<Slope>   NEGative | POSitive

                           *RST: POSitive

Example: INP:TRIG:SLOP NEG
                           Activates the falling slope of the external trigger signal at the
                           trigger input.

Manual operation: See "Trigger Slope" on page 130

12.14.5 SOURce:LFOutput Subsystem

The SOURce:LFOutput subsystem contains the commands for setting the LF signal
source in CW and Sweep mode and for analog modulation.

Example: Setup an LF sweep

The following example shows a command sequence to set up an LF sweep.

```
// Reset the instrument to start from an initial state
*RST; *CLS

// Set the trigger mode, the sweep mode and the sweep range
TRIGger1:LFFSweep:SOURce SINGle
SOURce1:LFOutput1:SWEep:FREQuency:MODE AUTO
SOURce1:LFOutput1:FREQuency:STARt 1 kHz
SOURce1:LFOutput1:FREQuency:STOP 7 kHz

// Select linear spacing
// Select the waveform shape for the frequency sweep cycle
// Set the step width and the dwell time.
```

```
SOURce1:LFOutput1:SWEep:FREQuency:SPACing LINear
SOURce1:LFOutput1:SWEep:FREQuency:SHAPe SAWtooth
SOURce1:LFOutput1:SWEep:FREQuency:STEP:LINear 100 Hz
SOURce1:LFOutput1:SWEep:FREQuency:DWELl 150 ms
// Alternatively to the step width set the number of steps
SOURce1:LFOutput1:SWEep:FREQuency:POINts 61

// Activate change to start frequency while waiting for next trigger
// Prerequisites: sweep mode single and sweep waveform sawtooth
SOURce1:LFOutput:SWEep:FREQuency:RETRace 1

// Activate the LF frequency sweep
SOURce1:LFOutput:FREQuency:MODE SWE

// Trigger the sweep(depending on the set mode) and query the status
// Perform a one-off LF sweep
SOURce1:LFOutput1:SWEep:FREQuency:EXECute
SOURce1:LFOutput1:SWEep:FREQuency:RUNNing?
// 1
// the sweep is running

// **************************************************
// For manual step LF sweep use the following commands
*RST; *CLS
SOURce1:LFOutput:SWEep:FREQuency:MODE MANual
// Activate the LF frequency sweep
SOURce1:LFOutput:FREQuency:MODE SWEep
// Activate LF Output1.
SOURce1:LFOutput1:STATe 1
// Input the frequency manually for each step
SOURce1:LFOutput1:FREQuency:MANual 2 kHz
SOURce1:LFOutput1:FREQuency:MANual 2.1 kHz
// Alternatively use UP or DOWN parameter with set step width.
SOURce1:LFOutput1:SWEep:FREQuency:STEP:LINear 500 Hz
SOURce1:LFOutput1:FREQuency:MANual UP
```

Example: Configuring the LF generator

The following is a simple example on how to configure the LF generator and output the generated signal.

```
// configure the signal of the LF1 generator
SOURce1:LFOutput1:SHAPe SQU
SOURce1:LFOutput1:SHAPe:PULSe:PERiod 0.001
SOURce1:LFOutput1:SHAPe:PULSe:WIDTh 0.0005
SOURce1:LFOutput1:SHAPe:PULSe:DCYCle 0.5
// configure the signal of the LF1 generator
SOURce1:LFOutput2:SHAPe SINE
SOURce1:LFOutput2:FREQuency 1000000
SOURce1:LFOutput2:PERiod?
// 0.000001
```

```
// changing the LF signal shape
// SOURce1:LFOutput2:SHAPe TRAP
// SOURce1:LFOutput2:SHAPe:PULSe:PERiod 0.2
// SOURce1:LFOutput2:SHAPe:TRAPeze:RISE 0.0001
// SOURce1:LFOutput2:SHAPe:TRAPeze:FALL 0.001
// SOURce1:LFOutput2:SHAPe:TRAPeze:FALL 0.0001
// SOURce1:LFOutput2:SHAPe:TRAPeze:HIGH 0.0005
// SOURce1:LFOutput2:SHAPe TRI
// SOURce1:LFOutput2:SHAPe:PULSe:PERiod 0.1
// SOURce1:LFOutput2:SHAPe:TRIangle:RISE 0.0001


// activate the LF output and select the LF1 as signal source
// configure the LF output signal
SOURce1:LFOutput1:FREQuency:MODE CW
SOURce1:LFOutput1:STATe 1
SOURce1:LFOutput1:SOURce LF1
SOURce1:LFOutput1:INTernal:VOLTage 1
SOURce1:LFOutput1:OFFSet 0.001
```

12.14.5.1 LF Generator Settings

With the commands described in this section, you can configure the LF signal source.

[:SOURce]:LFOutput<ch>:BANDwidth?

Queries the bandwidth of the external LF signal.

Return values:

<Bandwidth>	BW0M2	BW10m
	*RST: BW10m

Example:
```
LFO:BAND?
// BW10m
// the bandwidth of the externally supplied LF signal is 10 MHz
```

Usage: Query only

Manual operation: See "Bandwidth" on page 101

[:SOURce]:LFOutput<ch>:FREQuency <Frequency>

Sets the frequency of the LF signal in `[:SOURce<hw>]:LFOutput:FREQuency:MODE CW|FIXed` mode.

Note

- If signal source "Internal" is set, the instrument performs the analog modulations (AM/FM/PhiM/PM) with this frequency.
- In sweep mode (`[:SOURce<hw>]:LFOutput:FREQuency:MODE SWE`), the frequency is coupled with the sweep frequency.

Parameters:

<Frequency>	float
	Range: depends on the installed options
	*RST: 1000
	Default unit: Hz

Example:
```
SOURce1:LFOutput1:FREQuency 5 kHz
// sets the LF frequency
```

Manual operation: See " LF Gen Frequency " on page 80
See "Frequency" on page 99

[:SOURce<hw>]:LFOutput<ch>:PERiod?

Queries the repetition frequency of the sine signal.

Return values:

<LfSinePeriod>	float
	Range: 1E-6 to 100
	Increment: 10E-9
	*RST: 0.001
	Default unit: s

Example:	See Example "Configuring the LF generator" on page 409.
Usage:	Query only

[:SOURce<hw>]:LFOutput:FREQuency:MANual <Manual>

Sets the frequency of the subsequent sweep step if `LFO:SWE:MODE MAN`.

Use a separate command for each sweep step.

Parameters:

<Manual>	float
	You can select any value within the setting range, where:
	STARt is set with `[:SOURce<hw>]:LFOutput:FREQuency:STARt`
	STOP is set with `[:SOURce<hw>]:LFOutput:FREQuency:STOP`
	Range: STARt to STOP
	Increment: 0.1
	*RST: 1000

Example:	See Example "Setup an LF sweep" on page 408.
Manual operation:	See " Current Frequency" on page 127

[:SOURce<hw>]:LFOutput:FREQuency:MODE <Mode>

Sets the mode for the output of the LF generator frequency, and determines the commands to be used for frequency settings.

Parameters:

<Mode>	CW | FIXed | SWEep
	CW|FIXed
	Sets the fixed-frequency mode. CW and FIXed are synonyms. To set the output frequency, use command `[:SOURce]:LFOutput<ch>:FREQuency`
	SWEep
	Sets sweep mode.
	To set the frequency, use the commands:
	`[:SOURce<hw>]:LFOutput:FREQuency:STARt` and `[:SOURce<hw>]:LFOutput:FREQuency:STOP`
	Or `[:SOURce<hw>]:LFOutput:FREQuency:MANual`
	*RST: CW

Example: See Example "Setup an LF sweep" on page 408.

Manual operation: See "State (LF frequency sweep)" on page 98

[:SOURce<hw>]:LFOutput:FREQuency:STOP <Stop>
[:SOURce<hw>]:LFOutput:FREQuency:STARt <Start>

Sets the start/stop frequency for `[:SOURce<hw>]:LFOutput:FREQuency:MODE SWEep`.

Parameters:

<Start>   float

Range: 0.1 Hz to 1 MHz
Increment: 0.1
*RST: 1 KHz

<Stop>   float

Range: 0.1 Hz to 1 MHz
Increment: 0.1 Hz
*RST: 100 KHz

Example: See Example "Setup an LF sweep" on page 408.

Manual operation: See " Start Frequency/Stop Frequency " on page 131

[:SOURce]:LFOutput<ch>[:STATe] <State>

Activates LF signal output.

Parameters:

<State>   0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "State" on page 103

[:SOURce]:LFOutput<ch>:INTernal:VOLTage <Voltage>

Sets the output voltage for the LF generators.

The sum of both values must not exceed the overall output voltage, set with command `[:SOURce]:LFOutput:VOLTage`.

Suffix:

<ch>   [1]|2
              LF1 and LF2

Parameters:

<Voltage>   float

Range: 0 to 4
Increment: 0.001
*RST: 1

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Output Voltage" on page 104

[:SOURce]:LFOutput:OFFSet <Offset>

Sets a DC offset at the LF Output.

Parameters:

<Offset>   float

           Range: depends on lfo voltage
           Increment: 0.001
           *RST: 0

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "DC-Offset" on page 104

[:SOURce]:LFOutput<ch>:SOURce <Source>

Determines the LF signal to be synchronized, when monitoring is enabled.

Parameters:

<Source>   LF1 | LF2 | NOISe | AM | FMPM | EXT1

           LF1|LF2
           Selects an internally generated LF signal.

           NOISe
           Selects an internally generated noise signal.

           EXT1
           Selects an externally supplied LF signal

           AM
           Selects the AM signal.

           FMPM
           Selects the signal also used by the frequency or phase modulations.
           *RST: LF1

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Source" on page 104

[:SOURce]:LFOutput:SIMPedance <SImpedance>

Selects the impedance of the LF output.

Parameters:

<SImpedance>   G600 | G50

           *RST: G50

Example: `SOURce:LFOutput:SIMPedance G600`
                        Sets the output impedance of the LF generator to 600 Ohm.

Manual operation: See "Source Impedance" on page 104

[:SOURce]:LFOutput<ch>:SOURce:PATH <SourPath>

Determines the path of the LF output source.

Parameters:

<SourPath>   A | B

                            *RST: A

Example: `LFO:SOUR:PATH?`

                       Queries the currently set path for the LF output signal source.

[:SOURce]:LFOutput:VOLTage <Voltage>

Sets the voltage of the LF output.

Parameters:

<Voltage>   float

                            Range: dynamic (see data sheet)
                            Increment: 0.001
                            *RST: 1

Example: `SOURce:LFOutput:VOLTage 1.5`

[:SOURce<hw>]:LFOutput<ch>:SHAPe <Shape>

Selects the waveform shape of the LF signal.

Parameters:

<Shape>   SINE | SQUare | TRIangle | TRAPeze

                            *RST: SINE

Example: See Example "Configuring the LF generator" on page 409.

Options: TRIangle|TRAPeze require R&S SMBB-K24

Manual operation: See " LF Gen Shape " on page 80
                            See "Shape" on page 98

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:DCYCle <DCycle>

Sets the duty cycle for the shape pulse.

Parameters:

<DCycle>   float

                            Range: 1E-6 to 100
                            Increment: 1E-6
                            *RST: 50
                            Default unit: PCT

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Pulse Duty Cycle" on page 100

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:PERiod <Period>

Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period>	float

       Range: 1E-6 to 100
       Increment: 1E-8
       *RST: 1E-3

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Period" on page 100

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:WIDTh <Width>

Sets the pulse width of the generated pulse.

Parameters:

<Width>	float

       Range: 1E-6 to 100
       Increment: 1E-8
       *RST: 5E-4

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Pulse Width" on page 100

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL <Fall>

Selects the fall time for the trapezoid shape of the LF generator.

Parameters:

<Fall>	float

       Range: 1E-6 to 100
       Increment: 10E-9
       *RST: 250E-6

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Trapezoid Rise / Fall" on page 100

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH <High>

Sets the high time for the trapezoid signal of the LF generator.

Parameters:

<High>   float

	Range:	1E-6 to 100
	Increment:	10E-9
	*RST:	250E-6

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Trapezoid High" on page 100

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:PERiod <Period>

Sets the period of the generated trapezoid shape. The period determines the repetition frequency of the internal signal.

Parameters:

<Period>   float

	Range:	1E-6 to 100
	Increment:	1E-8
	*RST:	1E-3

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Period" on page 100

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:RISE <Rise>

Selects the rise time for the trapezoid shape of the LF generator.

Parameters:

<Rise>   float

	Range:	1E-6 to 100
	Increment:	10E-9
	*RST:	250E-6

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Trapezoid Rise / Fall" on page 100

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:PERiod <Period>

Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period>   float

	Range:	1E-6 to 100
	Increment:	10E-9
	*RST:	0.001

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Period" on page 100

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:RISE <Rise>

Selects the rise time for the triangle single of the LF generator.

Parameters:

<Rise>	float
	Range: 1E-6 to 100
	Increment: 10E-9
	*RST: 0.5E-3

Example: See Example "Configuring the LF generator" on page 409.

Manual operation: See "Triangle Rise" on page 100

12.14.5.2 LF Sweep Settings

With the commands described in this section, you can configure the sweep of the LF signal.

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl <Dwell>

Sets the dwell time for each frequency step of the sweep.

Parameters:

<Dwell>	float
	Range: 0.001 to 100
	Increment: 100E-6
	*RST: 0.01
	Default unit: s

Example: See Example "Setup an LF sweep" on page 408.

Manual operation: See " Dwell Time " on page 130

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute

Immediately starts an LF sweep.

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE determines which sweep is executed, e.g. SOURce:LFOutput:SWEep:FREQuency:MODE STEP.

Example: See Example "Setup an LF sweep" on page 408.

Usage:	Event
Manual operation:	See " Execute Single Sweep " on page 130

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE <Mode>

Sets the cycle mode of the LF sweep.

Parameters:

<Mode>	AUTO | MANual | STEP

                             AUTO
Performs a complete sweep cycle from the start to the end value when a trigger event occurs.
The dwell time determines the time period until the signal switches to the next step.

                             MANual
Performs a single sweep step when a manual trigger event occurs.
The trigger system is not active. To trigger each frequency step of the sweep individually, use the command `[:SOURce<hw>]:LFOutput:FREQuency:MANual` on page 412.

                             STEP
Each trigger command triggers one sweep step only.
The frequency increases by the value set with the coammnds:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear]` (linear spacing)
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic`(logarithmic spacing)

                             *RST: AUTO

Example:	See Example "Setup an LF sweep" on page 408.
Manual operation:	See "Mode" on page 127

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:POINts <Points>

Sets the number of steps in an LF sweep.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120

Parameters:

<Points>	integer	
	Range:	2 to POINts
	*RST:	50

Example:	See Example "Setup an LF sweep" on page 408.

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace <State>

Activates that the signal changes to the start frequency value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single".

Parameters:

<State>   0 | 1 | OFF | ON

                          *RST: 0

Manual operation: See "Retrace" on page 128

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RUNNing?

Queries the current status of the LF frequency sweep mode.

Return values:

<State>   0 | 1 | OFF | ON

Example: See Example "Setup an LF sweep" on page 408.

Usage: Query only

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe <Shape>

Sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape>   SAWTooth | TRIangle

                          *RST: SAWTooth

Example: See Example "Setup an LF sweep" on page 408.

Manual operation: See " Shape" on page 128

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing <Spacing>

Selects linear or logarithmic sweep spacing.

Parameters:

<Spacing>   LINear | LOGarithmic

                          *RST: LINear

Example: See Example "Setup an LF sweep" on page 408.

Manual operation: See " Spacing" on page 130

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic
<Logarithmic>

Sets the step width factor for logarithmic sweeps to calculate the frequencies of the steps.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120

Parameters:

<Logarithmic>	float
	The unit is mandatory
	Range: 0.01 to 100
	Increment: 0.01
	*RST: 1
	Default unit: PCT

Example:	See Example "Setup an LF sweep" on page 408.
Manual operation:	See " Step Linear/Step Logarithmic " on page 132

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step width for the linear sweep.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120

Parameters:

<Linear>	float
	Range: 0.1 to STOP-STARt
	Increment: 0.1
	*RST: 1000

Example:	See Example "Setup an LF sweep" on page 408.
Manual operation:	See " Step Linear/Step Logarithmic " on page 132

12.14.6 SOURce:LIST Subsystem

The SOURce:LIST subsystem contains all commands for defining lists and for handling of list files.

List files have the predefined file extension *.lsw.

Refer to Chapter 12.5.2, "Accessing Files in the Default or in a Specified Directory", on page 318 for general information on file handling in the default and in a specific directory.

- *RST does not affect data lists.
- SCPI refers to the individual lists as segments.

Example: Create an RF list and activate the list mode

The following example shows a command sequence to create an RF list and to acti-
vate the list mode. Further hardware settings are not considered.

```
// Reset the instrument to start from an initial state
// Query the available list files in the default
// directory /var/user
// Select the list file or create it (if not existing)
*RST; *CLS
SOUR1:LIST:CAT?
// Response:- shows the name of available list files (if applicable)
SOUR1:LIST:SEL "/var/user/list1.lsw"

// Write the frequency/level/dwell time values in the selected list file
// existing data is overwritten
// Query the number of frequency/power/dwell time entries in the selected list
// Query the amount of free memory (in bytes) for list mode lists
SOUR1:LIST:FREQ 58 MHz, 61 MHz, 73 MHz, 86 MHz, 91 MHz, 92 MHz, 98 MHz
SOUR1:LIST:POW 13 dBm, 12 dBm, 5 dBm, 3 dBm, 0 dBm, 4 dBm, 6 dBm
SOUR1:LIST:DWEL:LIST 10000, 100000, 200000, 19000, 10000, 150000, 220000
SOUR1:LIST:FREQ:POIN?
// 7
SOUR1:LIST:POW:POINT?
// 7
SOUR1:LIST:DWEL:LIST:POIN?
// 7
SOUR1:LIST:FREE?
// 2147483647 (bytes of free memory)

// Use dwell times from list
// Configure the list mode parameters
// Enable RF output
SOUR1:LIST:MODE AUTO
SOUR1:LIST:TRIG:SOUR AUTO
SOUR1:LIST:DWEL:MODE "LIST"

OUTP1:STAT ON

// Use global dwell time
// Set only a part of the list (value pairs 3 to 5) to be processed
// Configure the list mode parameters using global dwell time
// Enable RF output
SOUR1:LIST:IND:START 2
SOUR1:LIST:IND:STOP 4
SOUR1:LIST:MODE AUTO
SOUR1:LIST:TRIG:SOUR AUTO
SOUR1:LIST:DWEL:LIST 500 ms
OUTP1:STAT ON

// Enable the list mode
// Trigger the list (depending on the mode, not needed with trigger
```

```
// mode AUTO); query the current index
// Reset the list to the starting point
SOUR1:FREQ:MODE LIST
SOUR1:LIST:TRIG:EXEC
SOUR1:LIST:RUNN?
SOUR1:LIST:IND?
// 3
// value changes when the value is queried again
SOUR1:LIST:RES


// For list mode STEP use the following commands
*RST; *CLS
// Change list mode to STEP
SOUR1:LIST:MODE STEP
// Activate RF Output1
OUTP1:STAT 1
// Activate the list mode
SOUR1:FREQ:MODE LIST
// For each step: select frequency/powerlevel pair as index from the list
SOUR1:LIST:IND 2
SOUR1:LIST:IND 3
SOUR1:LIST:IND 4


// Use the selected list for path B (with List Mode B default settings)
SOUR2:LIST:SEL "/var/user/list1.lsw"
OUTP2:STAT ON
SOUR2:FREQ:MODE LIST
SOUR2:LIST:IND?
// 2
// value canges when the value is queried again


// Deactivate the list mode
SOUR1:FREQ:MODE CW
```

Example: List mode data exchange

The following example shows a command sequence to export a list (here the RF list created with the example before) into an ASCII file. Further hardware settings are not considered.

```
*RST; *CLS
LIST:DEXC:MODE EXP


// Set ASCII data parameters
// Set the ASCII file extension, the decimal separator
// and the column separator for the ASCII data
SOUR1:LIST:DEXC:AFIL:EXT CSV
SOUR1:LIST:DEXC:AFIL:SEP:DEC DOT
SOUR1:LIST:DEXC:AFIL:SEP:COL COMM


// Select source and destination path/directory
```

```
// Query available listfiles in default directory "/var/user"
SOUR1:LIST:CAT?
// list1
SOUR1:LIST:DEXC:AFIL:SEL "/var/user/list1ASCII"
SOUR1:LIST:DEXC:SEL "/var/user/list1"

// Export the list file data into the ASCII file
SOUR1:LIST:DEXC:EXEC

// Query the available ASCII files with extension .csv
SOUR1:LIST:DEXC:AFIL:CAT?
// Response: "list1ASCII"

// Deactivate the list mode
SOUR1:FREQ:MODE CW
```

12.14.6.1 List Mode Settings

With the following commands, you can create list mode data, select the trigger mode and determine the dwell time.

[:SOURce<hw>]:LIST:DWELl <Dwell>

Sets the global dwell time. The instrument generates the signal with the frequency / power value pairs of each list entry for that particular period.

See also Significant Parameters and Functions.

Parameters:

<Dwell>   float

                           Range: 1E-3 to 100
                           Increment: 1E-6
                           *RST: 0.01

Example: See Example "Create an RF list and activate the list mode"
                           on page 422.

Manual operation: See "Global Dwell Time" on page 137

[:SOURce<hw>]:LIST:DWELl:MODE <DwelMode>

Selects the dwell time mode.

Parameters:

<DwelMode>   LIST | GLOBal

                           LIST
                           Uses the dwell time, specified in the data table for each value
                           pair individually.

                           GLOBal
                           Uses a constant dwell time, set with command `[:
                           SOURce<hw>]:LIST:DWELl`.

                           *RST: GLOBal

Example: See Example "Create an RF list and activate the list mode"
                           on page 422.

Manual operation: See "Dwell Time Mode" on page 136

[:SOURce<hw>]:LIST:DWELl:LIST <Dwell>

Enters the dwell time values in the selected list in µs.

Parameters:

<Dwell>   <Dwell#1>{, <Dwell#2>, ...} | block data

                           You can either enter the data as a list of numbers, or as binary
                           block data. The list of numbers can be of any length, with the list
                           entries separated by commas.
                           In binary block format, 8 (4) bytes are always interpreted as a
                           floating-point number with double accuracy. See also `:
                           FORMat[:DATA]` on page 338 for more details.

Example: See Example "Create an RF list and activate the list mode"
                           on page 422.

Manual operation: See "Edit List Mode Data" on page 142

[:SOURce<hw>]:LIST:DWELl:LIST:POINts?

Queries the number (points) of dwell time entries in the selected list.

Return values:

<Points>   integer

                            Range: 0 to INT_MAX
                            *RST: 0

Example: See Example "Create an RF list and activate the list mode"
                            on page 422.

Usage: Query only

[:SOURce<hw>]:LIST:FREQuency <Frequency>

Enters the frequency values in the selected list.

Parameters:

<Frequency>   <Frequency#1>{, <Frequency#2>, ...} | block data

                            You can either enter the data as a list of numbers, or as binary
                            block data.
                            The list of numbers can be of any length, with the list entries
                            separated by commas.
                            In binary block format, 8 (4) bytes are always interpreted as a
                            floating-point number with double accuracy.
                            See also :FORMat[:DATA].

                            Range: 300 kHz to RFmax (depends on the installed
                                          options)

Example: See Example "Create an RF list and activate the list mode"
                            on page 422.

Manual operation: See "Edit List Mode Data" on page 142

[:SOURce<hw>]:LIST:FREQuency:POINts?

Queries the number (points) of frequency entries in the seleced list.

Return values:

<Points>   integer

                            Range: 0 to INT_MAX
                            *RST: 0

Example: See Example "Create an RF list and activate the list mode"
                            on page 422.

Usage: Query only

[:SOURce<hw>]:LIST:INDex <Index>

Sets the list index in LIST:MODE STEP.

After the trigger signal, the instrument processes the frequency and level settings of
the selected index.

Parameters:

<Index>   integer

                       *RST: 0

Example: See Example "Create an RF list and activate the list mode"
                       on page 422.

Manual operation: See " Current Index " on page 136

[:SOURce<hw>]:LIST:INDex:STARt <Start>
[:SOURce<hw>]:LIST:INDex:STOP <Stop>

Sets the start and stop index of the index range which defines a subgroup of fre-
quency/level value pairs in the current list.

Parameters:

<Start>/<Stop>   integer

                       Index range
                       Only values inside this range are processed in list mode

                       Range: 0 to list length
                       *RST: 0

Example: See Example "Create an RF list and activate the list mode"
                       on page 422.

Manual operation: See " List Range from/to " on page 138

[:SOURce<hw>]:LIST:MODE <Mode>

Sets the list mode.

The instrument processes the list according to the selected mode and trigger source,
see `LIST:TRIG:SOUR AUTO, SING or EXT`.

Parameters:

<Mode>   AUTO | STEP

                       AUTO
                       Each trigger event triggers a complete list cycle.

                       STEP
                       Each trigger event triggers only one step in the list processing
                       cycle. The list is processed in ascending order.
                       In this mode, you can select between `LIST:TRIG:SOUR SING`
                       `or EXT`.

                       *RST: AUTO

Example: See Example "Create an RF list and activate the list mode"
                       on page 422.

Manual operation: See "Mode" on page 136

[:SOURce<hw>]:LIST:POWer <Power>

Enters the level values in the selected list. The number of level values must correspond to the number of frequency values. Existing data is overwritten.

Parameters:

<Power> <Power#1>{, <Power#2>, ...} | block data

You can either enter the data as a list of numbers, or as binary block data.

The list of numbers can be of any length, with the list entries separated by commas.

In binary block format, 8 (4) bytes are always interpreted as a floating-point number with double accuracy.

See also `:FORMat[:DATA]`.

Range: depends on the installed options
Default unit: dBm

Example: See Example "Create an RF list and activate the list mode" on page 422.

Manual operation: See "Edit List Mode Data" on page 142

[:SOURce<hw>]:LIST:POWer:POINts?

Queries the number (points) of level entries in the selected list.

Return values:

<Points> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 422.

Usage: Query only

[:SOURce<hw>]:LIST:TRIGger:EXECute

Starts the processing of a list in list mode.

Example: See Example "Create an RF list and activate the list mode" on page 422.

Usage: Event

Manual operation: See " Execute Single" on page 137

[:SOURce<hw>]:LIST:TRIGger:SOURce <Source>

Selects the trigger source for processing lists.

The names of the parameters correspond to those in sweep mode. SCPI standard uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration. For an overview, see the following table:

Rohde & Schwarz name	SCPI name	Command in manual control
AUTO	IMMediate	`MODE AUTO`
SINGle	BUS	`MODE SINGLE` or `STEP`
EXTernal	EXTernal	`MODE EXT TRIG SINGLE` or `EXT TRIG STEP`

Parameters:

<Source>   SINGle | BUS | AUTO | EXTernal | IMMediate

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. The selected list is restarted as soon as it is finished.

SINGle|BUS
The list is triggered by the command `[:SOURce<hw>]:LIST:TRIGger:EXECute`. The list is executed once.

EXTernal
The list is triggered externally and executed once.

*RST: AUTO

Example: See Example "Create an RF list and activate the list mode" on page 422.

Manual operation: See "Mode" on page 136

[:SOURce<hw>]:LIST:RUNNing?

Queries the current state of the list mode.

Return values:

<State>   0 | 1 | OFF | ON

1
Signal generation based on the list mode is active.

Example: See Example "Create an RF list and activate the list mode" on page 422.

Usage: Query only

12.14.6.2 List Mode File Operation

The following section covers basic commands to file handling in list mode.

[:SOURce<hw>]:LIST:CATalog?

Queries the available list files in the specified directory.

Return values:

<Catalog>   string

                           List of list filenames, separated by commas

Example: See Example "Create an RF list and activate the list mode"
                          on page 422.

Usage: Query only

Manual operation: See " List Mode Data " on page 138

[:SOURce<hw>]:LIST:DELete <Filename>

Deletes the specified list.

Setting parameters:

<Filename>   string

                           Filename or complete file path; file extension is optional.

Example: See [:SOURce<hw>]:LIST:DELete:ALL on page 430.

Usage: Setting only

Manual operation: See " List Mode Data " on page 138

[:SOURce<hw>]:LIST:DELete:ALL

Deletes all lists in the set directory.

This command can only be executed, if:

- No list file is selected.
- List mode is disabled.

Example: SOUR1:LIST:CAT?
// list,my_list
SOUR1:LIST:DEL "/var/user/list1"
SOUR1:LIST:CAT?
// my_list
SOUR1:FREQ:MODE?
// LIST
SOUR1:LIST:SEL?
// /var/user/my_list.lsw
//deactivate list mode
SOUR1:FREQ:MODE CW
SOUR1:LIST:DELete:ALL
SOUR1:LIST:CAT?
// -
// all list files are deleted

Usage: Event

Manual operation: See " List Mode Data " on page 138

[:SOURce<hw>]:LIST:FREE?

Queries the amount of free memory (in bytes) for list mode lists.

Return values:

<Free>   integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 422.

Usage: Query only

[:SOURce<hw>]:LIST:RESet

Jumps to the beginning of the list.

Example: See Example "Create an RF list and activate the list mode" on page 422.

Usage: Event

Manual operation: See " Reset " on page 137

[:SOURce<hw>]:LIST:SELect <Filename>

Selects or creates a data list in list mode.

If the list with the selected name does not exist, a new list is created.

Parameters:

<Filename>

string

Filename or complete file path; file extension can be omitted.

Example: See Example "Create an RF list and activate the list mode" on page 422.

Manual operation: See " List Mode Data " on page 138
See "Functions for handling of data lists" on page 202

12.14.6.3 List Mode Data Exchange

With the following commands, you can configure lists in ASCII format and export or import them accordingly.

[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog?

Queries the available ASCII files for export or import of list mode data in the current or specified directory.

Return values:

<Catalog>

string

List of ASCII files *.txt or *.csv, separated by commas.

Example: See Example "List mode data exchange" on page 423.

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 94

[:SOURce<hw>]:LIST:DEXChange:EXECute

Executes the import or export of the selected list file, according to the previously set transfer direction with command `[:SOURce<hw>]:LIST:DEXChange:MODE`

Example: See Example "List mode data exchange" on page 423.

Usage: Event

Manual operation: See "Import / Export" on page 94

[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension <Extension>

Determines the extension of the ASCII file for import or export, or to query existing files.

Parameters:

<Extension>	TXT | CSV
	*RST: TXT

Example:	See Example "List mode data exchange" on page 423.

Manual operation:	See "ASCII File Settings" on page 93

[:SOURce<hw>]:LIST: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 "List mode data exchange" on page 423.

Manual operation:	See "Select (ASCII) Source/Select (ASCII) Destination" on page 94

[:SOURce<hw>]:LIST: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 "List mode data exchange" on page 423.

Manual operation:	See "ASCII File Settings" on page 93

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal <Decimal>

Sets "." (decimal point) or "," (comma) as the decimal separator used in the ASCII data with floating-point numerals.

Parameters:

<Decimal>	DOT | COMMa
	*RST: DOT

Example:	See Example "List mode data exchange" on page 423.

Manual operation:	See "ASCII File Settings" on page 93

[:SOURce<hw>]:LIST:DEXChange:MODE <Mode>

Determines the import or export of a list.

Specify the source or destination file with the command `[:SOURce<hw>]:LIST:DEXChange:SELect`.

Parameters:

<Mode>	IMPort | EXPort
	*RST: IMPort

Example:	See Example "List mode data exchange" on page 423.
Manual operation:	See " Mode " on page 93

[:SOURce<hw>]:LIST:DEXChange:SELect <Filename>

Selects the ASCII file for import or export, containing a list.

Parameters:

<Filename>	string
	Filename or complete file path; file extension can be omitted.

Example:	See Example "List mode data exchange" on page 423.
Manual operation:	See "Select Source/Select ASCII Destination" on page 94

12.14.7 SOURce:NOISe Subsystem

The `SOURce:NOISe` subsystem contains the commands for:

- Setting the noise modulation signal. The noise generator is optional.

Example: Configuring the noise generator

```
SOURce1:NOISe:DISTribution GAUSs
SOURce1:NOISe:BANDwidth 10000000
SOURce1:NOISe:BANDwidth:STATe 1

SOURce1:LFOutput1:SOURce NOIS
SOURce1:LFOutput1:STATe 1

SOURce1:NOISe:LEVel:RELative?
// -83.86
SOURce1:NOISe:LEVel:ABSolute?
// -13.86
```

12.14.7.1 Noise Generator

[:SOURce<hw>]:NOISe:BANDwidth|BWIDth <BWidth>

Sets the noise level in the system bandwidth when bandwidth limitation is enabled.

Parameters:

<BWidth>   float

                          Range: 100E3 to 10E6
                          Increment: 100E3
                          *RST: 100E3

Example: See Example "Configuring the noise generator" on page 434.

Manual operation: See "Bandwidth" on page 102

[:SOURce<hw>]:NOISe:BWIDth:STATe <State>

Activates noise bandwidth limitation.

Parameters:

<State>   0 | 1 | OFF | ON
                          *RST: 0

Example: See Example "Configuring the noise generator" on page 434.

Manual operation: See "Bandwidth" on page 102

[:SOURce<hw>]:NOISe:DISTribution <Distribution>

Sets the distribution of the noise power density.

Parameters:

<Distribution>   GAUSs | EQUal
                          *RST: GAUSs

Example: See Example "Configuring the noise generator" on page 434.

Manual operation: See "Distribution" on page 102

[:SOURce<hw>]:NOISe:LEVel:RELative?

Queries the level of the noise signal per Hz in the total bandwidth.

Return values:

<Relative>   float

Range: -149.18 to -52.67
Increment: 0.1
*RST: -69.84

Example: See Example "Configuring the noise generator" on page 434.

Usage: Query only

Manual operation: See "Noise Density" on page 105

[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?

Queries the level of the noise signal in the system bandwidth within the enabled bandwidth limitation.

Return values:

<Absolute>   float

Noise level within the bandwidth limitation
*RST: 3.84 MHz

Example: See Example "Configuring the noise generator" on page 434.

Usage: Query only

Manual operation: See "Noise Level" on page 105

12.14.8 SOURce:PGEN Subsystem

The PGEN subsystem contains the commands for setting output of the pulse modulation signal.

Example: Using pulse generator as source for pulse modulation

```
// select pulse generator as source for pulse modulation
// enable pulse modulation
SOURce1:PULM:SOURce INT
SOURce1:PULM:STATe 1
// pulse generator and signal output are also activated
SOURce1:PGENerator:STATe?
// 1
SOURce1:PGENerator:OUTPut:STATe?
// 1
PGENerator:OUTPut:POLarity NORMal
// to disable pulse generator
SOURce1:PGENerator:STATe 0
// activate the pulse modulation of the RF carrier
SOURce1:PULM:STATe 1
```

[:SOURce<hw>]:PGENerator:OUTPut:POLarity <Polarity>

Sets the polarity of the pulse output signal.

Parameters:

<Polarity>   NORMal | INVerted

                     NORMal
                     Outputs the pulse signal during the pulse width, that means dur-
                     ing the high state.

                     INVerted
                     Inverts the pulse output signal polarity. The pulse output signal is
                     suppressed during the pulse width, but provided during the low
                     state.

                     *RST: NORMal

Example: See Example "Using pulse generator as source for pulse modu-
                     lation" on page 436.

Manual operation: See "Pulse Output Polarity" on page 88

[:SOURce<hw>]:PGENerator:OUTPut[:STATe] <State>

Activates the output of the pulse modulation signal.

Parameters:

<State>   0 | 1 | OFF | ON
                     *RST: 0

Example: See Example "Using pulse generator as source for pulse modu-
                     lation" on page 436.

Manual operation: See "Pulse Output State" on page 88

[:SOURce<hw>]:PGENerator:STATe <State>

Enables the output of the video/sync signal.

If the pulse generator is the current modulation source, activating the pulse modulation
automatically activates the signal output and the pulse generator.

Parameters:

<State>   0 | 1 | OFF | ON
                     *RST: 0

Example: See Example "Using pulse generator as source for pulse modu-
                     lation" on page 436.

12.14.9 SOURce:PHASe Subsystem

This subsystem contains the commands for adjusting the phase of the RF output signal relative to a reference signal of the same frequency.

Example: Programming Example

```
// change the phase relative to the current phase
SOURce1:PHASe 2 DEG
// adopt the setting as the current phase
SOURce1:PHASe:REFerence
```

The following commands are available:

[:SOURce<hw>]:PHASe <Phase>

Specifies the phase variation relative to the current phase.

Parameters:

<Phase>   float

                               Range: -36000 to 36000
                               Increment: 0.1
                               *RST: 0
                               Default unit: DEG

Example: See Example "Programming Example" on page 438.

Manual operation: See "Delta Phase" on page 67

[:SOURce<hw>]:PHASe:REFerence

Assigns the value set with command `[:SOURce<hw>]:PHASe` as the reference phase.

Example: See Example "Programming Example" on page 438.

Usage: Event

Manual operation: See "Reset Delta Phase Display" on page 67

12.14.10 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 on of the following:

- Enter the unit after the numerical value
  Example: `:POW 0.5V`

- Set the unit with the command `:UNIT:POWer`.

[:SOURce<hw>]:POWer:ALC[:STATe] <State>

Parameters:

<State>   0 | OFF | AUTO | 1 | ON | ONTable | PRESet | OFFTable

AUTO
Adjusts the output level to the operating conditions automatically.

1|ON
Activates internal level control permanently.

OFFTable
Controls the level using attenuation values of the internal ALC table.

0|OFF
Deactivates the ALC, but allows you to recalibrate the level at each frequency and level change. The value remains up to the next change.

ONTable
Starts with the attenuation setting from the table and continues with automatic level control.

*RST: AUTO

Example: POW:ALC ON
Activates internal level control.

Manual operation: See "State" on page 151

[:SOURce<hw>]:POWer:ALC:DSENsitivity <Sensitivity>

Sets the sensitivity of the ALC detector.

Parameters:

<Sensitivity>   AUTO | FIXed | LOW | MEDium | HIGH

AUTO
Selects the optimum sensitivity automatically.

LOW|MEDium|HIGH
Sets either low, medium or high sensitivity.

FIXed
Fixes the internal level detector.

*RST: AUTO

Example: POW:ALC:DSEN FIX

Manual operation: See "Detector Sensitivity" on page 152

[:SOURce<hw>]:POWer:ALC:SONCe

Activates level control for correction purposes temporarily.

Example: POW:ALC OFF
Deactivates automatic level control at the RF output.
POW:ALC:SONC
Executes level control (once).

Usage: Event

Manual operation: See "Readjust" on page 66

[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE <Mode>

Selects the state the attenuator is to assume if the RF signal is switched off.

Parameters:

<Mode>   UNCHanged | FATTenuation

FATTenuation
The step attenuator switches to maximum attenuation

UNCHanged
Retains the current setting and keeps the output impedance
constant during RF off.

*RST: n.a. (factory preset: FATTenuation)

Example: SOURce1:POWer:ATTenuation:RFOFf:MODE
FATTenuation
uses maximum attenuation when the RF output is turned off.

Manual operation: See " RF OFF Mode " on page 149

[: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>	0 | 1 | OFF | ON
	*RST: n.a. (factory preset: 0)

Example:	`POW:EMF:STAT 1`
	Activates voltage level display.

Manual operation:	See " Display Level as Voltage of EMF " on page 225

[:SOURce<hw>]:POWer:LBEHaviour <Behaviour>

Selects the level behavior at the RF output over time.

Parameters:

<Behaviour>	AUTO | UNINterrupted | MONotone | CVSWr | USER | CPHase
	UNINterrupted|MONotone
	Uninterrupted level settings and strictly monotone modes.
	CWSWr
	Constant VSWR
	*RST: AUTO

Example:	`SOURce1:POWer:LBEHaviour AUTO`

Manual operation:	See " Setting Characteristics " on page 65

[: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 64

[:SOURce<hw>]:POWer:LMODe <LevMode>

Sets the RF level mode.

Parameters:

<LevMode>	NORMal | LOWNoise | LOWDistortion

NORMal

Supplies the RF signal with the standard power level of the instrument.

LOWNoise

Supplies a very low noise sinewave signal.

LOWDistortion

Supplies a very pure sinewave signal.

*RST: NORMal

Example: SOURce1:POWer:LMODe LOWD

Sets low distortion mode. The instrument reduces distortions of the RF signal to a minimum.

Manual operation: See " Mode " on page 65

[:SOURce<hw>]:POWer:MANual <Manual>

Sets the level for the subsequent sweep step if SWE:POW:MODE MAN.

Use a separate command for each sweep step.

Parameters:

<Manual>   float

You can select any level within the setting range, where:

STARt is set with [:SOURce<hw>]:POWer:STARt

STOP is set with [:SOURce<hw>]:POWer:STOP

OFFSet is set with [:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet

Range: (STARt + OFFSet) to (STOP + OFFSet)
Increment: 0.01
Default unit: dBm

Example: See Example "Setup an RF frequency or power sweep" on page 453

Manual operation: See " Current Level" on page 127

[: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].

SWEep

Sets sweep mode.

Set the range and current level with the commands:

`[:SOURce<hw>]:POWer:STARt` and `[:SOURce<hw>]:POWer:STOP`,

`[:SOURce<hw>]:POWer:MANual`.

*RST: CW

Example:	See Example "Setup an RF frequency or power sweep" on page 453
Manual operation:	See "State (RF level sweep)" on page 127

[: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.

See "RF frequency and level display with a downstream instrument" on page 59.

Parameters:

<Power>	float
	Level at the RF output, without level offset
	Range: See data sheet Increment: 0.01 Default unit: dBm

Example:	`SOURce1:POWer:POWer 15` Sets the level at RF output
Manual operation:	See "Amplitude" on page 64

[:SOURce<hw>]:POWer:STARt <Start>
[:SOURce<hw>]:POWer:STOP <Stop>

Sets the RF start/stop level in sweep mode.

Parameters:

<Stop>	float

	Sets the setting range calculated as follows:
	`(Level_min + OFFSet)` to `(Level_max + OFFSet)`
	Where the values are set with the commands:
	`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet`
	`[:SOURce<hw>]:POWer:STARt`
	`[:SOURce<hw>]:POWer:STOP`

	Range: Minimum level to maximum level *RST: -30 (Start)/ -10 (Stop) Default unit: dBm

Example: See

Manual operation: See

[: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.

USER
Increases or decreases the level in increments, determined with the command `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

*RST: DECimal

Example: `SOURce1:POWer:STEP:INCRement 2`
`SOURce1:POWer:STEP:MODE USER`
`SOURce1:POWer:LEVel:IMMediate:AMPLitude UP`
Increasing the RF level with a step size of 2 dB

Manual operation: See "Variation Active" on page 62

[: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`.

Note: The command also sets "Variation Step" in the manual control, that means the user-defined step width for setting the level with the rotary knob or the [Up/Down] arrow keys.

Parameters:

<Increment>   float

Range: 0 to 200
Increment: 0.01
*RST: 1
Default unit: dB

Example: See `[:SOURce<hw>]:POWer:STEP:MODE` on page 444.

Manual operation: See "Variation Step" on page 62

[: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]`.

See "RF frequency and level display with a downstream instrument" on page 59.

Note: The level offset also affects the RF level sweep.

Parameters:

<Offset>	float
	Range: -100 to 100
	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 64

[: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 199

[: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 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 + OFFStet)
	*RST: -30
	Default unit: dBm

Example:	`POWer -30`
	Sets the RF level

Example:	See also `[:SOURce<hw>]:POWer:STEP:MODE` on page 444.

Manual operation:	See "Amplitude" on page 64

[: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 65

[:SOURce]:POWer:WIGNore <State>

Ignores level range warnings.

Parameters:

<State>	0	1	OFF	ON
	*RST: n.a. (factory preset: 0)

Example:　　　　　SOURce:POWer:WIGNore 1

12.14.11 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 314).

Example: Configuring the reference oscillator

```
// Using 100 MHz external reference source
SOURce:ROSCillator:PRESet
SOURce:ROSCillator:SOURce EXT
SOURce:ROSCillator:EXTernal:RFOFf:STATe 1
SOURce:ROSCillator:EXTernal:FREQuency 100MHZ
SOURce:ROSCillator:EXTernal:SBANdwidth WIDE
// 100 MHz (loop thought) and 1 GHz output
SOURce:ROSCillator:OUTPut:FREQuency:MODE LOOP
SOURce:ROSCillator:OUTPut:ALTernate:FREQuency:MODE DER1G
SOURce:ROSCillator:INTernal:ADJust:STATe 0


// Variable external reference frequency
// SOURce:ROSCillator:EXTernal:FREQuency VAR
// SOURce:ROSCillator:EXTernal:FREQuency:VARiable 100000000


// Using the internal reference frequency
SOURce:ROSCillator:SOURce INT
SOURce:ROSCillator:INTernal:TUNing:STATe 1
SOURce:ROSCillator:INTernal:TUNing:SLOPe LOW
// 10 MHz and 1 GHz output
SOURce:ROSCillator:OUTPut:FREQuency:MODE DER10M
SOURce:ROSCillator:OUTPut:ALTernate:FREQuency:MODE DER1G

// 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:PRESet

Resets the reference oscillator settings.

Example: See Example "Configuring the reference oscillator" on page 448.

Usage: Event

Manual operation: See "Set to Default" on page 182

[: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 448.

Manual operation: See "Source" on page 182

[: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> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: See Example "Configuring the reference oscillator" on page 448.

Manual operation: See "Deactivate RF Output (if external reference is missing)" on page 183

[:SOURce]:ROSCillator:EXTernal:FREQuency <Frequency>

Sets the frequency of the external reference.

Parameters:

<Frequency> 100MHZ | 1GHZ | VARiable | 10MHZ

*RST: n.a. (factory preset: 10MHZ)

Example: See Example "Configuring the reference oscillator" on page 448.

Options: VARiable requires R&S SMBB-K704
1GHZ requires R&S SMBB-B3

Manual operation: See "External Reference Frequency" on page 183

[: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 448.

Options: R&S SMBB-K704

Manual operation: See "Variable Reference Frequency" on page 183

[:SOURce]:ROSCillator:EXTernal:SBANdwidth <SBandwidth>

Selects the synchronization bandwidth for the external reference signal.

For more information, see data sheet.

Parameters:

<SBandwidth>   WIDE | NARRow

                    NARRow
                    The synchronization bandwidth is a few Hz.
                    Suitable for external reference sources with phase noise worse
                    than the R&S SMB100B.

                    WIDE
                    Uses the widest possible synchronization bandwidth.
                    For more information, see data sheet.

                    *RST: n.a. (factory preset)

Example: See Example "Configuring the reference oscillator" on page 448.

Manual operation: See "Synchronization Bandwidth" on page 183

[:SOURce]:ROSCillator:EXTernal:MLRange?

Queries the minimum locking range for the selected external reference frequency.

Return values:

<MinLockRange>   string

Example: SOUR:ROSC:EXT:MLR?

Usage: Query only

Manual operation: See "Minimum Locking Range" on page 184

[: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 184

[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE <OutpFreqMode>

Selects the mode for the output reference frequency.

Parameters:

<OutpFreqMode>   DER10M | OFF | LOOPthrough

                        OFF
                        Disables the output.

                        DER10M
                        Sets the output reference frequency to 10 MHz.
                        The reference frequency is derived from the internal reference frequency.

                        LOOPthrough
                        This option is unavailable for
                        `ROSCillator:EXTernal:FREQuency 1GHZ`. Forwards the input reference frequency to the reference frequency output.

                        *RST: n.a. (factory preset: DER10M)

Example: See Example "Configuring the reference oscillator" on page 448.

Manual operation: See "Reference Output/1GHz Reference Output" on page 185

[:SOURce]:ROSCillator:OUTPut:ALTernate:FREQuency:MODE <OutpFreqMode>

Sets the output reference frequency.

Parameters:

<OutpFreqMode>   LOOPthrough | DER1G | OFF

                        OFF
                        Disables the output.

                        DER1G
                        Sets the output reference frequency to 1 GHz.
                        The reference frequency is derived from the internal reference frequency.

                        LOOPthrough
                        If `[:SOURce]:ROSCillator:EXTernal:FREQuency`1GHZ, forwards the input reference frequency to the reference frequency output.

                        *RST: n.a. (factory preset: OFF)

Example: See Example "Configuring the reference oscillator" on page 448.

Options:	DER1G requires R&S SMBB-B3
Manual operation:	See "Reference Output/1GHz Reference Output" on page 185

[: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 452
Manual operation:	See "Adjustment Value" on page 186

[: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>	0 | 1 | OFF | ON
	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)
Example:	See Example "Configuring the reference oscillator" on page 448.
Manual operation:	See "Adjustment Active" on page 185

12.14.12 SOURce:SWEep Subsystem

The SOURce:SWEep subsystem contains the commands for configuring RF sweep signals.

- The keyword `[:FREQuency]` can be omitted, then the commands are SCPI-compliant.
- To activate an RF sweep mode, use the following commands:
  - RF frequency sweep: `SOURce:FREQuency:MODE SWEep` (`SOURce:FREQuency:MODE CW` (off))
  - RF level sweep: `SOURce:POWer:MODE SWEep` (`SOURce:POWer:MODE CW` (off))
- All sweeps, including the LF sweep, can be set independently of each other.

For detailed information on the sweep modes and the triggering, see Chapter 6.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 112.

Example: Setup an RF frequency or power sweep

The following example shows a command sequence to set up an RF frequency sweep, triggered by the execute command. For an RF power sweep, replace `FREQuency` in the `SWEep` commands with `POWer`.

Exceptions are the power spacing (defined with `LINear` only) and the power step width (defined with `LOGarithmic` only).

```
// Reset the instrument to start from an initial state
// Switch off display update to improve performance
// (especially with short dwell times)
// Set the sweep mode (first two commands) and the sweep range
// Select linear spacing
// Select the waveform shape for the frequency sweep
*RST; *CLS
SYSTem:DISPlay:UPDate OFF
TRIGger1:FSWeep:SOURce SINGle
SOURce1:SWEep:FREQuency:MODE AUTO
SOURce1:FREQuency:SPAN 300 MHz
SOURce1:FREQuency:CENTer 200 MHz
// Alternatively use
// SOURce1:FREQuency:STARt 50 MHz
// SOURce1:FREQuency:STOP 350 MHz
SOURce1:SWEep:FREQuency:SPACing LINear
SOURce1:SWEep:FREQuency:SHAPe SAWTooth

// Activate change to start frequency while waiting for next trigger
// Prerequisites: sweep mode single and sweep waveform sawtooth
SOURce1:SWEep:FREQuency:RETRace 1
// Alternatively reset all sweeps to their initial value
SOURce1:SWEep:RESet:ALL

// Set the step width and dwell time
SOURce1:SWEep:FREQuency:STEP:LINear 1 MHz
// Alternatively set the number of steps, then the sweep step width is
// set automatically
SOURce1:SWEep:FREQuency:POINts 301
```

```
SOURce1:SWEep:FREQuency:DWELl 500 ms
// With logarithmic spacing select the step width as follows
// (steps of 10 percent of the previous frequency in each instance)
SOURce1:SWEep:FREQuency:SPACing LOG
SOURce1:SWEep:FREQuency:STEP:LOGarithmic 10PCT

// Activate the sweep
// Trigger the sweep (depending on the set mode) and query the status
SOURce1:FREQuency:MODE SWEep
// Perform a one-off RF frequency sweep
SOURce1:SWEep:FREQuency:EXECute
SOURce1:SWEep:FREQuency:RUNNing?
// 1
// the frequency sweep is running

// For manual step RF sweep use the following commands
*RST; *CLS
// Activate manual step RF sweep
SOURce1:SWEep:FREQuency:MODE MANual
// Activate the RF frequency sweep.
SOURce1:FREQuency:MODE SWEep
// Activate RF Output1.
Output1:STATe 1
// Input the frequency manually for each step
SOURce1:FREQuency:MANual 200 MHz
SOURce1:FREQuency:MANual 201 MHz
// Alternatively use the UP or DOWN commands with the set step width.
SOURce1:SWEep:FREQuency:STEP:LINear 1 MHz
SOURce1:FREQuency:MANual UP
```

[:SOURce<hw>]:SWEep:POWer:DWELl <Dwell>

Sets the dwell time for a level sweep step.

Parameters:

<Dwell>	float
	Range: 0.001 to 100
	Increment: 100E-6
	*RST: 0.01

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See " Dwell Time " on page 130

[:SOURce<hw>]:SWEep:POWer:MODE <Mode>

Sets the cycle mode for the level sweep.

Parameters:

<Mode>   AUTO | MANual | STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. You can trigger every step individually with the command `[:SOURce<hw>]:POWer:MANual`. The level value increases at each step by the value that you define with `[:SOURce<hw>]:POWer:STEP[:INCRement]`. Values directly entered with the command `[:SOURce<hw>]:POWer:MANual` are not taken into account.

STEP
Each trigger triggers one sweep step only. The level increases by the value entered with `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

*RST: AUTO

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See "Mode" on page 127

[:SOURce<hw>]:SWEep:POWer:POINts <Points>

Sets the number of steps within the RF level sweep range.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Parameters:

<Points>	integer
	Range: 2 to Max

Example: See Example "Setup an RF frequency or power sweep" on page 453.

[:SOURce<hw>]:SWEep:POWer:SPACing:MODE?

Queries the level sweep spacing. The sweep spacing for level sweeps is always linear.

Return values:

<Mode>   LINear

              *RST: LINear

Example: `SWE:POW:SPAC:MODE?`
queries the sweep spacing for a level sweep at RF output.
Result: `"LIN"`
linear spacing

Usage: Query only

[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic] <Logarithmic>

Sets a logarithmically determined step size for the RF level sweep. The level is increased by a logarithmically calculated fraction of the current level.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Parameters:

<Logarithmic>   float

              The unit dB is mandatory.

              Range: 0.01 to 139 dB
              Increment: 0.01
              *RST: 1
              Default unit: dB

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See " Step " on page 133

[:SOURce<hw>]:SWEep[:FREQuency]:DWELl <Dwell>

Sets the dwell time for a frequency sweep step.

Parameters:

<Dwell>   float

              Range: 0.001 to 100
              Increment: 100E-6
              *RST: 0.01

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See " Dwell Time " on page 130

[:SOURce<hw>]:SWEep[:FREQuency]:MODE <Mode>

Sets the cycle mode for the frequency sweep.

Parameters:

<Mode>   AUTO | MANual | STEP

AUTO
Each trigger event triggers exactly one complete sweep.

MANual
The trigger system is not active. You can trigger every step individually by input of the frequencies with the command `[:SOURce<hw>]:FREQuency:MANual`.

STEP
Each trigger event triggers one sweep step. The frequency increases by the value entered with `[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]` (linear spacing) or `[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic` (logarithmic spacing).

*RST: AUTO

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See "Mode" on page 127

[:SOURce<hw>]:SWEep[:FREQuency]:POINts <Points>

Sets the number of steps within the RF frequency sweep range.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Two separate `POINts` values are used for linear or logarithmic sweep spacing (`[:SOURce<hw>]:SWEep[:FREQuency]:SPACing LIN | LOG`). The command always affects the currently set sweep spacing.

Parameters:

<Points>   integer
                      Range: 2 to Max

Example: See Example "Setup an RF frequency or power sweep" on page 453.

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing <Spacing>

Selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

The keyword `[:FREQuency]` can be omitted; then the command is SCPI-compliant.

Parameters:

<Spacing>   LINear | LOGarithmic

LINear

Sets a fixed frequency value as step width and adds it to the current frequency.

The linear step width is entered in Hz, see `[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]`.

LOGarithmic

Sets a constant fraction of the current frequency as step width and adds it to the current frequency.

The logarithmic step width is entered in %, see `[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic`.

*RST: LINear

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See " Spacing" on page 130

[:SOURce<hw>]:SWEep:POWer:SHAPe <Shape>
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe <Shape>

Determines the waveform shape for a frequency sweep sequence.

Parameters:

<Shape> SAWTooth | TRIangle

*RST: SAWTooth

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See " Shape" on page 128

[:SOURce<hw>]:SWEep:POWer:EXECute
[:SOURce<hw>]:SWEep[:FREQuency]:EXECute

Executes an RF frequency sweep.

The command performs a single sweep and is therefore only effective in manual sweep mode.

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Usage: Event

Manual operation: See " Execute Single Sweep " on page 130

[:SOURce<hw>]:SWEep:POWer:RETRace <State>
[:SOURce<hw>]:SWEep[:FREQuency]:RETRace <State>

Activates that the signal changes to the start frequency value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single".

Parameters:

<State>   0 | 1 | OFF | ON

                            *RST: 0

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See "Retrace" on page 128

[:SOURce<hw>]:SWEep:POWer:RUNNing?
[:SOURce<hw>]:SWEep[:FREQuency]:RUNNing?

Queries the current sweep state.

Return values:

<State>   0 | 1 | OFF | ON

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Usage: Query only

[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

Sets a logarithmically determined step width for the RF frequency sweep. The value is added at each sweep step to the current frequency.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Parameters:

<Logarithmic>   float

                            The unit is mandatory.

                            Range: 0.01 to 100
                            Increment: 1E-3
                            *RST: 1
                            Default unit: PCT

Example: See Example "Setup an RF frequency or power sweep" on page 453.

Manual operation: See " Step Linear/Step Logarithmic " on page 132

[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step width for linear sweeps.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 120.

Omit the optional keywords so that the command is SCPI-compliant.

Parameters:

<Linear>	float
	Range: 0.001 Hz to (STOP - STARt)
	Increment: 0.01
Example:	See Example "Setup an RF frequency or power sweep" on page 453.
Manual operation:	See " Step Linear/Step Logarithmic " on page 132

[:SOURce<hw>]:SWEep:RESet[:ALL]

Resets all active sweeps to the starting point.

Usage:	Event
Manual operation:	See " Reset Sweep " on page 130

12.15 SYSTem Subsystem

The SYSTem subsystem contains a series of commands for general functions which do not directly affect signal generation.

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?
// "SMB100B-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: Finding out the used VISA ressource strings

```
SYSTem:COMMunicate:NETWork:RESource?
// "TCPIP::10.113.0.104::inst0::INSTR"

SYSTem:COMMunicate:HISLip:RESource?
// "TCPIP::10.113.0.104::hislip0::INSTR"

SYSTem:COMMunicate:GPIB:RESource?
// "GPIB::28::INSTR"
SYSTem:COMMunicate:GPIB:SELF:ADDRess?
// 28
SYSTem:COMMunicate:GPIB:LTERminator?
// STAN

SYSTem:COMMunicate:SERial:RESource?
// "ASRL1::INSTR"
SYSTem:COMMunicate:SERial:SBITs?
// 1
SYSTem:COMMunicate:SERial:BAUD?
// 115200
SYSTem:COMMunicate:SERial:PARity?
// NONE

SYSTem:COMMunicate:SOCKet:RESource?
// "TCPIP::10.113.0.104::5025::SOCKET"
SYSTem:COMMunicate:USB:RESource?
// "USB::0x0AAD::0x01DE::100001::INSTR"
```

Example: Querying the error queue

```
SYSTem:ERRor:STATic?
// -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
```

: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: `SYST:ERR: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 534

: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:	`SYST:ERR: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:	`SYST:ERR:CODE`
	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:	`SYST:ERR:COUN`
	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:　　　　　　　`SYST:ERR?`
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 Errors/Error History" on page 534

:SYSTem:ERRor:GNEXt?

Similar to `:SYSTem:ERRor[:NEXT]?`, but queries the next entry from the global persistant 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:　　　　　　　`SYST:ERR:GNEX?`
Returns 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 461

Usage:　　　　　　　　Event

Manual operation:　　　See "Clear History" on page 534

: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 461

Usage: Query only

Manual operation: See "Static Errors/Error History" on page 534

:SYSTem:DLOCk <DispLockStat>

Disables the manual operation via the display, including the front panel keyboard of the instrument and the Local key.

Parameters:

<DispLockStat>   0 | 1 | OFF | ON

                     *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 243
                     See "Enabling a locked user interface for manual operation"
                     on page 244

:SYSTem:KLOCk <State>

Disables the front panel keyboard of the instrument including the Local key.

Parameters:

<State>   0 | 1 | OFF | ON

                     *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 243
                     See "Enabling a locked user interface for manual operation"
                     on page 244

:SYSTem:ULOCk <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)

Example:	`:SYST:ULOC DIS` Activates the user interface lock, including display and controls.
Manual operation:	See "User Interface" on page 243 See "Enabling a locked user interface for manual operation" on page 244

: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 instrument settings to a file with defined filename.

Setting parameters:

<Pathname>	string

Example: `SYSTem:SAV`
`"/var/user/Instrument_settings.svrcltxt"`

Usage: Setting only

:SYSTem:RCL <Pathname>

Loads a file with previously saved instrument settings.

Setting parameters:

<Pathname>	string

Example: `SYSTem:RCL`
`"/var/user/Instrument_settings.svrcltxt"`

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 237

Parameters:

<State>	0	1	OFF	ON
	*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 238

: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 241

:SYSTem:COMMunicate:GPIB:LTERminator <LTerminator>

Sets the terminator recognition for remote control via GPIB interface.

Parameters:

<LTerminator>   STANdard | EOI

                          EOI
                          Recognizes an LF (Line Feed) as the terminator only when it is
                          sent with the line message EOI (End of Line). This setting is rec-
                          ommended particularly for binary block transmissions, as binary
                          blocks may coincidentally contain a characater with value LF
                          (Line Feed), although it is not determined as a terminator.

STANdard

Recognizes an LF (Line Feed) as the terminator regardless of whether it is sent with or without EOI.

*RST: n.a. (factory preset: STANdard)

Example: See Example "Finding out the used VISA ressource strings" on page 461.

:SYSTem:COMMunicate:GPIB:RESource?

Queries the visa resource string for remote control via the GPIB interface.

To change the GPIB address, use the command `:SYSTem:COMMunicate:GPIB[: SELF]:ADDRess`.

Return values:

\<Resource\>   string

Example: See Example "Finding out the used VISA ressource strings" on page 461.

Usage: Query only

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess \<Address\>

Sets the GPIB address.

Parameters:

\<Address\>   integer

                 Range: 0 to 30
                 *RST: 28

Example: See Example "Finding out the used VISA ressource strings" on page 461.

: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 the used VISA ressource strings" on page 461.

Usage: Query only

: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 460.

Manual operation: See "IP Address" on page 265

: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 460.

Example: `SYSTem:COMMunicate:NETWork:IPADdress:MODE STATic`
`SYSTem:COMMunicate:NETWork:IPADdress "10.113.0.105"`

Manual operation: See "Address Mode" on page 264

: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 460.

Manual operation: See "MAC Address" on page 266

:SYSTem:COMMunicate:NETWork:RESource?

Queries the visa resource string for Ethernet instruments.

Return values:

<Resource>	string

Example: See Example "Finding out the used VISA ressource strings" on page 461.

Usage: Query only

:SYSTem:COMMunicate:NETWork:RESTart

Restarts the network.

| **Example:** | SYSTem:COMMunicate:NETWork:RESTart |
| | // Terminates the network connection and sets it up again |

| **Usage:** | Event |

| **Manual operation:** | See "Restart Network" on page 264 |

:SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

Return values:
| <State> | 0 \| 1 \| OFF \| ON |

| **Example:** | See Example "Retrieving information on network-related settings" on page 460. |

| **Usage:** | Query only |

| **Manual operation:** | See "Network Status" on page 263 |

: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 460. |

| **Manual operation:** | See "DNS Suffix" on page 265 |

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

Sets an individual hostname for the RF signal generator.

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 460. |

| **Manual operation:** | See "Hostname" on page 264 |

: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 460.

Manual operation: See "Workgroup" on page 264

: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 460.

Manual operation: See "DNS Server" on page 265

: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 460.

Manual operation: See "Default Gateway" on page 265

: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 460.

Manual operation: See "Subnet Mask" on page 265

:SYSTem:COMMunicate:SERial:BAUD <Baud>

Defines the baudrate for the serial remote control interface.

Parameters:

<Baud>	2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200
	*RST: n.a. (factory preset: 115200)

Example:	See Example "Finding out the used VISA ressource strings" on page 461.
Manual operation:	See "Baud Rate" on page 267

:SYSTem:COMMunicate:SERial:PARity <Parity>

Enters the parity for the serial remote control interface.

Parameters:

<Parity>	NONE | ODD | EVEN
	*RST: n.a. (factory preset: NONE)

Example:	See Example "Finding out the used VISA ressource strings" on page 461.
Manual operation:	See "Parity" on page 268

:SYSTem:COMMunicate:SERial:RESource?

Queries the visa resource string for the serial remote control interface. This string is used for remote control of the instrument.

Return values:

<Resource>	string

Example:	See Example "Finding out the used VISA ressource strings" on page 461.
Usage:	Query only

:SYSTem:COMMunicate:SERial:SBITs <SBits>

Defines the number of stop bits for the serial remote control interface.

Parameters:

<SBits>	1 | 2
	*RST: n.a. (factory preset: 1)

Example:	See Example "Finding out the used VISA ressource strings" on page 461.
Manual operation:	See "Stop Bits" on page 268

: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 the used VISA ressource strings"
                             on page 461.

Usage: Query only

: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 the used VISA ressource strings"
                             on page 461.

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 instru-
ment, selected with command :SYSTem:LANGuage.

Note: While working in an emulation mode, the R&S SMB100B 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 269

: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 269

:SYSTem:IRESponse <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 269

:SYSTem:ORESponse <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 269

: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 268

: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: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 242

: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 240

: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 quieried with the command :SYSTem:SPECification: IDENtification:CATalog? on page 479

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. See also "Data Sheet" on page 278.

Example:	Retrieving instruments specification
	Note: The following values are merely an example.
	Query the data sheet versions stored in 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 data sheet version with that the instrument was delivered:
	:SYSTem:SPECification:VERSion:FACTory?
	"04.00"
	Select a data sheet version:
	:SYSTem:SPECification:VERSion?
	"04.00"
	:SYSTem:SPECification:VERSion "04.01"
	Selects one particular data sheet version.
	Queries regarding data sheet parameters (IDs) and their values Rrefer to this particular data sheet
	Query the IDs of all parameters listed in the **selected** data sheet version:
	:SYSTem:SPECification:IDENtification:CATalog?
	"ID_RF_FREQ_SETTING_TIME_ALC_ON_MS,
	ID_RF_FREQ_SETTING_TIME_MS,..."
	Query the data sheet information on a specific parameter, defined by its ID
	:SYSTem:SPECification?
	"ID_RF_FREQ_SETTING_TIME_ALC_ON_MS"
	Rreturned is the specified and, if available, the typical value of the parameter

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 479.

Parameters:

<Version>   string

Example: See `:SYSTem:SPECification?` on page 477.

: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 477.

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: **Note:** The following values are merely an example. Your instrument may not support the same parameters.
`SYST:SPEC:PAR? "ID_RF_FREQ_SETTING_TIME_MS",0.1`
`SYST:SPEC:PAR? "ID_RF_LEVEL_MAX_GENERAL_DBM", 0.1`

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 477.

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 477.

Usage: Query only

Manual operation: See "Versions" on page 529

:SYSTem:SRData?

Queris 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>             0 | 1 | OFF | ON
                       *RST:       0

**Example:**            ```
SYST:STAR:COMP?
```
                       Response: 1
                       the startup of the instrument is completed.

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: `:SYSTem:DATE?`
`// 2016,05,01`

Manual operation: See "Date" on page 519

: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 519

:SYSTem:NTP:STATe <UseNtpState>

Activates clock synchronization via NTP.

Parameters:

<UseNtpState>	0 | 1 | OFF | ON
	*RST: n.a. (factory preset: 0)

Example: `SYSTem:NTP:STATe 1`

Manual operation: See "Use Time from NTP Server" on page 519

: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: SYSTem:TIME?
                      // 10,27,14

Manual operation: See "Time" on page 519

:SYSTem:TIME:ZONE <TimeZone>

Sets the timezone. You can query the list of the available timezones with :SYSTem:TIME:ZONE:CATalog?.

Parameters:
<TimeZone>   string

Manual operation: See "Timezone" on page 519

:SYSTem:TIME:ZONE:CATalog?

Querys the list of available timezones.

Return values:
<Catalog>

Usage: Query only

Manual operation: See "Timezone" on page 519

: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: SYST:VERS
                            queries the SCPI version.
                            Response: "1996"
                            The instrument complies with the SCPI version from 1996.

Usage: Query only

:SYSTem:OSYStem?

Queries the operating system of the instrument.

Return values:

<OperSystem>   string

Example: SYSTem:OSYStem?
                            Response: "Linux"

Usage: Query only

:SYSTem:MMEMory:PATH:USER?

Queries the user directory, that means the directory the R&S SMB100B stores user files on.

Return values:

<PathUser>   string

Example: SYSTem:MMEMory:PATH:USER?
                            Response: "'/var/user/"

Usage: Query only

:SYSTem:DFPR?

Queries the device footprint of the instrument. The retrieved information is in machine-readable form suitable for automatic further processing.

Return values:

<DeviceFootprint>   string

                            Information on the instrument type, device identification and details on the installed FW version, hardware and software options.

Example: :SYSTem:DFPR?

Usage: Query only

: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

Manual operation: See "Shut down" on page 525

: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 10.2.3, "Assigning Actions to the [★ (User)] Key", on page 231.

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

:SYSTem:FILes:TEMPorary:DELete

Deletes the temporary files from the internal memory.

Example:
```
:SYSTem:FILes:TEMPorary:DELete
// temporary files are removed
```

Usage: Event

12.16 STATus Subsystem

This system contains the commands for the status reporting system. See also Chapter A.1.5, "Status Reporting System", on page 550 for detailed information.

*RST on page 314 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 SMB100B cause the status registers to be changed.
  Setting values: A decimal value in the range 0 to 32767 (=2^{15}-1)

:STATus:OPERation:CONDition?

Quieries 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] <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:

<Event>   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 correeponding EVENt bit is true, a positive transition occurs in the summary bit. This transition is reportet 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] <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:

<Event>   string

Example: STAT:QUES:EVEN?
                          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 STA-Tus: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 STA-Tus: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 465.

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

12.17 TEST Subsystem

The `TEST` subsystem contains the commands for performing test routines directly at the hardware assemblies.

The selftetst 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.

:TEST\<hw>:ALL:STARt

Usage: Event

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

12.18 TRIGger Subsystem

The `TRIGger` system contains the commands for selecting the trigger source for the RF and LF sweep.

You can work with an internal or with an externally applied trigger signal. In this case, use the commands in the `SOURce:INPut` subsystem to configure the signal.

The trigger system of the R&S SMB100B is a simplified implementation of the SCPI trigger system. The `TRIGger` system differs from the SCPI system as follows:

- No `INITiate` command; the instrument behaves as if `INITiate:CONTinuous ON` were set.

- Under `TRIGger` several sweep subsystems exist.

- The trigger source names correspond directly to the various settings of manual control. SCPI uses different names which are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

In addition to these commands, see more trigger-related commands in the modulation and RF signal subsystems.

Table 12-1: Cross-reference between the manual and remote control

R&S proprietary value name	SCPI conform value name	Parameter in manual control
AUTO	IMMediate	"Auto" mode
SINGle	BUS	"Single" mode.
EXTernal	EXTernal	"Ext Single" and "Ext Step" mode. Use command `LFO:SWEep:MODE` to select between the two sweep modes.
EAUTo	-	"Ext Start/Stop" mode.

:TRIGger<hw>:FSWeep:SOURce <Source>
:TRIGger<hw>:LFFSweep:SOURce <Source>
:TRIGger<hw>:PSWeep:SOURce <Source>
:TRIGger<hw>[:SWEep]:SOURce <Source>

Selects the trigger source for the corresponding sweeps:

- `FSWeep` - RF frequency

- `LFFSweep` - LF frequency

- `PSWeep` - RF level

- `SWEep` - all sweeps

The source names of the parameters correspond to the values provided in manual control of the instrument. They differ from the SCPI-compliant names, but the instrument accepts both variants.

Use the SCPI name, if compatibility is an important issue. Find the corresponding SCPI-compliant commands in Cross-reference between the manual and remote control .

Setting parameters:

<Source>   AUTO | IMMediate | SINGle | BUS | EXTernal | EAUTo

AUTO [IMMediate]
Executes a sweep automatically.
In this free-running mode, the trigger condition is met continuously. I.e. when a sweep is completed, the next one starts immediately.

SINGle [BUS]

Executes one complete sweep cycle.

The following commands initiate a trigger event:

`*TRG` on page 315

`[:SOURce<hw>]:SWEep:POWer:EXECute`

`[:SOURce<hw>]:SWEep[:FREQuency]:EXECute`

`:TRIGger<hw>[:SWEep][:IMMediate]`, `:TRIGger<hw>:PSWeep[:IMMediate]` and `:TRIGger<hw>:FSWeep[:IMMediate]`.

Set the sweep mode with the commands:

`[:SOURce<hw>]:SWEep:POWer:MODE AUTO|STEP`

`[:SOURce<hw>]:SWEep[:FREQuency]:MODE AUTO|STEP`

`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE AUTO|STEP`

In step mode (`STEP`), the instrument executes only one step.

EXTernal

An external signal triggers the sweep.

EAUTo

An external signal triggers the sweep. When one sweep is finished, the next sweep starts.

A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: AUTO

Example:	See Example "Setup an LF sweep" on page 408
Usage:	Setting only
Manual operation:	See "Mode" on page 127

:TRIGger<hw>:FSWeep[:IMMediate]
:TRIGger<hw>:PSWeep[:IMMediate]
:TRIGger<hw>:LFFSweep:IMMediate
:TRIGger<hw>[:SWEep][:IMMediate]

Performs a single sweep and immediately starts the activated, corresponding sweep:

- `FSWeep` - RF frequency
- `PSWeep` - RF level
- `LFFSweep` - LF frequency
- `SWEep` - all sweeps

Effective in the following configuration:

- `TRIG:FSW|LFFS|PSW|[:SWE]:SOUR` **SING**
- `SOUR:SWE:FREQ|POW:MODE` **AUTO** or `SOUR:LFO:SWE:[FREQ:]MODE` **AUTO**

Alternatively, you can use the `IMMediate` command instead of the respective `SWEep:[FREQ:]|POW:EXECute` command.

| **Example:** | TRIG |
| | Starts all active sweeps. |

| **Usage:** | Event |

| **Manual operation:** | See " Execute Single Sweep " on page 130 |

:TRIGger<hw>:LFFSweep

Executes an LF frequency sweep in the following configuration:

- `TRIG:LFFS:SOUR SING`
- `LFO:SWE:MODE AUTO`

Example:	LFO:SWE:MODE AUTO
	TRIG:LFFS:SOUR SING
	TRIG:LFFSweep

| **Usage:** | Event |

12.19 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 <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

12.20 Direct Commands for the Stereo/RDS Coder Option R&S SMBB-B5

The direct commands allow you the access to all functions of the stereo coder option R&S SMBB-B5.

Some of the functions are also available via SCPI commands. In this case, we recommend that you use the SCPI commands to keep the settings of the R&S SMB100B and the stereo coder synchronized. Direct commands for which an SCPI command is available are marked with "for documentation reasons only" and the SCPI command is given.

To send the direct commands, use the command `[:SOURce]:STEReo:DIRect` `"command string"`.

To retrieve information, send the query `[:SOURce]:STEReo:DIRect`? `"command string"`.

All parameters are string parameters. Send them in quotation marks ("). These characters are part of the full direct command.

Before using the stereo coder, activate stereo modulation of the R&S SMB100B with the command `SOURce:STEReo:STATe ON`. The SCPI command `SOURce:STEReo:AUDio:FREQuency` sets the LF-Generator frequency. `SOURce:STEReo:MMF` limits the modulation frequency. These commands have no counterpart in the direct commands.

12.20.1 Programming Examples

Example: Alternative frequency lists (AF)

Alternative frequency lists can be transmitted in two ways.

- **Method A:**
  Set the frequencies of an AF list one after the other; the frequency currently transmitted has to be specified as the first frequency.

- **Method B:**
  Set the frequencies of an AF list in pairs, where each pair contains the frequency currently transmitted and an alternative frequency.
  Enter the frequency pairs in ascending order.
  Choose descending order only if the alternative frequencies belong to different regions or are used to broadcast different programs at different times.

A maximum of five AF lists can be generated. For type A lists, max. 25 frequencies per list can be specified, for type B lists, max. 12 frequencies per list.

Consider the following:

- Do not combine method A and B.

- You can generate a maximum of five AF lists.
  For type A lists, you can specify up to 25 frequencies per list; for type B - up to 12.

- There is no validity check for the frequency lists. Make sure that the syntax is correct.

```
// Method A
// Generate a new alternative frequency list
STEReo:DIRect "AF=N,87.6,87.7,87.8"
// Set the group sequence
STEReo:DIRect "GS=0A,14A"
// The group sequence must contain group 0A
// The alternative frequencies are now transmitted in group 0A


// Add another alternative frequency list
STEReo:DIRect "AF=+,88.6,88.7,88.8"

// Method B
// Generate a new alternative frequency list
STEReo:DIRect "AF=N,87.6,90.2,87.6,90.2"
// Set the group sequence
STEReo:DIRect "GS=0A,14A"
// The group sequence must contain group 0A
// The alternative frequencies are now transmitted in group 0A


// Add another alternative frequency list
STEReo:DIRect "AF=+,88.6,91.2,88.6,91.2"
```

Example: Creating an EON (Enhanced Other Networks) data set

```
// Query the list of existing EON data sets
STEReo:DIRect? "EON-PI"
// the list shows the EON PI codes already used and codes remaining for new data sets

// Create an EON data set
STEReo:DIRect "EON-PI=1234"
// Set the program service (PS) name for the EON data set
STEReo:DIRect "EON-PS=1234,TEST EON"
// Set the group sequence, e.g. group 14A with variants 0 to 3
STEReo:DIRect "GS=0A,14A"

// Create an AF list for the EON
// Method A
STEReo:DIRect "EON-AFA=1234,N,87.6,87.7,87.8"
// Add further AF lists for the EON
STEReo:DIRect "EON-AFA=1234,+,88.6,88.7,88.8"
// Query the  first AF list of the EON
STEReo:DIRect? "EON-AFA,1234,1"

// Create an AF list for the EON
// Method B
STEReo:DIRect "EON-AFB=1234,N,87.6,87.7,87.8"
// 87.6 = tuned frequency, 87.7 = mapped frequency 1 (variant 5),
// 87.8 = mapped frequency 2 (variant 6)
```

Example: Free Format Groups (FFGs)

In the user-definable groups 1A, 3A, 5A, 6A, 7A, 8A, 9A, 10A, 11A, 12A and 13A, any desired data can be transmitted. Five bits of this data are transmitted in block B and 16 bits each in blocks C and D of the specified group.

You can define up to 20 different data sequences.

```
// Define the transmitted data in group 1A
STEReo:DIRect "1A=05,0000000000,1FFFFFFFFF"
// Group 1A  transmitts 5 times "0000000000" followed by 5 times "1FFFFFFFFF"

// Set the group sequence, e.g. transmit the defined data in group 1A
STEReo:DIRect "GS=0A,1A"
```

Example: Transparent Mode

The transparent mode allows you to transmit user-defined binary data instead of the standard RDS data. The transparent mode uses blocks A to D of the RDS groups. Standard RDS data is suppressed and not transmitted.

You can define up to 20 different data sequences.

The binary data is sent even if it constitutes no valid or meaningful RDS data. Always delete the transparent data first, before you resume the transmission of standard RDS data.

```
// Transmit the alternating sequences '0123456789ABCDEF' and
// 'ABCDEF0123456789' instead of the RDS data

// Delete the transparent data
// Enable standard RDS data transmission
STEReo:DIRect "TRANS=0"
```

12.20.2 Remote-Control Commands

STEReo:DIRect "<FFG>=<RetrNumb>,<DataSeq#1>,<DataSeq#2>,..."
STEReo:DIRect? "<FFG>"

Transmits data via free format groups (FFGs). A free format group can be filled with any desired data. (5 bits in block B and 16 bits each in blocks C and D of the group).

Note: This command causes that a queue is filled with data for a specific group. Sends the data only if the group in question is added to the group sequence with the command STEReo:DIRect.

Setting parameters:

<RetrNumb>	Number of retransmissions
<DataSeq>	You can define up to 20 different data sequences. Specify at least 10 characters per <DataSeq>. Add leading zeros, if any. 00 Erases the data.
	Range: 0000000000 to 1FFFFFFFFF (10 ASCII coded hexadecimal characters each)

Parameters for setting and query:

<FFG>	1A | 3A | 5A | 6A | 7A | 8A | 9A | 10A | 11A | 12A | 13A
	Determines the free format group. To transmit the FFGs of the B group, use same commands. Replace the A groups are by the B groups in the group sequence. If B groups are transmitted, block C is overwritten with the PI code.
Example:	STEReo:DIRect "1A=01,0123456789,1FFFFFFFFF" Fills a queue with the data "0123456789,1FFFFFFFFF". The data is sent in consecutive order in group 1A after group 1A is added to the group sequence. Query the data of group 1A STEReo:DIRect? "1A" Response: "01,0123456789,1FFFFFFFFF"

STEReo:DIRect "AF=<A>,<Freq#1>,<Freq#2>,..."
STEReo:DIRect? "AF<z>"

Defines an alternative frequency list.

A maximum of five AF lists with max. 25 frequencies per list can be created.

Parameters:

<Freq>	xxx.x
	Sets the alternative frequencies as ASCII coded decimal numbers.
	If list <z> is not available, the response is ().
	Range: 87.6 to 107.9

Setting parameters:

<A>	**N**
	New AF list
	+
	AF list to be added.

Query parameters:

<z>	AF list to be read.
	Range: 1 to 5

Example: `STEReo:DIRect "AF=N,97.4,98.3"`
Defines an alternative frequency list, the alternative frequencies 97.4 and 98.3 are inserted.
`STEReo:DIRect? "AF1"`
Response: `"97.4,98.3"`
`STEReo:DIRect "AF=N"`
Deletes all frequency lists.

STEReo:DIRect "ARI=<State>"
STEReo:DIRect? "ARI"

(for documentation reasons only)

Activates ARI signal transmission.

Use the command `[:SOURce]:STEReo:ARI:STATe` instead.

Setting parameters:

<State>	0	1

Example: `STEReo:DIRect "ARI=0"`
Deactivates ARI signal transmission.
`STEReo:DIRect? "ARI"`
Response: `"0"`

STEReo:DIRect "ARI-DEV=<Deviation>"
STEReo:DIRect? "ARI-DEV"

(for documentation reasons only)

Sets the frequency deviation of the ARI signal (max. deviation).

Use the command `[:SOURce]:STEReo:ARI[:DEViation]` instead.

Setting parameters:

<Deviation>	Sets the frequency deviation.
	Note: Always set a four-digit value. Specify leading zeros, if any.
	Range: 0000 to 1000 (ASCII coded decimal numbers), corresponding to 0 Hz to 10 kHz

Example: `STEReo:DIRect "ARI-DEV=1000`
Sets the ARI frequency deviation to 10 kHz.
`STEReo:DIRect? "ARI"`
Response: `"1000"`

STEReo:DIRect "ARI-ID=<Id>"
STEReo:DIRect? "ARI-ID"

(for documentation reasons only)

Selects the ARI identification.

Use the command `[:SOURce]:STEReo:ARI:TYPE` instead.

Parameters:

<Id>	0 | 1 | 2 | 3
	0
	Off
	1
	DK (traffic announcement identification)
	2
	BK (area identification)
	3
	DK and BK (traffic announcement identification and area identification)

Example: `STEReo:DIRect "ARI-ID=0"`
Deactivates the ARI identification.
`STEReo:DIRect? "ARI-ID"`
Response: `"0"`

STEReo:DIRect "BIN=<x>"

Defines and sends, or queries, binary test patterns. The BIN command causes the Stereo/RDS Coder to send periodic binary bit patterns instead of RDS data.

Parameters:

<x>	**0**
	Binary mode OFF
	1
	00000000...,
	2
	11111111...,

3

01010101...,

4

11001100...

Example: `STEReo:DIRect "BIN=2"`

The binary test pattern is set to "2" so that only "1s" are transmitted.

STEReo:DIRect "BK=<Code>"
STEReo:DIRect? "BK"

(for documentation reasons only)

Sets the ARI area identification.

Use the command `[:SOURce]:STEReo:ARI:BK[:CODE]` instead.

Parameters:

<Code>   A | B | C | D | E | F

Example: `STEReo:DIRect "BK=E"`

The ARI area identification is set to "E".

`STEReo:DIRect? "BK"`

Response: `"E"`

STEReo:DIRect "CT= <Hour>:<Min>:<Sec>,<Day>.<Month>.<Year>"
STEReo:DIRect? "CT"

Sets and activates transmission of the real-time clock.

Note: The CT data is transmitted in group 4A. Setting the real-time clock (CT command) automatically adds group 4A to the group sequence.

Do not manually add group 4A to, or remove group 4A from, the group sequence.

To remove group 4A from the group sequence, use the command `STEReo:DIRect`.

Setting parameters:

<Hour>:<Min>:<Sec> Range: 00:00:00 to 23:59:59

<Day>.<Month>.<Year> Range: 01.01.00 to 31.12.85

Example: `STEReo:DIRect "CT=20:30:59,01.08.03"`

The real-time clock is set.

`STEReo:DIRect? "CT"`

Response: `"20:31:06,01.08.03"`

STEReo:DIRect "CT=off"

Deactivates transmission of the real-time clock signal in the RDS signal.

Note: This command is used to remove group 4A from the group sequence. Do not manually remove group 4A from the group sequence.

Example:	STEReo:DIRect "CT=off"
	The real-time clock signal is no longer transmitted in the RDS signal.

Usage:	Setting only

STEReo:DIRect "DI=<x>"
STEReo:DIRect? "DI"

Sets or reads the decoder information (DI).

This command reads, and if necessary changes, the current decoder operating mode (mono, stereo, etc.).

Parameters:

<x>	Range:	0 to F (ASCII coded hexadecimal numbers)

Example:	STEReo:DIRect "DI=4"

STEReo:DIRect "DS=<x>"
STEReo:DIRect? "DS"

(for documentation reasons only)

Selects/activates a storage area in the Stereo/RDS Coder.

If activated, the settings stored in the selected area can be loaded.

Use the command [:SOURce]:STEReo:RDS:DATaset instead.

Parameters:

<x>	Range:	1 to 5

Example:	STEReo:DIRect "DS=2"
	Storage area 2 is activated.

STEReo:DIRect "EON-AFA= <PI>,<A>,<Freq#1>,<Freq#2>,..."
STEReo:DIRect? "EON-AFA,<PI>,<z>"

Enhanced Other Networks: Defines type A alternative frequencies for the EON with the selected PI.

Parameters:

<PI>	Range:	0000 to FFFF (ASCII coded hexadecimal numbers)

<Freq>	xxx.x
	Sets the alternative frequencies as ASCII coded decimal numbers.
	If list <z> is not available, the response is ().
	Note: For each Enhanced Other Network (EON), a maximum of five type A alternative frequency lists can be created.
	Range: 87.6 to 107.9

Setting parameters:

<A>	**N**
	New AF list
	+
	AF list to be added.

Query parameters:

<z>	AF list to be read.
	Range: 1 to 5

Example:	STEReo:DIRect "EON-AFA=1000,N,97.4,98.3"
	Creates a type A alternative frequency list for the EON with PI=1000. The new list contains the alternative frequencies 97.4 MHz and 98.3 MHz.
	STEReo:DIRect? "EON-AFA,1000,1"
	Queries the first type A alternative frequency list of the EON with PI=1000.
	Response: "97.4,98.3"

STEReo:DIRect "EON-AFB= <PI>,<A>,<Freq#1>,<Freq#2>,..."
STEReo:DIRect? "EON-AFB,<PI>,<z>"

Enhanced Other Networks: Defines type B alternative frequencies for the EON with the selected PI.

Parameters:

<PI>	Range:	0000 to FFFF (ASCII coded hexadecimal numbers)

<Freq>   xxx.x

Sets the alternative frequencies as ASCII coded decimal numbers.
If list <z> is not available, the response is ().
Note: For each Enhanced Other Network (EON), a maximum of five type B alternative frequency lists can be created. Each list contains a maximum of five frequencies, where <Freq#1> is Tuned Frequency (TF) and <Freq#2..5> are the Mapped Frequencies (MF). A minimum of two frequencies per EON is required.

Range: 87.6 to 107.9

Setting parameters:

<A>   **N**
                                New AF list

                                +
                                AF list to be added.

Query parameters:

<z>   AF list to be read.

                                Range: 1 to 5

Example: See STEReo:DIRect.

STEReo:DIRect "EON-DEL=<PI>"

Enhanced Other Networks: Deletes the complete EON with selected <PI>.

Parameters:

<PI>   Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

Example: STEReo:DIRect "EON-DEL=1000"
                    Deletes the EON with PI=1000.

Usage: Setting only

STEReo:DIRect "EON-PI=<PI>"
STEReo:DIRect? "EON-PI"

Enhanced Other Networks: Creates an EON or reads the list of the program identification (PI) codes of all EONs created so far.

Note: A maximum of eight EONs can be created.

Parameters:

<PI>   **Note:** Always set a four-digit value. Leading zeros, if any, must also be specified.

                    Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

Example: `STEReo:DIRect "EON-PI=1000"`
Creates an EON with PI=1000.

STEReo:DIRect "EON-PS=<PI>,<PS>"
STEReo:DIRect? "EON-PS,<PI>"

Enhanced Other Networks: Sets the program service (PS) name for the EON with the selected <PI>.

Parameters:

<PI>   Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

Setting parameters:

<PS>   8 ASCII characters
Note: Always set an eight-digit value. Blank spaces, if any, must also be entered.

Example: `STEReo:DIRect "EON-PS=1000,Test 123"`
Sets the program service name for the EON with PI=1000 to "Test 123".

STEReo:DIRect "EON-PTY=<PI>,<PTY>"
STEReo:DIRect? "EON-PTY,<PI>"

Enhanced Other Networks: Sets the program type (PTY) for the EON with the selected <PI>.

Parameters:

<PI>   Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

Setting parameters:

<PTY>   Range: 00 to 31 (ASCII coded decimal numbers)

Example: `STEReo:DIRect "EON-PTY=1000,10"`
Sets the program type for the EON with PI=1000 to "10".

STEReo:DIRect "EON-TA=<PI>,<TA>"
STEReo:DIRect? "EON-TA,<PI>"

Enhanced Other Networks: Sets the TA flag for the EON with the selected <PI>.

Parameters:

<PI>   Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

Setting parameters:

<TA>   0 | 1

Example: `STEReo:DIRect "EON-TA=1000,1"`
Sets the TA flag for the EON with PI=1000 to "1".

STEReo:DIRect "EON-TP=<PI>,<TP>"
STEReo:DIRect? "EON-TP,<PI>"

Enhanced Other Networks: Sets the TP flag for the EON with the selected <PI>.

Parameters:

<PI>   Range: 0000 to FFFF (ASCII coded hexadecimal num-
                                        bers)

Setting parameters:

<TP>   0 | 1

Example: `STEReo:DIRect "EON-TP=1000,1"`
                        Sets the TP flag for the EON with PI=1000 to "1".

STEReo:DIRect "GS=<Group#1>,<Group#2>,...<Grpup#36>"
STEReo:DIRect? "GS"

Sets or reads the group sequence.

Note: Sends only group A **or** group B data at a time. Transmits only groups that con-
tain data. The groups 4A, 14B and 15B are automatically added to the group sequence
and must not be added or removed manually.

Setting parameters:

<Group>   0A,1A,2A, … to 15B

Example: `STEReo:DIRect "GS=0A,1B,10A,15A"`
                        The groups 0A, 1B, 10A and 15A are transmitted.

STEReo:DIRect "IMP=<x>"
STEReo:DIRect? "IMP"

(for documentation reasons only)

Sets external L, R impedances.

Use the SCPI command `[:SOURce]:STEReo:EXTernal:IMPedance` instead.

Setting parameters:

<x>   1 | 2

                            1
                            600 Ohms
                            2
                            100 kOhm

Example: `STEReo:DIRect "IMP=1"`
                        Sets the external impedance to 600 Ohms.

STEReo:DIRect
"MASK=<NumbGroups>,<ErrFreeGroups>,<BitMaskBlcA>,<BitMaskBlcB>,<BitMaskBlcC>,<BitMaskBlcD>"
STEReo:DIRect? "MASK"

Sets a bit mask to generate defined bit errors in the RDS data stream.

Setting parameters:

<NumbGroups>	Number of groups to be masked.
	If <NumbGroups> = 0, the RDS groups are continuously linked to the error mask.
	If <NumbGroups> ≠ 0, this value is decremented after each errored group transmitted. When zero count is reached, no further errored groups are transmitted, and STEReo:DIRect is set to "0".
	Range: 00 to FF (hexadecimal values)
<ErrFreeGroups>	Number of error-free groups to be inserted after each errored group.
	Range: 00 to FF (hexadecimal values)
<BitMaskBlc>	<BitMaskBlcA>,<BitMaskBlcB>,<BitMaskBlcC>,<BitMaskBlcD>
	Hexadecimal bit mask for blocks A, B, C and D of the RDS groups. For each block, 26 bits (16 data bits and 10 CRC bits) have to be entered in hexadecimal code.
	Range: 0000000 to 3FFFFFFF
Example:	STEReo:DIRect
	"MASK=09,01,0000001,0000000,0000000,0000000"
	In nine RDS groups, the least significant bit of the CRC code of block A is inverted, i.e. an errored bit is sent. After each errored group, one error-free group is inserted. After transmission of the complete sequence, MASK_STATE is set to "0".
	With the command MASK_STATE=1, the above sequence (9 errored groups with one error-free group inserted after each errored group) is retransmitted once.
	Then, MASK_STATE is again set to "0".

STEReo:DIRect "MASK_STATE=<State>"
STEReo:DIRect? "MASK_STATE"

Switches on or off the transmission of defined bit errors in the RDS data stream.

Setting parameters:

<State>	0	1

Example: `STEReo:DIRect "MASK_STATE=1"`

With the command `MASK_STATE=1`, a sequence of errored groups as defined by the `MASK` command is retransmitted once if the number of groups to be masked is other than zero. Then, `MASK_STATE` is automatically set to "0".

If the number of groups to be masked is equal to zero in the `MASK` command (which means continuous error transmission), the masking function can be switched off with `MASK_STATE=0`.

Example: `STEReo:DIRect? "MASK_STATE"`

Response: `"1"`

The `MASK_STATE` query provides information whether the RDS data stream is linked to an error mask.

STEReo:DIRect "MODE=<EMODE>"
STEReo:DIRect? "MODE"

(for documentation reasons only)

Sets one of various transmission modes.

Use the command `[:SOURce]:STEReo:AUDio:MODE` instead.

Setting parameters:

<EMODE>   1 | 2 | 3 | 4 | 5

1
L: Signal in left channel only

2
R: Signal in right channel only

3
Signal of equal frequency and phase in left and right channel

4
Signal of equal frequency and opposite phase in left and right channel

5
Different, independent signals in left and right channel
(5 is not possible if the internal LF generator is selected as source (SRC = LFGen)).

Example: `STEReo:DIRect "MODE=1"`
Only the signal of the left channel is transmitted.

STEReo:DIRect "MS=<Flag>"
STEReo:DIRect? "MS"

Sets or reads the music/speech flag.

The flag signals whether music or speech is being transmitted.

Setting parameters:

<Flag>   M | S

Example: STEReo:DIRect "MS=M"

The music/speech flag is set to "M", which signals that music is transmitted.

STEReo:DIRect "MPX-DEV=<Deviation>"
STEReo:DIRect? "MPX-DEV"

(for documentation reasons only)

Sets the MPX frequency deviation (max. deviation).

Use the the command [:SOURce]:STEReo[:DEViation] instead.

Setting parameters:

<Deviation>   **Note:** Always set a four-digit value. Leading zeros, if any, must also be specified.

Range: 00000 to 10000 (ASCII coded decimal numbers), corresponding to 0 Hz to 100 kHz

Example: STEReo:DIRect "MPX-DEV=00201"

Sets the MPX frequency deviation to 2.01 kHz.

STEReo:DIRect "PI=<PI>"
STEReo:DIRect? "PI"

Sets or reads the RDS program identification (PI) code.

Setting parameters:

<PI>   **Note:** Always set a four-digit value. Add leading zeros, if any.

Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

Example: STEReo:DIRect "PI=1234"

The program identification code to be transmitted is set to "1234".

STEReo:DIRect "PIL=<State>"
STEReo:DIRect? "PIL"

(for documentation reasons only)

Activates/deactivates the pilot tone.

Use the command [:SOURce]:STEReo:PILot:STATe instead.

Setting parameters:

<State>   0 | 1

Example: STEReo:DIRect "PIL=1"

The pilot tone is activated.

STEReo:DIRect "PIL-DEV=<Deviation>"
STEReo:DIRect? "PIL-DEV"

(for documentation reasons only)

Sets the pilot tone frequency deviation (max. deviation).

Use the command [:SOURce]:STEReo:PILot[:DEViation] instead.

Setting parameters:

<Deviation>	**Note:** Always set a four-digit value. Add leading zeros, if any.
	Range: 0000 to 1000 (ASCII coded decimal numbers), corresponding to 0 Hz to 10 kHz

Example:	STEReo:DIRect "PIL-DEV=1000"
	Sets the frequency deviation of the pilot tone to 10 kHz.

STEReo:DIRect "PIL-PH=<Phase>"
STEReo:DIRect? "PIL-PH"

(for documentation reasons only)

Sets the pilot tone phase.

Use the command [:SOURce]:STEReo:PILot:PHASe instead.

Setting parameters:

<Phase>	**Note:** Always set a two-digit value with a sign ("+" or "-") in front of it. Add leading zeros, if any.
	Range: -5.0 to +5.0 (ASCII coded decimal numbers), corresponding to ±5.0

Example:	STEReo:DIRect "PIL-PH=-33"
	Sets the pilot tone phase.

STEReo:DIRect "PRE=<Preemphasis>"
STEReo:DIRect? "PRE"

(for documentation reasons only)

Sets one of various preemphasis options.

Use the commands [:SOURce]:STEReo:AUDio:PREemphasis:STATe and [:SOURce]:STEReo:AUDio:PREemphasis instead.

Setting parameters:

<Preemphasis>	0 | 1 | 2
	0
	Off
	1
	50 us
	2
	75 us

Example: `STEReo:DIRect "PRE=1"`
                       The preemphasis is set to 50 us.

STEReo:DIRect "PRESET"

Sets the default settings in accordance with specifications.

Example: `STEReo:DIRect "PRESET"`

Usage: Event

STEReo:DIRect "PS=<PS>"
STEReo:DIRect? "PS"

Sets or reads the RDS program service (PS) name.

Setting parameters:

<PS>   8 ASCII characters

                       Note: Always set an eight-digit value. Blank spaces, if any, must also be entered.
                       Special characters in the program service name are entered with a leading back slash (\) followed by the decimal code of the special character according to table E1 of CENELEC.

Example: `STEReo:DIRect "RT=02,0,test text with \217"`
                       Sets the program service name. 217 denotes the German letter ü.

STEReo:DIRect "PS-TABLE=<Table>"
STEReo:DIRect? "PS-TABLE"

Selects the character set table used for the display of the RDS program service (PS) name in the receiver.

The information concerning the character set is transmitted in segment 0 of the PS. Segment 0 is repeatedly transmitted if the value for `PS-TABLE` > 0. For `PS-TABLE` = 0 no information concerning the character set is transmitted.

Setting parameters:

<Table>   0 | 1 | 2 | 3

                       0
                       No information concerning the character set table in the PS

                       1
                       Table E.1 is used.

                       2
                       Table E.2 is used.

                       3
                       Table E.3 is used.

Example: STEReo:DIRect "PS-TABLE=2"

The information concerning the character set is transmitted in segment 0 of the PS in group 0A. To this end, segment 0 is transmitted repeatedly. At the first transmission segment 0 contains the information about the character set, at the second transmission segment 0 contains the first two characters of the PS.

STEReo:DIRect "PTY=<PTY>"
STEReo:DIRect? "PTY"

Sets or reads the program type (PTY).

Setting parameters:

<PTY>   **Note:** Always set a two-digit value. Add leading zero, if any.

Range: 00 to 31 (ASCII coded decimal numbers)

Example: STEReo:DIRect "PTY=08"
Sets the program type.

STEReo:DIRect "PTYN=<PTYN>"
STEReo:DIRect? "PTYN"

Sets or reads the RDS program type (PTY) name.

Setting parameters:

<PTYN>   8 ASCII characters

Note: Always set an eight-digit value. Add blank spaces, if any.

Example: STEReo:DIRect "PTYN=Football"
Sets the program type name.
STEReo:DIRect "GS=0A,10A"
Group 10A is activated in addition to group 0A.
The specified program type name is transmitted.

STEReo:DIRect "RDS=<State>"
STEReo:DIRect? "RDS"

(for documentation reasons only)

Switches RDS on or off.

Use the command [:SOURce]:STEReo:RDS:STATe instead.

Setting parameters:

<State>   0 | 1

Example: STEReo:DIRect "RDS=1"
Activates RDS.

STEReo:DIRect "RDS-PH=<Phase>"
STEReo:DIRect? "PDS-PH"

Sets the RDS phase.

Setting parameters:

<Phase>   Range: 000 to 359 (ASCII coded decimal numbers)

Example: STEReo:DIRect "RDS-PH=100"
                        Sets the RDS phase.

STEReo:DIRect "RDS-DEV=<Deviation>"
STEReo:DIRect? "RDS-DEV"

(for documentation reasons only)

Sets the RDS frequency deviation (max. deviation).

Use the command [:SOURce]:STEReo:PILot[:DEViation] instead.

Setting parameters:

<Deviation>   **Note:** Always set a four-digit value. Add leading zeros, if any.

                        Range: 0000 to 1000 (ASCII coded decimal numbers),
                                     corresponding to 0 Hz to 10.00 kHz)

Example: STEReo:DIRect "RDS-DEV=0201"
                        Sets the RDS frequency deviation to 2.01 kHz.

STEReo:DIRect "RDS-PRESET"

All RDS-specific parameters are deleted or set to default values.

Example: STEReo:DIRect "RDS-PRESET"
                        Sets all RDS parameter to their preset values.

Usage: Event

STEReo:DIRect "RT=<RetranNumber>,<A/
      BFlag>,<RadioTextMsg#1>,<RadioTextMsg#2>"
STEReo:DIRect? "RT"

Sets a flag signaling the transmission of new radio text and the message of the radio text.

Setting parameters:

<RetranNumber>   Range: 00 to 15 (ASCII coded decimal numbers), number
                                     of retransmissions of radio text message

<A/BFlag>   0 | 1
                        If the A/B flag is set, the A/B bit in group 2A is toggled to signal
                        that a new radio text message is transmitted.

<RadioTextMsg>	Max. 64 characters
	Two texts of 64 characters each can be transmitted in a radio text message. **Note:** For group B, the length of a radio text is limited to 32 characters. Special characters in the radio text are entered with a leading back slash (\) followed by the decimal code of the special character according to table E1 of CENELEC.
Example:	`STEReo:DIRect "RT=02,0,test text with \217"` Sets the radio text message. 217 denotes the German letter ü.

STEReo:DIRect "SPS=<Time>,<PSN#1>,<PSN#2>,...<PSN#20>"
STEReo:DIRect? "SPS"

Switches program service names (PSN). The program service name automatically changes after the set time interval.

Parameters:

<PSN>	8 ASCII characters
	Max. 20 program service names of eight characters each can be entered. **Note:** Enter the program service names as 8-digit texts. Add blank spaces, if any. `STEReo:DIRect "SPS=0"` stops the transmission of the scrolling PS and starts the transmission of the standard PS.

Setting parameters:

<Time>	Time interval in seconds
	Range: 00 to 59 s
Example:	`STEReo:DIRect "SPS=05,TEST0123,TEST4567"` Transmitts the program service names "TEST0123" and "TEST4567" alternately, each 5 seconds.

STEReo:DIRect "SRC=<SigSource>"
STEReo:DIRect? "SRC"

(for documentation reasons only)

Selects the signal source.

Use the command `[:SOURce]:STEReo:SOURce` instead.

Setting parameters:

<SigSource>	0 | 1 | 2 | 3
	0 Off
	1 External analog (via L and R inputs)
	2 External digital

3
Internal with LF generator

Example:	STEReo:DIRect "SRC=1"
	Selects the external analog L and R inputs as source.

STEReo:DIRect? "STATUS"

Status request whether the encoder or the update loader program is being executed.

Return values:

<Status>	**ENC**
	Encoder program is running.
	UPL
	Update loader program is running.
Example:	STEReo:DIRect? "STATUS"
	Response: "ENC"
Usage:	Query only

STEReo:DIRect "STORE=<DataSet#>"

Saves data in the flash memory. All RDS-specific settings are stored in data set <DataSet#> of the flash memory.

Setting parameters:

<DataSet#>	Range:	1 to 5
Example:	STEReo:DIRect "STORE=1"	
	Current setting are saved as data set 1.	
Usage:	Setting only	

STEReo:DIRect "TA=<State>"
STEReo:DIRect? "TA"

(for documentation reasons only)

Sets or reads the traffic announcement flag.

This flag signals whether traffic information is being broadcast.

Use the command [:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe] instead.

Setting parameters:

<State>	0	1
Example:	STEReo:DIRect "TA=1"

STEReo:DIRect "TP=<State>"
STEReo:DIRect? "TP"

(for documentation reasons only)

Sets or reads the traffic program flag. This flag signals whether traffic information is transmitted.

Use the command `[:SOURce]:STEReo:RDS:TRAFfic:PROGram[:STATe]` instead.

Setting parameters:

<State>	0 | 1

Example: STEReo:DIRect "TP=1"

STEReo:DIRect "TRANS<DataNumber>=<DataStream>"
STEReo:DIRect? "TRANS<DataNumber>"

Transparent mode.

An RDS data stream of binary data is generated. If transparent data is selected, all other RDS data is ignored.

Parameters:

<DataNumber>	Max. 20 different data sequences can be defined.
	Range: 0 to 13
<DataStream>	16 ASCII coded hexadecimal characters (blocks A to D of the RDS groups)
	TRANS=0 deletes all transparent data and switches back to normal RDS data transmission.
	Note: 16 characters must be specified for each data sequence. Leading zeros, if any, must also be specified. Transmitts the data even if it constitutes no meaningful RDS data.

Example: STEReo:DIRect "TRANS1=0123456789ABCDEF"
Sends the data "0123456789ABCDEF" instead of the RDS data.

13 Maintenance

The instrument does not need periodic maintenance. Only the cleaning of the instrument is essential.

Follow the instructions in the service manual and the safety instructions when exchanging modules or ordering spares. The order no. for spare parts is included in the service manual. The service manual includes further information particularly on troubleshooting, repair, exchange of modules and alignment.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

NOTICE

Risk of damage during shipment

Insufficient protection against mechanical and electrostatic effects during shipment can damage the instrument.

- When shipping an instrument, use the original packaging. If you do not have the original packaging, use sufficient padding to prevent the instrument from moving around inside the box.
- Pack the instrument in antistatic wrap to protect it from electrostatic charging.
- Secure the instrument to prevent any movement and other mechanical effects during transportation.

13.1 Cleaning

⚠ WARNING

Risk of electric shock

If moisture enters the casing, for example if you clean the instrument using a moist cloth, contact with the instrument can lead to electric shock. Before cleaning the instrument other than with a dry cloth, make sure that the instrument is switched off and disconnected from all power supplies.

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances such as solvents (thinners, acetone, etc.), acids, bases, or other substances. Solvents can damage the front panel labeling, plastic parts, or screens, for example.

Never use cleaning agents to clean the outside of the instrument. Use a soft, dry, lint-free dust cloth instead.

NOTICE

Risk of instrument damage due to obstructed fans

If the instrument is operated in dusty areas, the fans become obstructed by dust or other particles over time. Check and clean the fans regularly to ensure that they always operate properly. If the instrument is run with obstructed fans for a longer period, the instrument overheats, which can disturb the operation and even cause damage.

---

1. Clean the outside of the instrument using a soft, dry, lint-free dust cloth.

2. Check and clean the fans regularly to ensure that they always operate properly.

3. Clean the touchscreen as follows:

   a) Apply a small amount of standard screen cleaner to a soft cloth.
   b) Wipe the screen gently with the moist, but not wet, cloth.
   c) If necessary, remove any excess moisture with a dry, soft cloth.

13.2 Storing and Packing

The storage temperature range of the instrument is given in the data sheet. If the instrument is to be stored for a longer period of time, it must be protected against dust.

Repack the instrument as it was originally packed when transporting or shipping. The two protective foam plastic parts prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.

If you do not use the original packaging, use a sturdy cardboard box of suitable size and provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electro-static charging.

13.3 Performing Maintenance Tasks

The R&S SMB100B is accurate due to integrated adjustment procedures, which you can execute directly on the instrument.

Internal Adjustments

NOTICE

Risk of invalid adjustment

Wait until the instrument has reached its operating temperature before you start the adjustment procedure. The warm-up time is 30 minutes.

Self-calibration routines that require additional (external) equipment are performed at an authorized Rohde & Schwarz service center.

See also "Protection levels" on page 237.

When to perform adjustments?

We recommend that you perform internal adjustments in the following cases:

- Before starting any application, that requires a maximum of level and frequency 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
- When changing the frequency setting

Additional Information to the Adjustments

During adjustments, a progress indicator shows the status of the process. If any error occurs, the process aborts and an error message appears in the info line.

The extent of the adjustments depends on the installed options.

13.3.1 Date and Time Settings

The R&S SMB100B 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.

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.

The required remote commands are described in Chapter 12.15, "SYSTem Subsystem", on page 460.

To select the timezone

1. Press the [Setup] key.

2. Select "Maintenance > Date /Time > Timezone".

3. 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.

4. Close the dialogs.

   The instrument adjusts the time according to the selected location.

To set the date and time

1. Press the [Setup] key.

2. Select "Security > Protection".

3. Enable the "Protection Level 1".
   The default password is *123456*.

4. Select "Setup > Maintenance > Date / Time".

5. Adjust the settings.

6. Close the dialogs.

   The instrument adopts the new date and time.

Settings:

Date
Displays the date set in the operating system in the format [dd.mm.yyyy].

Remote command:
:SYSTem:DATE on page 480

Time
Displays the time set in the operating system in the format [hh.mm.ss].

The time setting corresponds to the selected Use Time from NTP Server.

Remote command:
:SYSTem:TIME on page 481

Timezone
Selects the timezone.

You can select the timezone according to the major cities on the respective continents.

Note: By typing the first letter, you can quickly navigate through the lists to find the desired destination.

Remote command:
:SYSTem:TIME:ZONE on page 482
:SYSTem:TIME:ZONE:CATalog? on page 482

NTP Address
Sets the IP address or host name of the NTP server.

NTP is a network time protocol used for synchronizing all participating devices in a data network.

You can select a high-precision time server to reduce the impact of varying network delays.

Remote command:
:SYSTem:NTP:HOSTname on page 481

Use Time from NTP Server
Activates clock synchronization of the network via the NTP protocol.

Remote command:
:SYSTem:NTP:STATe on page 481

13.3.2 Check Front Panel

Within this dialog, you can verify the functionality of the control keys.

For Instructions on how to perform the tests and the expected results, see Chapter 13.3.2.2, "How to Test the Front Panel", on page 520

In case of malfunctions:

Contact the Rohde & Schwarz customer support, see Chapter 14.6, "Collecting Information for Technical Support", on page 535.

Accessing the online help in the check front panel dialog or exiting via [Esc]

During the test, the actual functions of all keys are disabled, including the [Help] and the [Esc] keys.

13.3.2.1 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.

13.3.2.2 How to Test the Front Panel

How to perform the key panel test

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 prop-

erly, 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. Press the [Setup] key.

2. Select "Maintenance > Check Front Panel"
   The "Check Front Panel" dialog opens.

3. Press a key on the front panel.
   Check if the corresponding key in the "Check Front Panel" dialog turns green.

4. 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, see Press the ESC key a third time.

5. Continue with the next key on the front panel and repeat step 3 to step 5 until all keys are tested.

   The test is completed, when each key is verified successfully, confirmed by a "Test passed" message.

► Press the [Esc] key a third time.
   Exits the "Check Front Panel" dialog.

Expected responses:
● Pressing a key once (green), pressing twice (red)
● Pressing the [Esc] key a third time exits the dialog.

If you detect a malfunction, for example, you press the front panel key the first time, and the color of the button in the dialog turns red (instead of green), the front panel key may be stuck.

Contact the Rohde & Schwarz customer support, see Chapter 14.6, "Collecting Information for Technical Support", on page 535.

How to perform the touchscreen test

1. Press the [Setup] key.

2. Select "Maintenance > Check Touch Panel"
   The "Finger Paint" test window opens.

3. 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].

   If there are malfunctions:
   Contact the Rohde & Schwarz customer support, see Chapter 14.6, "Collecting Information for Technical Support", on page 535.

13.3.3 Internal Adjustment 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 remote commands required to define these settings are described in Chapter 12.6, "CALibration Subsystem", on page 327.

The background color of "Temperature Offset" depends on the deviation of the temperature at the beginning of the adjustment, compared to the last adjustment. We recommend that you perform internal adjustments if the instrument is warmed up, but depending on instrument usage, less than 30 minutes are sufficient.

Further functions and individually targeted calibration routines are also available but password-protected.

● Calibration routines
  Self-calibration routines that require additional (external) equipment are performed in the Rohde & Schwarz service center.
  These functions are password-protected and require higher-level protection password, see "Protection levels" on page 237

For more information, see R&S SMB100B Service Manual.

Adjust All

Performs all available internal calibration routines of the instrument.

Remote command:
:CALibration:ALL[:MEASure]? on page 328

Last Full Adjustment
Displays the date of the last fully performed adjustment.

Remote command:
:CALibration<hw>:ALL:DATE? on page 328

Time Since Last Full Adjustment
Displays the elapsed time since the last full adjustment.

Remote command:
:CALibration<hw>:ALL:TIME? on page 329

Temperature Offset Since Last Full Adjustment
Displays the temperature difference, comparing the temperature at the beginning of the last adjustment to the temperature at the beginning of the present adjustment.

If the temperature deviates more than ± 5 K, the background of the parameter turns yellow.

Remote command:
:CALibration<hw>:ALL:TEMP? on page 329

Information
Displays information to the current adjustment state.

Remote command:
:CALibration<hw>:ALL:INFormation? on page 328

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 329

13.3.4 FPGA/uC Update Settings

Access:

► Select "System Config > Setup > Maintenance > FPGA/µC Update".

This dialog enables you to check for and install internal assembly updates.

Settings:

Check For Updates
Check for updates of the FPGA/µC.

Remote command:
n.a.

Assembly
The table shows the installed assemblies and their states.

"Assembly"   Assembly designation.

"State"   Indicates the current state of installed assemblies.

Install
Install all available updates for the FPGA/µC.

Remote command:
n.a.

Shut down
For at least one assembly "State = Done" and no pending assemblies, shuts the instrument down to applies installed updates.

Remote command:
:SYSTem:SHUTdown on page 484

13.3.5 Requesting Instrument Configuration and Specifications

The R&S SMB100B is equipped with various hardware and software components. To get an overview of what your instrument is equipped with, you can request the assemblies, hardware and software options, and the firmware version. The components are structured according to the hardware configuration, software options, including the license management, and externally used Rohde & Schwarz equipment, like R&S NRP power sensors.

Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. How to install options is described in chapter 4 of the R&S SMB100B service manual.

The installation of hardware options purchased at a later stage is also described in chapter 4 of the service manual. Most of the hardware options have to be installed at an authorized Rohde & Schwarz service center.

13.3.5.1 Hardware Configuration Settings

Access:

► Select "System Config > Setup > Instrument Assembly > Hardware Config".

The "Hardware Config" dialog lists all installed assemblies and externally connected instruments with information on their part and serial numbers, and revision states. The BIOS version is also listed; firmware updates do not update the BIOS version.
The dialog is divided in tabs, according to the hardware components of the signal domains. The "Counter" tab provides information on the operation time and number of times the instrument was powered on.

The remote commands required to query the hardware configuration are described in Chapter 12.7, "DIAGnostic Subsystem", on page 330.

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 331

Counter

Displays information on the operation times of the R&S SMB100B.

Operation Time / h ← Counter

Displays the operation time in hours.

Remote command:
n.a.

Power On Count ← Counter

Displays the number of power-on.

Remote command:
n.a.

Last Factory Calibration ← Counter

Displays the date of the last factory calibration.

Remote command:
:CALibration:DATA:FACTory:DATE? on page 329

13.3.5.2   Versions/Options Settings

Access:

► Select "System Config > Setup > Instrument Assembly > Versions / Options".

Package	Version	
FW	4.20.044	
Service Pack	not installed	
Bios Version	VirtualBox	

Downgrade Info:

Package	Version	
Factory Version	4.20.044	
Min. Version	4.00.016.00	

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.

Show Open Source Acknowledgements

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

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.

See www.rohde-schwarz.com/firmware/smb100b

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.

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. Some options are available as trial versions. This column shows their expiration date. After this date, the option is no longer available on the instrument.

Remote command:
*OPT? on page 313
*IDN? on page 312

Versions

The "Versions" tab shows the versions of the technical specification of the R&S SMB100B and of the software components that comprise the firmware.

"Package"   Name of the component.

"Version"   Current issue of the component.
                   E.g. the data sheet covers the technical data of the hardware components of the factory settings.
                   See also "Data Sheet" on page 278.

Remote command:
:SYSTem:SPECification:VERSion:FACTory? on page 480

13.3.5.3 Requesting the Data Sheet

You can access data sheet realted inforamtion vie the LXI web browser, see "Data Sheet" on page 278.

14 Troubleshooting and Error Messages

The R&S SMB100B distinguishes between various messages such as status messages, error messages, warnings, or information that are displayed in the "Info" line on the screen, and also entered in the error/event queue of the status reporting system.

This section describes the types of error messages and warnings. The status reporting system is described in detail in Chapter A.1.5, "Status Reporting System", on page 550.

You can also access an Info window with detailed information about all messages in a history list. For details, see Chapter 14.4, "Querying Error Messages", on page 532

14.1 Error Messages

Error messages indicate errors in the instrument. They are displayed in different colors depending on their importance and display duration. Errors (e.g. no calibration data) are displayed in red, information (e.g. file not found) and warnings in black. Warnings indicate less significant errors (e.g. the instrument operates outside specified data).

Some error messages require that the error must be eliminated before correct instrument operation can be ensured. To access the "Info" dialog with a list of current messages and a detailed description of each message, select "Info".

In the remote control mode, error messages are entered in the error/event queue of the status reporting system and can be queried with the command SYSTem:ERRor?. If the error queue is empty, 0 ("No error") is returned.

14.1.1 Volatile Messages

Volatile messages report automatic settings in the instrument (e.g. switching off incompatible types of modulation) or on illegal entries that are not accepted by the instrument (e.g. range violations). They are displayed in the info line on a yellow background. They are displayed on top of status information or permanent messages.

Volatile messages do not normally demand user actions and disappear automatically after a brief period of time. They are stored in the history, however.

Remote command:

:SYSTem:ERRor:ALL? or

:SYSTem:ERRor:CODE[:NEXT]?

14.1.2 Permanent Messages

Permanent messages are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signaled by a permanent message 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-Error Messages

The SCPI error messages are the same in all SCPI instruments. Detailed information and an overview of all error messages as defined in SCPI standard can be found in the corresponding documentation.

SCPI errors 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 as to the respective error.

14.3 Device-Specific Error Messages

The following table contains all error messages specific for the instrument in alphabetical order, as well as 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	Extern reference out of range or disconnected	External reference is selected but no external signal is applied or the signal is out of range.	• Check the selected reference signal source (internal or external) in the "Setup > Reference Oscillator" dialog. • Change setting to 'internal' if no appropriate external source is available.
140	This modulation forces other modulations off	A modulation has been switched on which cannot be used at the same time as an already active modulation. The previous modulation has been switched off.	
180	Adjustment failed	Adjustment could not be executed	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

Error Code	Error	Description	Remedy
183	Adjustment data invalid	Adjustment data is invalid and must be restored.	Generate the adjustment data and load it into the device
200	Cannot access hardware	The data transmission to a module was unsuccessful.	The module is not installed, not properly installed or missing.
201	Hardware revision out of date	A later version of certain parts of the instrument is necessary to execute the function selected.	The driver does not support the installed version of a module.
202	Cannot access the EEPROM	An error occurs when writing or reading a EEPROM.	The EEPROM is possibly defect. Replace it.
203	Invalid EEPROM data	Reading a EEPROM is possible, however 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 selected. To execute the required operation, a list has to be selected in the related dialog. If no list is available, a new list must be created.	
242	Unknown list type specified	The list type selected is not valid for the required operation.	Check the selected list type.
460	Cannot open the file	The selected file cannot be opened.	Check the path and file name.
461	Cannot write file	The file cannot be written.	Check if the file is read-only.
462	Cannot read file	The file cannot be read.	Check if the file contents are compatible with the file type.
463	Filename missing	The required operation cannot be executed because the file name is not specified.	Enter file name when creating list.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extension.
465	File contains invalid data	The selected file contains data that is not valid for the file type. The file extension determines the data that is valid for this file type. If the file extension is changed, the lists are no longer recognized and the data is therefore invalid.	Check the file extension.

14.4 Querying Error Messages

The R&S SMB100B monitors the functions performed and automatically detects errors and irregularities. The instrument displays the messages in the "Info" line and records them in the background with a detailed description.

Find details to the system messages in Chapter 14, "Troubleshooting and Error Messages", on page 530.

To display information on static errors and error history

1. In the taskbar, select the "Info" icon.

2. For some messages, the information line appears briefly on the home screen.
   To open the dialog, in the "Info" line select the "Info" button.

- The "Static Errors" dialog lists the last monitored messages chronologically and displays additional information on the highlighted message.
- The "Error History" dialog lists the accumulated messages with a short description.
  Volatile errors are reported once, at the time they appear. If identical errors occur subsequently, they are not reported repeatedly.
  In the "Info" line, identical errors are displayed repeatedly only if the original error has already disappeared from the display. If queried by SCPI command, identical errors are only reported if the original error has already been retrieved from (and hence not any more present in) the error queue.

> **Indication and handling of permanent messages**
>
> If any critical error occurs, the R&S SMB100B automatically shows the ⚠ icon in the taskbar. Select the icon to obtain information on the error and the number of occurrences.
>
> The icon is assigned to permanent messages. The message and icon are displayed until the error is eliminated.

Static Errors/Error History

Toggles between "Static" and "History" view of the info dialog.

Remote command:
`:SYSTem:ERRor[:NEXT]?` on page 465
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 466
Queries the list of all errors.

Clear History

Clears all messages in the "History" view.

Remote command:
`:SYSTem:ERRor:ALL?` on page 463
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 465
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 SMB100B and certain switches or routers available on the market
● An invalid IP address assigned to the instrument

Possible solutions

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses

Errors can affect the entire network.

- Check the network infrastructure. Exchange connecting cables if obvious damage is visible.
- Observe the link status LED on the R&S SMB100B or the connected network device. The link status LED is located next to the LAN connector.
  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. See Chapter 10.4.3, "Configuring LAN Services", on page 245.
- Check whether the IP address of the instrument is within the network's address range.
  (See also "IP Address" on page 265).
  Check whether IP addresses that were set manually or obtained via the Zeroconf (APIPA) protocol are valid.

14.6 Collecting Information for Technical Support

If you encounter problems that you cannot solve yourself, contact your Rohde & Schwarz support center as listed at http://www.customersupport.rohde-schwarz.com. 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

- `SystemRestaurationSMB100B.savrcltxt`: 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, "Error Messages", on page 530.

To collect error information in a support file

1. Connect a USB device to the R&S SMB100B.

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 `RSSupport_DeviceInfo`.

The error information and further required data is collected automatically.
The support file `RSSupport_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 for your region as listed on the Internet (http://www.customersupport.rohde-schwarz.com).

To remove sensitive data

► For information on how to handle or remove the sensitive data from your instrument, refer to the description "Resolving Security Issues when working with R&S SMB100B".

Packing and transporting the instrument

► If the instrument has to be transported or shipped, observe the notes described in Chapter 3.1.1.2, "Unpacking and Checking the Instrument", on page 21.

Annex

A Reference Information for Remote Control

A.1 Additional Basics on Remote Control

This section provides basic information using the remote control.

A.1.1 Messages

The messages transferred on the data lines are divided into the following categories:

- Interface messages
  Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They are used to communicate between the controller and the instrument. Interface messages can only be sent by instruments that have GPIB bus functionality. For details see the sections for the required interface.

- Instrument messages
  Instrument messages are employed in the same way for all interfaces, if not indicated otherwise in the description. Structure and syntax of the instrument messages are described in Chapter A.1.3, "SCPI Command Structure", on page 539. A detailed description of all messages available for the instrument is provided in the chapter "Remote Control Commands".
  There are different types of instrument messages, depending on the direction they are sent:
  - Commands
  - Instrument responses

Commands

Commands (program messages) are messages the controller sends to the instrument. They operate the instrument functions and request information. The commands are subdivided according to two criteria:

- According to the effect they have on the instrument:
  - **Setting commands** cause instrument settings such as a reset of the instrument or setting the frequency.
  - **Queries** cause data to be provided for remote control, e.g. for identification of the instrument or polling a parameter value. Queries are formed by directly appending a question mark to the command header.

- According to their definition in standards:
  - **Common commands**: their function and syntax are precisely defined in standard IEEE 488.2. They are employed identically on all instruments (if implemented). They refer to functions such as management of the standardized status registers, reset and self-test.

   – **Instrument control commands** refer to functions depending on the features of the instrument such as frequency settings. Many of these commands have also been standardized by the SCPI committee. These commands are marked as "SCPI confirmed" in the command reference chapters. Commands without this SCPI label are device-specific; however, their syntax follows SCPI rules as permitted by the standard.

Instrument responses

Instrument responses (response messages and service requests) are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status.

A.1.2 LAN Interface Messages

In the LAN connection, the interface messages are called low–level control messages. These messages can be used to emulate interface messages of the GPIB bus.

Command	Long term	Effect on the instrument
&ABO	Abort	Aborts processing of the commands just received.
&DCL	Device Clear	Aborts processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
&GTL	Go to Local	Transition to the "local" state (manual control). (The instrument automatically returns to remote state when a remote command is sent UNLESS &NREN was sent before.)
&GTR	Go to Remote	Enables automatic transition from local state to remote state by a subsequent remote command (after &NREN was sent).
&GET	Group Execute Trigger	Triggers a previously active instrument function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
&LLO	Local Lockout	Disables transition from remote control to manual control by means of the front panel keys.
&NREN	Not Remote Enable	Disables automatic transition from local state to remote state by a subsequent remote command. (To re-activate automatic transition use &GTR.)
&POL	Serial Poll	Starts a serial poll.

A.1.3 SCPI Command Structure

SCPI commands consist of a header and, in most cases, one or more parameters. The header and the parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several mnemonics (keywords). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common commands). Common and device-specific commands differ in their syntax.

A.1.3.1 Syntax for Common Commands

Common (= device-independent) commands consist of a header preceded by an asterisk (*), and possibly one or more parameters.

Table A-1: Examples of common commands

*RST	RESET	Resets the instrument.
*ESE	EVENT STATUS ENABLE	Sets the bits of the event status enable registers.
*ESR?	EVENT STATUS QUERY	Queries the contents of the event status register.
*IDN?	IDENTIFICATION QUERY	Queries the instrument identification string.

A.1.3.2 Syntax for Device-Specific Commands

Not all commands used in the following examples are necessarily implemented in the instrument. For demonstration purposes only, assume the existence of the following commands for this section:

- `DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`
- `FORMat:READings:DATA <type>[,<length>]`
- `HCOPy:DEVice:COLor <Boolean>`
- `HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`
- `HCOPy[:IMMediate]`
- `HCOPy:ITEM:ALL`
- `HCOPy:ITEM:LABel <string>`
- `HCOPy:PAGE:DIMensions:QUADrant[<N>]`
- `HCOPy:PAGE:ORIentation LANDscape | PORTrait`
- `HCOPy:PAGE:SCALe <numeric value>`
- `MMEMory:COPY <file_source>,<file_destination>`
- `SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
- `SENSe:FREQuency:STOP <numeric value>`
- `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

HCOPy:DEVice:COLor ON is equivalent to HCOP:DEV:COL ON.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric Suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:

Definition: HCOPy:PAGE:DIMensions:QUADrant[<N>]

Command: HCOP:PAGE:DIM:QUAD2

This command refers to the quadrant 2.

Different numbering in remote control

For remote control, the suffix may differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. If the numbering differs in manual operation and remote control, it is indicated for the corresponding command.

Optional Mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: HCOPy[:IMMediate]

Command: HCOP:IMM is equivalent to HCOP

🛈 **Optional mnemonics with numeric suffixes**

Do not omit an optional mnemonic if it includes a numeric suffix that is relevant for the effect of the command.

Example:

Definition:`DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`

Command: `DISP:MAX ON` refers to window 1.

In order to refer to a window other than 1, you must include the optional `WINDow` parameter with the suffix for the required window.

`DISP:WIND2:MAX ON` refers to window 2.

A.1.3.3   SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank).

The parameters required for each command and the allowed range of values are specified in the command description.

Allowed parameters are:

Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed.

Example:

`SENS:FREQ:STOP 1500000` = `SENS:FREQ:STOP 1.5E6`

Units

For physical quantities, the unit can be entered. If the unit is missing, the basic unit is used. Allowed unit prefixes are:

- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)

- N (nano)

Example:

SENSe:FREQ:STOP 1.5GHz **=** SENSe:FREQ:STOP 1.5E9

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the PCT string.

Example:

HCOP:PAGE:SCAL 90PCT

Special Numeric Values

The following mnemonics are special numeric values. In the response to a query, the numeric value is provided.

- **MIN and MAX**: denote the minimum and maximum value.
- **DEF**: denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command.
- **UP and DOWN**: increases or reduces the numeric value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP and DOWN.
- **INF and NINF**: INFinity and negative INFinity (NINF) represent the numeric values 9.9E37 or -9.9E37, respectively. INF and NINF are only sent as instrument responses.
- **NAN**: Not A Number (NAN) represents the value 9.91E37. NAN is only sent as a instrument response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Example:

Setting command: SENSe:LIST:FREQ MAXimum

Query: SENS:LIST:FREQ?

Response: 3.5E9

ℹ️ **Queries for special numeric values**

The numeric values associated to MAXimum/MINimum/DEFault can be queried by adding the corresponding mnemonic after the quotation mark.

Example: SENSe:LIST:FREQ? MAXimum

Returns the maximum numeric value as a result.

Boolean Parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The numeric values are provided as the response for a query.

Example:

Setting command: `HCOPy:DEV:COL ON`

Query: `HCOPy:DEV:COL?`

Response: `1`

Text Parameters

Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the response to a query, the short form of the text is provided.

Example:

Setting command: `HCOPy:PAGE:ORIentation LANDscape`

Query: `HCOP:PAGE:ORI?`

Response: `LAND`

Character Strings

Strings must always be entered in quotation marks (' or ").

Example:

`HCOP:ITEM:LABel "Test1"`
`HCOP:ITEM:LABel 'Test1'`

Block Data

Block data is a format which is suitable for the transmission of large amounts of data. For example, a command using a block data parameter has the following structure:

`FORMat:READings:DATA #45168xxxxxxxx`

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted.

#0 specifies a data block of indefinite length. The use of the indefinite format requires a `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

A.1.3.4 Overview of Syntax Elements

The following tables provide an overview of the syntax elements and special characters.

Table A-2: Syntax elements

:	The colon separates the mnemonics of a command.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk marks a common command.
'' ""	Quotation marks introduce a string and terminate it (both single and double quotation marks are possible).
#	The hash symbol introduces binary, octal, hexadecimal and block data. • Binary: #B10110 • Octal: #O7612 • Hexa: #HF3A7 • Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

Table A-3: Special characters

		Parameters
|	A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used. Example: Definition:`HCOPy:PAGE:ORIentation LANDscape	PORTrait`   Command `HCOP:PAGE:ORI LAND` specifies landscape orientation   Command `HCOP:PAGE:ORI PORT` specifies portrait orientation **Mnemonics** A selection of mnemonics with an identical effect exists for several commands. These mnemonics are indicated in the same line; they are separated by a vertical stroke. Only one of these mnemonics needs to be included in the header of the command. The effect of the command is independent of which of the mnemonics is used. Example: Definition`SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>` The two following commands with identical meaning can be created: `SENS:BAND:RES 1` `SENS:BWID:RES 1`
[ ]	Mnemonics in square brackets are optional and may be inserted into the header or omitted. Example: `HCOPy[:IMMediate]` `HCOP:IMM` is equivalent to `HCOP`

{ }	Parameters in curly brackets are optional and can be inserted once or several times, or omitted.
	
	Example: `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`
	
	The following are valid commands:
	
	`SENS:LIST:FREQ 10`
	
	`SENS:LIST:FREQ 10,20`
	
	`SENS:LIST:FREQ 10,20,30,40`

A.1.3.5   Structure of a Command Line

A command line may consist of one or several commands. It is terminated by one of the following:

- <New Line>
- <New Line> with EOI
- EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";".

Example:

`MMEM:COPY "Test1","MeasurementXY";:HCOP:ITEM ALL`

This command line contains two commands. The first command belongs to the MMEM system, the second command belongs to the HCOP system. If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

`HCOP:ITEM ALL;:HCOP:IMM`

This command line contains two commands. Both commands are part of the `HCOP` command system, i.e. they have one level in common.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. When abbreviating the command line, the second command begins with the level below HCOP. The colon after the semi-colon is omitted. The abbreviated form of the command line reads as follows:

`HCOP:ITEM ALL;IMM`

Example:

`HCOP:ITEM ALL`

`HCOP:IMM`

A new command line always begins with the complete path.

A.1.3.6   Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

- The requested parameter is transmitted without a header.
  Example: `HCOP:PAGE:ORI?`, Response: `LAND`

- Maximum values, minimum values and all other quantities that are requested via a special text parameter are returned as numeric values.
  Example: `SENSe:FREQuency:STOP? MAX`, Response: `3.5E9`

- Numeric values are output without a unit. Physical quantities are referred to the basic units or to the units set using the `Unit` command. The response `3.5E9` in the previous example stands for 3.5 GHz.

- Truth values (Boolean values) are returned as `0` (for OFF) and `1` (for ON).
  Example:
  Setting command: `HCOPy:DEV:COL ON`
  Query: `HCOPy:DEV:COL?`
  Response: `1`

- Text (character data) is returned in a short form.
  Example:
  Setting command: `HCOPy:PAGE:ORIentation LANDscape`
  Query: `HCOP:PAGE:ORI?`
  Response: `LAND`

- Invalid numerical results
  In some cases, particularly when a result consists of multiple numeric values, invalid values are returned as 9.91E37 (not a number).

A.1.4 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command always completes executing before the next command starts. Commands that are processed quickly are defined as sequential commands. They are not implemented in the instrument. However, the execution time of most of the commands is so short that they act as sequential commands, if they are sent in separate command lines.

- An overlapping command is still running when the next command starts. Usually, an overlapping command takes a certain time to process its task, and thus allows the program to execute other tasks, while it is still running. If overlapping commands have to follow a specific order, for example to avoid incorrect measurement readings, they must be executed in sequence. This is called synchronization between the controller and the instrument.

Several setting commands within a command line are not necessarily processed in the order they are received. Even if they are implemented as sequential commands. To follow a particular sequence, send each command in a separate line.

As a rule, send commands and queries in different program messages.

A.1.4.1 Preventing Overlapping Execution

To prevent an overlapping execution of commands, one of the commands `*OPC`, `*OPC?` or `*WAI` can be used. All three commands cause a certain action only to be carried out after the hardware has been set. The controller can be forced to wait for the corresponding action to occur.

*Table A-4: Synchronization using *OPC, *OPC? and *WAI*

Com-mand	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This occurs when all pending operations are completed.	Send *OPC? directly after the command whose processing must be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Send *WAI directly after the command whose processing must be terminated before other commands are executed.

Command synchronization using `*WAI` or `*OPC?` is a good choice if the overlapped command takes only little time to process. The two synchronization commands simply block overlapped execution of the command. Append the synchronization command to the overlapping command, for example:

```
SINGle; *OPC?
```

For time consuming overlapped commands, you can allow the controller or the instrument to do other useful work while waiting for command execution. Use one of the following methods:

*OPC with a service request

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1

2. Set bit no. 5 in the SRE: `*SRE 32` to enable ESB service request.

3. Send the overlapped command with `*OPC` .

4. Wait for a service request.

    The service request indicates that the overlapped command has finished.

*OPC? with a service request

1. Set bit no. 4 in the SRE: `*SRE 16` to enable MAV service request.

2. Send the overlapped command with `*OPC?`.

3. Wait for a service request.

    The service request indicates that the overlapped command has finished.

Event status register (ESE)

1. Set the OPC mask bit (bit no. 0) in the ESE: `*ESE 1`

2. Send the overlapped command without `*OPC`, `*OPC?` or `*WAI`.

3. Poll the operation complete state periodically (with a timer) using the sequence:
   `*OPC; *ESR?`

   A return value (LSB) of 1 indicates that the overlapped command has finished.

A.1.4.2 Examples to Command Sequence and Synchronization

See the following examples to command sequences and synchronization. Some examples given illustrate possible constellations for overlapping tasks.

Example: Commands and queries in one message

The response to a query combined in a program message with commands that affect the queried value is not predictable.

The following commands always return the specified result:

`:FREQ:STAR 1GHZ;SPAN 100 :FREQ:STAR?`

Result:

`1000000000` (1 GHz)

Whereas the result for the following commands is not specified by SCPI:

`:FREQ:STAR 1GHz;STAR?;SPAN 1000000`

The result could be the value of `STARt` before the command was sent since the instrument might defer executing the individual commands until a program message terminator is received. The result could also be 1 GHz if the instrument executes commands as they are received.

Example: Overlapping command with *OPC

The instrument implements `*RST` as an overlapped command. Assuming that `*RST` takes longer to execute than `*OPC`, sending the following command sequence results in initiating a reset and, after some time, setting the `OPC` bit in the `ESR`:

`*RST; *OPC`

Sending the following commands still initiates a reset:

`*RST; *OPC; *CLS`

However, since the operation is still pending when the instrument executes `*CLS`, forcing it into the "Operation Complete Command Idle" State (OCIS), `*OPC` is effectively skipped. The `OPC` bit is not set until the instrument executes another `*OPC` command.

Example: Overlapped command followed by non-conflicting commands

Suppose that the instrument is switched on to provide a real time test signal that requires some calculation time. At the same time, some settings for the configuration of a different signal are made which do not interact with the generated signal (for example the signal may be used later on). The signal generation and the signal configuration are independent from each other, so there is no need to synchronize the following overlapped commands:

`SOUR:BB:3GPP:STAT ON`

`SOUR:BB:GSM:FORM FSK2`

Example: Overlapped command followed by conflicting commands

Suppose that the generator is switched on to provide a real time test signal that requires some calculation time. This signal is to be added to a waveform from the second baseband generator. In this case, the application program has to make sure that the real signal is available in the added signal before further action is started. This involves an appropriate synchronization technique for the first command (the following sequence assumes an appropriate routing):

```
SOUR:BB:3GPP:STAT ON
```

The instrument waits until command has finished.

```
SOUR2:BB:GSM:STAT ON
```

Depending on the selected synchronization techniques, non-conflicting commands can be executed while waiting until the synchronized overlapped command has finished.

Example: Polling the progress of the zeroing process

Suppose that you start the zeroing for a connected power sensor via the remote control command SENS1:ZERO. This process blocks the processing of further tasks during execution. The query for completeness is performed with the *OPC? command. It returns a 1 in the output buffer when the process is completed.

```
SENS:ZERO;*OPC?
```

Instead of waiting via *OPC?, you can perform alternative tasks while the zeroing is running, as for example updating the GUI or adjusting other instruments. Synchronize the commands by querying the progress of the zeroing process periodically via the event status register *ESR?:

```
*SRE 32
```

Sets the service request enable. The bit is set when an event in the event status register occurs.

```
*ESE 1
```

Configures the mask of the event status register to "Operation Complete".

```
SENS:ZERO;*OPC
```

Sets the evaluation via the status byte query. It uses *OPC? as the reference.

```
*CLS
```

Clears all status registers.

Even if the instrument is busy, you can perform this procedure, since the query is executed in a subchannel.

A.1.5 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 both with the commands of the STATus Subsystem.

A.1.5.1   Hierarchy of the Status Registers

The Figure A-1 shows the hierarchical structure of information in the status registers (ascending from left to right).

Figure A-1: 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

Note: This legend explains the abbreviations to the Status Byte Register.

The R&S SMB100B uses the following status registers:

- **Status Byte** (STB) and **Service Request Enable** (SRE), see Chapter A.1.5.3, "Status Byte (STB) and Service Request Enable Register (SRE)", on page 554.
- **Standard Event Status**, i.e. the Event status Register (ESR) and the Event Status Enable (ESE), see Chapter A.1.5.4, "Event Status Register (ESR) and Event Status Enable Register (ESE)", on page 555.
- **Questionable Status** and **Operation Status**, the (SCPI status registers, see Chapter A.1.5.2, "Structure of a SCPI Status Register", on page 552, Chapter A.1.5.5, "Questionable Status Register (STATus:QUEStionable)", on page 556 and Chapter A.1.5.6, "Operation Status Register (STATus:OPERation)", on page 556.
- **Output-Queue**
  The output queue contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in the overview.
- **Error- /Event-Queue**
  The error-/event-queue contains all errors and events that have occurred in the past. When reading the queue, the instrument starts with the first occurred error/event.

All status registers have the same internal structure.

SRE, ESE

The service request enable register SRE can be used as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be used as the ENABle part of the ESR.

A.1.5.2 Structure of a SCPI Status Register

Each standard SCPI register consists of 5 parts. Each part has a width of 16 bits and has different functions. The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integers.

Figure A-2: The status-register model

Description of the five status register parts

The five parts of a SCPI register have different properties and functions:

- **CONDition**
  The `CONDition` part is written into directly by the hardware or the sum bit of the next lower register. Its contents reflect the current instrument status. This register part can only be read, but not written into or cleared. Its contents are not affected by reading.

- **PTRansition / NTRansition**
  The two transition register parts define which state transition of the `CONDition` part (none, 0 to 1, 1 to 0 or both) is stored in the `EVENt` part.
  The **Positive-TRansition** part acts as a transition filter. When a bit of the `CONDition` part is changed from 0 to 1, the associated `PTR` bit decides whether the `EVENt` bit is set to 1.

  – PTR bit =1: the `EVENt` bit is set.

  – PTR bit =0: the `EVENt` bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.
  The **Negative-TRansition** part also acts as a transition filter. When a bit of the `CONDition` part is changed from 1 to 0, the associated `NTR` bit decides whether the `EVENt` bit is set to 1.

  – NTR bit =1: the `EVENt` bit is set.

  – NTR bit =0: the `EVENt` bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.

- **EVENt**
  The `EVENt` part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be

read by the user. Reading the register clears it. This part is often equated with the entire register.

- **ENABle**
  The ENABle part determines whether the associated EVENt bit contributes to the sum bit (see below). Each bit of the EVENt part is "ANDed" with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an "OR" function (symbol '+').
  ENABle bit = 0: the associated EVENt bit does not contribute to the sum bit
  ENABle bit = 1: if the associated EVENt bit is "1", the sum bit is set to "1" as well.
  This part can be written into and read by the user as required. Its contents are not affected by reading.

Sum bit

The sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.

The instrument automatically generates the sum bit for each register. Thus an event can lead to a service request throughout all levels of the hierarchy.

A.1.5.3 Status Byte (STB) and Service Request Enable Register (SRE)

The STatus Byte (STB) is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STB is read using the command *STB? or a serial poll.

The STatus Byte (STB) is linked to the Service Request Enable (SRE) register. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) is generated. The SRE can be set using the command *SRE and read using the command *SRE?.

Table A-5: Meaning of the bits used in the status byte

Bit No.	Meaning
0...1	Not used
2	Error Queue not empty
	The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
3	QUEStionable status register summary bit
	The bit is set if an EVENt bit is set in the QUEStionable status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by querying the STATus:QUEStionable status register.

Bit No.	Meaning
4	MAV bit (message available)
	The bit is set if a message is available in the output queue which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
5	ESB bit
	Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	MSS bit (master status summary bit)
	The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	STATus:OPERation status register summary bit
	The bit is set if an EVENt bit is set in the OPERation status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by querying the STATus:OPERation status register.

A.1.5.4   Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the EVENt part of a SCPI register. The event status register can be read out using command *ESR?.

The ESE corresponds to the ENABle part of a SCPI register. If a bit is set in the ESE and the associated bit in the ESR changes from 0 to 1, the ESB bit in the STB is set. The ESE register can be set using the command *ESE and read using the command *ESE?.

Table A-6: Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete
	This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	Not used
2	Query Error
	This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	Device-dependent Error
	This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error
	This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.

Bit No.	Meaning
5	Command Error
	This bit is set if a command is received, which is undefined or syntactically incorrect. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue.
6	User Request
	This bit is set when the instrument is switched over to manual control.
7	Power On (supply voltage on)
	This bit is set on switching on the instrument.

A.1.5.5 Questionable Status Register (STATus:QUEStionable)

This register contains information on questionable instrument states. Such states may occur when the instrument is not operated in compliance with its specifications.

To read the register, use the query commands `STAT:QUEST:COND?` or `STAT:QUEST[:EVEN]?`.

Table A-7: Meaning of the bits used in the questionable status register

Bit No.	Meaning
0–15	Not used

A.1.5.6 Operation Status Register (STATus:OPERation)

This condition part contains information on the actions currently being performed by the instrument, while the event part contains information on the actions performed by the instrument since the last readout of the register.

To read the register, use the query commands `STAT:OPER:COND?` or `STAT:OPER[:EVEN]?`.

Table A-8: Meaning 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	Sweeping
	This bit is set during a sweep in automatic or single mode.
4–15	Not used

A.1.5.7 Application of the Status Reporting System

The purpose of the status reporting system is to monitor the status of one or several devices in a measuring system. To do this and react appropriately, the controller must

receive and evaluate the information of all devices. The following standard methods are used:

- **Service request** (SRQ) initiated by the instrument
- **Serial poll** of all devices in the bus system, initiated by the controller to find out who sent an SRQ and why
- Query of a **specific instrument status** by commands
- Query of the **error queue**

Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. An SRQ is always initiated if one or several of bits 2, 4 or 5 of the status byte are set and enabled in the SRE. Each of these bits combines the information of the error queue or the output buffer. To use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Example:

Use command `*OPC` to generate an SRQ .

`*ESE 1` - set bit 0 of ESE (Operation Complete)

`*SRE 32` - set bit 5 of SRE (ESB).

After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

Serial Poll

In a serial poll, just as with command `*STB`, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster.

The serial poll method is defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

Query of an instrument status

Each part of any status register can be read using queries. There are two types of commands:

- The common commands `*ESR?, *IDN?, *IST?, *STB?` query the higher-level registers.
- The commands of the STATus system query the SCPI registers (`STATus:QUEStionable`...)

The returned value is always a decimal number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain text error messages that can be looked up in the Error Log or queried via remote control using `SYSTem:ERRor[:NEXT]?`. Each call of `SYSTem:ERRor[:NEXT]?` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

A.1.5.8 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 of `*RST` and `SYSTem:PRESet` affect the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table A-9: 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`
Effect	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.						

A.1.6 General Programming Recommendations

Initial instrument status before changing settings

Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the instrument status. Thus, when a command attempts to define incompatible settings, the command is ignored and the instrument status remains unchanged, i.e. other settings are not automatically adapted. Therefore, control programs should always define an initial instrument status (e.g. using the *RST command) and then implement the required settings.

Command sequence

As a general rule, send commands and queries in different program messages. Otherwise, the result of the query may vary depending on which operation is performed first (see also Preventing Overlapping Execution).

Reacting to malfunctions

The service request is the only possibility for the instrument to become active on its own. Each controller program should instruct the instrument to initiate a service request in case of malfunction. The program should react appropriately to the service request.

Error queues

The error queue should be queried after every service request in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

A.2 Telnet program examples

The following program example shows a simple `TcpClient` class that is intended to explain on how to get started with programming of sockets.

The example sets up a socket communication to R&S SMB100B and opens a simple user interface, very similar to the telnet, which allows input of commands. To enable real automation, further development of the program is required.

TcpClient.h

```
#include <string>
//defines structs for socket handling
#include <netinet/in.h>
using namespace std;
typedef struct sockaddr_in SockAddrStruct;
typedef struct hostent     HostInfoStruct;
```

```
class TcpClient
{
  public:
    TcpClient();
    ~TcpClient();
    void connectToServer( string &hostname, int port );
    void disconnect( );
    void transmit( string &txString );
    void receive( string &rxString );
    string getCurrentHostName( ) const;
    int    getCurrentPort( ) const;
  private:
    string           currentHostName;
    int              currentPort;
    int              currentSocketDescr;
    SockAddrStruct   serverAddress;
    HostInfoStruct * currentHostInfo;
    bool             clientIsConnected;
    int              receiveBufferSize;
};
```

TcpClient.cpp

```
#include <string>
//defines structs for socket handling
#include <netinet/in.h>
using namespace std;
typedef struct sockaddr_in SockAddrStruct;
typedef struct hostent     HostInfoStruct;
class TcpClient
{
  public:
    TcpClient();
    ~TcpClient();
    void connectToServer( string &hostname, int port );
    void disconnect( );
    void transmit( string &txString );
    void receive( string &rxString );
    string getCurrentHostName( ) const;
    int    getCurrentPort( ) const;
  private:
    string           currentHostName;
    int              currentPort;
    int              currentSocketDescr;
    SockAddrStruct   serverAddress;
    HostInfoStruct * currentHostInfo;
    bool             clientIsConnected;
    int              receiveBufferSize;
};
```

```
#include <netdb.h>
#include <netinet/in.h>
#include <unistd.h>
#include "TcpClient.h"
TcpClient::TcpClient()
: currentHostName( "" )
, currentPort( 0 )
, currentSocketDescr( 0 )
, serverAddress ( )
, currentHostInfo( NULL )
, clientIsConnected( false )
, receiveBufferSize( 1024 )
{
}
TcpClient::~TcpClient()
{
  currentHostInfo = NULL;
}

void TcpClient::connectToServer( string &hostname, int port )
{
  currentHostInfo = gethostbyname( hostname.c_str( ) );
  if( currentHostInfo == NULL )
  {
    currentHostName   = "";
    currentPort       = 0;
    currentHostInfo   = NULL;
    clientIsConnected = false;
    printf("error connecting host\n" );
  }
  currentHostName = hostname;
  currentPort     = port;
  currentSocketDescr = socket(AF_INET, SOCK_STREAM, 0);
  if( currentSocketDescr == 0 )
  {
    currentHostName   = "";
    currentPort       = 0;
    currentHostInfo   = NULL;
    clientIsConnected = false;
    printf("can't create socket\n" );
  }
  serverAddress.sin_family = currentHostInfo->h_addrtype;
  serverAddress.sin_port   = htons( currentPort );
  memcpy( (char *) &serverAddress.sin_addr.s_addr,
  currentHostInfo->h_addr_list[0], currentHostInfo->h_length );
  if( connect( currentSocketDescr, ( struct sockaddr *) &serverAddress,
  sizeof( serverAddress ) ) < 0 )
  {
   throw string("can't connect server\n" );
  }
```

```
          clientIsConnected = true;
        }
        void TcpClient::disconnect( )
        {
          if( clientIsConnected )
          {
            close( currentSocketDescr );
          }
          currentSocketDescr = 0;
          currentHostName    = "";
          currentPort        = 0;
          currentHostInfo    = NULL;
          clientIsConnected  = false;
        }
        void TcpClient::transmit( string &txString )
        {
          if( !clientIsConnected )
          {
          throw string("connection must be established before any data can be sent\n");
          }
          char * transmitBuffer = new char[txString.length() +1];
          memcpy( transmitBuffer, txString.c_str(), txString.length() );
          transmitBuffer[txString.length()] = '\n'; //newline is needed!
          if( send( currentSocketDescr, transmitBuffer, txString.length() + 1, 0 ) < 0 )
          {
            throw string("can't transmit data\n");
          }
          delete [] transmitBuffer;
        }
        void TcpClient::receive( string &rxString )
        {
          if( !clientIsConnected )
          {
          throw string("connection must be established before any data can be received\n");
          }
          char * receiveBuffer = new char[receiveBufferSize];
          memset( receiveBuffer, 0, receiveBufferSize );
          bool receiving = true;
          while( receiving )
          {
            int receivedByteCount = recv( currentSocketDescr,
            receiveBuffer, receiveBufferSize, 0 );
            if( receivedByteCount < 0 )
            {
              throw string("error while receiving data\n");
            }
            rxString += string( receiveBuffer );
            receiving = ( receivedByteCount == receiveBufferSize );
          }
          delete [] receiveBuffer;
```

```
}
string TcpClient::getCurrentHostName( ) const
{
  return currentHostName;
}
int TcpClient::getCurrentPort( ) const
{
  return currentPort;
}
```

TelnetClient.cpp

```cpp
#include <iostream>
#include "TcpClient.h"
void printUsage()
{
  cout<<"usage: EthernetRawCommand <server-ip> [scpi-command]"<<endl;
}
int main( int argc, char *argv[] )
{
  int errorCode        = 0; //no error
  bool useSingleCommand = false;
  string singleCommand  = "";
  string hostname       = "";
  int    port           = 5025;
  string input          = "";
  TcpClient client;
  switch( argc )
  {
    case 3:
      useSingleCommand = true;
      singleCommand    = argv[2];
    case 2:
      hostname         = argv[1];
      break;
    default:
        printUsage();
        return(-1);
  }
  try
  {
    client.connectToServer( hostname, port );
    bool terminate = false;
    while( !terminate )
    {
      char buffer[1024];
      if( useSingleCommand )
      {
        input =  singleCommand; //send string
      }
```

```
      else
      {
        cin.getline( buffer, 1024 );
        input = buffer;
        if( input == "end" )
        {
          terminate = true;
        }
      }
      if( !terminate)
      {
        client.transmit( input ); //send string
        int qPos = input.find( "?", 0 );
        //receive string only when needed
        if( qPos > 0 )
        {
          string rcStr = "";
          client.receive( rcStr );
          cout << rcStr << endl;
        }
      }
      if( useSingleCommand )
      {
        terminate = true;
      }
    }
  }catch( const string errorString )
  {
    cout<<errorString<<endl;
  }
  client.disconnect( );
  return errorCode;
}
```

B Hardware Interfaces

This section covers hardware-related topics, like pin assignment of the IEC 625/IEEE 488 interface.

The remote control interfaces are described in details in Chapter 11, "Network Operation and Remote Control", on page 251.

All other interfaces are described in Chapter 3.2, "Instrument Tour", on page 30.

For specifications, refer to the data sheet.

B.1 GPIB-Bus Interface

Option: R&S SMBB-B86.

Pin assignment

Figure B-1: Pin assignment of GPIB-bus (IEEE 488) interface

Bus lines

- Data bus with 8 lines D0 to D7:
  The transmission is bit-parallel and byte-serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.

- Control bus with five lines:
  IFC (Interface Clear): active LOW resets the interfaces of the instruments connected to the default setting.
  ATN (Attention): active LOW signals the transmission of interface messages, inactive HIGH signals the transmission of device messages.

SRQ (Service Request): active LOW enables the connected device to send a service request to the controller.

REN (Remote Enable): active LOW permits switchover to remote control.

EOI (End or Identify): has two functions in connection with ATN:

– ATN=HIGH active LOW marks the end of data transmission.

– ATN=LOW active LOW triggers a parallel poll.

● Handshake bus with three lines:

DAV (Data Valid): active LOW signals a valid data byte on the data bus.

NRFD (Not Ready For Data): active LOW signals that one of the connected devices is not ready for data transfer.

NDAC (Not Data Accepted): active LOW signals that the instrument connected is accepting the data on the data bus.

Interface functions

Instruments which can be controlled via GPIB-bus interface can be equipped with different interface functions. Table B-1 lists the interface functions for the R&S SMB100B.

Table B-1: GPIB-bus interface functions

Control character	Interface function
SH1	Handshake source function (source handshake), full capability
AH1	Handshake sink function (acceptor handshake), full capability
L4	Listener function, full capability, de-addressed by MTA.
T6	Talker function, full capability, ability to respond to serial poll, deaddressed by MLA
SR1	Service request function (Service Request), full capability
PP1	Parallel poll function, full capability
RL1	Remote/Local switch over function, full capability
DC1	Reset function (Device Clear), full capability
DT1	Trigger function (Device Trigger), full capability

C Extensions for User Files

The Table C-1 lists all available file extensions for user files. The currently available files on the instrument depend on the installed options.

Table C-1: List of the automatically assigned file extensions in the instrument

Function	List type	Contents	File suffix
Instrument State	Settings	Instrument settings	`*.savrcltxt`
License Key		License Key	`*.xml`
"User Correction"	List	User-defined level correction values	`*.uco`
"List Mode"	List	User-defined frequency/level value pairs	`*.lsw`
	Settings	Response file	`*.txt`
"Pulse Train"	Settings	Pulse train data	`*.pulstrn`
"NRP Settings"	Settings	R&S NRP Settings	`*.nrp,*.rsu`
SCPI command list	List	Export file containing list of SCPIs	`*.iec`
R&S Support Info Archive	Support File	Automatically collected support information	`*.tar.gz`
Tutorials	Tutorial files	Lists containing SCPIs and explanations	`*.tut`

Glossary: List of the Often Used Terms and Abbreviations

A

Absolute file path: Complete file path

B

Base unit: This term describes a R&S SMB100B equipped with the option R&S SMBB-B103.

C

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.
See also Chapter 12.5.2, "Accessing Files in the Default or in a Specified Directory", on page 318.

Computer name: An unambiguous indication of the instrument a LAN that uses a DNS server.
The default computer name follows the syntax `SMAB100A-<serial number>`, e.g. *SMB100B-102030*.
Synonym: Hostname
See Serial number.

D

daisy chain: A connection scheme in which instruments are connected together in sequence, i.e. an output of the first one is the 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

Full file path: Complete file path

G

Glossary: List of the often used terms and abbreviations

GUI: Graphical user interface

H

Hostname: Computer name

I

i.e.: That is

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 SMB100B product page http://www.rohde-schwarz.com/product/SMA100B.html

R

Remote access: Remote operation

Remote control: The operation of the R&S SMB100B by remote control commands or programs to perform automated tests.

The instrument is connected to a system controller via LAN/VXI-11, GPIB or USB using VISA. The instrument is controlled directly or supported by instrument drivers.

Remote device: External device controls the R&S SMB100B in remote operation mode, see Remote operation.
Synonyms: External controller, client device

Remote operation: Allows you to operate the R&S SMB100B from a remote device via VNC.
Both the R&S SMB100B and the remote device are connected in a LAN.
Synonym: Remote access

Removable memory: General term describing mass memory that can be unmounted from the instrument.

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. `SMB100B-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.
Depending on the installed options, the user directory is physically located on the System drive or on the Removable memory
In the file system, user directory is always indicated as `/var/user`

V

VISA: Virtual instrument software architecture

List of Commands

Index

Z