R&S®SMB100B
RF and Microwave Signal Generator
User Manual



1178371102
Version 11

ROHDE&SCHWARZ
Make ideas real

This document describes the R&S®SMB100B signal generator models (1422.1000.02) and options.

R&S®SMB100B RF signal generator options:

- R&S®SMBB-B101/-B103/-B106
- R&S®SMBB-B1/-B1H
- R&S®SMBB-B3
- R&S®SMBB-B5
- R&S®SMBB-B32
- R&S®SMBB-B86
- R&S®SMBB-K22/-K23/-K24/-K27
- R&S®SMBB-K31
- R&S®SMBB-K704
- R&S®SMBB-K720
- R&S®SMBB-K980

R&S®SMB100B microwave signal generator options:

- R&S®SMBB-B112/-B120/-B131/-B140(N)
- R&S®SMBB-B1/-B1H
- R&S®SMBB-B3
- R&S®SMBB-B85
- R&S®SMBB-K22/-K23/-K24/-K27
- R&S®SMBB-K33/-K35
- R&S®SMBB-K554
- R&S®SMBB-K704
- R&S®SMBB-K720
- R&S®SMBB-K980
- R&S®SMBB-K986

This manual describes firmware version FW 5.40.102.xx and later of the R&S®SMB100B.

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1178.3711.02 | Version 11 | R&S®SMB100B

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

Contents

1 Safety and regulatory information....13

1.1 Safety instructions....13

1.2 Labels on R&S SMB100B....16

1.3 Warning messages in the documentation....16

1.4 CE declaration of conformity....17

1.5 Where to find key documents on Rohde & Schwarz....17

1.6 Korea certification class A....17

2 Welcome....18

2.1 Key features....18

2.2 What's new....18

2.3 Documentation overview....18

2.3.1 Getting started manual....19

2.3.2 User manuals and help....19

2.3.3 Service manual....19

2.3.4 Instrument security procedures....19

2.3.5 Printed safety instructions....19

2.3.6 Specifications and product brochures....19

2.3.7 Calibration certificate....20

2.3.8 Release notes and open source acknowledgment....20

2.3.9 Application notes, application cards, white papers, etc....20

2.3.10 Videos....20

3 Getting started....21

3.1 Preparing for use....21

3.1.1 Lifting and carrying....21

3.1.2 Unpacking and checking....21

3.1.3 Choosing the operating site....21

3.1.4 Setting up the R&S SMB100B....22

3.1.5 Considerations for test setup....24

3.1.6 Connecting to power....24

3.1.7 Connecting to LAN....25

3.1.8 Connecting USB devices....25

3.1.9 Connecting to RF coaxial connectors ... 26
3.1.10 Connecting to RF 50 Ω ... 28
3.1.11 Connecting to Ref In/Ref Out ... 28
3.1.12 Switching on or off ... 28
3.2 Instrument tour ... 30
3.2.1 Front panel tour ... 30
3.2.2 Rear panel tour ... 36
3.3 Trying out the instrument ... 38
3.3.1 Generating an unmodulated carrier ... 39
3.3.2 Generating an RF frequency sweep signal ... 41
3.3.3 Saving and recalling settings ... 43
3.4 Operating the instrument ... 46
3.4.1 Means of manual interaction ... 47
3.4.2 Understanding the display information ... 48
3.4.3 Accessing the functionality ... 51
3.4.4 Entering data ... 52
3.4.5 Undo and redo actions ... 53
3.4.6 Getting information and help ... 54
4 RF signal configuration ... 56
4.1 Activating RF signal output ... 57
4.2 How to set the frequency and level ... 57
4.3 RF frequency settings ... 59
4.4 RF level settings ... 61
4.5 RF phase settings ... 66
5 Analog modulations ... 68
5.1 Required options ... 68
5.2 Modulation types and signal sources ... 68
5.3 Activating analog modulations ... 70
5.4 Modulation settings ... 71
5.4.1 Pulse modulation settings ... 71
5.4.2 FM, PhiM and AM modulation settings ... 72
5.4.3 Stereo modulation ... 78
5.4.4 Pulse generator ... 87

5.4.5 Pulse graph 98
5.4.6 Pulse external / trigger settings 99
5.4.7 FM, PhiM and AM modulation sources 100
5.4.8 LF signal output settings 107
5.4.9 Overview 109
5.5 How to generate an amplitude modulated signal 111
5.6 How to generate a pulse modulated signal 111
5.7 How to generate a pulse train modulated signal 112
6 Multiplying RF output frequencies 114
6.1 About frequency multipliers 114
6.2 Operating frequency multipliers 115
6.2.1 Test setup 115
6.2.2 Connecting a frequency multiplier 116
6.2.3 Controlling the frequency multiplier 117
6.2.4 Generating RF output signals 121
6.3 External RF configuration and settings 122
6.3.1 External RF settings 122
6.3.2 Remote instrument settings 124
6.3.3 RF frontend settings 126
7 List and sweep mode 133
7.1 Signal generation and triggering in the sweep and list modes 135
7.2 About sweep mode 142
7.2.1 Correlating parameters in sweep mode 143
7.2.2 Sweep signal shapes 145
7.3 About list mode 146
7.4 Significant parameters and functions 147
7.5 Sweep mode settings 149
7.5.1 General sweep settings 149
7.5.2 Frequency range settings 155
7.5.3 Level range settings 157
7.6 List mode settings 159
7.6.1 General settings 160
7.6.2 List mode data settings 162

7.6.3 Import/export settings....163
7.7 List data editor....166
7.8 How to generate a signal in list or sweep mode....168
8 Improving level performance....171
8.1 Attenuator....171
8.1.1 Attenuator settings....172
8.1.2 Reverse power protection....173
8.2 Automatic level control (ALC)....174
8.2.1 ALC settings....175
8.3 User correction....176
8.3.1 User correction settings....179
8.3.2 Ucor data editor....181
8.3.3 Fill with sensor....184
8.3.4 Import/export list files....186
8.4 Using power sensors....189
8.4.1 About....189
8.4.2 Connecting R&S NRP power sensors to the R&S SMB100B....191
8.4.3 NRP power viewer....192
8.4.4 NRP power control....193
8.4.5 NRP sensor configuration....198
8.4.6 NRP sensor mapping....203
8.5 Improving the RF signal performance....206
9 Reference oscillator....211
9.1 Required options....211
9.2 Reference frequency settings....211
9.3 Reference output settings....215
9.4 Adjustment settings....216
9.5 Using the reference frequency for instruments synchronization....216
10 File and data management....220
10.1 Accessing, retrieving and handling data....220
10.2 About the file system....221
10.3 Restoring an instrument configuration....224

10.3.1 Preset, set to default and factory preset settings....226
10.3.2 Identifying parameters with non-default values....227
10.3.3 Presetting the instrument to a user-defined state....227
10.3.4 Reference....228
10.4 Protecting data....229
10.5 Saving and recalling settings....230
10.5.1 Save/Recall settings....230
10.5.2 Saving and recalling instrument settings....233
10.6 Accessing files with user data....234
10.6.1 File select settings....234
10.7 Exporting and importing remote command lists....236
10.8 Loading, importing and exporting lists....237
10.9 Using the file manager....237
10.9.1 File manager settings....238
10.9.2 Map network share settings....239
10.9.3 Displaying all saved files....241
10.9.4 Mapping a network folder....241
10.10 Transferring files from and to the instrument....243
10.10.1 Removing file system protection....243
10.10.2 Accessing the file system using FTP....245
10.10.3 Accessing the R&S SMB100B file system using SMB (Samba)....246
10.10.4 Using a USB storage device for file transfer....247
10.10.5 Using a file server for test files exchange....248
10.11 Creating screenshots of current settings....249
10.11.1 Hardcopy settings....249
10.11.2 Creating a hardcopy of the display....252
11 General instrument functions....254
11.1 Customizing the user interface....254
11.1.1 Display and keyboard settings....255
11.1.2 Display update settings....257
11.1.3 Defining the RF signal state on power on....258
11.1.4 How to set the initial instrument settings....258
11.2 Organizing frequently used settings as favorites....260

11.2.1 Configuring settings quickly with the user menu 262
11.2.2 How to assign actions to the [★ (User)] key 264
11.2.3 User menu settings 265
11.2.4 Define user key actions settings 266
11.3 Managing licenses and license keys 268
11.3.1 Manage license keys settings 268
11.3.2 Using the license server 271
11.3.3 How to move a portable license 275
11.4 Using the security settings 277
11.4.1 Disk & memory security settings 278
11.4.2 Manual operation security settings 280
11.4.3 Protection level settings 282
11.4.4 Configuring LAN services 283
11.4.5 Password management 287
11.4.6 Preventing unauthorized access 290
11.5 Undoing or restoring actions 294
11.6 Shutting down and rebooting the instrument 295

12 Network operation and remote control 296
12.1 Overview of remote access modes 297
12.2 Remote control interfaces and protocols 298
12.2.1 LAN interface 299
12.2.2 USB interface 301
12.2.3 GPIB interface (IEC/IEEE bus interface) 302
12.2.4 LXI browser interface 303
12.3 Remote control programs and libraries 303
12.4 Status reporting system 306
12.4.1 Overview of the status registers 306
12.4.2 Instrument-specific status operation register 308
12.4.3 Instrument-specific status questionable register 308
12.4.4 Reset values of the status reporting system 309
12.5 Remote access settings 309
12.5.1 Network settings 310
12.5.2 VISA resource strings settings 313

12.5.3 GPIB address settings 314
12.5.4 RS232 settings 315
12.5.5 Instrument emulations settings 316
12.5.6 Active remote connection settings 318
12.5.7 Closed remote connection settings 319
12.5.8 HUMS settings 320
12.5.9 HUMS enhanced settings 322
12.5.10 QR code 331
12.6 LXI status settings 332
12.7 LXI browser settings 333
12.7.1 LAN configuration 335
12.7.2 SCPI remote trace 337
12.7.3 Health and utilization 339
12.7.4 Datasheet 339
12.8 Setting up remote control 340
12.8.1 Configuring remote access 341
12.8.2 Starting remote control with LXI 344
12.8.3 Starting remote control with VXI-11 345
12.8.4 Starting remote control with socket communication 350
12.8.5 Starting remote control over GPIB 351
12.8.6 Starting remote control over USB 352
12.8.7 Stopping remote control 352
12.9 Using remote command scripts 354
12.9.1 SCPI recording settings 354
12.9.2 Creating remote command lists 358
12.9.3 Checking and verifying a remote command list 361
12.9.4 Converting a remote command list to a script 362
12.9.5 Running a remote command script 364
12.10 Setting up remote operation over VNC 364
12.10.1 Using a controller PC 365
12.10.2 Using a smart device 367
12.10.3 Stopping remote operation 370
12.11 References 370

12.11.1 LXI functionality....370
12.11.2 Code generator templates....371
13 Remote control commands....374
13.1 Conventions used in SCPI command descriptions....374
13.2 Programming examples....375
13.3 Common commands....376
13.4 Preset commands....380
13.5 MMEMory subsystem....382
13.5.1 File naming conventions....382
13.5.2 Handling files in the default or in a specified directory....383
13.5.3 Programming examples....384
13.5.4 Remote control commands....386
13.6 CALibration subsystem....392
13.7 DIAGnostic subsystem....396
13.8 HUMS remote control commands....399
13.9 DISPlay subsystem....406
13.10 FORMat subsystem....411
13.11 HCOPy subsystem....412
13.11.1 Hard copy settings....414
13.11.2 Automatic naming....415
13.12 KBOard subsystem....418
13.13 OUTPut subsystem....419
13.14 SENSe, READ, INITiate and SLISt subsystems....422
13.15 SCONfiguration subsystem....436
13.15.1 External instruments....438
13.16 SOURce subsystem....441
13.16.1 Analog modulation subsystems....442
13.16.2 SOURce:CORRection subsystem....476
13.16.3 SOURce:EFRontend subsystem....484
13.16.4 SOURce:FREQuency subsystem....487
13.16.5 SOURce:INPut subsystem....493
13.16.6 SOURce:LFOutput subsystem....495
13.16.7 SOURce:LIST subsystem....508

13.16.8 SOURce:NOISe subsystem 520
13.16.9 SOURce:PGEN subsystem 522
13.16.10 SOURce:PHASe subsystem 523
13.16.11 SOURce:POWer subsystem 524
13.16.12 SOURce:ROSCillator subsystem 537
13.16.13 SOURce:SWEep subsystem 543
13.17 SYSTem subsystem 555
13.18 STATus subsystem 585
13.19 TEST subsystem 589
13.20 TRIGger subsystem 592
13.21 UNIT subsystem 596
13.22 Direct commands for the stereo/rds coder option R&S SMBB-B5 596
13.22.1 Programming examples 597
13.22.2 Remote-control commands 599
14 Troubleshooting and notifications 618
14.1 Notifications 618
14.1.1 Volatile notifications 618
14.1.2 Permanent notifications 619
14.2 SCPI notifications 619
14.3 Device-specific notifications 619
14.4 Querying notifications 620
14.5 Resolving network connection failures 622
14.6 Resolving errors during internal adjustments 623
14.7 Measuring USB cable quality 624
14.8 Checking the instrument configuration 624
14.8.1 Hardware configuration settings 626
14.8.2 Versions and options settings 627
14.9 Collecting information for technical support 629
14.10 Contacting customer support 630
15 Transporting 632
16 Maintenance, storage and disposal 633
16.1 Cleaning 633

16.2 Storage....633
16.3 Performing maintenance tasks....633
16.3.1 Internal adjustments....633
16.3.2 Date and time....637
16.3.3 Check front panel....640
16.3.4 Check display screen....643
16.3.5 FPGA/uC update settings....644
16.3.6 Delete temporary files....646
16.4 Disposal....647

Annex....648

A Reference information for remote control....648
A.1 Telnet program examples....648
A.2 Available user files and file extensions....653

B Unit shortcuts....654

C GPIB interface....656

Glossary: Terms and abbreviations....658

List of commands....662

Index....675

1 Safety and regulatory information

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

Intended use

The product is intended for the development, production and verification of electronic components and devices. It generates radio frequency (RF) signals for test setups in industrial, administrative, and laboratory environments. Use the product only for its designated purpose. Observe the operating conditions and performance limits stated in the specifications document.

Target audience

The target audience of this document includes developers, technicians, operators, administrators and maintenance personnel. The required skills and experience of the users depend on the test setup and application of the product.

Where do I find safety information?

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

- In Section 1.1, "Safety instructions", on page 13. The same information is provided in many languages in printed format. The printed "Safety Instructions" for "Mains-Powered Products, Not Heavy" (document number 1171.1771.99) are delivered with the product.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation.

1.1 Safety instructions

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

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

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

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

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

Lifting and carrying the product

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

Choosing the operating site

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

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

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

Setting up the product

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

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

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

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

Connecting the product

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

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

Connecting to power

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

Take the following measures for your safety:

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

Cleaning the product

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

Meaning of safety labels

Safety labels on the product and its accessories warn against potential hazards.

	Potential hazard Read the product documentation to avoid personal injury or product damage.

	Electrical hazard Indicates live parts. Risk of electric shock, fire, personal injury or even death.

	Hot surface Do not touch. Risk of skin burns. Risk of fire.

	Protective conductor terminal Connect this terminal to a grounded external conductor or to protective ground. This connection protects you against electric shock if an electric problem occurs.

1.2 Labels on R&S SMB100B

Labels on the casing inform about:

- Personal safety, see "Connecting to power" on page 15.
- Product and environment safety, see "Labels regarding product and environment safety" on page 16.
- Identification of the product, see the serial number on the rear panel.

Labels regarding product and environment safety

	Labeling in line with EN 50419 for disposal of electrical and electronic equipment after the product has come to the end of its life.

1.3 Warning messages in the documentation

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

DANGER

Imminently hazardous situation. Will result in death or serious injury if not avoided.

WARNING

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

CAUTION

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

NOTICE

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

1.4 CE declaration of conformity

The CE declaration of conformity of the base unit is delivered with the product. Keep the document for further reference. The current version of this CE declaration of conformity is available at:

www.rohde-schwarz.com/company-documents/smb100b

1.5 Where to find key documents on Rohde & Schwarz

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

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

1.6 Korea certification class A



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

2 Welcome

The R&S SMB100B is a 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.

2.1 Key features

Outstanding key features of the R&S SMB100B are:

- Frequency range from 8 kHz up to 40 GHz
- Excellent SSB phase noise
- Low wideband noise
- High output power
- Closed loop power control
- User correction
- Pulse train generation
- SCPI macro recorder and code generator for generating executable remote control code from manual operating steps (for MATLAB®, CVI, etc.)
- Compact racks with a height of 2 U and different widths and depths
- 5" Graphical user interface with touchscreen

For more information, refer to the specifications document.

2.2 What's new

This manual describes firmware version FW 5.40.102.xx and later of the R&S®SMB100B.

Compared to the previous version, it provides the new features listed below:

- Connecting a frequency multiplier with option R&S SMBB-K554, see Section 6, "Multiplying RF output frequencies", on page 114.
- Editorial changes

2.3 Documentation overview

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

www.rohde-schwarz.com/manual/smb100b

2.3.1 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.

2.3.2 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.

2.3.3 Service manual

Describes the performance test for checking compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

2.3.4 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.

2.3.5 Printed safety instructions

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

2.3.6 Specifications and product brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S SMB100B. It also lists the firmware applications 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

2.3.7 Calibration certificate

The document is available on https://gloris.rohde-schwarz.com/calcert. You need the device ID of your instrument, which you can find on a label on the rear panel.

2.3.8 Release notes and open source acknowledgment

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

The software uses several valuable open source software packages. An open source acknowledgment document provides verbatim license texts of the used open source software.

www.rohde-schwarz.com/firmware/smb100b

2.3.9 Application notes, application cards, white papers, etc.

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

For some application sheets, see also:

www.rohde-schwarz.com/application/smb100b

2.3.10 Videos

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

3 Getting started

3.1 Preparing for use

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

3.1.1 Lifting and carrying

For safety information, see "Lifting and carrying the product" on page 14.

Use the handles for lifting and carrying the R&S SMB100B.

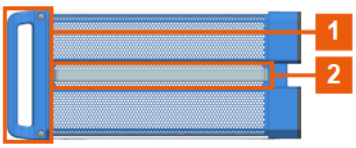


Figure 3-1: Instrument side view with front handles (1) and side handles (2)

3.1.2 Unpacking and checking

1. Unpack the R&S SMB100B carefully.
2. Retain the original packing material. Use it to protect the control elements and connectors when transporting or shipping the R&S SMB100B later.
   See also Section 15, "Transporting", on page 632.
3. Using the delivery notes, check the equipment for completeness.
4. Check the equipment for damage.

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

3.1.3 Choosing the operating site

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

For safety information, see "Choosing the operating site" on page 14.

Electromagnetic compatibility classes

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

- Class B equipment is suitable for use in:

  - Residential environments
  - Environments that are directly connected to a low-voltage supply network that supplies residential buildings
- Class A equipment is intended for use in industrial environments. It can cause radio disturbances in residential environments due to possible conducted and radiated disturbances. It is therefore not suitable for class B environments.
  If class A equipment causes radio disturbances, take appropriate measures to eliminate them.

3.1.4 Setting up the R&S SMB100B

See also:

- "Setting up the product" on page 14
- "Intended use" on page 13

3.1.4.1 Placing the R&S SMB100B on a bench top

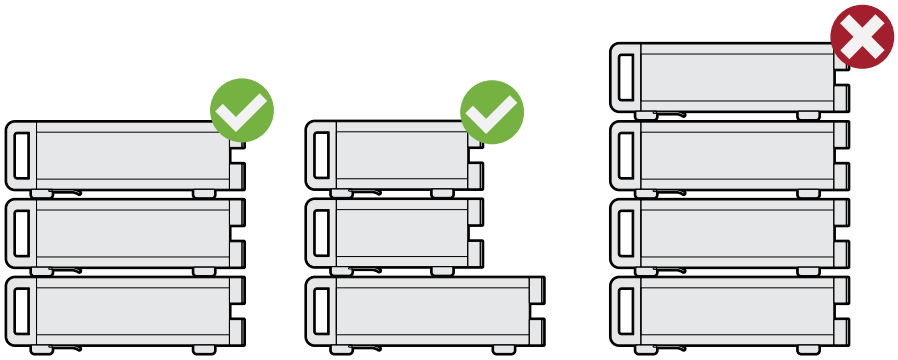
To place the product on a bench top

1. Place the product on a stable, flat and level surface. Ensure that the surface can support the weight of the product. For information on the weight, see the specifications document.
2. **CAUTION!** Foldable feet can collapse. For safety information, see "Setting up the product" on page 14.

   Always fold the feet completely in or out. With folded-out feet, do not place anything on top or underneath the product.
3. **WARNING!** A stack of products can fall over and cause injury. Never stack more than three products on top of each other. Instead, mount them in a rack.

   Stack as follows:

   - If the products have foldable feet, fold them in completely.
   - It is best if all products have the same dimensions (width and length). If the products have different dimensions, stack according to size and place the smallest product on top.
   - Do not exceed the permissible total load placed on the product at the bottom of the stack:
     - 50 kg when stacking products of identical dimensions (left figure).
     - 25 kg when stacking smaller products on top (middle figure).



Left = Stacked correctly, same dimensions
Middle = Stacked correctly, different dimensions
Right = Stacked incorrectly, too many products

4. **NOTICE!** Overheating can damage the product.
   Prevent overheating as follows:
   - Keep a minimum distance of 10 cm between the fan openings of the product and any object in the vicinity to provide sufficient airflow and ventilation.
   - Do not place the product next to heat-generating equipment such as radiators or other products.

3.1.4.2 Mounting the product in a rack

To prepare the rack

1. Observe the requirements and instructions in "Setting up the product" on page 14.
2. **NOTICE!** Insufficient airflow can cause overheating and damage the product.
   Design and implement an efficient ventilation concept for the rack.

To mount the product in a rack

1. Use an adapter kit that fits the dimensions of the R&S SMB100B to prepare the instrument for rack mounting.
   a) Order the rack adapter kit designed for the R&S SMB100B.
      For more information, refer to the specifications document.
   b) Mount the adapter kit. Follow the assembly instructions provided with the adapter kit.
2. Lift the product to shelf height.
   If the rack is high, use a safe climbing aid when placing on upper shelves.
3. Grab the handles at the front.
4. Push the R&S SMB100B onto the shelf until the rack brackets fit closely to the rack.

5. Tighten all screws at the rack brackets with a tightening torque of 1.2 Nm to secure the R&S SMB100B in the rack.

To unmount the product from a rack

1. Loosen the screws at the rack brackets.
2. **WARNING!** The product is heavy. For safety information, see "Lifting and carrying the product" on page 14.

   Bring the lifting equipment to shelf height.
3. Remove the R&S SMB100B from the rack.
4. If placing the R&S SMB100B on a bench top again, unmount the adapter kit from the R&S SMB100B. Follow the instructions provided with the adapter kit.

3.1.5 Considerations for test setup

For safety information, see "Connecting the product" on page 14.

Cable selection to minimize electromagnetic interference

Electromagnetic interference (EMI) can affect the measurement results.

To suppress electromagnetic radiation during operation:

- Use high-quality shielded cables, for example, double-shielded RF, LAN and USB cables.
- Always terminate open cable ends.
- Ensure that connected external devices comply with EMC regulations.

Signal input and output levels

Keep the signal levels within the specified ranges to avoid damage to the R&S SMB100B and connected devices.

For more information, refer to the specifications document.

Preventing electrostatic discharge (ESD)

Electrostatic discharge is most likely to occur when you connect or disconnect a DUT.

► **NOTICE!** Electrostatic discharge can damage the electronic components of the product and the device under test (DUT).

Ground yourself to prevent electrostatic discharge damage:

a) Use a wrist strap and cord to connect yourself to ground.
b) Use a conductive floor mat and heel strap combination.

3.1.6 Connecting to power

For safety information, see "Connecting to power" on page 15.

1. Plug the AC power cable into the AC power connector on the rear panel. Only use the AC power cable delivered with the R&S SMB100B.
2. Plug the AC power cable into a power outlet with ground contact.

   The required ratings are listed next to the AC power connector.

For more information, refer to the specifications document.

3.1.7 Connecting to LAN

Network environment

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

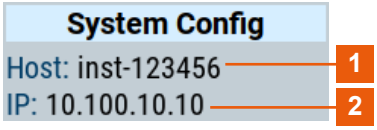
- Install the latest firmware to reduce security risks.
- For internet or remote access, use secured connections if applicable.
- Ensure that the network settings comply with the security policies of your company. Contact your local system administrator or IT department before connecting your product to your company LAN.
- When connected to the LAN, the product may potentially be accessed from the internet, which may be a security risk. For example, attackers might misuse or damage the product.

To connect to LAN

► Connect the LAN socket on the rear panel via an RJ-45 cable to the LAN.

Using DHCP (dynamic host configuration protocol), the R&S SMB100B assigns the IP address automatically.

If connected to the LAN, the R&S SMB100B displays the IP address and the host name at the left bottom of the home screen.



1 = Hostname
2 = IP address

If disconnected from the LAN, the R&S SMB100B displays the IP address *0.0.0.0*.

See also Section 12.8, "Setting up remote control", on page 340.

3.1.8 Connecting USB devices

You can connect or disconnect all USB devices from the R&S SMB100B during operation.

To connect USB storage devices

USB storage devices, such as memory sticks, allow data transfer from or to the R&S SMB100B. You can also use them for firmware updates.

► Connect the USB storage device to any of the USB connectors.

To connect USB devices with an external power supply

1. **NOTICE!** Connected devices with external power supply can feed back current into the 5 V power supply of the USB interface and thus damage the R&S SMB100B.

   Ensure that there is no connection between the positive pole of the power supply and the +5 V power pin of the USB interface (VBUS).

2. Connect the USB device to any of the USB connectors.

To connect a keyboard

► Connect the keyboard to any of the USB connectors.

When connected, the R&S SMB100B detects the keyboard automatically. A detected keyboard has the default layout English – US.

To connect a mouse

► Connect the mouse to any of the USB connectors.

When connected, the R&S SMB100B detects the mouse automatically.

To connect power sensors

Connect the power sensors of the R&S NRP families to any of the USB connectors.

See Section 8.4, "Using power sensors", on page 189.

To connect a frequency multiplier

► Connect the frequency multiplier for control connection to the "USB" connector on the front panel or rear panel.

3.1.9 Connecting to RF coaxial connectors

Here, you find information on how to prepare and to connect to RF coaxial connectors of the R&S SMB100B. Use these RF connectors, for example, for output of the RF signal or for input of an external reference signal.

To prepare for connecting

1. **NOTICE!** Damaged or not clean connections can lead to RF insertion loss and mismatch, and even premature wear of the connectors.

   Before connecting to the port, inspect the RF connector visually. Check that it is clean, undamaged and mechanically compatible.

2. **NOTICE!** DC voltage at the RF connector can damage the instrument. Never apply DC voltage to the RF input connectors.

   Make sure that the values are within the DC limits given in the specifications document.

3. If your test setup has a DC component at the RF input, insert a DC blocker.

4. Use a high-quality RF cable that matches the RF connector type. See also "Cable selection to minimize electromagnetic interference" on page 24.

5. You can connect to two kinds of connectors:
   - "To connect to screwable connectors" on page 27
   - "To connect to pluggable connectors" on page 27

To connect to screwable connectors

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

1. Carefully align the connector of the cable and the connector along a common axis.

2. Mate the connectors along the common axis until the male pin of the inner connector engages with the female socket of the outer connector.

3. Turn the nut of the outer connector until you couple the connectors firmly.

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

   Using a calibrated torque wrench torque the nut to the limit as in the table below. Hold the opposite connector part stationary with a spanner.

The R&S SMB100B provides screwable RF connectors as in Table 3-1.

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

Connector		Torque limit		Nut opening	
Type	Name	lb-Inch	Nm	Inch	mm
N	RF 50 Ω*)	13.3	1.5	3/4	20
SMA	Ref In 1 GHz Ref Out 1 GHz	5	0.56	5/16	8
2.92 mm	RF 50 Ω*)	8	0.9	5/16	8

*) maximum frequency f_{max} depends on the connector type: f_{max}(N) ≤ 7 GHz, f_{max}(2.92 mm) ≤ 40 GHz

To connect to pluggable connectors

The R&S SMB100B provides pluggable Bayonet Neill-Concelman (BNC) connectors.

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

1. Carefully align the connector of the cable and the BNC connector along a common axis.

2. Mate the connectors along the common axis until the male pin of the connector of the cable engages with the female socket of the BNC connector.

For more information on handling and maintaining coaxial RF connectors, see the application note 1MA99.

For information on mounting test port adapters onto the RF connector, see the application note 1MA100.

3.1.10 Connecting to RF 50 Ω

1. Before connecting, disable the RF output:
   In the home screen, switch off the RF block.
2. For connection, use the connector "RF 50 Ω" on the front panel.
   See "To connect to screwable connectors" on page 27.

To prevent RF output switch-off

► **NOTICE!** High reflected powers can force the R&S SMB100B to switch off the RF output.

Connect a load with sufficient return loss.
For more information, refer to the specifications document.

3.1.11 Connecting to Ref In/Ref Out

For connection, the R&S SMB100B provides BNC connectors or SMA connectors on the rear panel. See "To connect to pluggable connectors" on page 27 and "To connect to screwable connectors" on page 27.

3.1.12 Switching on or off

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

Table 3-2: Overview of power states

State	LED	Position of power switch
Off	gray	[0]
Standby	orange orange	[I]
Ready	yellow	[I]

To switch on the R&S SMB100B

The R&S SMB100B is off but connected to power. See Section 3.1.6, "Connecting to power", on page 24.

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

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

2. Wait until the oven-controlled oscillator (OCXO) warms up.
   For more information, refer to the specifications document.

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

   The LED changes to green. The R&S SMB100B boots.

   After booting, the R&S SMB100B starts up displaying the home screen on the screen on the front panel.

To check startup functions

When starting for the first time, the R&S SMB100B starts with the default settings. When restarting, the R&S SMB100B recalls the instrument configuration before shut-down.

See Section 10.5.2, "Saving and recalling instrument settings", on page 233.

When switched on, the R&S SMB100B monitors the main functions and logs erroneous functions. See the following:

See Section 14.4, "Querying notifications", on page 620.

To shut down the product

The product is in the ready state.

► Press the [On/Standby] key.

  The operating system shuts down. The LED changes to orange. The product changes to standby state.

In the standby state, the power switch circuits and the OCXO are active. To deactivate them, disconnect the instrument from the power supply.

To disconnect from power

The R&S SMB100B is in the standby state.

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

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

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

2. Disconnect the R&S SMB100B from the power source.

3.2 Instrument tour

This section explains the control elements and the connectors of the R&S SMB100B. The views of the front panel and the rear panel help you to get familiar with the instrument and to perform the first steps. For specifications of the interfaces, see the specifications document.

The meanings of the labels on the R&S SMB100B are described in Section 1.2, "Labels on R&S SMB100B", on page 16.

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 Section 3.2.2, "Rear panel tour", on page 36.

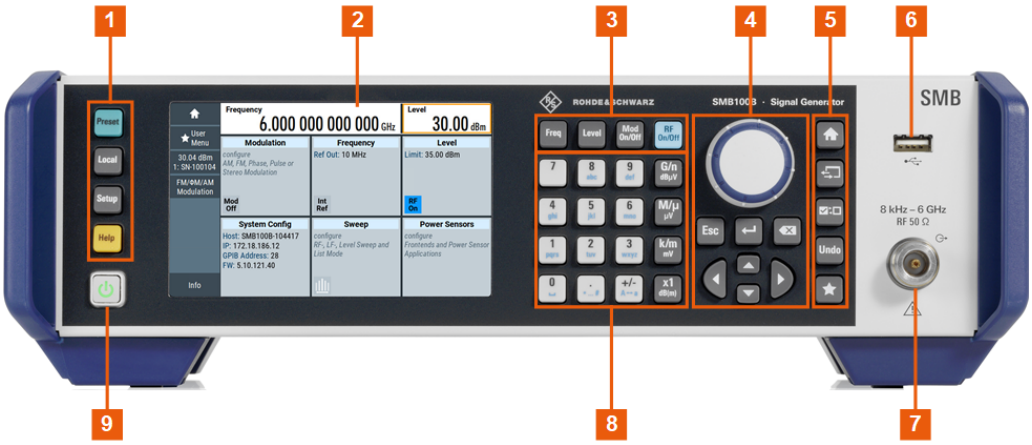


Figure 3-2: Front panel view of the R&S SMB100B RF signal generator

1 = Utility keys
2 = Touchscreen
3 = Function keys
4 = Navigation controls
5 = Display keys
6 = USB connector
7 = RF 50 Ω
8 = Keypad
9 = On/Standby



Figure 3-3: Front panel view of the R&S SMB100B Microwave signal generator

1 = Utility keys
2 = Touchscreen
3 = Function keys
4 = Navigation controls
5 = Display keys
6 = USB connector
7 = SD card slot
8 = RF 50 Ω
9 = Keypad
10 = On/Standby

3.2.1.1 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 3-3: 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

3.2.1.2 Touchscreen

The screen display on the front panel is the graphical user interface. It shows the most important settings, the current configuration at a glance and provides access to the settings dialogs.

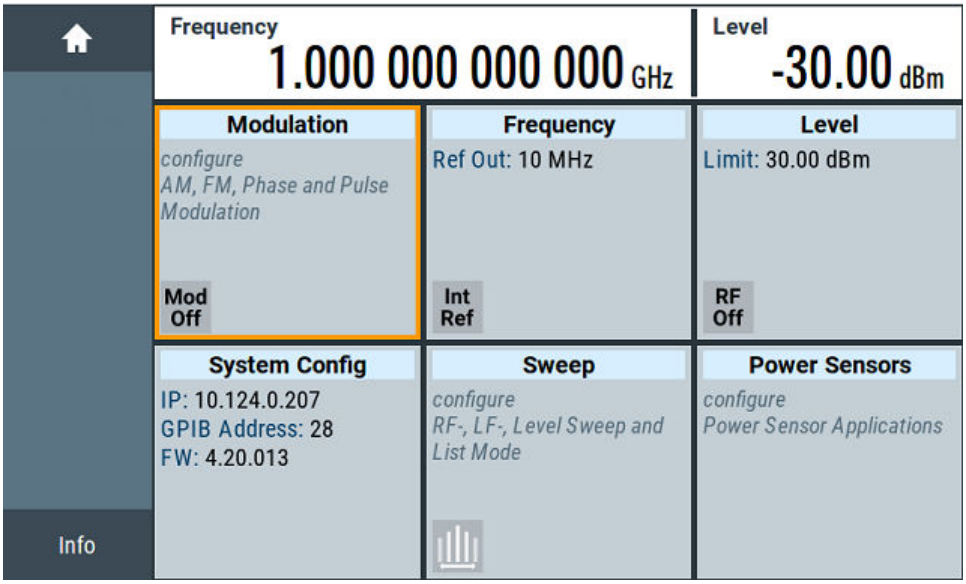


Figure 3-4: Touchscreen

The screen is touch-sensitive, offering an alternative means of user interaction for quick and easy handling of the instrument.

See also:

- Section 3.4.2, "Understanding the display information", on page 48.
- Section 3.4, "Operating the instrument", on page 46, for operating the touch-screen.
- Section 16.1, "Cleaning", on page 633, for cleaning the screen.

3.2.1.3 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 3-4: 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.

3.2.1.4 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) numeric instrument parameters at a defined step width.
- 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.
- Opens a context-sensitive menu, when it is pressed and held.

Editing keys

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

Table 3-5: 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. Equals selecting the "Cancel" button in dialogs, if provided. For "Edit" dialog boxes, the following applies: • 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 3-6: 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.

3.2.1.5 Display keys

The display keys arrange different windows on the display.

Table 3-7: 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.

3.2.1.6 USB connector

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.

How to: Section 3.1.8, "Connecting USB devices", on page 25

3.2.1.7 SD card slot

Option: R&S SMBB-B85 (R&S SMB100B microwave instruments only)

Slot for removable mass storage.

To prevent from unauthorized removal, the SD card holder includes wholes that provide the opportunity of sealing the SD card. We recommend that you seal the SD card crosswise.

3.2.1.8 RF 50 Ω

The connector type depends on the installed frequency option.

Table 3-8: RF connector types of the frequency options

Installed RF frequency option	Connector type	Frequency range
R&S SMBB-B101	N female	f_{max} ≤ 6 GHz
R&S SMBB-B103		
R&S SMBB-B106		
R&S SMBB-B112	PC 2.92 mm female Instrument equipped with interchangeable PC 2.92 mm test port adapter.	f_{max} ≤ 40 GHz
R&S SMBB-B120		
R&S SMBB-B131		
R&S SMBB-B140(N)		

How to: Section 3.1.10, "Connecting to RF 50 Ω", on page 28

3.2.1.9 Keypad

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

Table 3-9: 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.
Sign key	Changes the sign of a numeric parameter. For 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. For 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.

3.2.1.10 On/Standby

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

The LED above the [On/Standby] key indicates the instrument state, see Section 3.1.12, "Switching on or off", on page 28.

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.

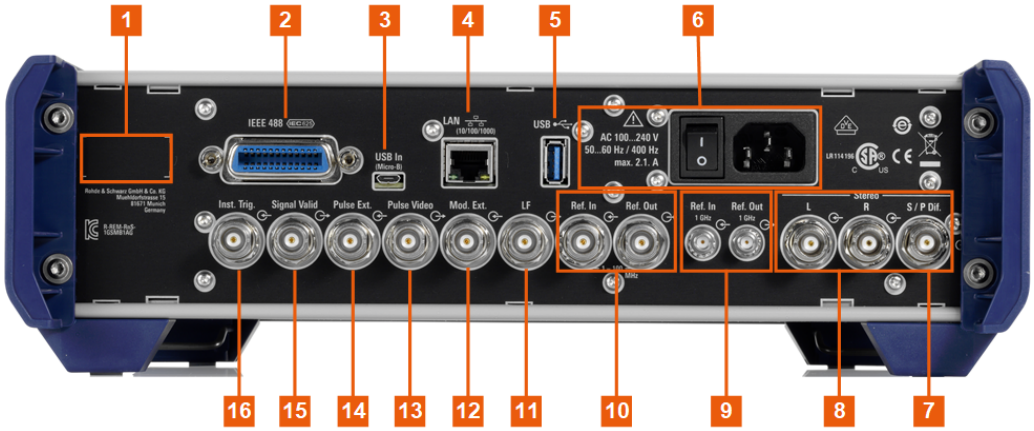


Figure 3-5: Rear panel view R&S SMB100B RF signal generator

1 = Serial number (six digits in the string 1400.1000.02-<serial number>-<checksum>)
2 = IEC 625/IEEE 488
3, 5 = USB/USB In
4 = LAN
6 = AC power supply connector and switch
7 = S/P Dif
8 = Stereo L/R
9, 10 = Ref In/Ref Out
11 = LF
12 = Mod. Ext.
13 = Pulse Video
14 = Pulse Ext.
15 = Signal Valid
16 = Inst Trig

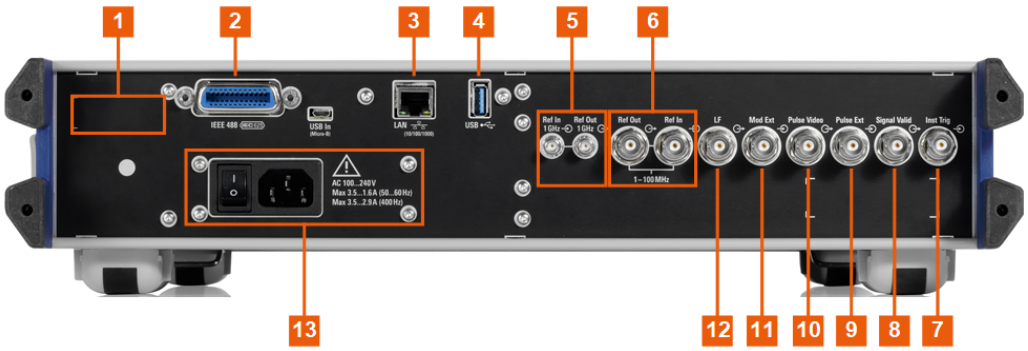


Figure 3-6: Rear panel view R&S SMB100B Microwave signal generator

1 = Serial number (six digits in the string 1400.1000.02-<serial number>-<checksum>)
2 = IEC 625/IEEE 488 (option R&S SMBB-K986)
3 = LAN
4 = USB/USB In (option R&S SMBB-K986)
5, 6 = Ref In/Ref Out
7 = Inst Trig

8 = Signal Valid
9 = Pulse Ext.
10 = Pulse Video
11 = Mod. Ext.
12 = LF
13 = AC power supply connector and switch

3.2.2.1 Connectors

IEC 625/IEEE 488
Option: R&S SMBB-B86/-K986

General purpose interface bus (GPIB) interface for remote control of the instrument. The interface complies with the standards IEC 625, IEEE 488 and SCPI.

Use this interface to connect a computer for remote control of the R&S SMB100B. See also the following sections:

- Section 12.2.3, "GPIB interface (IEC/IEEE bus interface)", on page 302
- Section 12.5.3, "GPIB address settings", on page 314
- Section C, "GPIB interface", on page 656

USB/USB In

- Female USB (universal serial bus) 3.0 connector of type A (host USB), 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
- Option: R&S SMBB-B86/-K986
  Female USB 2.0 connector of type Micro-B (USB In), for example, for remote control.

How to: Section 3.1.8, "Connecting USB devices", on page 25

LAN
RJ-45 connector to connect the R&S SMB100B to a LAN for remote control, remote operation, and data transfer.

How to: Section 3.1.7, "Connecting to LAN", on page 25

AC power supply connector and switch
Mains power switch for performing the following tasks:

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

How to: Section 3.1.6, "Connecting to power", on page 24.

S/P Dif
Option: R&S SMBB-B5

BNC input connector for digital stereo signals.

See also Section 5.4.3, "Stereo modulation", on page 78.

Stereo L/R
Option: R&S SMBB-B5

BNC input connectors for analog stereo modulation signals. External modulation sources or the internal LF generator can be used.

See also Section 5.4.3, "Stereo modulation", on page 78.

Ref In/Ref Out
Input/output for external reference signal.

BNC connectors for reference signals from 1 MHz to 100 MHz.

SMA connectors for 1 GHz reference signals.

How to: Section 3.1.11, "Connecting to Ref In/Ref Out", on page 28

LF
BNC connector for output of the internal LF generator signal.

For more information, refer to the specifications document.

Mod. Ext.
BNC connector for input of external analog modulation signals.

See Section 5, "Analog modulations", on page 68.

Pulse Video
BNC connector for output of the internal pulse generator signal or the looped through pulse signal from Pulse Ext. connector (video signal).

See Section 5.4.1, "Pulse modulation settings", on page 71.

Pulse Ext.
BNC connector for input of an external pulse modulation signal or an external trigger/ gate signal for the pulse generator.

Signal Valid
BNC connector for output of a signal that determines 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 Section 5.4.4, "Pulse generator", on page 87.

Inst Trig
BNC connector for input of external trigger signals. The signals trigger sweeps and list mode.

See Section 7.1, "Signal generation and triggering in the sweep and list modes", on page 135.

3.3 Trying out the instrument

This section 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 Section 3.4, "Operating the instrument", on page 46.

Prerequisites

The instrument is set up, connected to the power supply, and started up as described in Section 3.1, "Preparing for use", on page 21.

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.

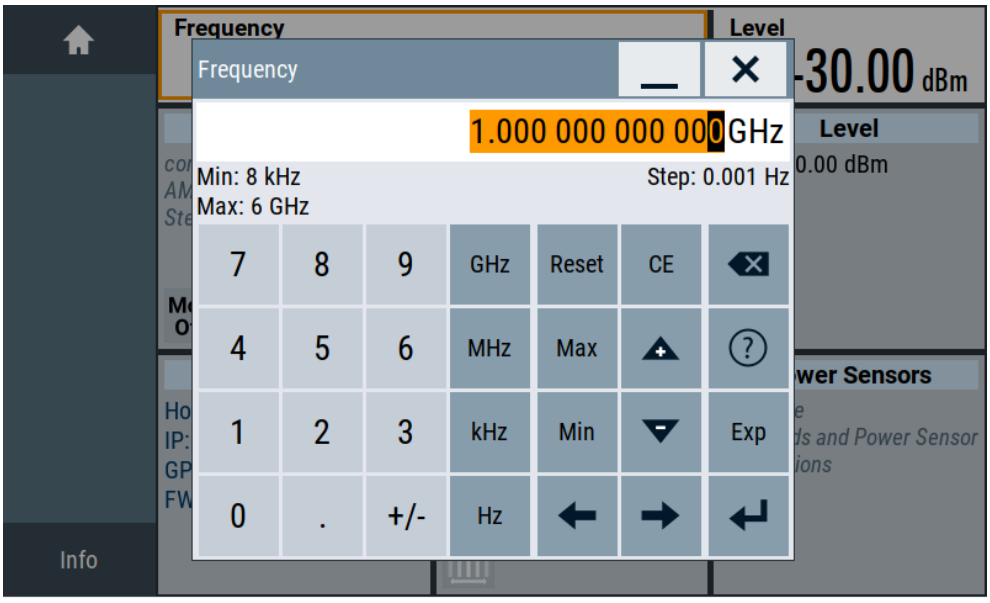
The instrument is manually operated via the touchscreen. Try out the following:

- Generating an unmodulated carrier 39
- Generating an RF frequency sweep signal 41
- Saving and recalling settings 43

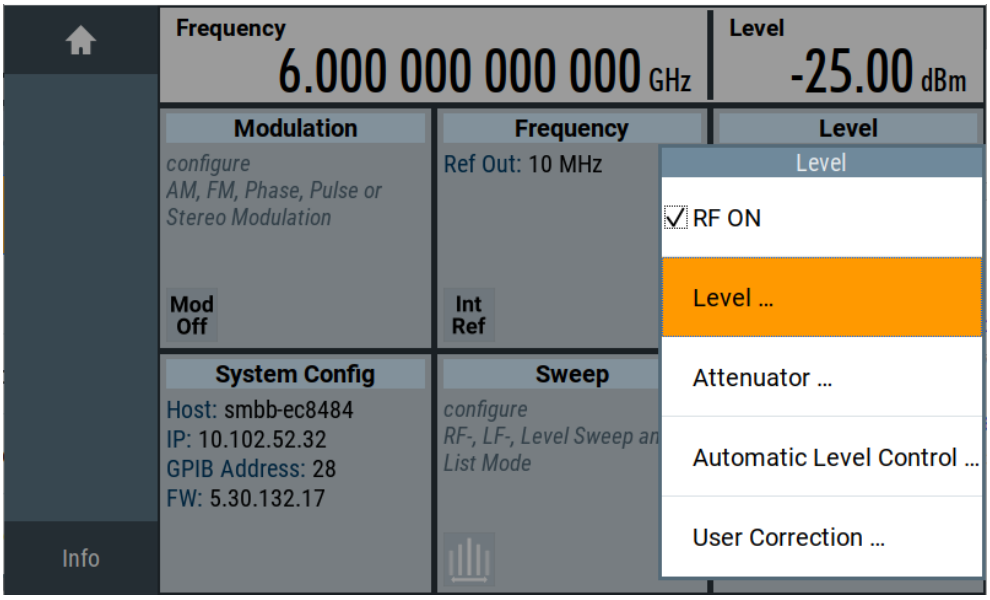
3.3.1 Generating an unmodulated carrier

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.

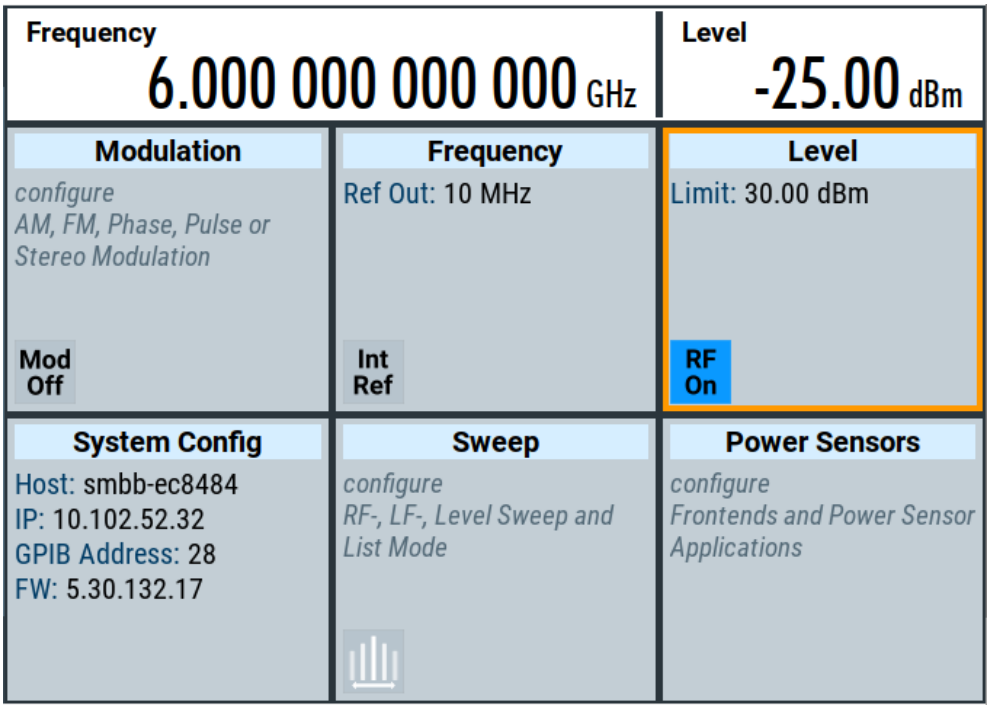


Figure 3-7: Generating an unmodulated signal

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 Section 4, "RF signal configuration", on page 56.

Try out the front panel keys

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



Connect RF 50 Ω 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.

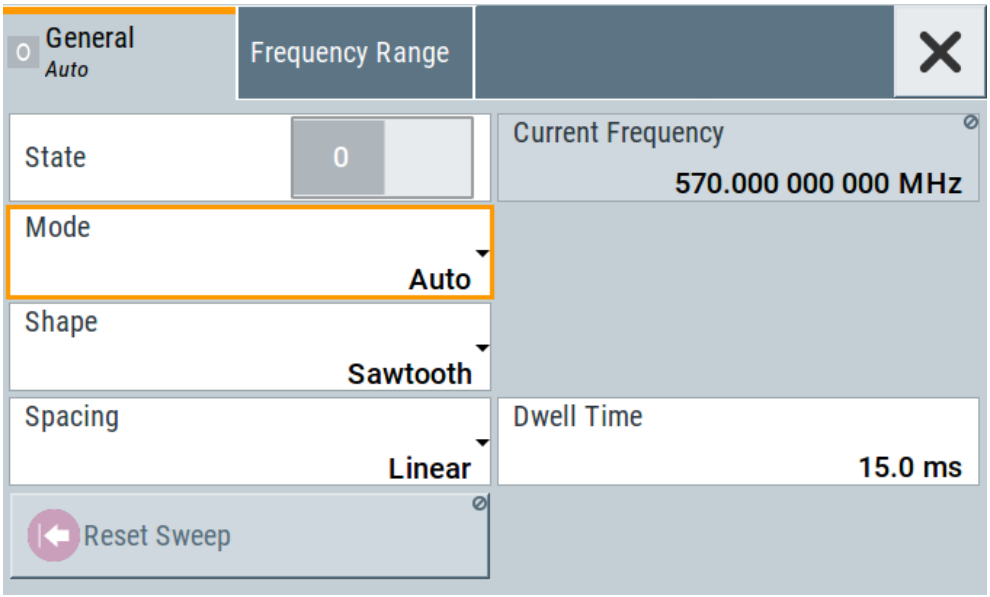
3.3.2 Generating an RF frequency sweep signal

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.

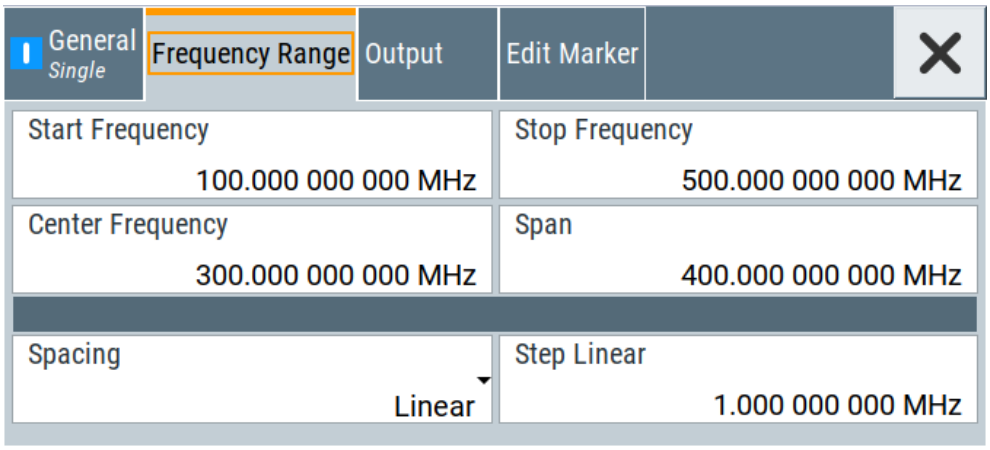
The sweep function does not require specific options.

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:



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.



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".

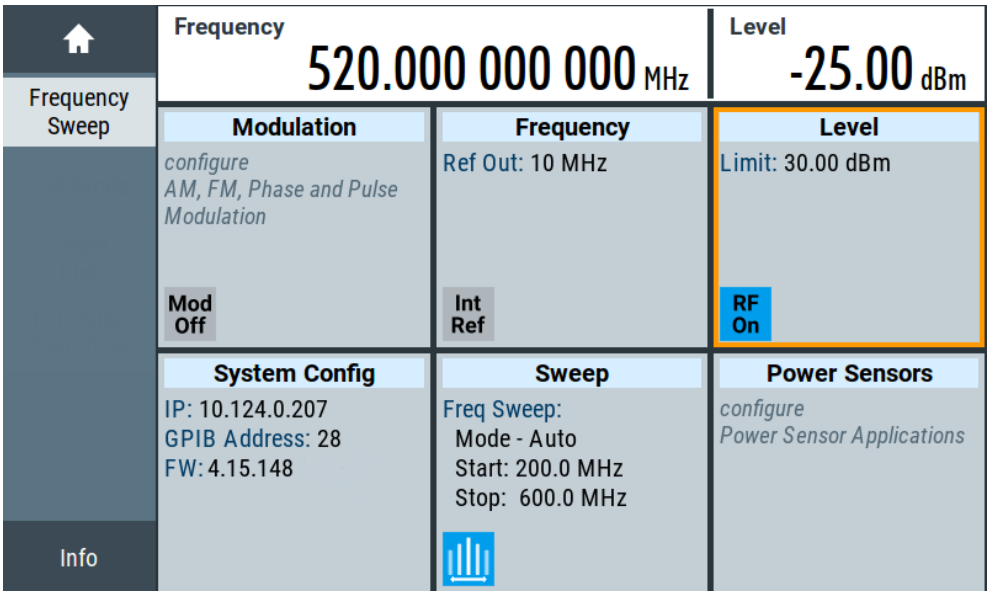


Figure 3-8: Generating a frequency sweep signal

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

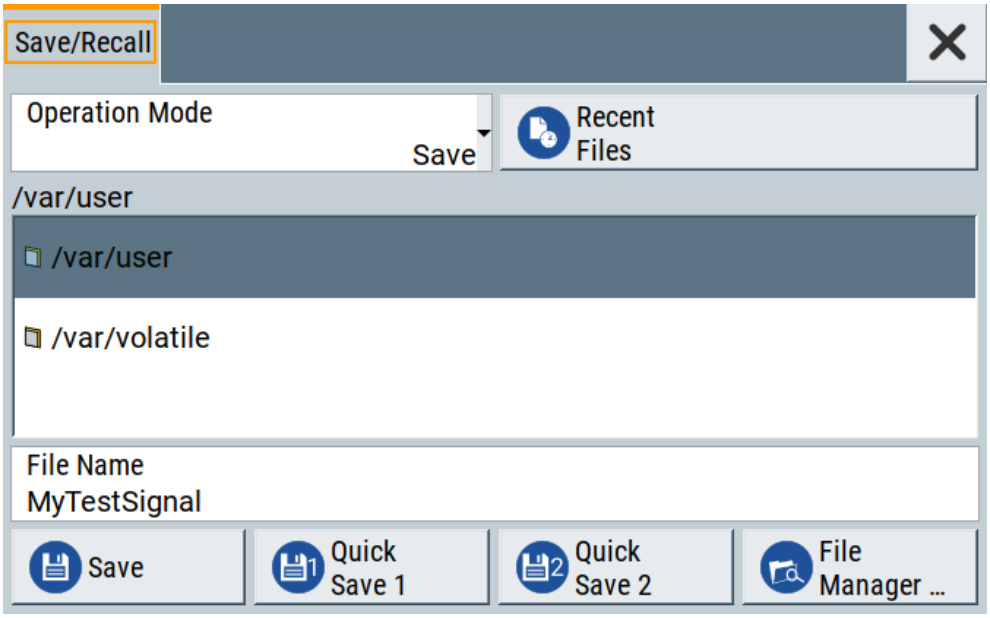
3.3.3 Saving and recalling settings

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 Section 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".



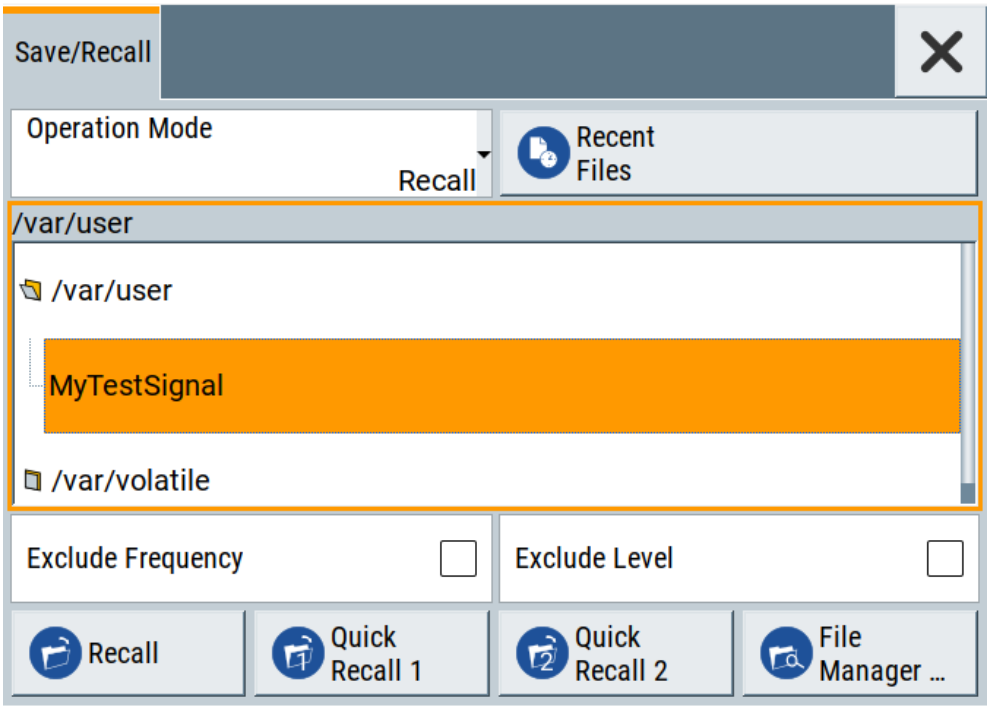
4. Tap the "Filename", use the on-screen keyboard, and enter *MyTestSignal*.
5. Tap the "Save" button.

   The file `MyTestSignal.savrcltxt` is stored in the default directory `/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.

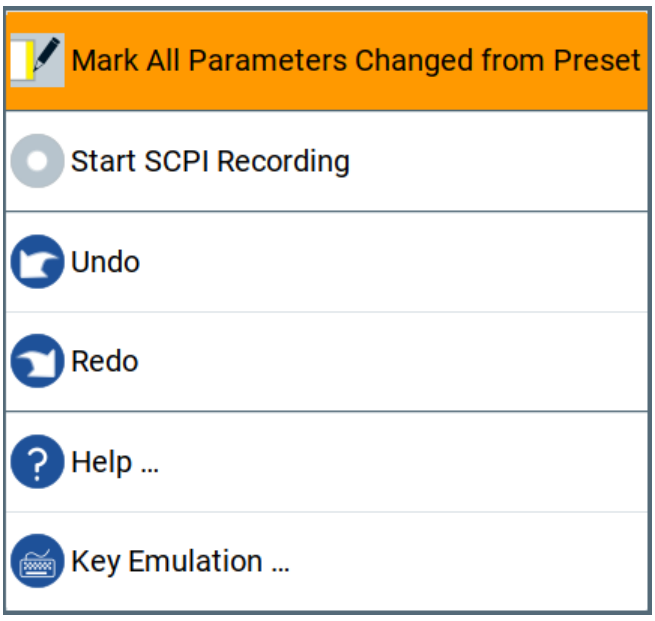
   All instrument settings are restored and the display resembles Section 3.3.2, "Generating an RF frequency sweep signal", on page 41, which shows the instrument display right before the settings were saved.

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

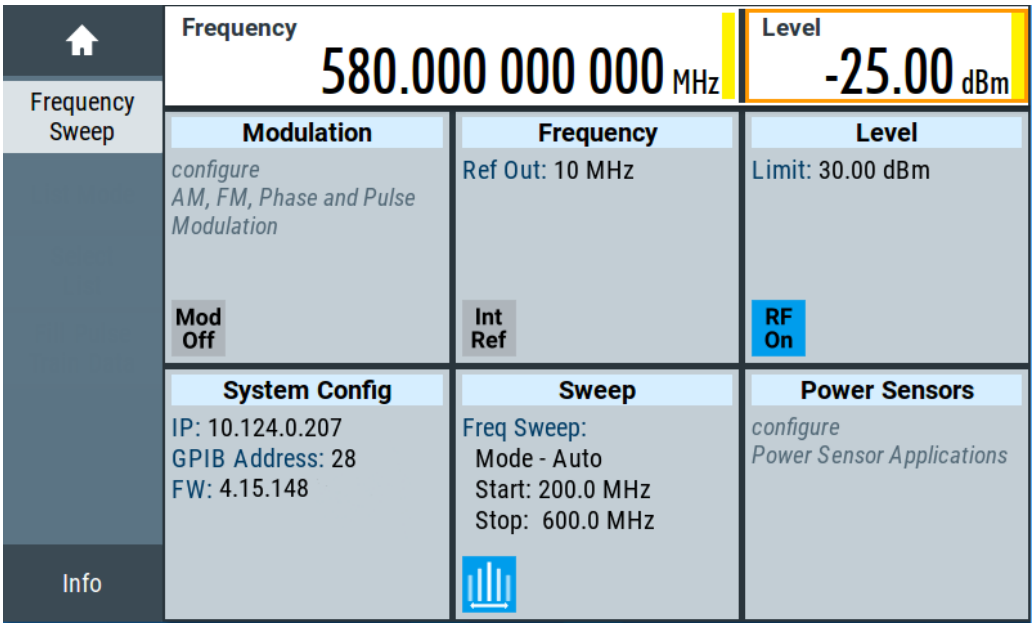
When you load a file to your instrument, you do not have enough information on the changed settings. In such case, it is useful to visualize all parameters that have been changed from their default state.

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".



- All changed parameters are highlighted.



See also Section 10, "File and data management", on page 220.

3.4 Operating the instrument

This section provides an overview on basic operating tasks. There are three ways to operate the R&S SMB100B.

Manual operation

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

Remote control

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

This way of operation is described in Section 12.1, "Overview of remote access modes", on page 297.

Remote operation

For remote monitoring and operation of the instrument, a VNC server is installed on the R&S SMB100B. You need a LAN connection to the computer, and a VNC client or browser to connect to the instrument.

This way of operation is described in Section 12.1, "Overview of remote access modes", on page 297.

The following sections show how to operate the instrument manually.

- Means of manual interaction....47
- Understanding the display information....48
- Accessing the functionality....51
- Entering data....52
- Undo and redo actions....53
- Getting information and help....54

3.4.1 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 touchscreen and navigation keys is described in Section 3.4.3, "Accessing the functionality", on page 51.

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

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

3.4.2 Understanding the display information

The home screen of the R&S SMB100B displays all main settings and generator states, divided into main operation areas.

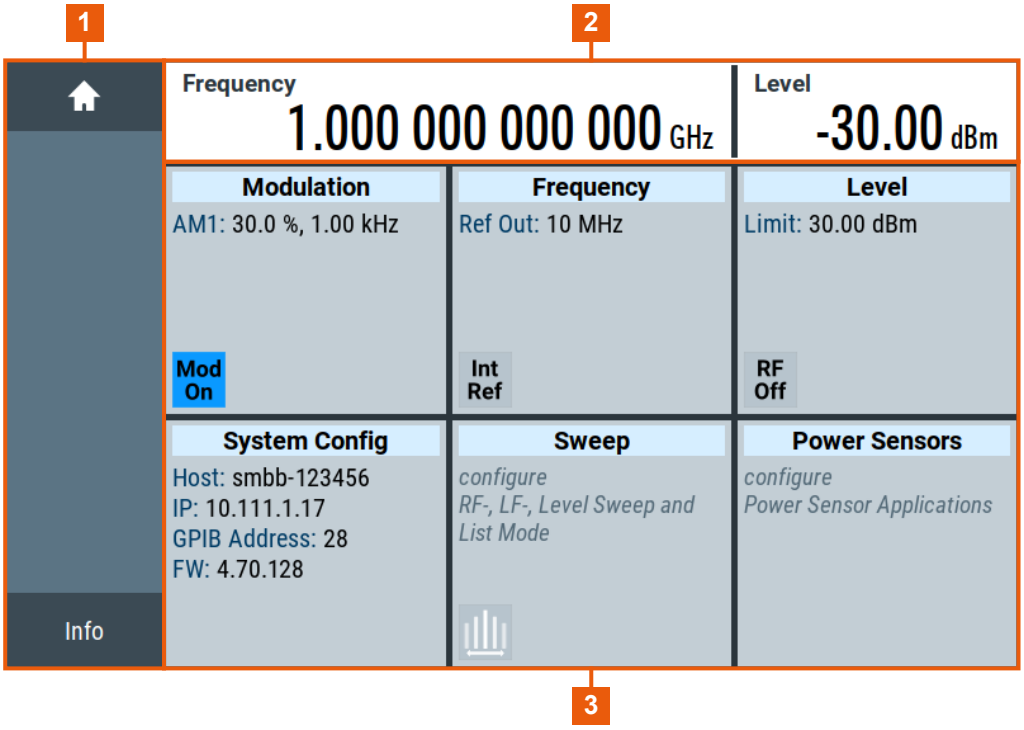


Figure 3-9: Home screen

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

- Status bar....49
- Tile diagram....49
- Taskbar....49
- Additional display characteristics....50

3.4.2.1 Status bar

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

3.4.2.2 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	

3.4.2.3 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 3-10: Example of buttons in the taskbar



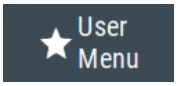
"Home" button

Returns to the home screen.



"Busy" indicator

Indicates a running process.



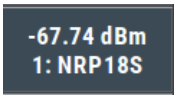
"User Menu"

Lists parameters that can be defined for quick access.



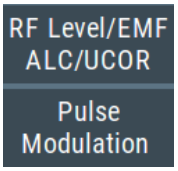
Shows the current remote access connections when the instrument is remotely controlled.

Tip: An indicator in the "System Config" tile shows the current remote control status.



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.

3.4.2.4 Additional display characteristics

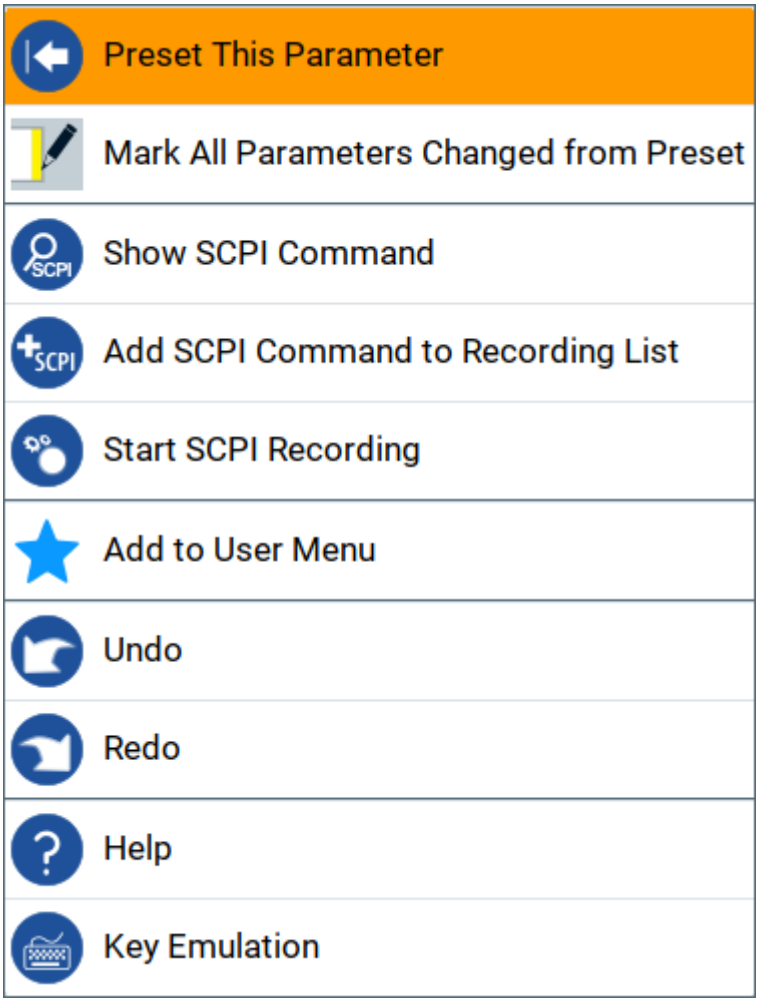
The following section provides a short insight on the indication of the screen in general, and significant elements that you see under specific modes, in dialogs or settings.

- **Appearance of active elements**
  - *Active* elements like On/Off switches, state buttons have a **blue** background.
  - *Selected* elements are framed or highlighted **orange**.
  - *Inactive* elements are **gray**.
- **On-screen keypads**
  Either a numerical or alphanumerical on-screen keypad appears when you enable an entry field, see Section 3.4.4, "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. If selected, the R&S SMB100B shows information on static errors and the error history.

- **Key parameters indicated in tab labels**
- **Scrollbar handle**
  An arrow icon that appears when you touch a scrollbar 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.
- **Progress indicators**
  A busy icon indicates a currently running process. If a process takes some time, a progress bar shows the current state.

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



3.4.3 Accessing the functionality

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

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

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

To open a dialog box

► Perform one of the following actions:

- Select the required tile, and then the menu entry.
- Select 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, select the "Home" button.
2. To switch to another dialog, select 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:

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

To select an option in a dialog box

► Select the required option.

3.4.4 Entering data

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

To enter numeric values with the on-screen keypad

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

1. Enter the numeric value.

   Tip: For a quick entry, you can enter a value in an exponential representation, for example *1e7* for *10000000*.

2. Tap the unit button to complete the entry.

   The unit is added to the entry.

   Tip: For a quick unit change, you can enter shortcuts, for example for a frequency value *1e8h* for *100 MHz*.
   For an overview of shortcuts supported by the R&S SMB100B, see Section B, "Unit shortcuts", on page 654.

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

To enter numeric values with 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, enable edit mode first. Press [Enter] or press the rotary knob.

To enter alphanumeric values

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

To complete an entry

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

To correct an entry

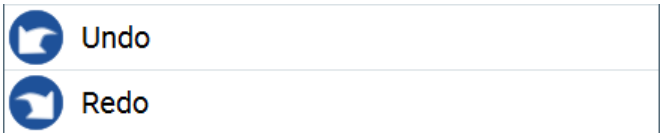
1. Using the arrow keys, move the cursor to the right of the entry you want to delete.
2. Press the [Backspace] key.
3. Deletes the entry to the left of the cursor.
4. Enter your correction.

To abort an entry

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

3.4.5 Undo and redo actions

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



"Redo" restores a previously undone action.

3.4.6 Getting information and help

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

For further information, you can use the following sources:

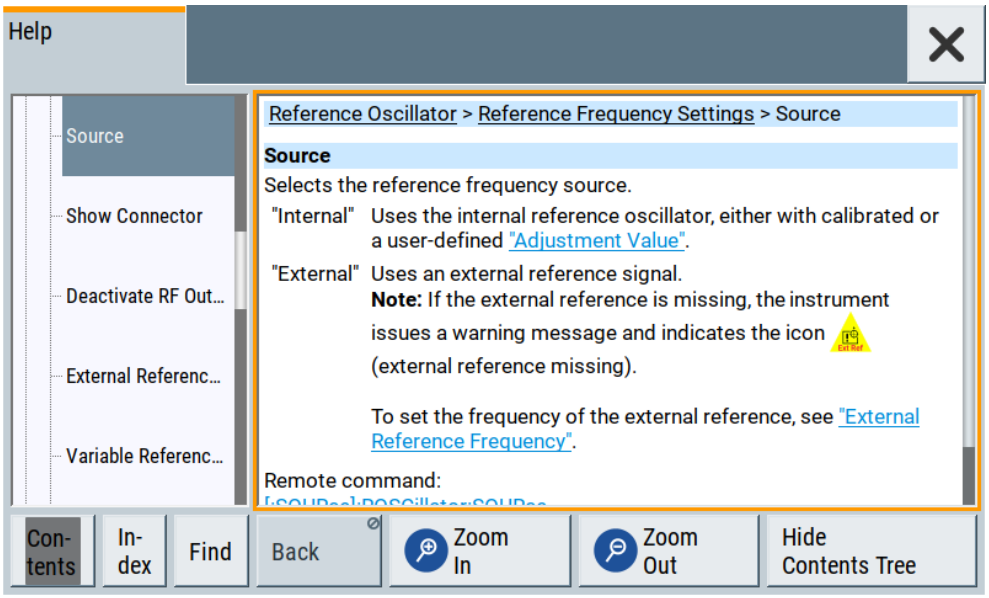
- Tooltips give the value range of the parameter.
- The context help provides a functional description on a setting.
- The general help explains a dialog box, provides instructions, and general information.

To display context help

► To access a help topic, perform one of the following:

a) Tap and hold the parameter for which you need information.
b) In the opening context menu, tap "Help".
c) Tap the parameter.
d) 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 content entries, tap on an entry.
   Entries with a plus sign contain further entries.
2. To display a help topic, tap on the topic name.
3. To follow a cross-reference, tap on the link text.
4. To return to the previous page, select "Back".
   This function scrolls back all steps that you have performed before.
5. Use the "scroll bars" to shift the visible section of content shown.
6. To maximize the "Topics" area, tap the "Hide Contents Tree" button to hide the contents tree.

Using the index

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

4 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 40 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. Several methods enable you to improve the 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 with 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:
  - Section 4.3, "RF frequency settings", on page 59
  - Section 4.4, "RF level settings", on page 61
  - Section 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 Section 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 Section 7, "List and sweep mode", on page 133.

4.1 Activating RF signal output

By default, the RF output signal is deactivated.

To activate the RF output signal

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.

   When activated, the "RF On" icon in the "Level" tile turns blue.

RF State/RF ON....57
RF output impedance....57

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

Acts as the [RF on/off] key.

Remote command:
`:OUTPut<hw>[:STATe]` on page 419

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

Remote command:
`:OUTPut<hw>:IMPedance?` on page 420

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.

To configure the RF signal.

1. Use one of the following:

a) In the home screen select:
   - "Frequency" and "Level" in the status bar
   - "Frequency" in the "Frequency" tile
   - "Level" in the "Level" tile
   - "Phase" in the "Frequency" tile

b) On the front panel:
   - Press the [Freq] key
   - Press the [Level] key

2. Enter the values as required.

The R&S SMB100B indicates the frequency and level settings in the status bar of the home screen, and shows active functions and parameters of the RF signal in the "Frequency" and "Level" tiles.

See "RF frequency and level display with a downstream instrument" on page 58.

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.

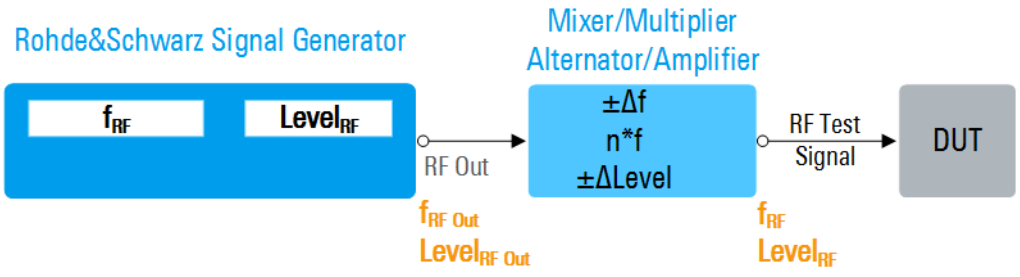


Figure 4-1: Frequency and Level display vs frequency and level at the RF output

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 50 Ω] ("RF > RF Frequency > Frequency" and "RF > RF Level > Amplitude")
n*f = Multiplication factor ("RF > RF Frequency > Multiplier")
Δf = Frequency offset ("RF > RF Frequency > Offset")
ΔLevel = Power offset ("RF > RF Level > Offset")

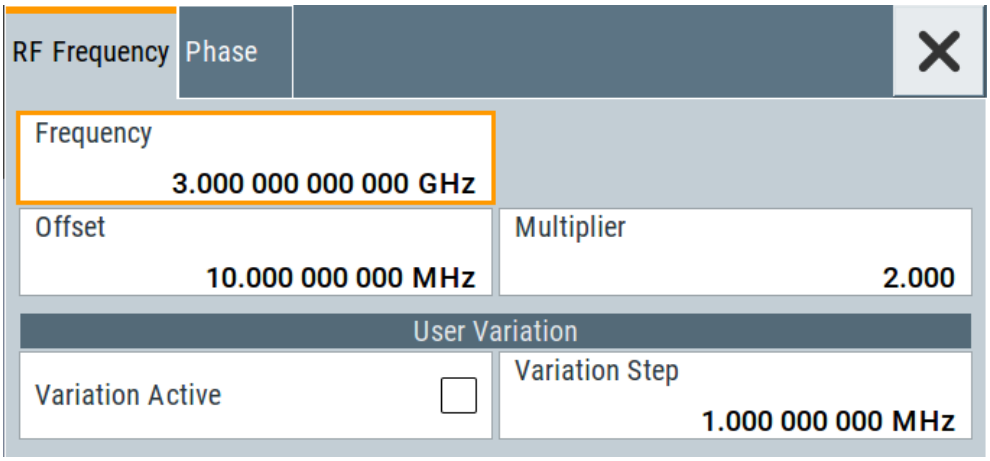
Calculation of f_{RF} and $Level_{RF}$

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

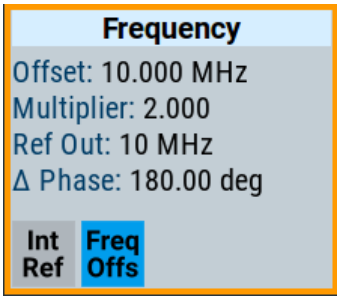
4.3 RF frequency settings

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 Section 13.16.4, "SOURce:FREQuency subsystem", on page 487.

Settings

Frequency 60
Offset 60
Multiplier 61
User Variation 61
└ Variation Active 61
└ Variation Step 61

Frequency
Sets the RF frequency.

This frequency is output at the RF 50 Ω connector.

It does not consider any parameter that affect the frequency, as e.g., a frequency offset.

See "RF frequency and level display with a downstream instrument" on page 58.

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 Section 7, "List and sweep mode", on page 133.

Remote command:
`[:SOURce<hw>]:FREQuency[:CW|FIXed]` on page 489

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 58.

Remote command:
[:SOURce<hw>]:FREQuency:OFFSet on page 491

Multiplier
Sets the multiplication factor for the RF frequency.

This value represents the multiplication factor of a downstream instrument, as for example a multiplier. You can also assign a negative multiplication factor, for example -1.0 to support frequency converters working in the reverse frequency position.

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 58.

Remote command:
[:SOURce<hw>]:FREQuency:MULTiplier on page 490

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 493
[:SOURce<hw>]:POWer:STEP:MODE on page 534

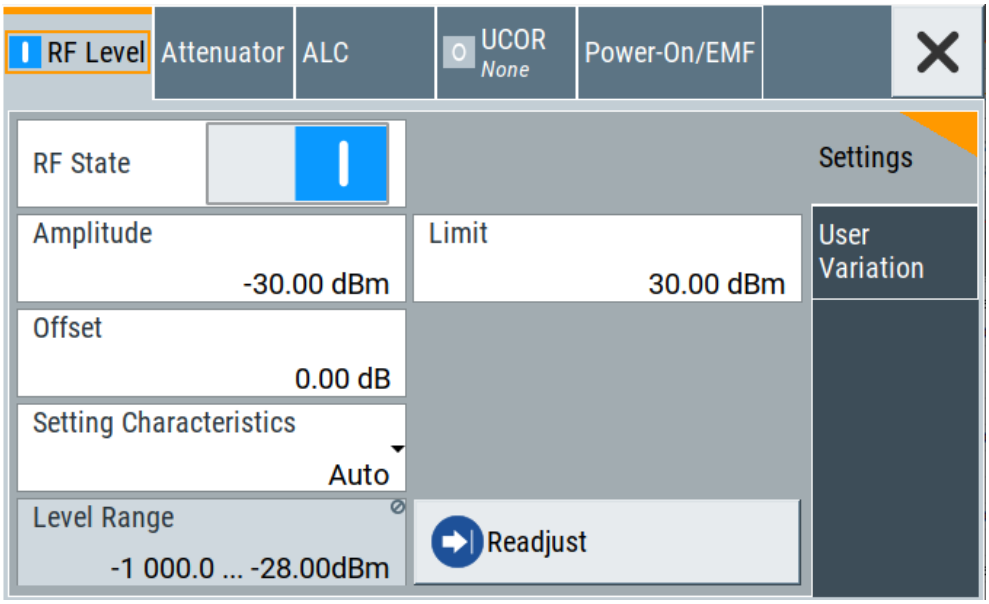
Variation Step ← User Variation
Sets the user-defined step width.

Remote command:
[:SOURce<hw>]:FREQuency:STEP[:INCRement] on page 493
[:SOURce<hw>]:POWer:STEP[:INCRement] on page 534

4.4 RF level settings

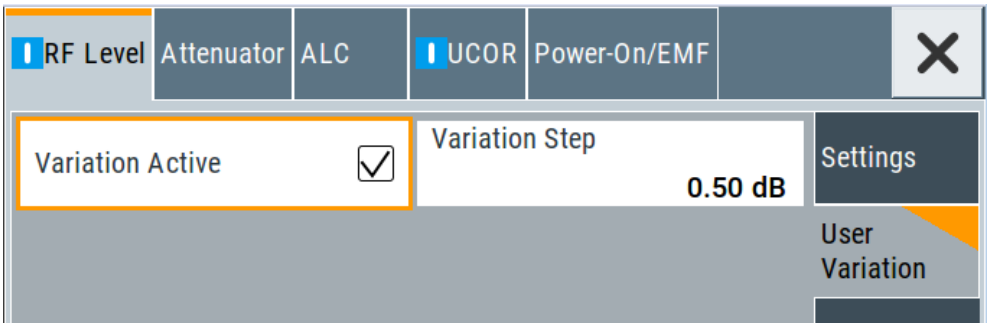
Access:

1. Select "Level" > "RF Level".

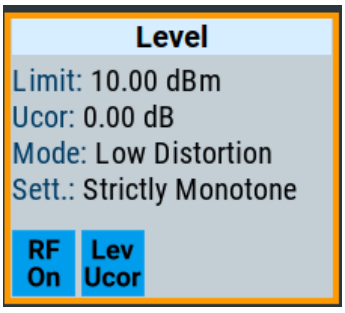


In the "RF Level" dialog, you can configure the offset-free level, the level limit, and the step width for varying the level with the rotary knob.

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



3. Observe the information on the home screen, "Level" tile.



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 Section 13.16.11, "SOURce:POWer subsystem", on page 524.

Settings

RF State/RF ON....63
Amplitude....63
Limit....63
Offset....64
Setting Characteristics....64
Level Range....65
Readjust....65
User Variation....65
└ Variation Active....65
└ Variation Step....65

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

Acts as the [RF on/off] key.

Remote command:
`:OUTPut<hw>[:STATe]` on page 419

Amplitude
Sets the level of the RF signal.

The value is offset-free and corresponds to the level at the RF 50 Ω connector.

See "RF frequency and level display with a downstream instrument" on page 58.

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 Section 7, "List and sweep mode", on page 133.

Remote command:
`[:SOURce<hw>]:POWer:POWer` on page 530
Note: The SCPI command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the "Level" display.
This means, the level containing offset.

Limit
Sets an upper limit for the output power.

Note: The parameter "RF level" > **"Limit"** and "NRP power control" > **"RF Amplitude Limit"** are identical.

You can use this value to protect your DUT from damage due to high input power. If you enter an RF level above this value, the instrument limits the output power to this specified value, and generates the warning message:

"Pep value greater than the defined limit." However, the level indication in the status bar is not affected.

The setting is not affected by an instrument preset ([Preset] key or `*RST`) and the "Save/Recall" function. It is reset only by factory preset.

Remote command:
`[:SOURce<hw>]:POWer:LIMit[:AMPLitude]` on page 529

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 58.

Remote command:
`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet` on page 535

Setting Characteristics
Selects additional quality characteristics to optimize the behavior of the RF signal level for the specific application.

"Auto"
Sets the RF output level automatically according to the selected mode.
In this mode, the instrument provides the highest dynamic range and fastest setting times.
The RF signal is shortly blanked when the step attenuator is switching.

For more information, refer to the specifications document.

"Uninterrupted"
Suppresses blanking at level transitions. Frequency transitions can lead to an RF level blanking due to hardware-specific switching points.
This mode reduces the dynamic range of the instrument. The step attenuator is fixed.

"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 can 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 50 Ω output connector, due to changed level settings.

"User"
Selects this entry automatically when you change one of the following parameters from the default setting:
- "Attenuator" > Mode
- "ALC" > State or Detector Sensitivity

Note: If you select another setting characteristic, the R&S SMB100B presets the modified attenuator and ALC parameters.

Remote command:
[:SOURce<hw>]:POWer:LBEHaviour on page 529

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 536
[:SOURce<hw>]:POWer:RANGe:UPPer? on page 536

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

The R&S SMB100B provides the "Readjust" function when you change one of the following parameters from the default setting:
- "RF Level" > Setting Characteristics
- "Attenuator" > Mode > FixedSetting Characteristics

Remote command:
[:SOURce<hw>]:POWer:ALC:SONCe on page 528

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 493
[:SOURce<hw>]:POWer:STEP:MODE on page 534

Variation Step ← User Variation
Sets the user-defined step width.

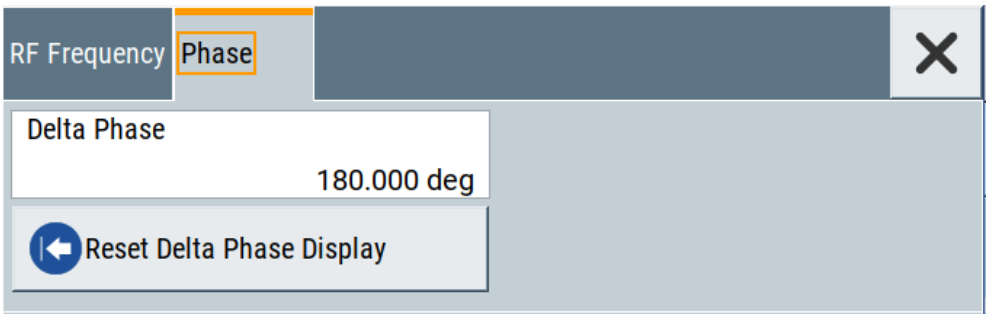
Remote command:
[:SOURce<hw>]:FREQuency:STEP[:INCRement] on page 493
[:SOURce<hw>]:POWer:STEP[:INCRement] on page 534

4.5 RF phase settings

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

Access:

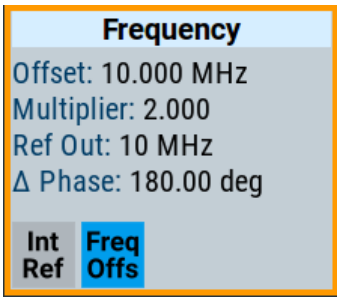
1. Select "Frequency" > "Phase".



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

2. Switch to the home screen, "Frequency" tile.

The R&S SMB100B indicates the configured settings.



The remote commands required to define the settings are described in Section 13.16.10, "SOURce:PHASe subsystem", on page 523.

Settings

Delta Phase....66
Reset Delta Phase Display....66

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 524

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 524

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-K22, enables generation of pulse modulated RF signals.

Option: R&S SMBB-B5, Stereo/RDS-Coder enables generation of stereo-modulated RF signals (R&S SMB100B RF instruments only).

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, R&S SMB100B analog RF instruments only)
- 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 (R&S SMBB-K720)

For more information, refer to the specifications document.

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, refer to the specifications document.

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.
- Considerations to AM when using an external modulation signal:
  If external modulation is enabled, the RFoutput amplitude follows the external modulation signal with a scaling factor defined by the modulation sensitivity setting.

  With Coupling (AC/DC) > DC, the RF output signal behaves according to:
  - input signal = 0 V: the RF output amplitude corresponds to the level value set in the R&S SMB100B
  - input signal = +1 V: the output level increases up to the maximum value given by the set modulation sensitivity
  - input signal = -1 V: the output level decreases down to the minimum value given by the set modulation sensitivity

  With Coupling (AC/DC) > AC, the modulation input signal is internally highpass filtered. Therefore, the DC content of the input signal is removed before it reaches the amplitude modulator.

For more information, refer to the specifications document.

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 442

5.4 Modulation settings

Access:

► Select "Modulation" > "Modulation Sources".

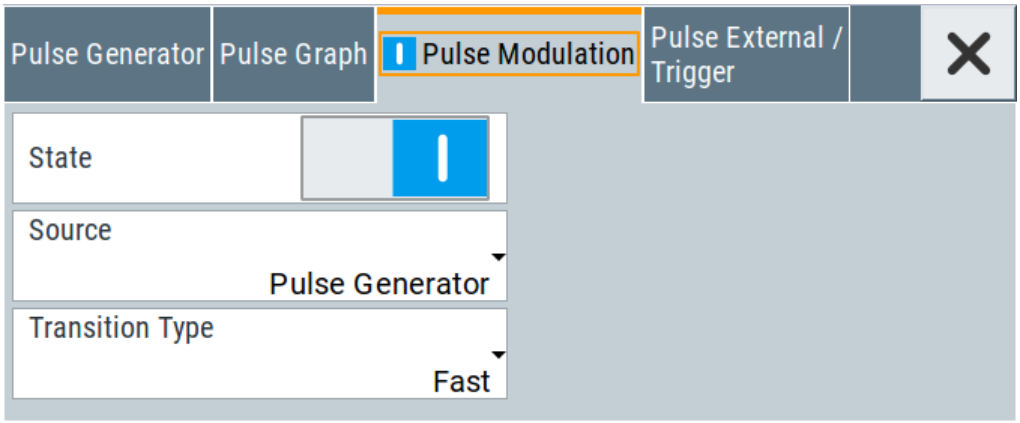
The "Modulation" dialog contains all functions and settings to configure the analog modulations, the LF signal sources for performing a modulation, and the LF signal output.

5.4.1 Pulse modulation settings

Option: see Section 5.1, "Required options", on page 68.

Access:

► Select "Modulation" > "Pulse Modulation".



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 Section 5.2, "Modulation types and signal sources", on page 68.

The remote commands required to define these settings are described in Section 13.16.1.5, "SOURce:PULM subsystem", on page 457.

Settings

State....71
Source....72
Transition Type....72

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 461

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 461

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.

For more information, refer to the specifications document.

For more information, refer to the specifications document.

For more information, refer to the specifications document.

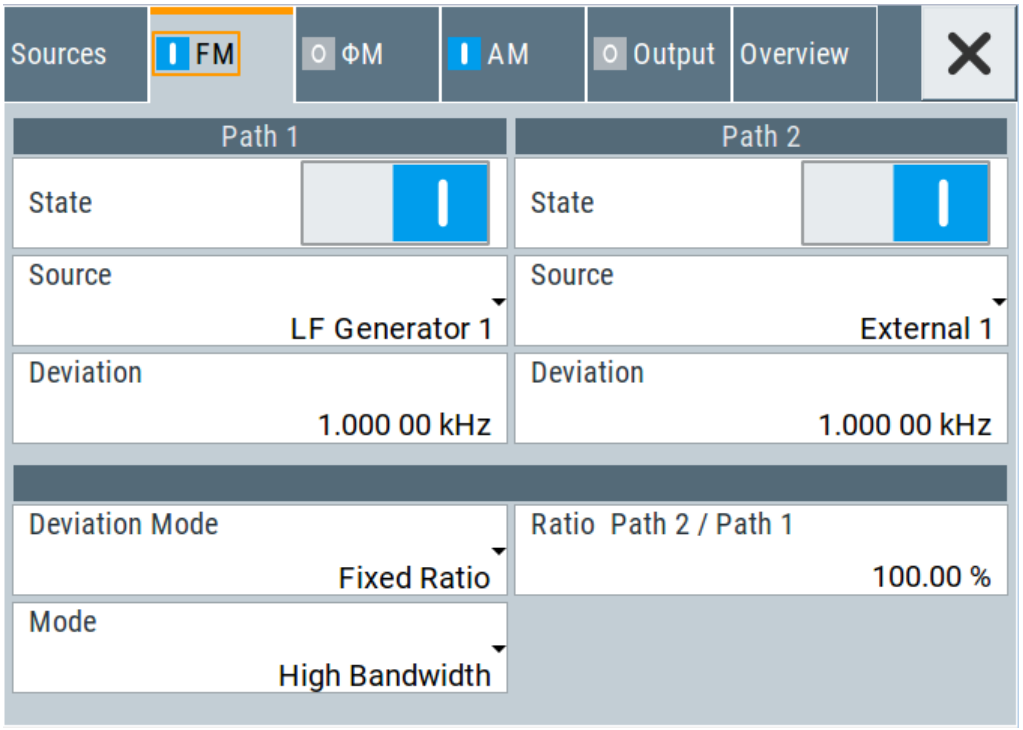
Remote command:
[:SOURce<hw>]:PULM:TTYPe on page 462

5.4.2 FM, PhiM and AM modulation settings

Option: R&S SMBB-K720

Access:

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



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

The remote commands required to define these settings are described in:

- Section 13.16.1.2, "SOURce:AM subsystem", on page 443
- Section 13.16.1.3, "SOURce:FM subsystem", on page 448
- Section 13.16.1.4, "SOURce:PM subsystem", on page 453

Settings

State....74
Source....74
FM settings....74
└ Deviation....74
└ Deviation Mode....75
└ Total Deviation....75
└ Ratio Path2/Path1....75
└ Mode....75
PhiM settings....76
└ Deviation....76
└ Deviation Mode....76
└ Total Deviation....76
└ Ratio Path2/Path1....76
└ Mode....77

AM settings 77
└ Depth 77
└ Sensitivity 77
└ Deviation Mode 77
└ Total Depth 78
└ Ratio Path2/Path1 78

State
Activates a modulation.

Note: Some modulations exclude each other and cannot be performed simultaneously. For more information, refer to the specifications document.

Remote command:
`[:SOURce<hw>]:AM<ch>:STATe` on page 445
`[:SOURce<hw>]:FM<ch>:STATe` on page 450
`[:SOURce<hw>]:PM<ch>:STATe` on page 454

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 Section 5.4.7.1, "Source > LF generator settings", on page 100.

"External" Selects an externally supplied LF signal.

"Noise Generator"
Selects the internally generated noise signal.
See Section 5.4.7.3, "Source > noise generator settings", on page 105.

Remote command:
`[:SOURce<hw>]:AM<ch>:SOURce` on page 446
`[:SOURce<hw>]:FM<ch>:SOURce` on page 450
`[:SOURce<hw>]:PM<ch>:SOURce` on page 455

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.

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.

For more information, refer to the specifications document.

Remote command:
[:SOURce<hw>]:FM<ch>[:DEViation] on page 450

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 451

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 451

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 452

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.

For more information, refer to the specifications document.

Remote command:
[:SOURce<hw>]:FM:MODE on page 452

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.

For more information, refer to the specifications document.

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 457

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 456

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 456

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 456

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.
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.

For more information, refer to the specifications document.

Remote command:
[:SOURce<hw>]:PM:MODE on page 455

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 446

Sensitivity ← AM settings
Sets the input sensitivity of the external modulation signal.

Remote command:
[:SOURce<hw>]:AM<ch>:SENSitivity on page 448

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 447

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 447

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 447

5.4.3 Stereo modulation

R&S SMB100B RF instruments only

Option: see Section 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.

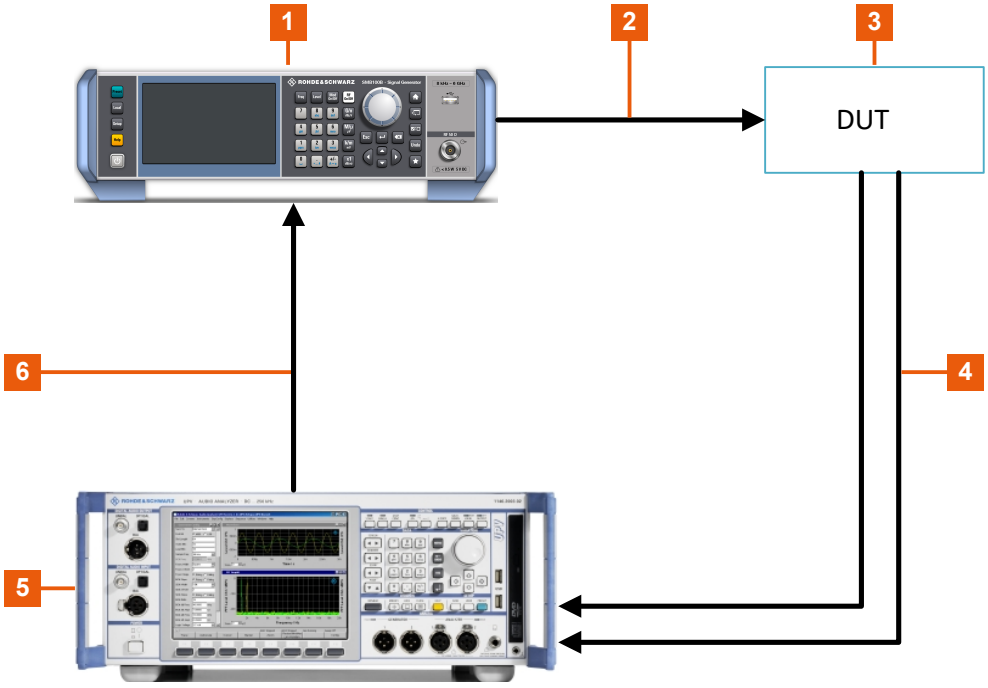


Figure 5-1: Example setup

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

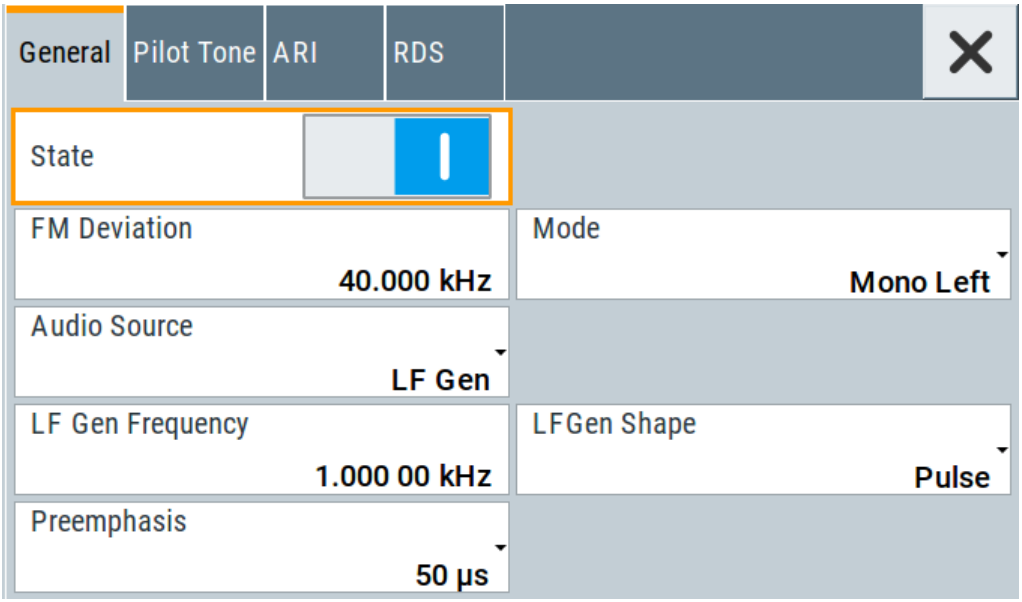
- General settings....79
- Pilot tone....82
- ARI....83
- RDS....85

5.4.3.1 General settings

Access:

► Select "Modulation" > "Stereo Modulation".

The "General" tab contains the settings for creating a stereo modulation signal.



The remote commands required to define these settings are described in Section 13.16.1.6, "SOURce:STEReo subsystem", on page 468.

Settings

State....80
FM Deviation....80
Mode....80
Audio Source....81
LF Gen Frequency....81
LF Gen Shape....81
External R/L Impedance....81
Preemphasis....81
Max Modulation Frequency....82

State
Activates stereo modulation.

Remote command:
`[:SOURce]:STEReo:STATe` on page 470

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

Remote command:
`[:SOURce]:STEReo[:DEViation]` on page 470

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 471

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 471

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 497

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 501

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 472

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 472
[:SOURce]:STEReo:AUDio:PREemphasis on page 472

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.

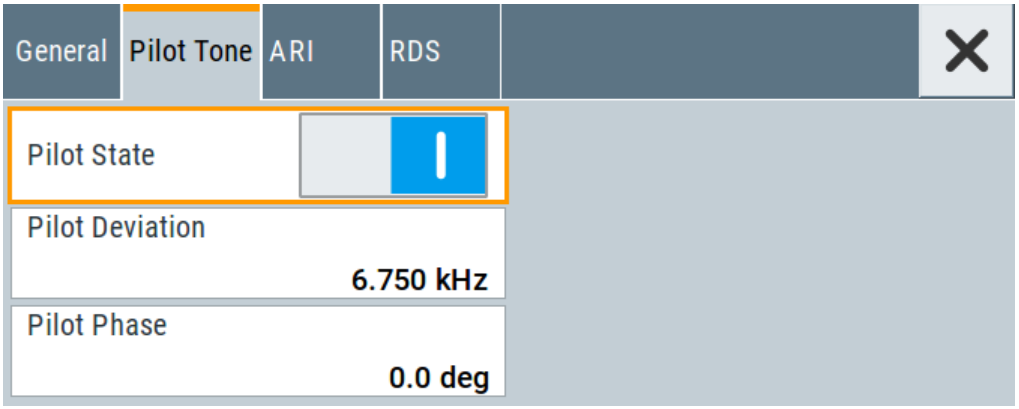
The default value of this parameter works for normal modulation signals, such as voice or music, because the amplitude of the high-frequency portions of these signals normally decreases substantially.

Remote command:
[:SOURce]:STEReo:MMF on page 472

5.4.3.2 Pilot tone

Access:

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



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.

The remote commands required to define these settings are described in Section 13.16.1.6, "SOURce:STEReo subsystem", on page 468.

Settings

Pilot State....83
Pilot Deviation....83
Pilot Phase....83

Pilot State
Activates the pilot tone generation.

Remote command:
`[:SOURce]:STEReo:PILot:STATe` on page 473

Pilot Deviation
Sets the deviation of the pilot tone.

Remote command:
`[:SOURce]:STEReo:PILot[:DEViation]` on page 473

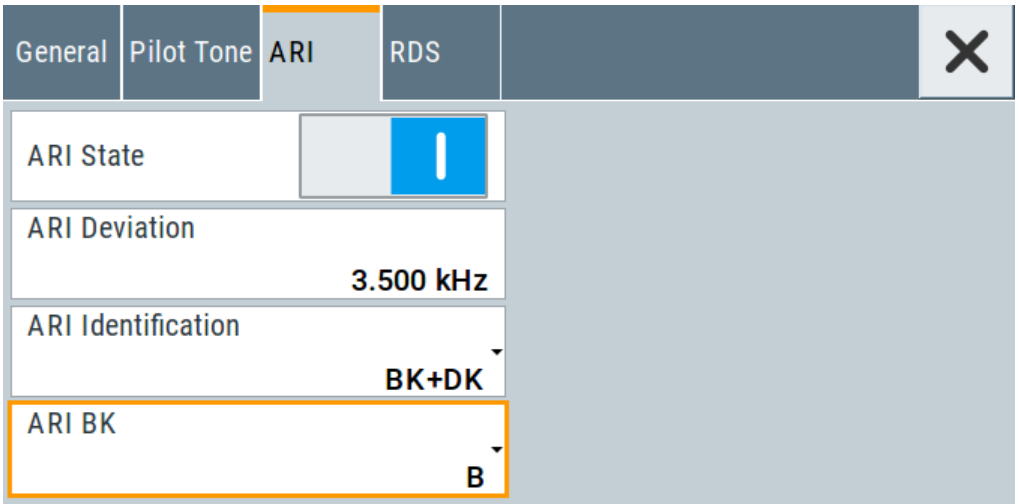
Pilot Phase
Sets the phase of the pilot tone in relation to the 38 kHz carrier signal of the receiver. For a correct demodulation, the pilot tone must be in phase with the 38 kHz carrier.

Remote command:
`[:SOURce]:STEReo:PILot:PHASe` on page 473

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.

The remote commands required to define these settings are described in Section 13.16.1.6, "SOURce:STEReo subsystem", on page 468.

Settings

ARI State....84
ARI Deviation....84
ARI Identification....84
ARI BK....84

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 473

ARI Deviation
Sets the frequency deviation of the ARI subcarrier signal.

Remote command:
`[:SOURce]:STEReo:ARI[:DEViation]` on page 474

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 474
`[:SOURce]:STEReo:ARI:TYPE` on page 474

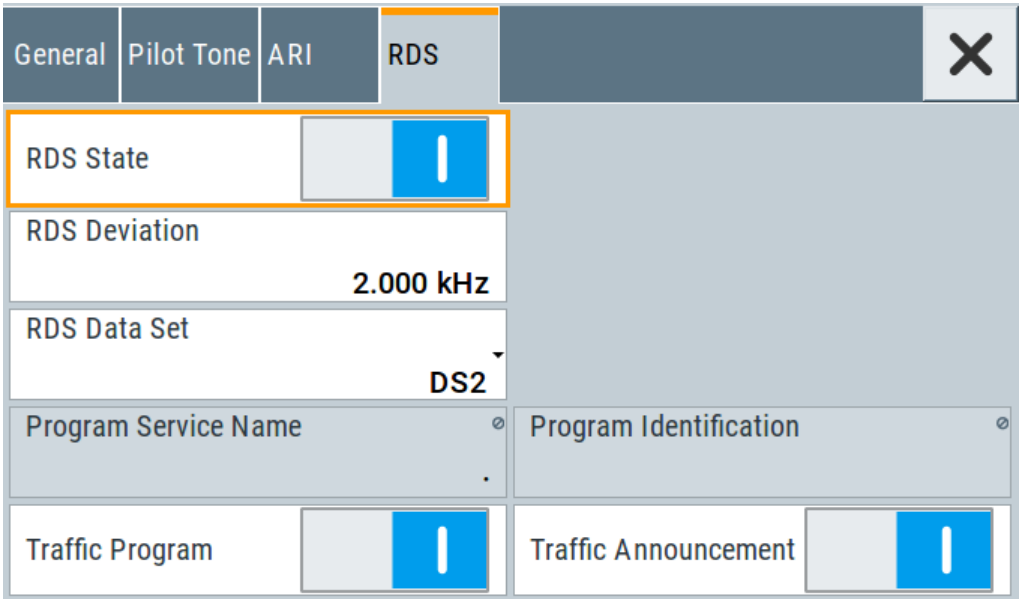
ARI BK
Selects the specific area identification (BK) code of the ARI signal. The six letters (six different frequencies) identify a specific region in each country.

Remote command:
`[:SOURce]:STEReo:ARI:BK[:CODE]` on page 475

5.4.3.4 RDS

Access:

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



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.

The remote commands required to define these settings are described in Section 13.16.1.6, "SOURce:STEReo subsystem", on page 468.

Settings

RDS State 85
RDS Deviation 86
RDS Data Set 86
Program Service Name 86
Program Identification 86
Traffic Program 86
Traffic Announcement 87

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 475

RDS Deviation
Sets the deviation of the RDS subcarrier.

Remote command:
[:SOURce]:STEReo:RDS[:DEViation] on page 475

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 476

Program Service Name
Indicates the RDS program service name.

Remote command:
[:SOURce]:STEReo:DIRect on page 470

Program Identification
Indicates the RDS program identification.

Remote command:
[:SOURce]:STEReo:DIRect on page 470

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 476

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.

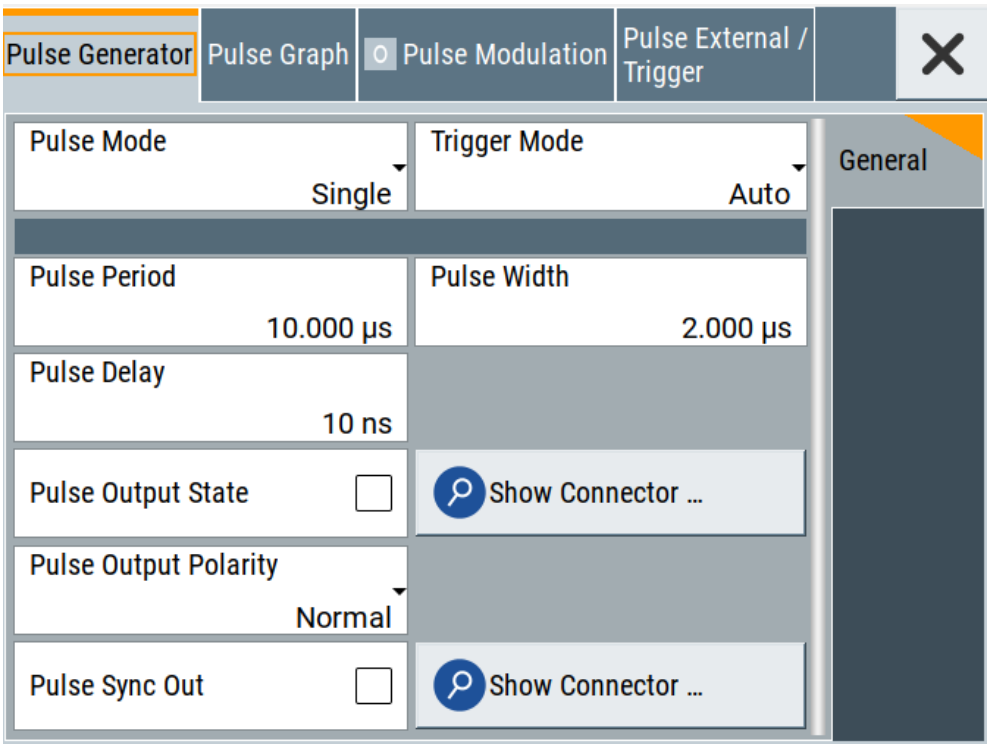
Remote command:
[:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe] on page 476

5.4.4 Pulse generator

Option: see Section 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.

The remote commands required to define these settings are described in Section 13.16.1.5, "SOURce:PULM subsystem", on page 457.

- Pulse generator > general settings 88
- Pulse generator > pulse train settings 91
- Import/export list files 95

5.4.4.1 Pulse generator > general settings

Access:

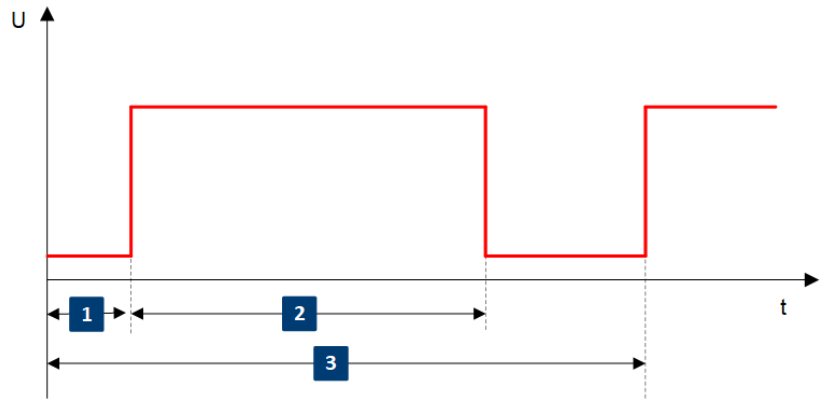
► Select "Modulation" > "Pulse Modulation > Pulse Generator".

Settings

Pulse Mode 88
Trigger Mode 89
Pulse Period 90
Pulse Width 90
Double Pulse Width 90
Pulse Delay 90
Double Pulse Delay 90
Pulse Output State 90
Show/Show Connector 91
Pulse Output Polarity 91
Execute Single Trigger 91
Pulse Sync Out 91

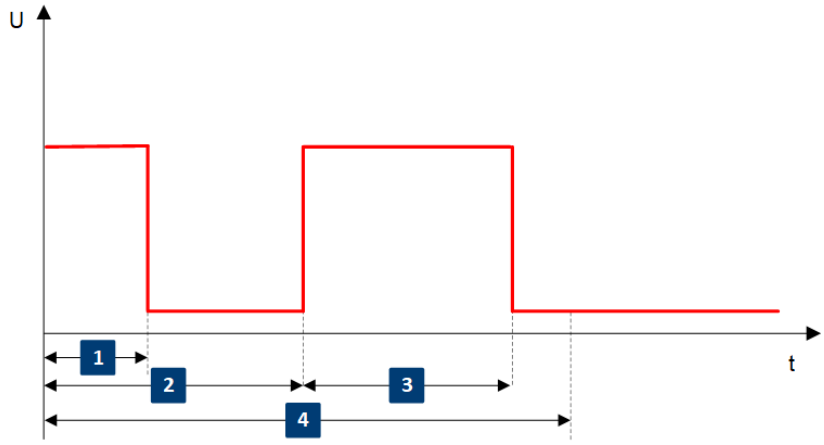
Pulse Mode
Sets the operating mode of the pulse generator. Depending on the selection, the instrument displays the associated parameters.

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



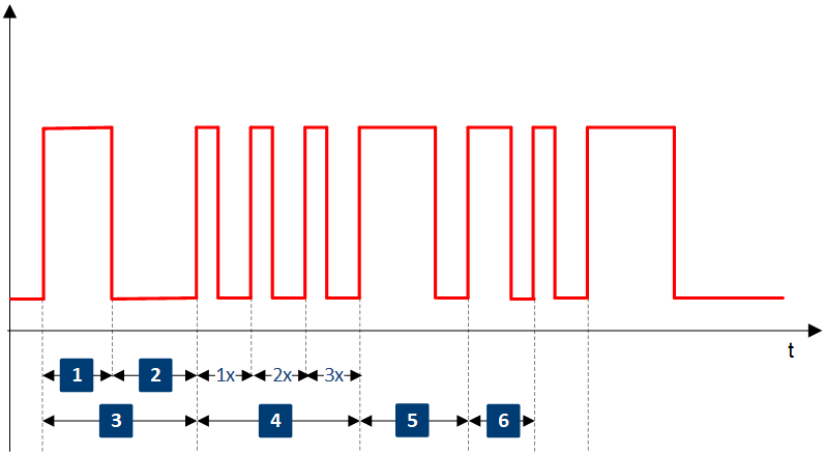
1 = Pulse delay
2 = Pulse width
3 = Pulse period

"Double" Generates two pulses in one pulse period.



1 = Pulse width
2 = Double pulse delay
3 = Double pulse width
4 = Pulse period

"Train" Option: R&S SMBB-K27
Generates a user-defined pulse train.



1 = 1st pulse: On-time
2 = 1st pulse: Off-time
3 = 1st pulse: pulse period
4 = 2nd pulse: repeated 3 times
5 = 3rd pulse
6 = 4th pulse

See Section 5.4.4.2, "Pulse generator > pulse train settings", on page 91.

Remote command:
`[:SOURce<hw>]:PULM:MODE` on page 459

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.

For more information, refer to the specifications document.

Remote command:
`[:SOURce<hw>]:PULM:TRIGger:MODE` on page 459

Pulse Period
Sets the repetition rate of the generated pulse signal.

Remote command:
`[:SOURce<hw>]:PULM:PERiod` on page 460

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 460

Double Pulse Width
Sets the width of the second pulse.

Remote command:
`[:SOURce<hw>]:PULM:DOUBle:WIDTh` on page 461

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 460

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 461

Pulse Output State
Activates the output of the pulse modulation signal.

Remote command:
`[:SOURce<hw>]:PGENerator:OUTPut[:STATe]` on page 523

Show/Show Connector
Opens a dialog that displays the location of the connector on the front panel or rear panel of the instrument. A blinking rectangle shows the connector.

Pulse Output Polarity
Sets the polarity of the pulse output signal.

Remote command:
`[:SOURce<hw>]:PGENerator:OUTPut:POLarity` on page 522

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

Remote command:
`[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate` on page 460

Pulse Sync Out
Assigns the pulse synchronization signal to the [Signal Valid] connector at the rear panel.

"checked" Sets the validity of the RF signal at the output:
- **high:** while the signal settles.
- **low:** when it is stable (valid).

"cleared" Generates a single pulse at the beginning of a pulse sequence, e.g. to synchronize pulse modulation.

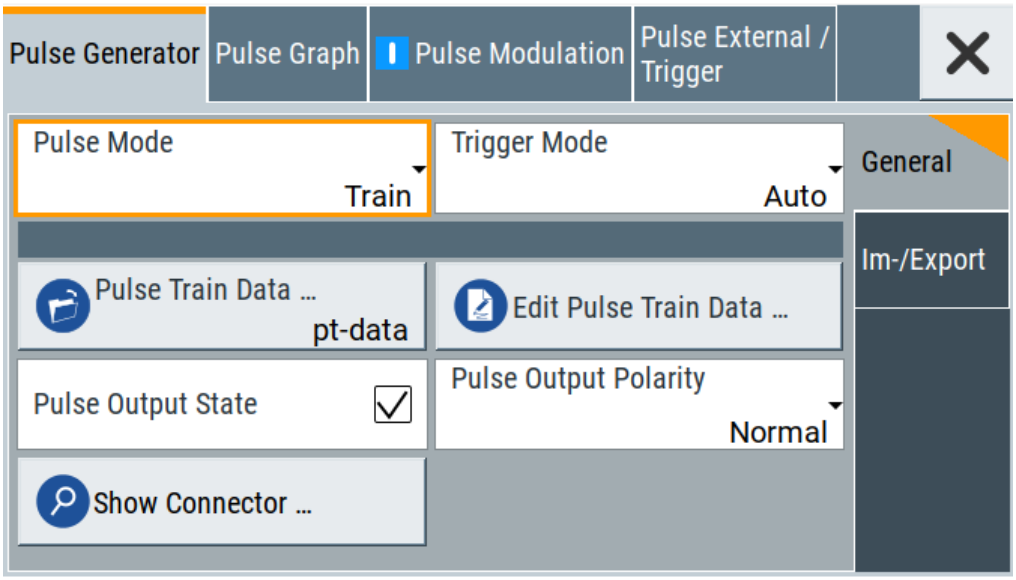
Remote command:
`[:SOURce<hw>]:PULM:OUTPut:SYNC[:STATe]` on page 462

5.4.4.2 Pulse generator > pulse train settings

Option: see Section 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 Section 10.9, "Using the file manager", on page 237.

The remote commands required to define these settings are described in Section 13.16.1.5, "SOURce:PULM subsystem", on page 457.

Settings

Pulse Train Data....93
Edit Pulse Train Data....94
Data handling keys....94
└ Go To....94
└ Edit....94
└ Save As/Save....94
Fill....94

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 464
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 466
`[:SOURce<hw>]:PULM:TRAin:DELete` on page 464

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 465
`[:SOURce<hw>]:PULM:TRAin:OFFTime` on page 465
`[:SOURce<hw>]:PULM:TRAin:REPetition` on page 465
`[:SOURce<hw>]:PULM:TRAin:DELete` on page 464

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.

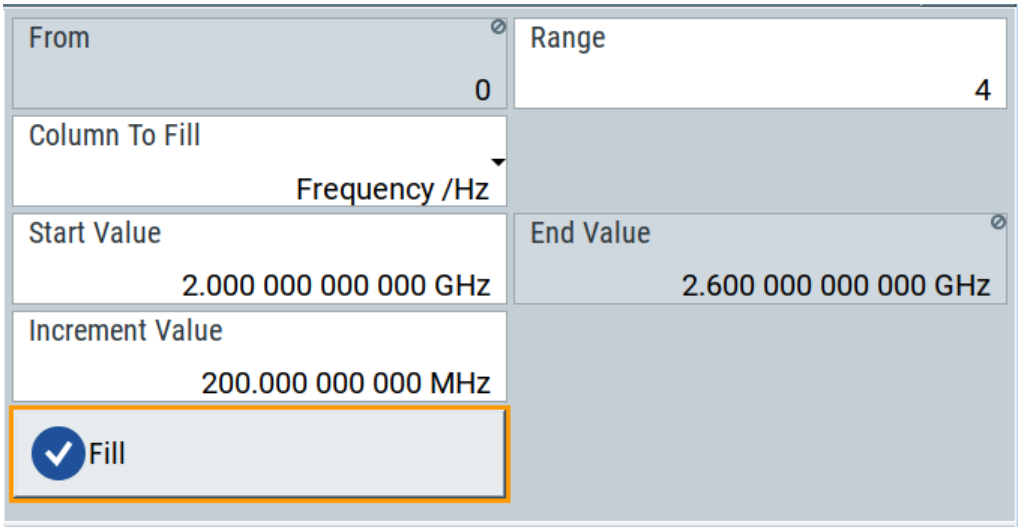
Go To ← Data handling keys
Selects a row for editing.

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 94.

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.



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".

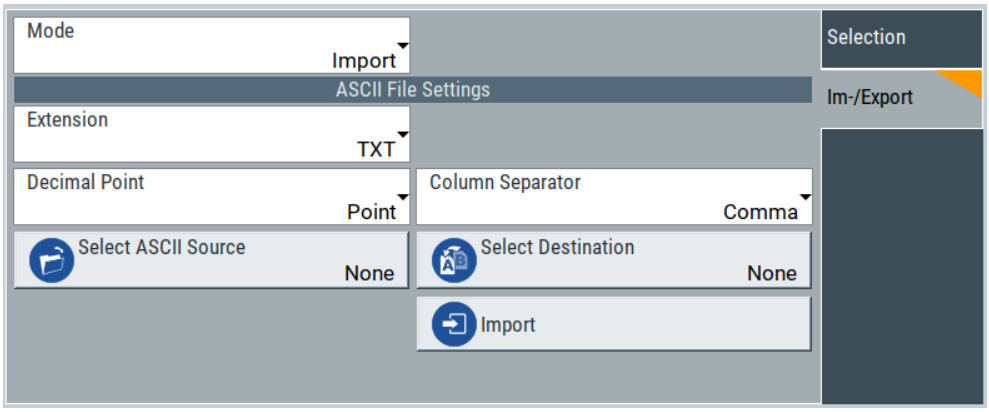


Figure 5-2: Im-/Export dialog (example with UCOR settings)

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 96
ASCII File Settings 96
Select (ASCII) Source/Select (ASCII) Destination 97
Select Source/Select ASCII Destination 97
Import / Export 97

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 520
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 483
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 466

ASCII File Settings
Defines the format and the separators of the associated data file.

"Extension" Selects `*.csv` or `*.txt` format.

"Decimal Point" Sets "Point" (dot) or "Comma" as the decimal separator used in the 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 518
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal` on page 519

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 519
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 482
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal on page 483
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn on page 467

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 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 519
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 482
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 468

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 520
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 484
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 468

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

Remote command:
[:SOURce<hw>]:LIST:DEXChange:EXECute on page 519
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 468

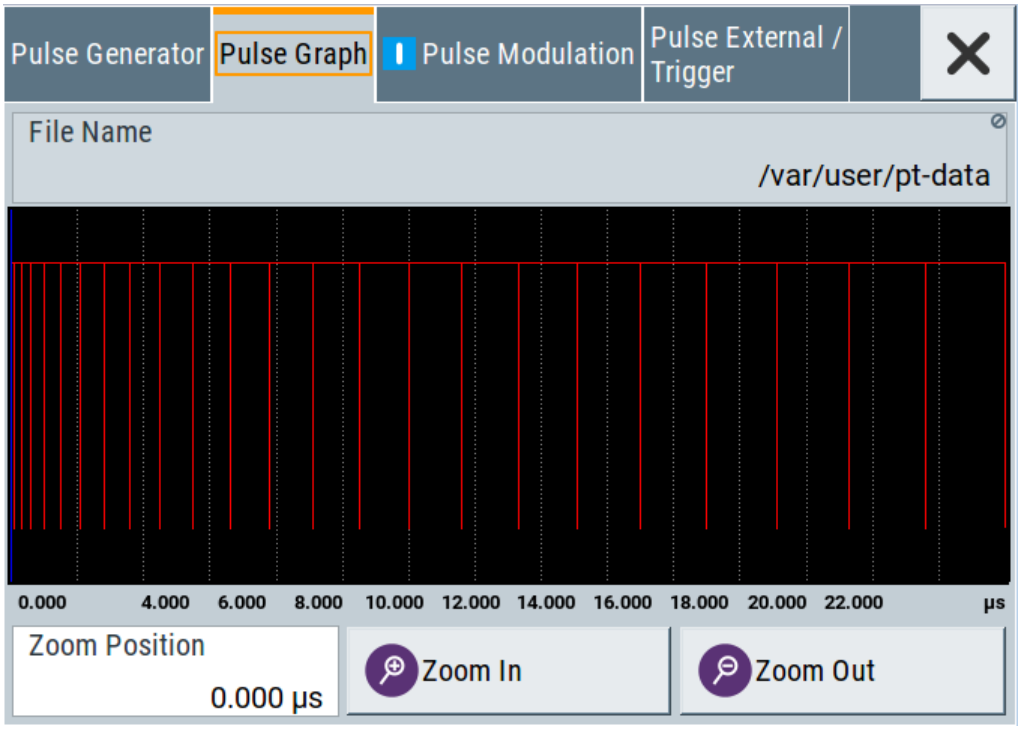
5.4.5 Pulse graph

Option: see Section 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.

The remote commands required to define these settings are described in Section 13.16.1.5, "SOURce:PULM subsystem", on page 457.

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

To create or select a file, see "Pulse Train Data" on page 93.

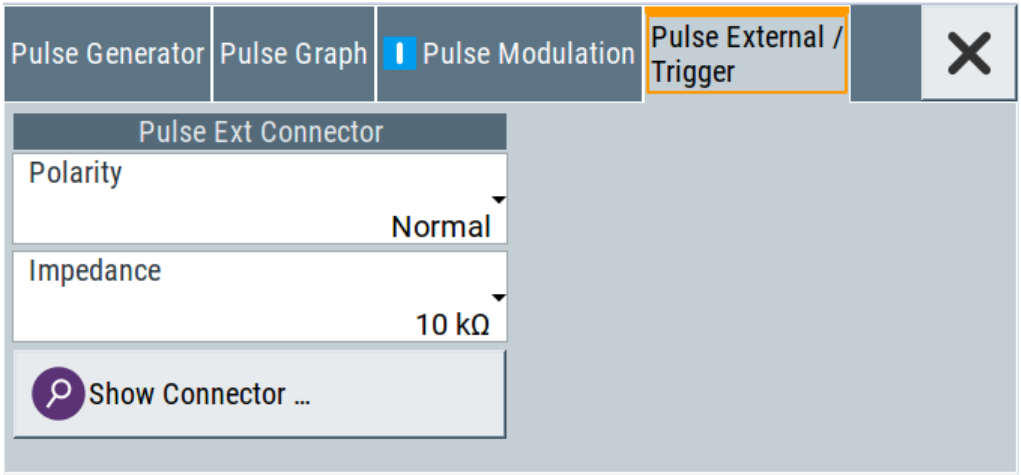
Remote command:
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 466

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.

The remote commands required to define these settings are described in Section 13.16.1.5, "SOURce:PULM subsystem", on page 457.

Settings

Polarity 99
Impedance 99
Show/Show Connector 99

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 462

Impedance
Sets the input impedance.

Remote command:
`[:SOURce<hw>]:PULM:IMPedance` on page 463

Show/Show Connector
Opens a dialog that displays the location of the connector on the front panel or rear panel of the instrument. A blinking rectangle shows the connector.

5.4.7 FM, PhiM and AM modulation sources

Access:

► Select "Modulation > Modulation Sources".

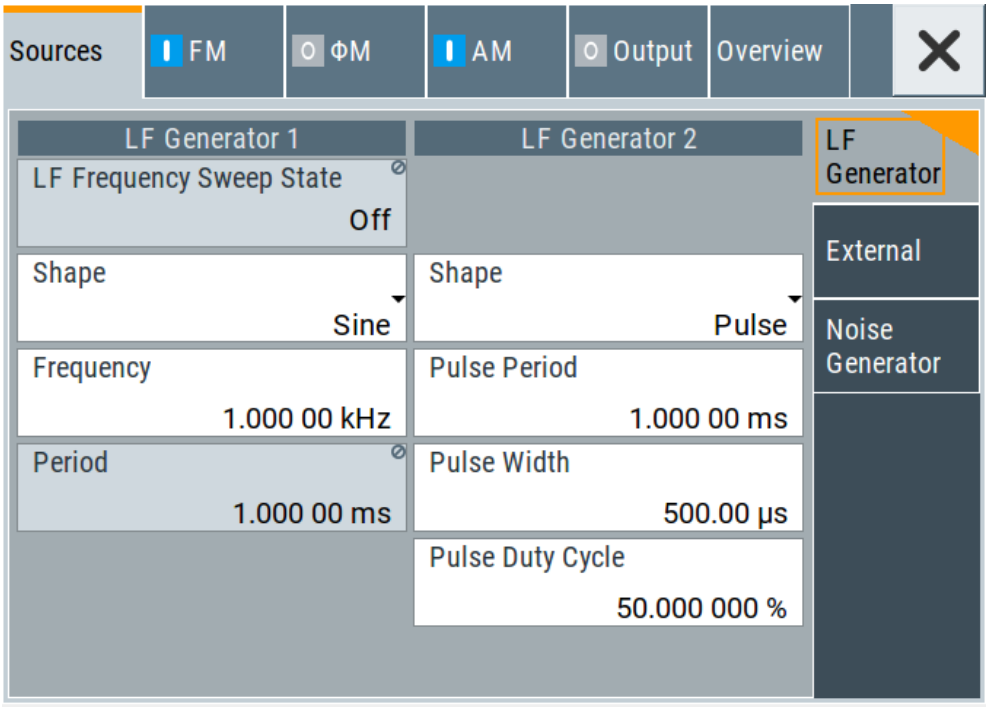
In the "Sources" tab, you can configure an LF modulation signal for performing analog modulations. It includes the setting parameters of the internal LF-and multi-function generators, the noise generator, and an external signal source.

- Source > LF generator settings 100
- Source > external settings 104
- Source > noise generator settings 105

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.

The remote commands required to define these settings are described in Section 13.16.6, "SOURce:LFOutput subsystem", on page 495.

Settings

State (LF frequency sweep)..... 101
Shape..... 101
Frequency..... 103
Period..... 103
Pulse Width..... 103
Pulse Duty Cycle..... 103
Triangle Rise..... 104
Trapezoid Rise / Fall..... 104
Trapezoid High..... 104

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.

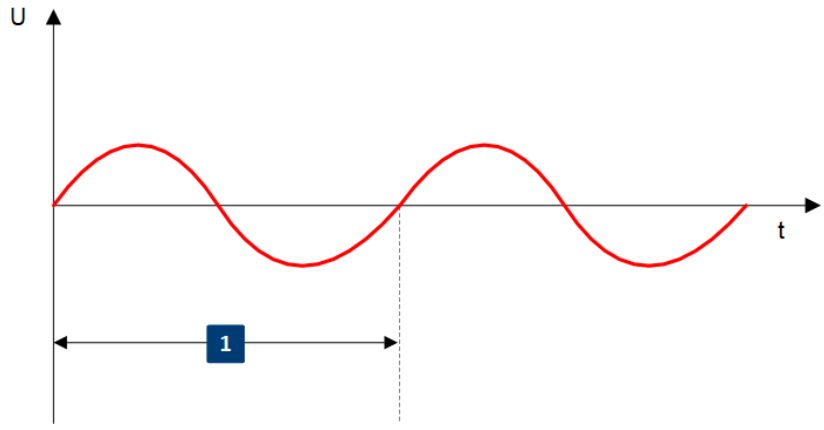
Note: Active RF frequency, RF level or RF combined sweep modes deactivate the LF sweep or List mode and vice versa.

Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:MODE` on page 499

Shape
Option: R&S SMBB-K24.

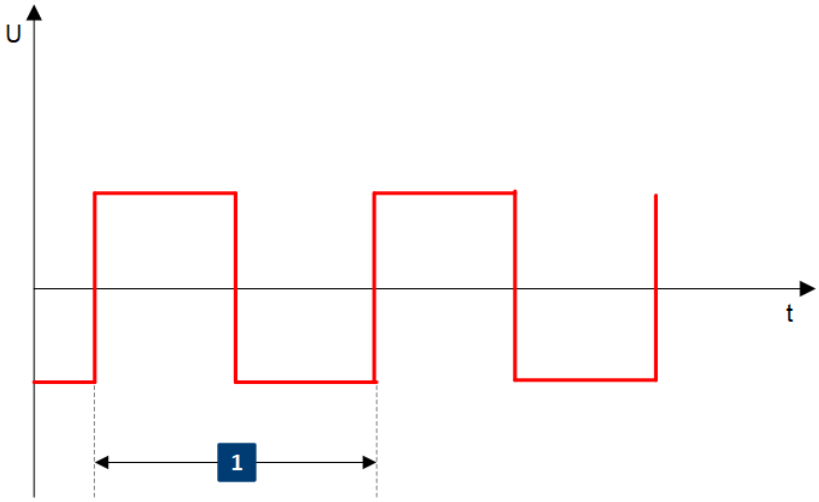
Selects the waveform shape of the LF generator signal.

"Sine"



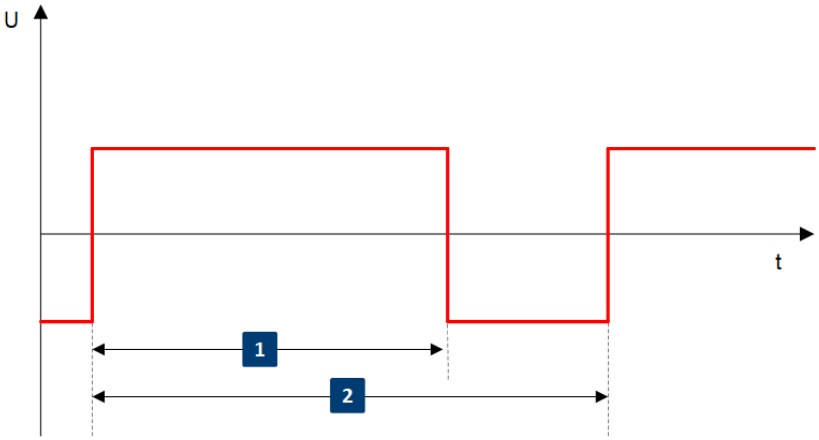
1 = Period

"Square"



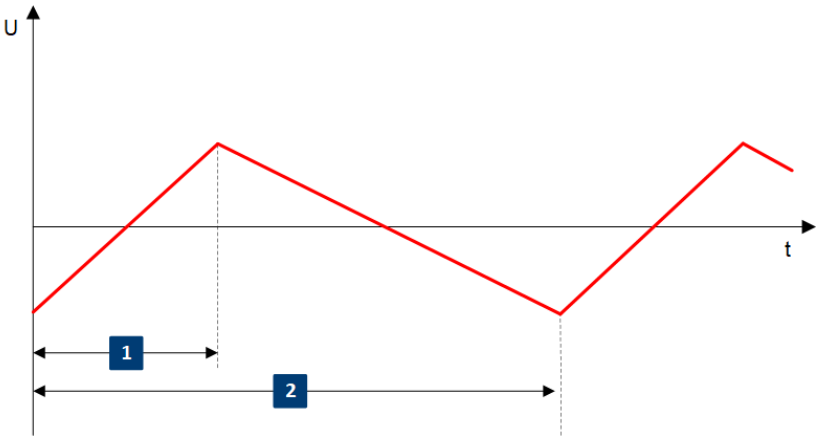
1 = Period

"Pulse"



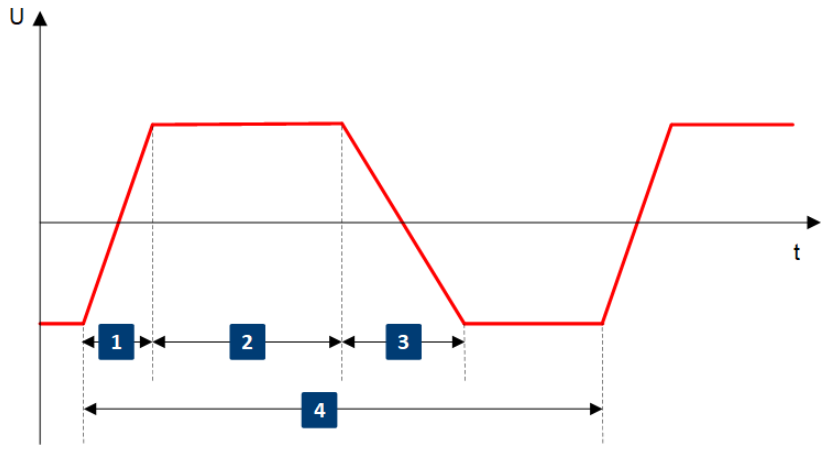
1 = Pulse width
2 = Pulse period

"Triangle"



1 = Triangle rise
2 = Triangle period

"Trapezoid"



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

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe` on page 501

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 497

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 503
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:PERiod` on page 504
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:PERiod` on page 502

Pulse Width
Sets the pulse duration of the generated pulse signal.

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:WIDTh` on page 502

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 502

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 504

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 503
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL` on page 502

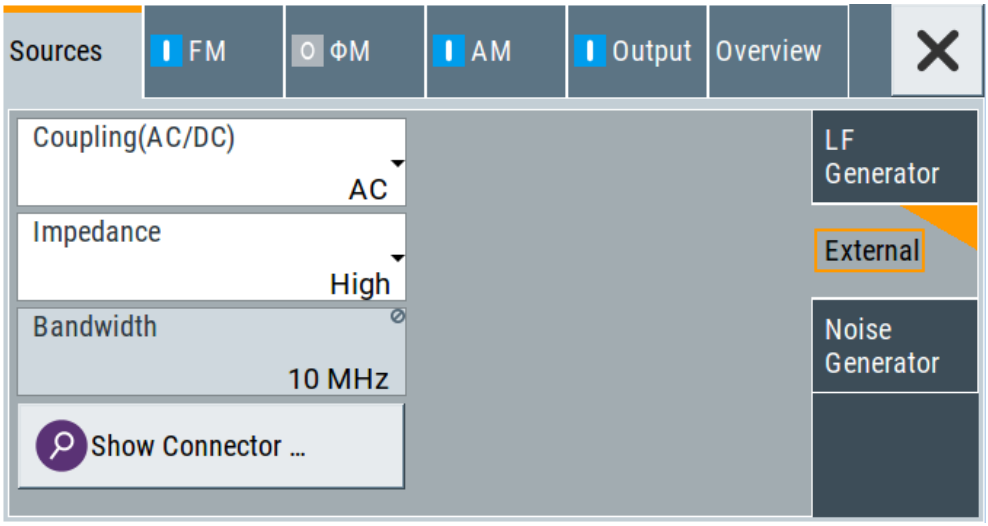
Trapezoid High
Sets how long the trapezoid signal is at high level.

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH` on page 503

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.

The remote commands required to define these settings are described in Section 13.16.5, "SOURce:INPut subsystem", on page 493.

Settings

Coupling (AC/DC)..... 105
Impedance..... 105
Bandwidth..... 105
Show/Show Connector.....105

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 494

Impedance
Sets the impedance for the externally supplied signal.

Remote command:
`[:SOURce<hw>]:INPut:MODext:IMPedance<ch>` on page 494

Bandwidth
Displays the maximum bandwidth of the external LF signal.

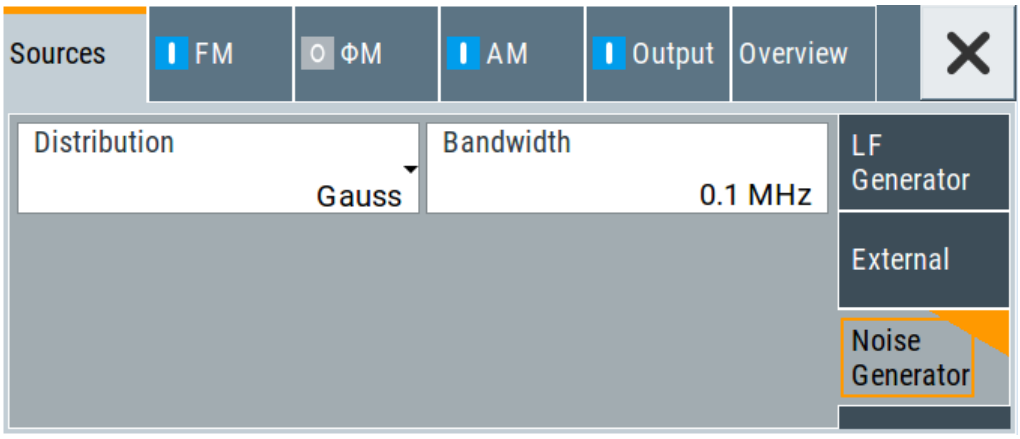
Remote command:
`[:SOURce]:LFOutput<ch>:BANDwidth?` on page 497

Show/Show Connector
Opens a dialog that displays the location of the connector on the front panel or rear panel of the instrument. A blinking rectangle shows the connector.

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.

The remote commands required to define these settings are described in Section 13.16.8, "SOURce:NOISe subsystem", on page 520.

Settings

Distribution 106
Bandwidth 106

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 521

Bandwidth
Sets the noise bandwidth as distinct value.

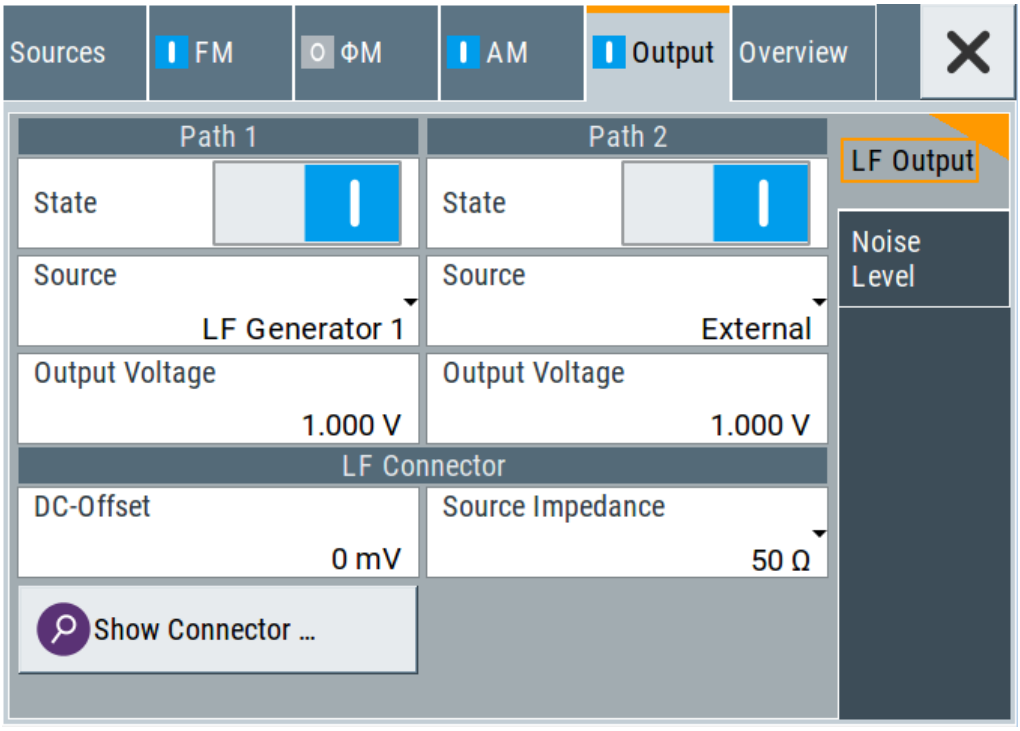
You can set the bandwidth between 100 kHz and 10 MHz in 100 KHz steps.

Remote command:
`[:SOURce<hw>]:NOISe:BANDwidth|BWIDth` on page 521

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....107
Source....108
Show/Show Connector....108
Output Voltage....108
DC-Offset....108
Source Impedance....108
Load Impedance....108
Noise Level....109
└ Noise Density....109
└ Noise Level....109

State
Activates the output of the LF signal.

Remote command:
`[:SOURce]:LFOutput<ch>[:STATe]` on page 499

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 500



Show/Show Connector
Opens a dialog that displays the location of the connector on the front panel or rear panel of the instrument. A blinking rectangle shows the connector.

Output Voltage
Sets the peak to peak voltage of the selected LF output source.

This value, e.g. +1 V to -1 V refers to 50 Ohm at the RF output with high termination impedance at the LF output.

Remote command:
`[:SOURce]:LFOutput<ch>:INTernal:VOLTage` on page 500

DC-Offset
Adds a DC offset to the LF output signal.

Remote command:
`[:SOURce]:LFOutput:OFFSet` on page 500

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 501

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 317.

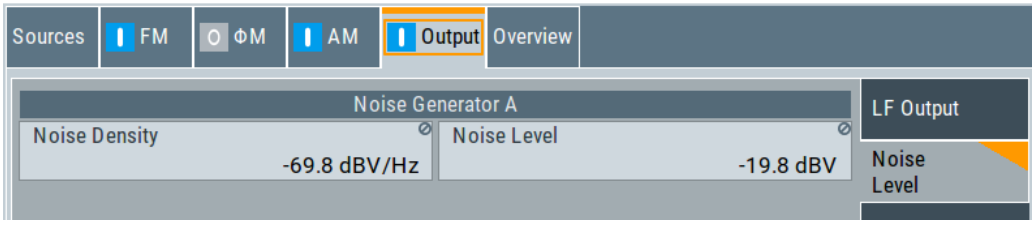
These signal generators come with an LF generator source impedance of 10 Ohm which is not available with the R&S SMB100B.

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 521

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

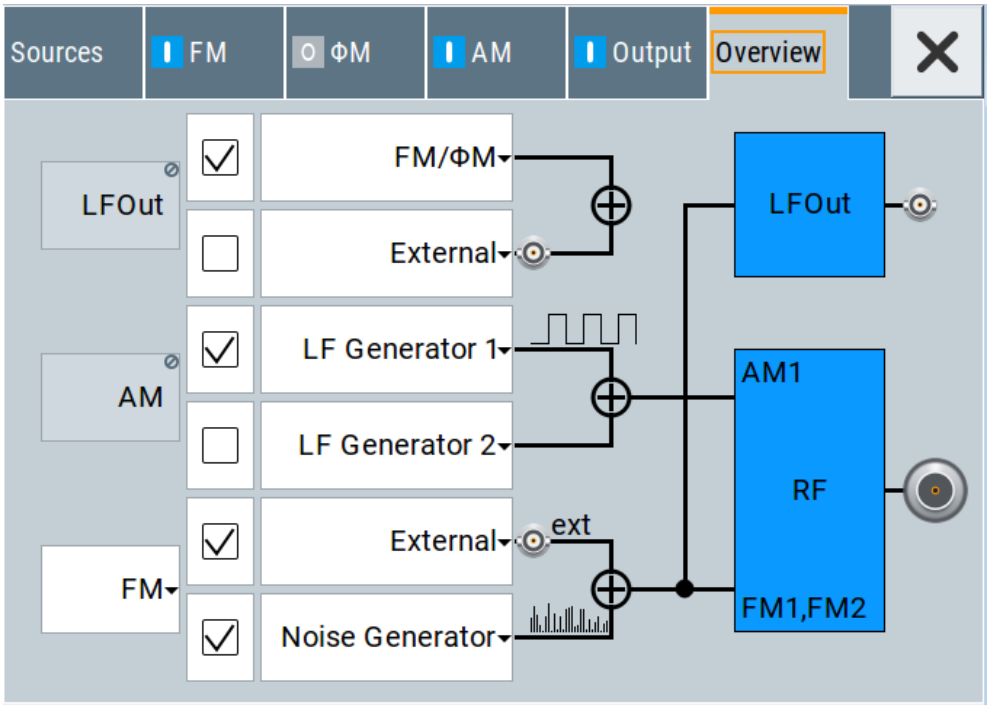
Remote command:
`[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?` on page 521

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 from 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 Multiplying RF output frequencies

6.1 About frequency multipliers

The R&S SZM multiplies the input frequency by its multiplication factor. Depending on the R&S SZM base unit, you can optionally install high output power, an attenuator or an isolator. All three options are integrated in the same housing as the frequency multiplier, which simplifies setups and the operation compared to conventional setups.

In addition, you can connect an optional external test port adapter (TPA) which is a straight waveguide and simplifies connection of the DUT. The TPA protects internal assemblies and their flange and if damaged, you can replace it.

The R&S SMB100B signal generator can communicate with an R&S SZM via USB. For the USB communication between the R&S SMB100B and the frequency multiplier R&S SZM, the R&S SMBB-K554 key must be installed on the R&S SMB100B. In case a mechanically or electronically controlled attenuator is installed, the pre-calibrated frequency response values of the multiplier are read out via USB by the R&S SMB100B. Also the multiplication factor is automatically set in the R&S SMB100B and the correct incident power of +7 dBm to the R&S SZM. Therefore, the instruments are able to provide a precise R&S SZM output signal for the DUT for a specific frequency.

Required options

- For operation of the R&S SZM with the R&S SMB100B via USB the R&S SMBB-K554 option Multiplier Control must be installed on the R&S SMB100B.
- Depending on the frequency multiplier used and its multiplication factor, different input frequency ranges are required. The R&S SMB100B must at least cover this input frequency range.
  For details on the R&S SZM input frequency ranges, see the R&S SZM specifications document.

Control of the R&S SZM via USB

If the control connection between R&S SMB100B and R&S SZM is established, the following features are available:

- The right multiplication factor and incident power on the R&S SMB100B is automatically set in accordance to the connected R&S SZM.
- The connected R&S SZM is shown in the R&S SMB100B taskbar. If the mechanically controlled attenuator option is installed on the R&S SZM, the value of the micrometer screw for the correct R&S SZM output power is shown in the taskbar.
- Read out of the frequency response of the connected R&S SZM without internal attenuator option.
- Read out the calibration data of the R&S SZM if an internal attenuator option is installed
- You can correct cable losses of the connecting cable between the frequency multiplier and the R&S SMB100B.

Impact of operating modes and functions

The output level of the RF signal is determined by the operation mode that the instrument generates the signal and also by the level correction functions the generator provides to optimize the accuracy of the level.

Some of these functions affect the operation with an R&S SZM. To avoid impact, the generator automatically switches off the associated operating modes once an R&S SZM is connected via USB.

Interactions and special characteristics to the operating modes of the R&S SMB100B when an R&S SZM is connected:

- AM (amplitude modulation): blocked
- List mode: blocked
- Sweep mode: It is recommended that you use an R&S SZM with electronically controlled attenuator to generate an RF signal in frequency or level sweep mode. Also note the response times of the dwell time in the specifications document of the R&S SZM.

6.2 Operating frequency multipliers

This section provides an overview on step-by-step instructions related to connecting and configuring frequency multipliers.

It includes the following:

- Test setup 115
- Connecting a frequency multiplier 116
- Controlling the frequency multiplier 117
- Generating RF output signals 121

6.2.1 Test setup

The R&S SMB100B supports the following frequency multiplier types:

- R&S SZM

For details, see the specifications document of the R&S SMB100B.

OTA microwave test setup

Typically, mmWave signals are transmitted and received over-the-air (OTA) inside an RF shield box. The figure below illustrates a test setup with a frequency multiplier connected to a signal generator and an antenna that is mounted inside an RF shield box.

The signal generator provides the IF signal to the frequency multiplier. The frequency multiplier multiplies the IF signal from the signal generator and transmits the RF signal to the DUT.

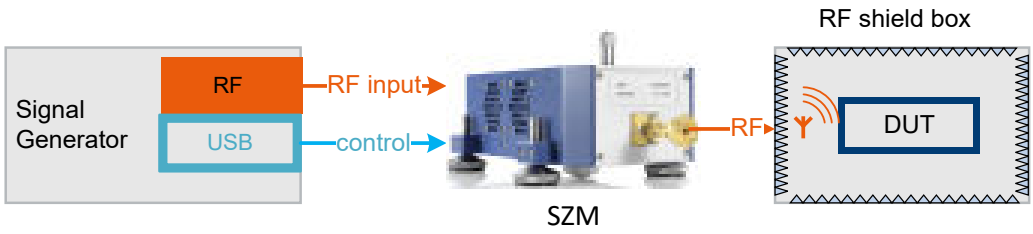


Figure 6-1: Typical setup using a frequency multiplier

Frequency multiplier connection

You can control a frequency multiplier via USB by one R&S SMB100B that exclusively controls the frequency multiplier.

The R&S SMB100B

- Reads out the frequency multiplication factor of the R&S SZM
- Reads out the serial number of the R&S SZM
- Sets the R&S SZM incident power on the R&S SMB100B RF output

6.2.2 Connecting a frequency multiplier

This section provides step-by-step descriptions for connecting a frequency multiplier. Connecting procedures for relevant connector types are described for the R&S SZM as an example.

To connect an R&S SZM

The following procedure describes how to connect the R&S SMB100B to an R&S SZM using the "RF 50 Ω" connector as IF signal output. The R&S SZM and R&S SMB100B are connected to power and switched on.

1. Use all cables delivered with the R&S SZM. Other connections can require additional cables.
   For the control connection, use the high-quality USB cable provided with the delivery.
   For the IF connection, we recommend using a coaxial cable with K connectors, 50 Ω, length 1.0 m. The cable is available under order number 1348.3850.00 (see recommended extras in the R&S SZM specifications document).
   See "Cable selection to minimize electromagnetic interference" on page 24.
2. **NOTICE!** Risk of SMA connector damage and cable damage. Excessive tightening can damage the connecting cable, the SMA connectors and components inside the R&S SMB100B.
   Connect the "RF 50 Ω" connector of the R&S SMB100B with the "RF In" connector of the R&S SZM.
   See also Section 3.1.9, "Connecting to RF coaxial connectors", on page 26.
3. Connect the "USB" connector with the "USB" connector of the R&S SZM.

See also "To connect a frequency multiplier" on page 26.

Table 6-1 and Figure 6-2 provide an overview on connections and a test setup.

Table 6-1: Signals and connections

Signal	R&S SMB100B	R&S SZM
Control	USB connector	"USB"
RF	"RF 50Ω"	"RF In"

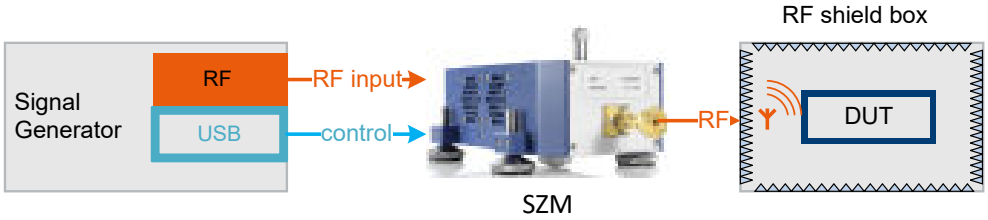


Figure 6-2: Test setup with R&S SMB100B, R&S SZM and RF shield box

Signal generator = R&S SMB100B

6.2.3 Controlling the frequency multiplier

This section provides step-by-step descriptions for controlling, updating and operating a frequency multiplier with the R&S SMB100B. For controlling the frequency multiplier R&S SZM via USB, the R&S SMBB-K554 key must be installed on the R&S SMB100B.

The descriptions cover the following topics:

- "To configure the R&S SMB100B" on page 117
- "To configure for R&S SZM with no attenuator option installed" on page 119
- "To configure for R&S SZM with electronically attenuator option installed" on page 120
- "To configure for R&S SZM with mechanically attenuator option installed" on page 120

To configure the R&S SMB100B

The following procedure describes how to configure the R&S SMB100B to establish a control connection between R&S SMB100B and a frequency multiplier.

The R&S SMB100B is connected to the R&S SZM, see "To connect an R&S SZM" on page 116.

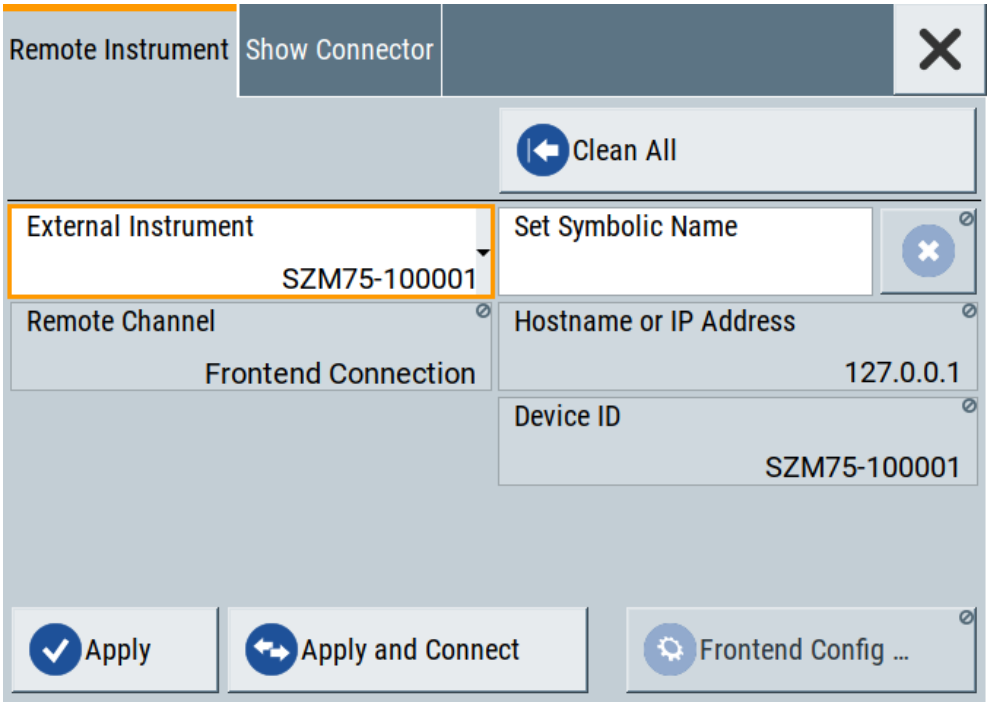
1. Select "System Configuration" tile > "System Configuration".

   The "External RF" dialog opens.

2. Click "External Instrument > Config".

   The "Remote Instrument" dialog for configuration of the external instrument opens.

3. Select the R&S SZM from the "External Instrument" list.



4. Select "Apply and Connect".

   A message displays if the remote connection to the external frontend is successfully established.

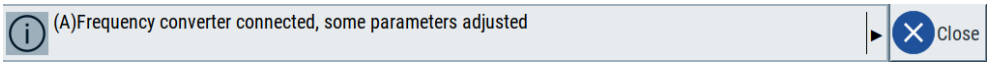
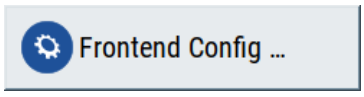


Figure 6-3: Message displaying an established remote connection

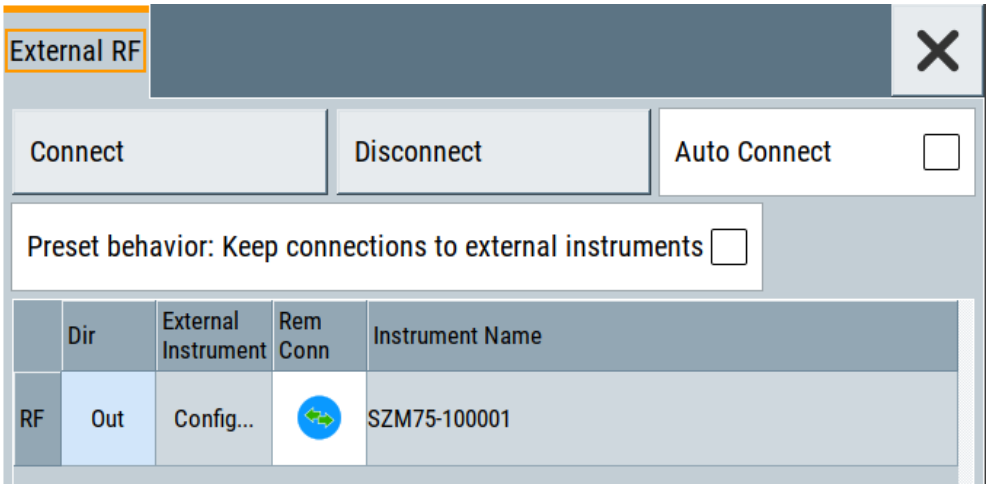
5. Configure the connection mode between R&S SZM frequency multiplier and R&S SMB100B:

   a) Click "Frontend Configuration".



   b) Check the "Settings".
   See Section 6.3.3.1, "General settings", on page 127.
   c) Check the "Versions/Options".
   See Section 6.3.3.2, "Versions and options information", on page 128.
   d) If necessary, activate "Cable Correction".
   See Section 6.3.3.3, "Cable correction settings", on page 130.

6. In the "System Config > System Configuration > External RF" dialog, check the control connection state.



The "RF" > "Rem Conn" field displays an active control connection:

7. Optionally, specify connection characteristics:
   a) Select "Auto Connect > On".
      If you select this setting, you do not need to execute steps 1 to 6 each time you reconnect the R&S SZM to the R&S SMB100B via USB.
   b) Select "Preset behavior: Keep connections to external instruments > On".

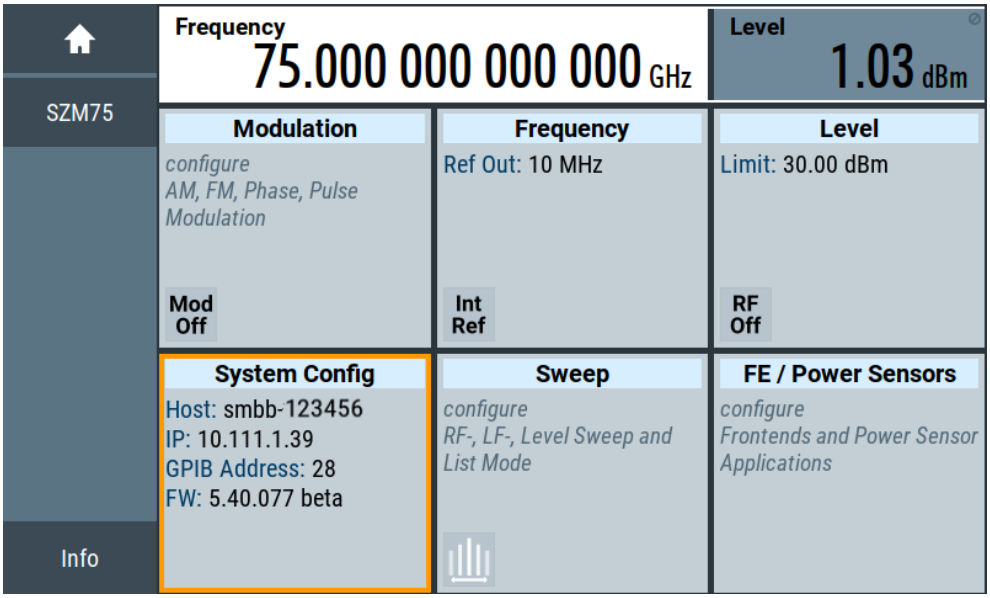
To configure for R&S SZM with no attenuator option installed

When using a base instrument without the attenuator option R&S SZM-BxxE or R&S SZM-BxxM installed:

1. Enter the "Frequency" value in the "Frequency" field on the home screen.

   Note: The "Level" field is grayed out and shows the output power of the R&S SZM. The R&S SMB100B reads out this number from a calibration table internally stored on the R&S SZM.

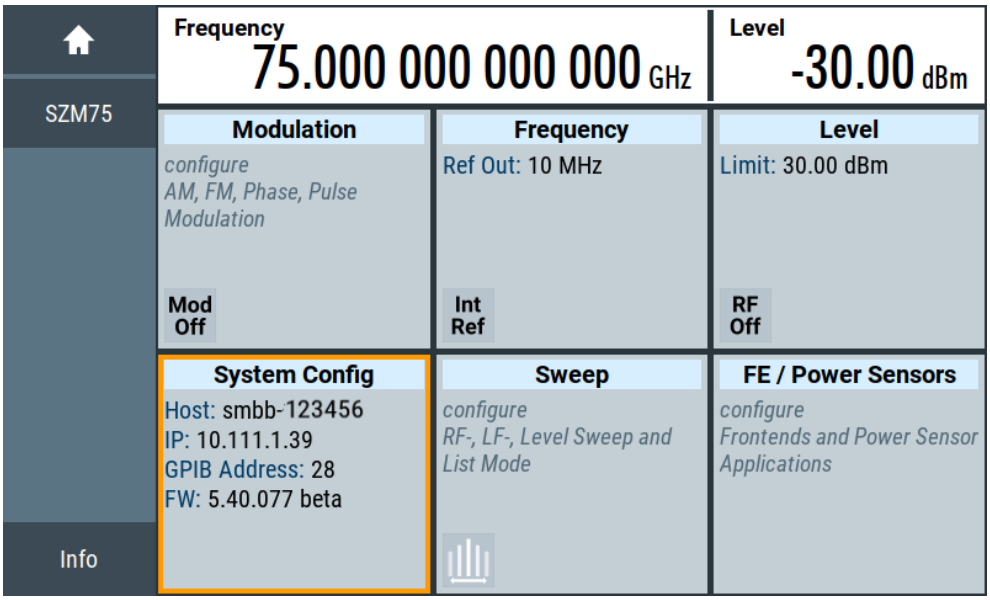
2. Switch on the RF on the front panel of the R&S SMB100B.



To configure for R&S SZM with electronically attenuator option installed

When using a base instrument with the attenuator option R&S SZM-BxxE installed:

1. Enter the "Frequency" value in the "Frequency" field on the home screen.
2. Enter the "Level" value in the "Level" field on the home screen.
3. Switch on the RF on the front panel of the R&S SMB100B.

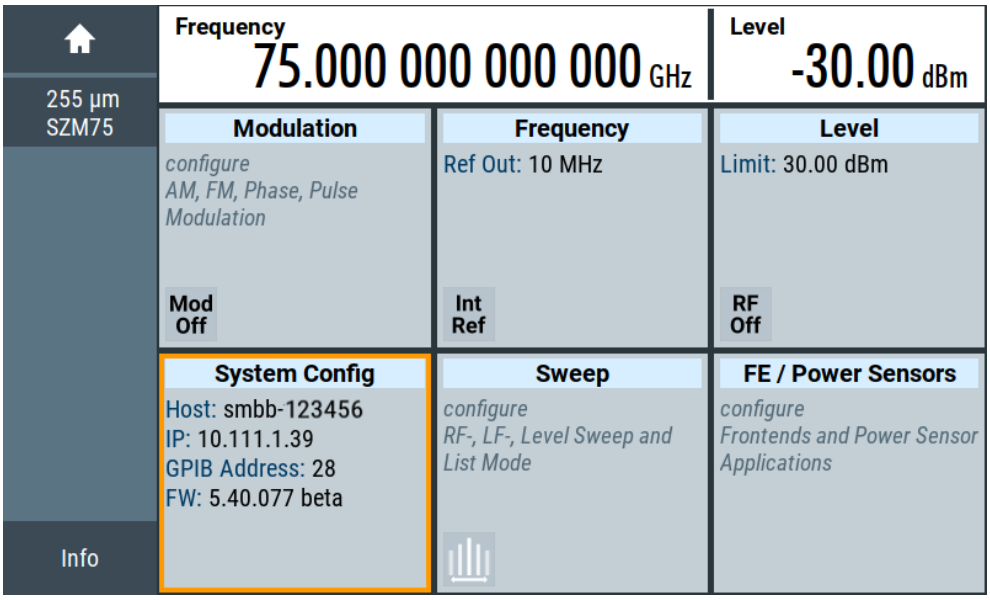


To configure for R&S SZM with mechanically attenuator option installed

When using a base instrument with the attenuator option R&S SZM-BxxM installed:

1. Enter the "Frequency" value in the "Frequency" field on the home screen.

2. Enter the "Level" value in the "Level" field on the home screen.
3. Set the micrometer screw to the value displayed in the taskbar on the left.
   After setting the micrometer screw to the displayed value, the previously set level and the corresponding frequency is output at the R&S SZM.



Note: Position 0 µm is equivalent with maximum attenuation that means minimum signal level according to the set frequency.

6.2.4 Generating RF output signals

To multiply the RF output signal frequency

This manual operation is only necessary if there is no USB connection between R&S SMB100B and R&S SZM.

To multiply the input frequency by individual factor due to the frequency range:

1. Select the "Frequency" tile.
2. Select "Frequency".
3. Enter the "Multiplier" value.

To output the external frontend RF signal

The procedure assumes, that a remote control connection between R&S SMB100B and R&S SZM is established.

See "To configure the R&S SMB100B" on page 117.

► Activate the RF output.

See "To activate the RF output signal" on page 57.

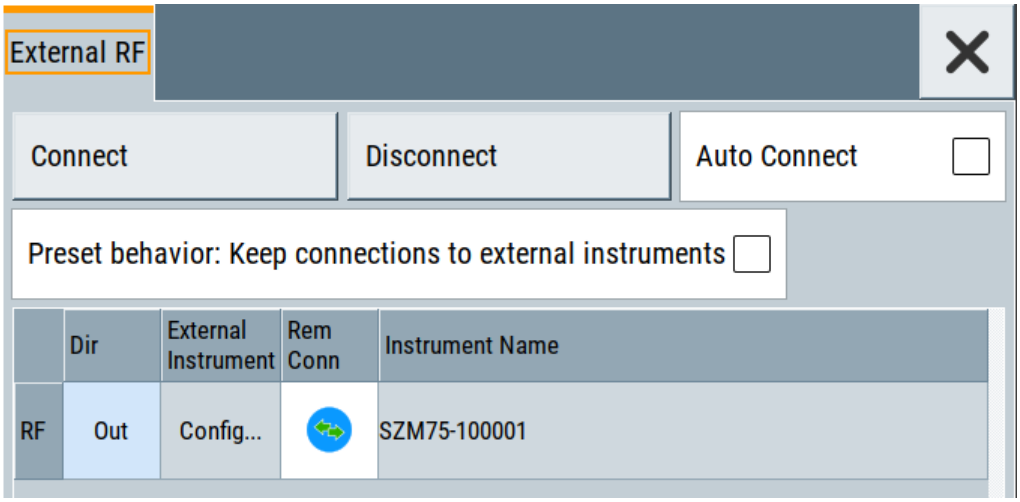
6.3 External RF configuration and settings

- External RF settings....122
- Remote instrument settings....124
- RF frontend settings....126

6.3.1 External RF settings

Access:

► Select "System config" tile > "System Configuration" > "External RF" tab.



In the "External RF" tab you can connect the frequency multiplier with the R&S SMB100B, see "To configure the R&S SMB100B" on page 117.

Settings:

Connect/Disconnect....122
Auto Connect....123
Preset behavior: Keep connections to external instruments....123
Direction....123
External Instrument....124
Remote Connection Status....124
Instrument Name....124

Connect/Disconnect
Triggers the instrument to:

- Establish the remote connections to all configured external instruments.

- Terminate all existing remote connections. The external instruments are not removed from the list of external instruments. Only the remote connection status changes.

Remote connection status can be toggled with the parameter Remote Connection Status.

To ensure that the remote connections to the external instruments will be automatically established after the instrument's startup or a reboot, set Auto Connect > "On".

Remote command:
`:SCONfiguration:EXTernal:REMote:CONNect[:ALL]` on page 438
`:SCONfiguration:EXTernal:REMote:DISConnect[:ALL]` on page 438

Auto Connect
With enabled auto connect function, the instrument automatically detects connected external instruments and establishes the required connection.

If the "Auto Connect > Off", however, after a R&S SMB100B startup you have to revise the test setup and perform the following:

- Check whether the necessary connections between the R&S SMB100B and the external instruments are still existing.
- Prove that the remote control of the particular instruments is required.
- Trigger the Connect function.

Remote command:
`:SCONfiguration:EXTernal:ACONnect` on page 438

Preset behavior: Keep connections to external instruments
Sets the effect of R&S SMB100B preset ([Preset] or `*RST`) on the following:

- The connection status between the instrument and the connected external instruments.
- The R&S SMB100B itself and the preset values.
- The connected instruments.

"Preset behavior..."	Off	On
R&S SMB100B and preset values	Standard R&S SMB100B preset See Table 10-1.	• RF = max. frequency of the connected frequency multiplier • RF > Off
Connection status	Terminated ("Disconnect All Remote")	Unchanged
Connected instruments	External instrument preset (`:DEVice:PRESet`)	External instrument preset

Remote command:
`:SCONfiguration:EXTernal:PBEHaviour` on page 438

Direction
Displays the connector direction as a color coded field.

"Out" The RF connector is used as output.

Remote command:
`:SCONfiguration:EXTernal:RF<ch>:DIRection?` on page 439

External Instrument
Accesses a dialog with settings that help you to establish the connection to the external instruments, see Section 6.3.2, "Remote instrument settings", on page 124.

Remote Connection Status
Indicates the status of the remote connection. Click the status indicator to toggle the remote connection status.

To connect/disconnect all external instruments, use the functions Connect/Disconnect.

Remote command:
`:SCONfiguration:EXTernal:RF<ch>:RCONnection:STATe?` on page 439

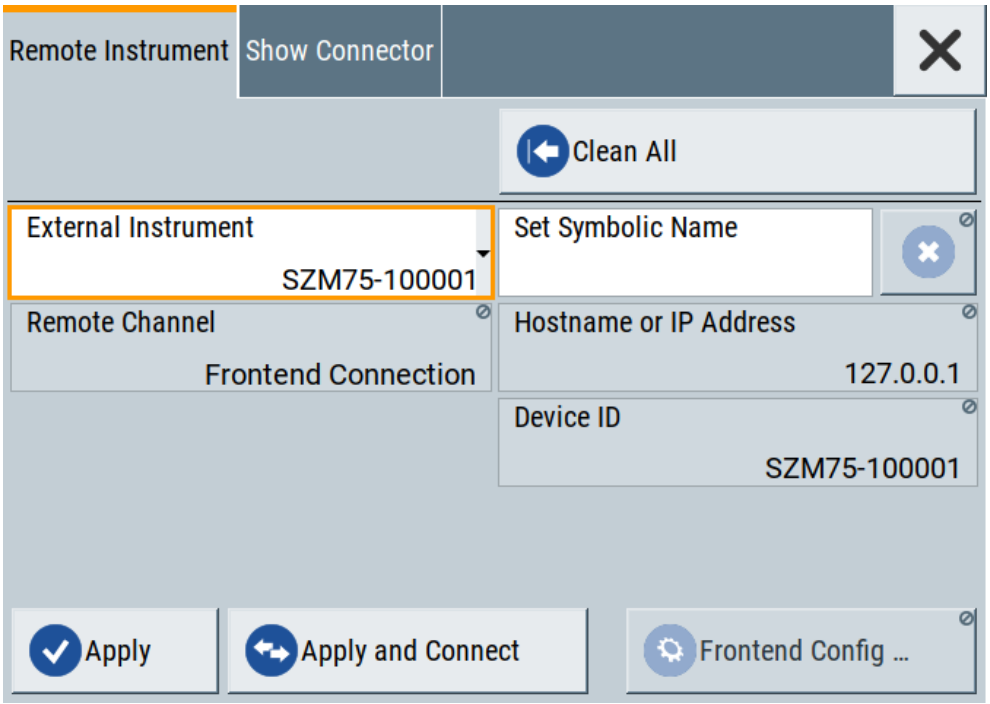
Instrument Name
Displays useful information on the connected external instrument, like the instrument designation.

Remote command:
`:SCONfiguration:EXTernal:RF<ch>:INAMe?` on page 439

6.3.2 Remote instrument settings

Access:

► Select the "System Configuration" tile > "System Configuration" > "External Instrument" > "Config".



The "Remote Instrument" tab provides settings to connect the frequency multiplier.

Settings:

Clean All....125
External Instrument....125
Set Symbolic Name....125
Remote Channel....125
Hostname or IP Address....125
Device ID....125
Apply....126
Apply and Connect....126
Frontend Configuration....126

Clean All
The "Clean All" function unselects the external instrument, disables the connection and removes all configured settings of the external instrument in the system configuration.

It also removes all instruments not connected via USB cable to the R&S SMB100B from the "External Instrument" list.

Remote command:
`:SCONfiguration:EXTernal:REMote:CLEan` on page 441

External Instrument
Lists all available instruments.

- Select the external instrument from the list of available instruments. The required settings are retrieved and updated automatically.
- "None": Unselects the external instrument and disables the connection.

Remote command:
`:SCONfiguration:EXTernal:REMote:LIST?` on page 439

Set Symbolic Name
Sets the alias name of the instrument.

Remote command:
`:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?` on page 440

Remote Channel
Displays the hardware channel used by the remote channel to the external instrument.

Remote command:
`:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?` on page 440

Hostname or IP Address
Displays the hostname or IP address of the connected external instrument.

Remote command:
`:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?` on page 440

Device ID
Displays the device identifier that is a unique string with the following structure:

`<frontend type>-<serial number>`

For a defined "External Instrument", the information is read out automatically.

Remote command:
:SCONfiguration:EXTernal:RF<ch>:REMote:INFO? on page 440

Apply
Confirms the settings and displays the external instrument in the "External RF" dialog.

Remote command:
:SCONfiguration:EXTernal:RF<ch>:REMote:ISELect on page 440

Apply and Connect
Confirms the settings and triggers the connection establishment. In the connected instruments, the status of this active remote connection is displayed by the "Remote" indication.

Remote command:
:SCONfiguration:EXTernal:RF<ch>:REMote:ICONnect on page 440

Frontend Configuration
Requires R&S SMBB-K554.

Accesses the "RF Frontend" dialog to configure settings of the connected external instrument.

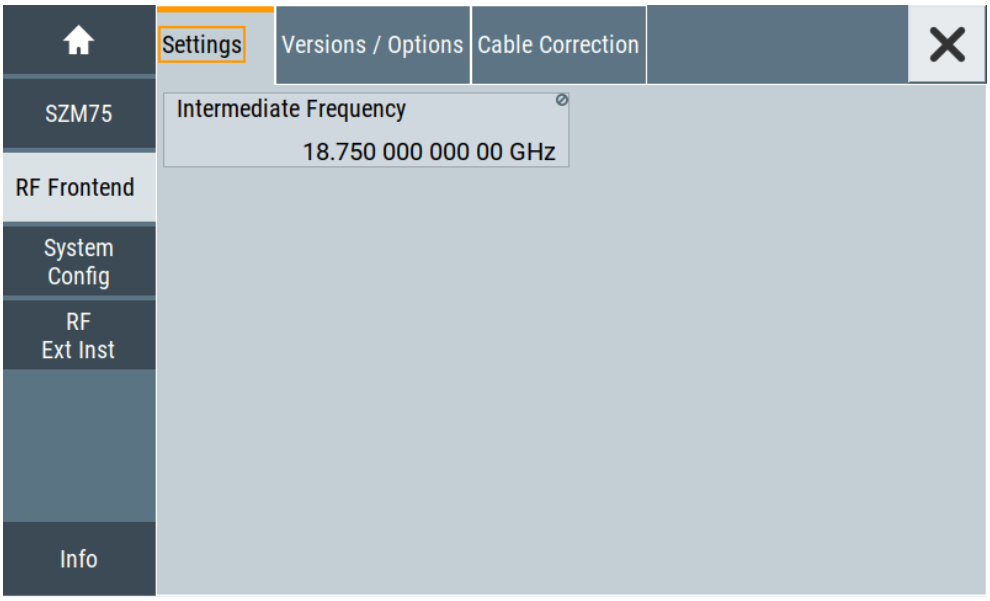
See Section 6.3.3, "RF frontend settings", on page 126.

6.3.3 RF frontend settings

Access:

► Select one of the following in the home screen:
- Select "Clk Syn / FE / Pow Sens" tile > "RF Frontend" > "Frontend Device".

- Select "System Config" tile > "System Configuration" > "External RF > External Instrument > Config" > "Remote Instrument > Frontend Config".



The "RF Frontend" dialog provides tabs for settings and information about the external instrument.

The remote commands required to define the settings are described in Section 13.16.3, "SOURce:EFRontend subsystem", on page 484.

To operate an external frontend with the R&S SMB100B

See Section 6.2, "Operating frequency multipliers", on page 115.

Settings:

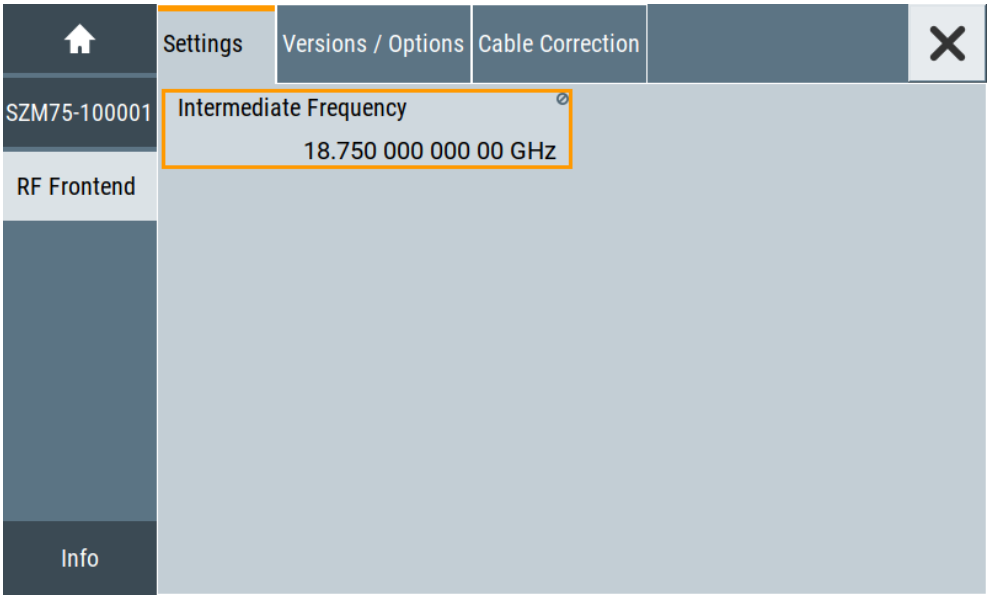
- General settings....127
- Versions and options information....128
- Cable correction settings....130

6.3.3.1 General settings

Access:

1. Select "Clk Syn / FE / Pow Sens" tile > "RF Frontend" > "Frontend Device".

2. Select "Settings".



The "Settings" tab provides information about the intermediate frequency for the connected external frontend, e.g., R&S SZM.

Settings:

Intermediate Frequency
Displays the frequency of the IF signal that is the frequency at the RF 50 Ω connector.

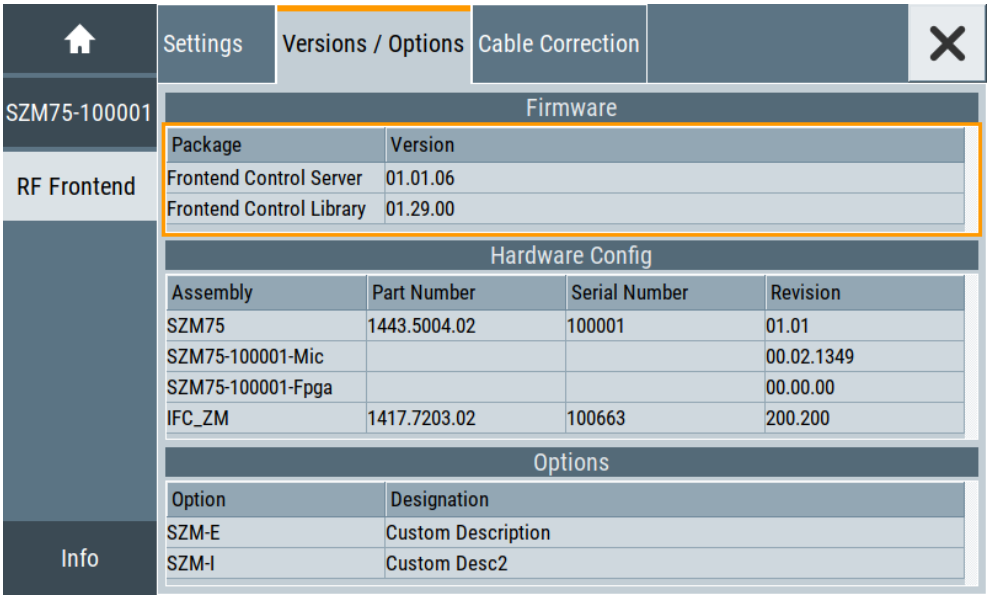
Remote command:
`[:SOURce<hw>]:EFRontend[:FREQuency]:IFRequency[:VALue]?`
on page 485

6.3.3.2 Versions and options information

Access:

1. Select "Clk Syn / FE / Pow Sens" tile > "RF Frontend" > "Frontend Device".

2. Select "Version / Options".



The "Versions / Options" tab displays information on the firmware and hardware of the connected external frontend.

Settings:

Firmware 129
Hardware Config 129
Options 130

Firmware
Displays firmware information on the control server and control library of the external frontend. The information is displayed in a table and consists of installed packages and versions.

"Package" Comprises the frontend control server and frontend control library.

"Version" Denotes the version of the installed package.

Remote command:
n.a.

Hardware Config
Displays hardware information of the hardware components of the external frontend. The information is displayed in a table and consists of component name, its part number and serial number, and revision version.

"Assembly" Displays the assembly part name for hardware component.

"Part Number" Displays the part number for each hardware component.

"Serial Number"
Displays the serial number for each hardware component.

"Revision" Displays the revision version for each hardware component.

Remote command:
[:SOURce<hw>]:EFRontend:IDN? on page 485

Options
Displays the frontend options installed on the frequency multiplier.

"Option" Displays the name of the frontend option.

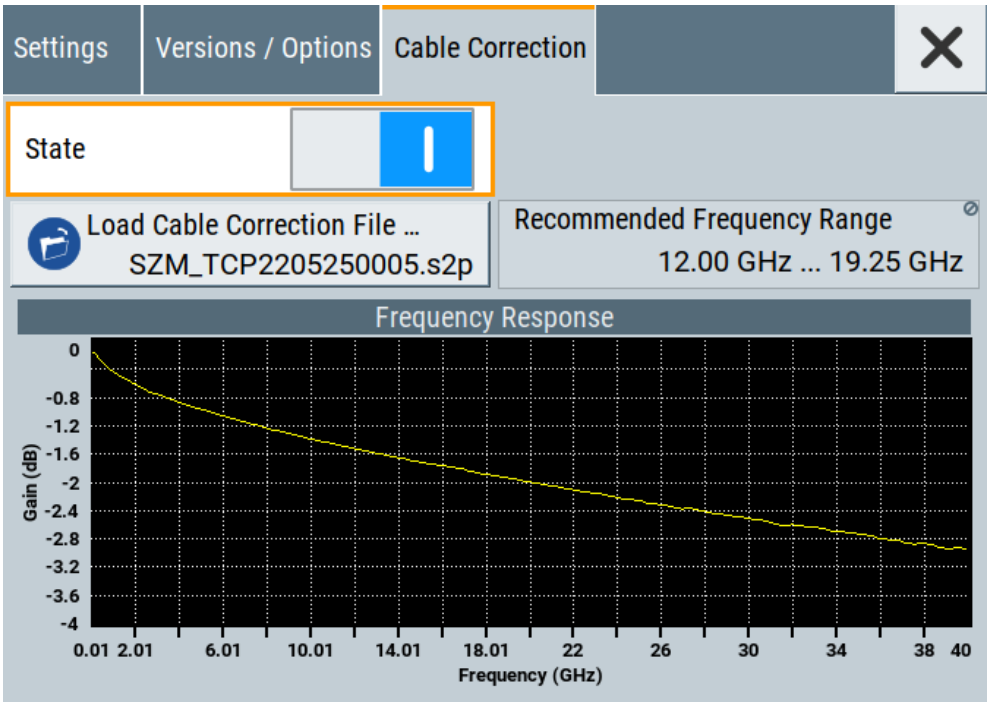
"Designation" Displays a short description of the frontend option.

Remote command:
[:SOURce<hw>]:EFRontend:OPT? on page 486

6.3.3.3 Cable correction settings

Access:

1. Select "Clk Syn / FE / Pow Sens" tile > "RF Frontend" > "Frontend Device".
2. Select "Cable Correction".



The "Cable Correction" tab provides settings necessary to configure the frequency response correction of the IF signal path.

You can load correction data to compensate for signal losses in the cable occurring at different IF signal frequencies. Files containing correction data have the extension `*.s2p` or `*.uco`. The following descriptions are exemplary with `*.s2p` files. Working with `*.uco` files is analogous.

Settings:

State 131
Load Cable Correction File 131
Recommended Frequency Range 132

State
Activates correction of the IF signal for different IF signal frequencies.

Activation requires loading of a valid cable correction file, see "Load Cable Correction File" on page 131.

Remote command:
`[:SOURce<hw>]:EFRontend:ALIGnment[:STATe]` on page 487

Load Cable Correction File
Accesses a standard file-select dialog to load correction data to compensate for signal losses in the cable occurring at different IF signal frequencies.

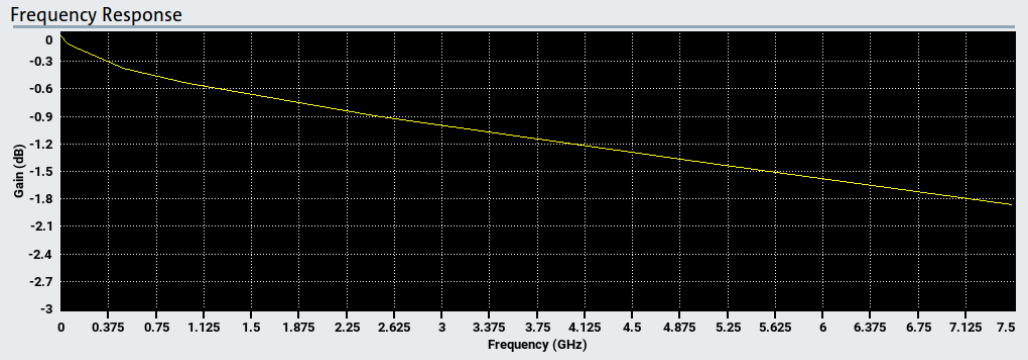
If a correction file is loaded, the button also displays the filename.

You can load predefined cable correction files from frontend-specific folders. The predefined cable correction files stored on the R&S SMB100B contain correction data for the recommended standard R&S IF cable, using the S-parameter S21.

Example: Displaying file correction data

The example for the `*.s2p` file below comprises correction data for frequencies from 0 GHz to 7.5 GHz.

```
# HZ S DB R 50.00
! Date: 2020-06-12;11:48:28
! freq[Hz] db:S11 ang:S11 db:S21 ang:S21 db:S12 ang:S12 db:S22 ang:S22
100000.0 0.001 0 -0.018267469344920073 0 -0.018267469344920073 0 0.001 0
50000000.0 0.001 0 -0.10438567392872056 0 -0.10438567392872056 0 0.001 0
100000000.0 0.001 0 -0.1402532552881901 0 -0.1402532552881901 0 0.001 0
500000000.0 0.001 0 -0.37850173705964973 0 -0.37850173705964973 0 0.001 0
1000000000.0 0.001 0 -0.5387899823157998 0 -0.5387899823157998 0 0.001 0
2500000000.0 0.001 0 -0.8994010660064706 0 -0.8994010660064706 0 0.001 0
5000000000.0 0.001 0 -1.3888357992535698 0 -1.3888357992535698 0 0.001 0
7500000000.0 0.001 0 -1.8624967962088599 0 -1.8624967962088599 0 0.001 0
```



Remote command:
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:CATalog? on page 486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE[:SELect] on page 486

Recommended Frequency Range
Displays the recommended frequency range of the IF signal that the external frontend requires.

We recommend that you cover this range in the cable correction file. See Example "Displaying file correction data" on page 131.

Remote command:
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:FREQuency:RANGe:LOWer? on page 486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:FREQuency:RANGe:UPPer? on page 486

7 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.

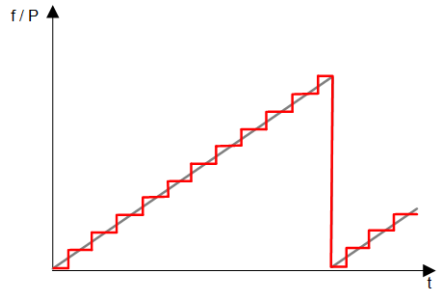


Figure 7-1: Schematic representation of a signal generated in sweep mode

  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 7-2 represents the frequency and power value pairs, in this case with the dwell time set the same for all steps (global dwell time).

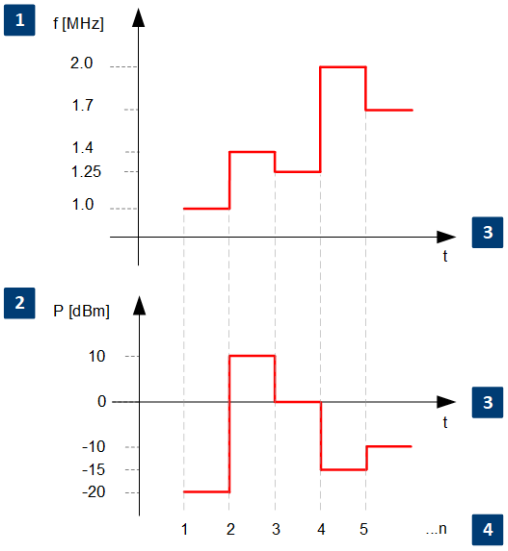


Figure 7-2: Schematic representation of a signal generated in list mode (global dwell time)

1 = RF frequency
2 = RF Level
3 = Dwell time (global)
4 = List index

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 Section 11.1.2, "Display update settings", on page 257.

7.1 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 "Setting up an RF frequency or power sweep" on page 544
- Example "Setting up an LF sweep" on page 495
- Example "Create an RF list and activate the list mode" on page 508

Auto mode (Sweep/List)

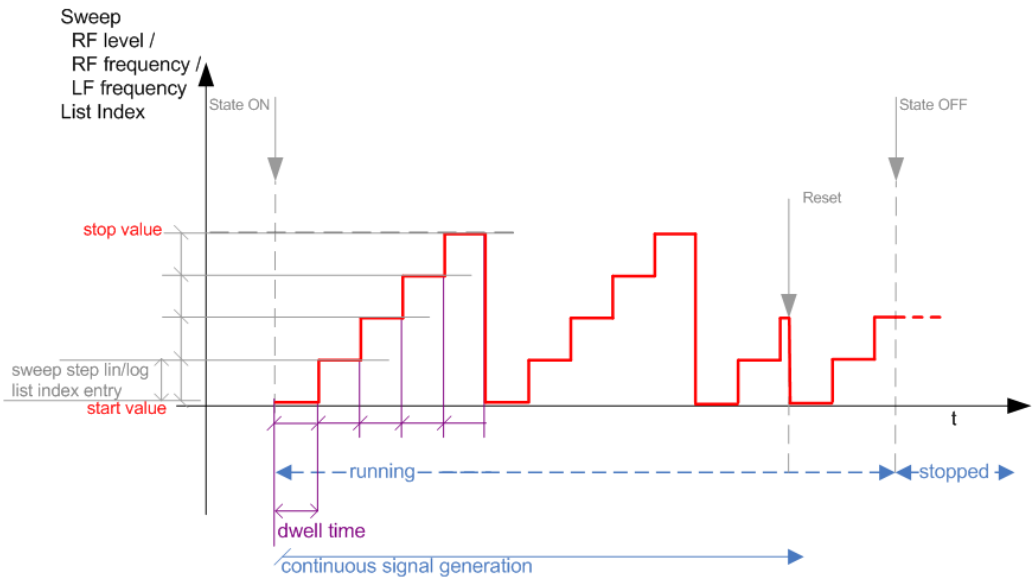


Figure 7-3: Auto mode (Sweep/List)

- 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 7-1: 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)

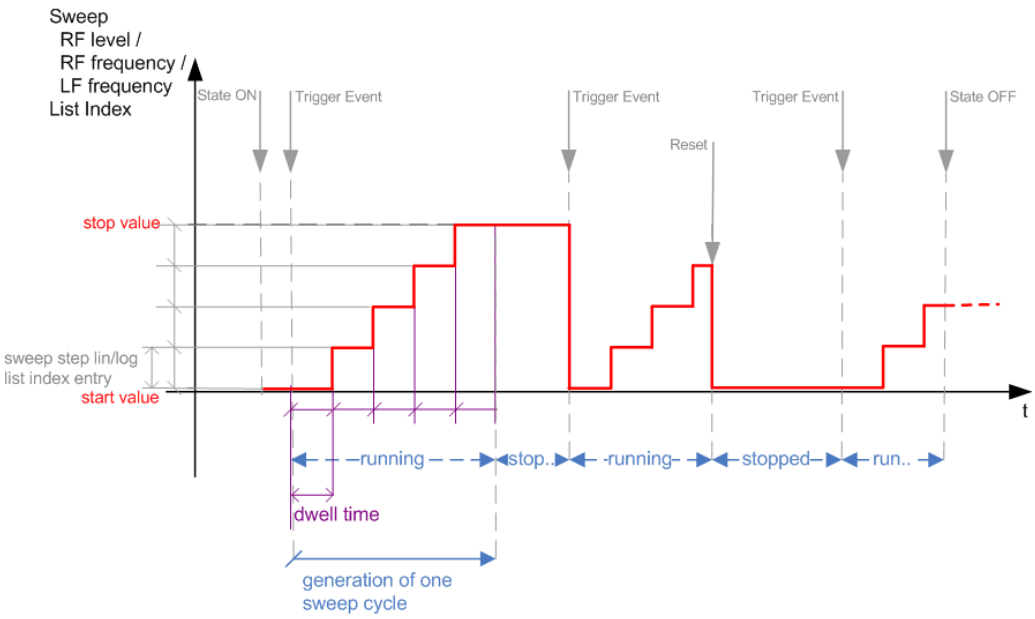


Figure 7-4: Single / Extern Single mode (sweep / list)

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 142 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 7-2: 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)

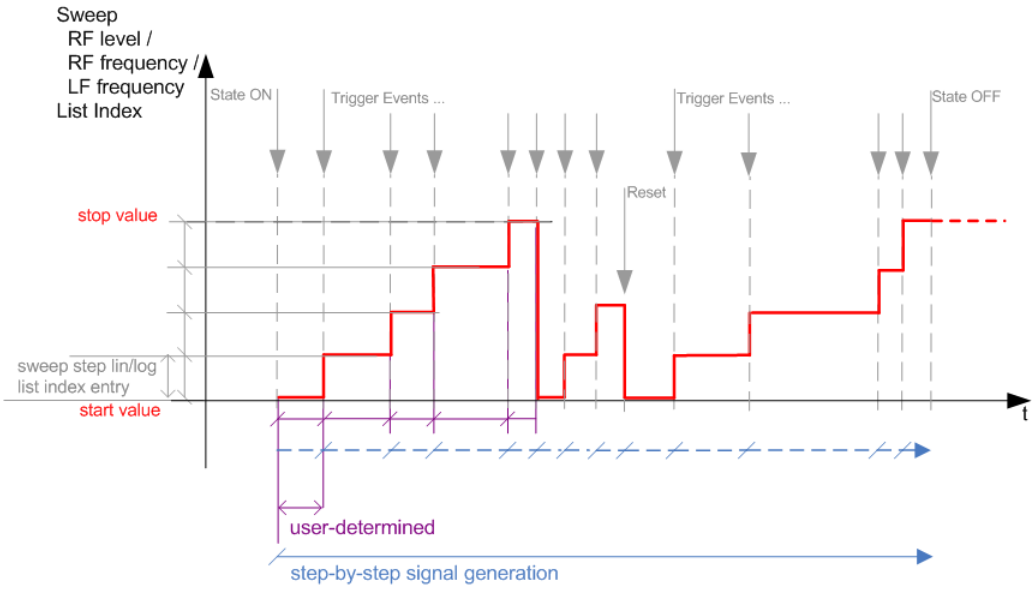


Figure 7-5: Step / Extern Step mode (sweep / list)

- 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 7-3: 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)

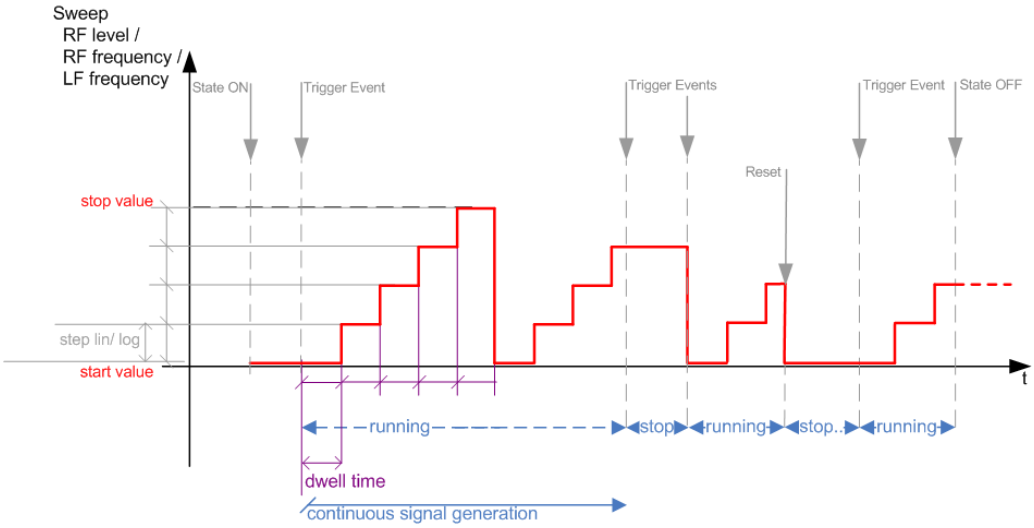


Figure 7-6: Extern Start/Stop mode (sweep)

- 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 7-4: 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.

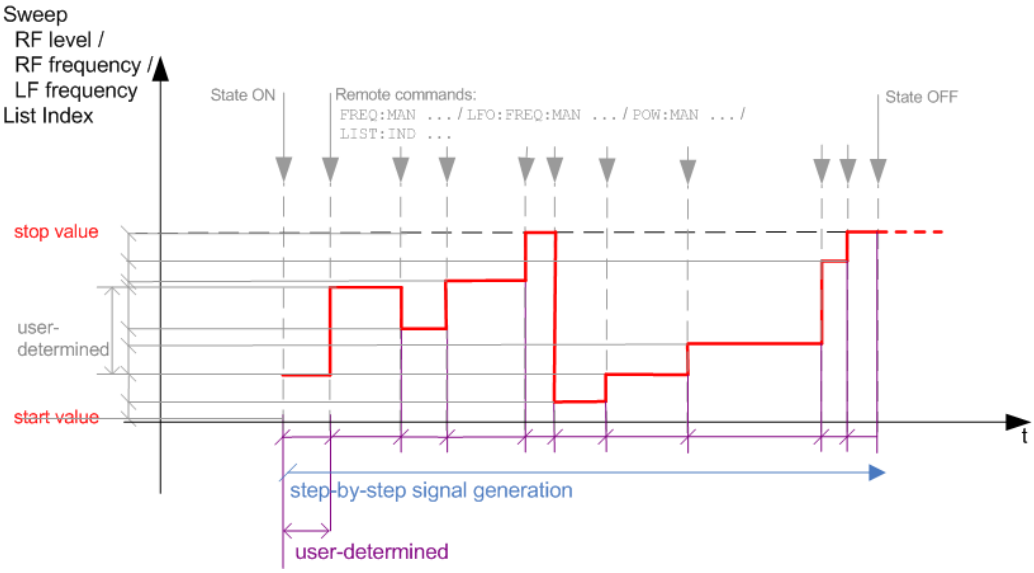


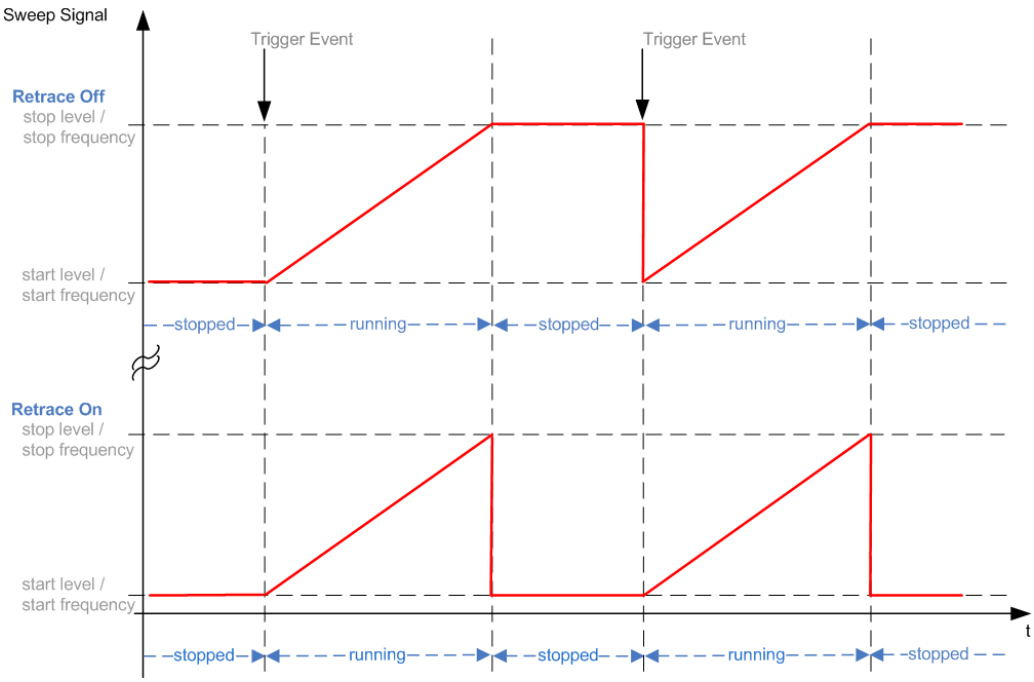
Figure 7-7: Manual mode in remote control (sweep / list)

- 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 7-5: 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 152
- "Mode" on page 151

7.2 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 Section 7.2.2, "Sweep signal shapes", on page 145.

Configuration and operation of sweep mode signals

- The R&S SMB100B generates a sweep signal by varying the following parameters: either the *RF frequency*, the *RF level* or both, the *RF frequency* and the *RF level* in combined RF sweep mode, or the *LF frequency*.
- 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.

Combined RF frequency / level sweep processing mode

The combined RF sweep functionality processes the signal similar to the Live list mode. The R&S SMB100B sets the frequency and level values simultaneously in the hardware. The difference to the list mode is that the values are not taken from a previously created list, but are calculated using the selected frequency and level ranges, the dwell time and the number of steps.

7.2.1 Correlating parameters in sweep mode

A sweep signal is a periodic signal that changes its frequency or level, or both, 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 7-6: 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

Variable	Description
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.

7.2.2 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.

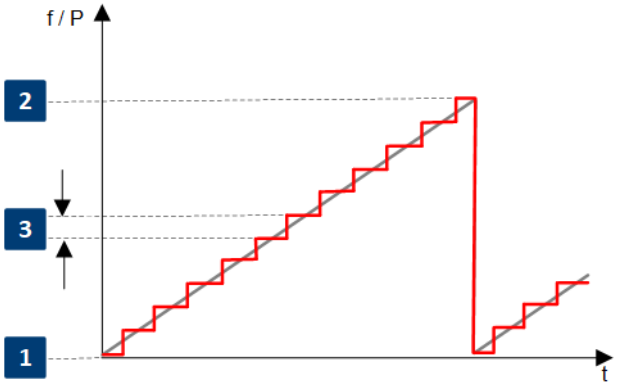


Figure 7-8: Sweep signal sawtooth shape

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.

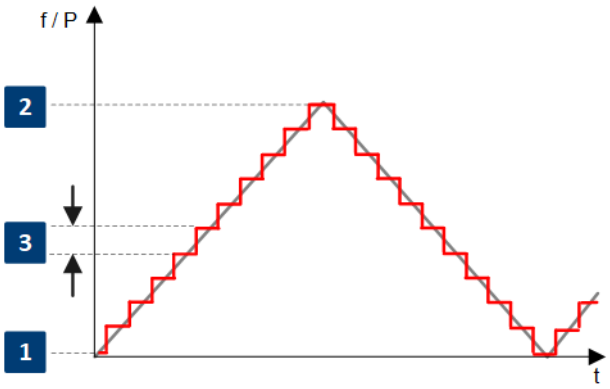


Figure 7-9: Sweep signal triangle shape

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.

7.3 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 Section 7.7, "List data editor", on page 166.

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 Section 10.9, "Using the file manager", on page 237.

- 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 Section 7.7, "List data editor", on page 166.
- "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 149

7.4 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.

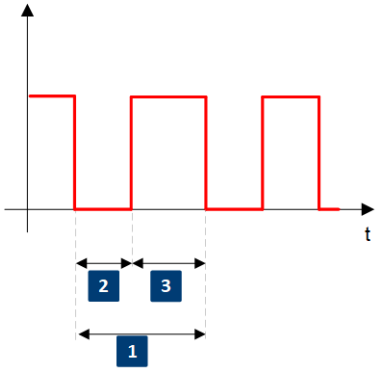


Figure 7-10: Dwell Time vs. settling time

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.

7.5 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" > "RF Combined Sweep"
4. Select "Sweep" > "LF Frequency Sweep"

The remote commands required to define these settings are described in:

- Section 13.16.13, "SOURce:SWEep subsystem", on page 543
- Section 13.16.4, "SOURce:FREQuency subsystem", on page 487
- Section 13.16.11, "SOURce:POWer subsystem", on page 524
- Section 13.16.6, "SOURce:LFOutput subsystem", on page 495

Settings

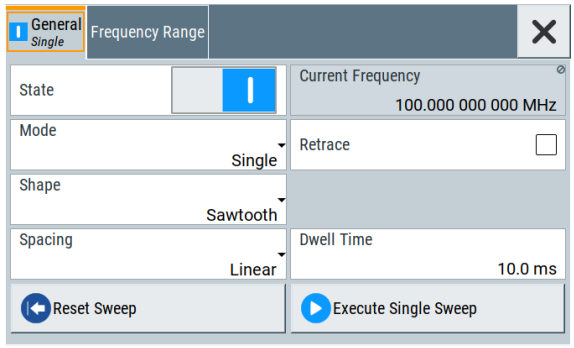
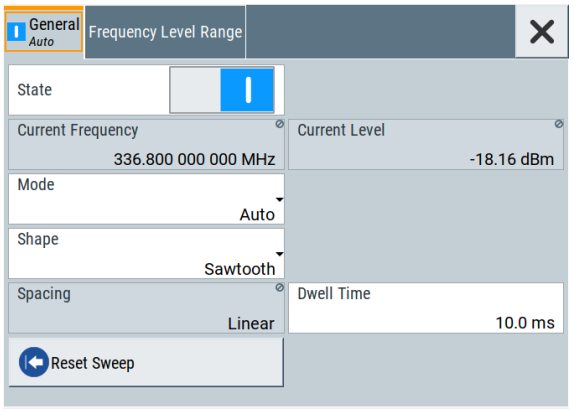
- General sweep settings....149
- Frequency range settings....155
- Level range settings....157

7.5.1 General sweep settings

Access:

► Select for example "Sweep" > "RF Frequency Sweep".

Table 7-7: General settings dialog: Examples of RF Frequency and RF Combined Sweep dialogs

> "RF Frequency Sweep"	> "RF Combined Sweep"
	

Settings

State (RF frequency sweep)..... 150
State (RF level sweep)..... 150
State (RF frequency / level sweep)..... 151
State (LF frequency sweep)..... 151
Current Frequency..... 151
Current Level..... 151
Mode..... 151
Retrace..... 152
Shape..... 152
Spacing..... 154
Dwell Time..... 154
Trigger Slope..... 154
Show/Show Connector..... 154
Reset Sweep..... 155
Execute Single Sweep..... 155

State (RF frequency sweep)
Activates RF frequency sweep signal generation.

Note: Active RF frequency, RF level or RF combined sweep modes deactivate the LF sweep or List mode and vice versa.

Remote command:
`[:SOURce<hw>]:FREQuency:MODE` on page 488

State (RF level sweep)
Activates RF level sweep signal generation.

Note: Active RF frequency, RF level or RF combined sweep modes deactivate the LF sweep or List mode and vice versa.

Remote command:
`[:SOURce<hw>]:POWer:MODE` on page 530

State (RF frequency / level sweep)
Activates the RF frequency / level sweep signal generation.

Note: Active RF frequency, RF level or RF combined sweep modes deactivate the LF sweep or List mode and vice versa.

Remote command:
`[:SOURce<hw>]:FREQuency:MODE` on page 488
`[:SOURce<hw>]:POWer:MODE` on page 530

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 RF frequency, RF level or RF combined sweep modes deactivate the LF sweep or List mode and vice versa.

Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:MODE` on page 499

Current Frequency
Displays the current frequency sweep value for all sweep Modes, except of Mode > Step. In this mode, you can enter the next frequency setting manually.

Remote command:
`[:SOURce<hw>]:FREQuency:MANual` on page 490
`[:SOURce<hw>]:LFOutput:FREQuency:MANual` on page 498

Current Level
Displays the current level sweep value for all sweep Modes, except of Mode > Step. In this mode, you can enter the next level setting manually.

Remote command:
`[:SOURce<hw>]:POWer:MANual` on page 529

Mode
Selects the sweep mode.

See Section 7.1, "Signal generation and triggering in the sweep and list modes", on page 135.

"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:
RF frequency sweep:
`[:SOURce<hw>]:SWEep[:FREQuency]:MODE` on page 549
`:TRIGger<hw>:FSWeep:SOURce` on page 593
RF level sweep:
`[:SOURce<hw>]:SWEep:POWer:MODE` on page 547
`:TRIGger<hw>:PSWeep:SOURce` on page 593
RF combined sweep:
`[:SOURce<hw>]:SWEep:COMBined:MODE` on page 554
`:TRIGger<hw>:FPSWeep:SOURce` on page 594
LF frequency sweep:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE` on page 505
`:TRIGger<hw>:LFFSweep:SOURce` on page 593

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:
RF frequency sweep:
`[:SOURce<hw>]:SWEep[:FREQuency]:RETRace` on page 550
RF level sweep:
`[:SOURce<hw>]:SWEep:POWer:RETRace` on page 550
RF combined sweep:
`[:SOURce<hw>]:SWEep:COMBined:RETRace` on page 554
LF frequency sweep:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace` on page 506

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.

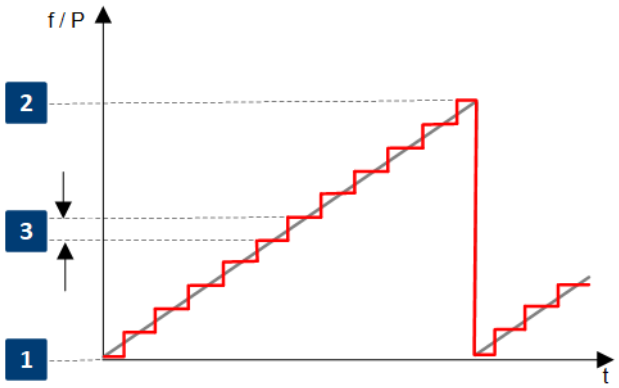


Figure 7-11: Sweep signal sawtooth shape

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.

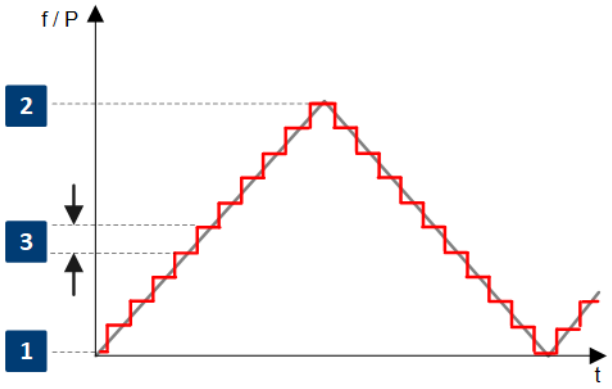


Figure 7-12: Sweep signal triangle shape

1 = Start value
2 = Stop value
3 = Step width

Remote command:
RF frequency sweep:
`[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe` on page 550
RF level sweep:
`[:SOURce<hw>]:SWEep:POWer:SHAPe` on page 550
RF combined sweep:
`[:SOURce<hw>]:SWEep:COMBined:SHAPe` on page 555
LF frequency sweep:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe` on page 506

Spacing
In "RF and LF Frequency Sweep" mode, "Spacing" selects the mode for calculating the frequency interval, which increases or decreases the current frequency at each step.

To determine the step size, select the parameter Step Linear/Step Logarithmic.

In "RF Combined Sweep" mode, the parameter indicates that the step intervals are linearly (straight proportional) distributed, i.e. the intervals have the same size. The frequency / level range and the Dwell Time time determine the calculated step size.

"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:
RF frequency sweep:
`[:SOURce<hw>]:SWEep[:FREQuency]:SPACing` on page 549
RF combined sweep: n.a.
LF frequency sweep:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing` on page 507

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 Section 7.4, "Significant parameters and functions", on page 147.

Remote command:
RF frequency sweep:
`[:SOURce<hw>]:SWEep[:FREQuency]:DWELl` on page 548
RF level sweep:
`[:SOURce<hw>]:SWEep:POWer:DWELl` on page 546
RF combined sweep:
`[:SOURce<hw>]:SWEep:COMBined:DWELl` on page 553
LF frequency sweep:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl` on page 504

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 494

Show/Show Connector
Opens a dialog that displays the location of the connector on the front panel or rear panel of the instrument. A blinking rectangle shows the connector.

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 555

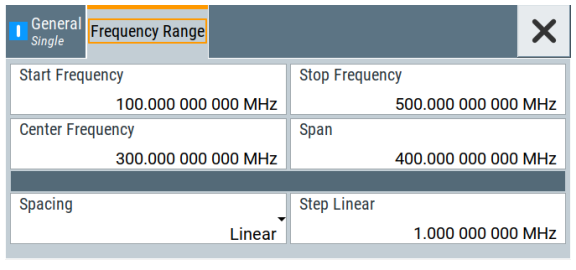
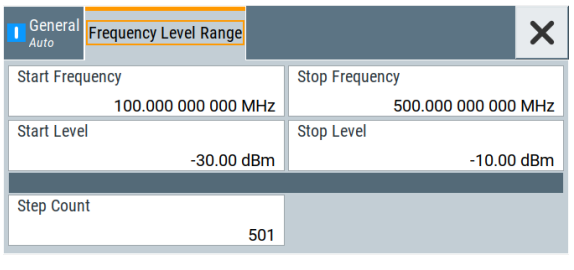
Execute Single Sweep
In "Mode = Single", starts a sweep manually.

Remote command:
RF frequency sweep:
`[:SOURce<hw>]:SWEep[:FREQuency]:EXECute` on page 550
`:TRIGger<hw>:FSWeep[:IMMediate]` on page 595
RF level sweep:
`[:SOURce<hw>]:SWEep:POWer:EXECute` on page 550
`:TRIGger<hw>:PSWeep[:IMMediate]` on page 595
RF combined sweep:
`[:SOURce<hw>]:SWEep:COMBined:EXECute` on page 553
LF frequency sweep:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute` on page 505
`:TRIGger<hw>:LFFSweep:IMMediate` on page 595
General:
`:TRIGger<hw>[:SWEep][:IMMediate]` on page 595

7.5.2 Frequency range settings

Access:

1. Select for example "Sweep" > "RF Frequency Sweep"
2. Select for example "Frequency Range".

> "Frequency Range"	> "Frequency / Level Range"
	

Settings

Start Frequency/Stop Frequency 156
Center Frequency 156
Span 156
Spacing 156
Step Linear/Step Logarithmic 157

Start Frequency/Stop Frequency
Defines the frequency sweep range by setting the start and end values.

See Section 7.2.1, "Correlating parameters in sweep mode", on page 143.

Remote command:
RF frequency sweep:
`[:SOURce<hw>]:FREQuency:STARt` on page 492
`[:SOURce<hw>]:FREQuency:STOP` on page 492
RF combined sweep:
`[:SOURce<hw>]:COMBined:FREQuency:STARt` on page 552
`[:SOURce<hw>]:COMBined:FREQuency:STOP` on page 552
LF frequency sweep:
`[:SOURce<hw>]:LFOutput:FREQuency:STARt` on page 499
`[:SOURce<hw>]:LFOutput:FREQuency:STOP` on page 499

Center Frequency
In "RF Frequency Sweep" mode, sets the RF center frequency.

See Section 7.2.1, "Correlating parameters in sweep mode", on page 143.

Remote command:
`[:SOURce<hw>]:FREQuency:CENTer` on page 491

Span
In "RF Frequency Sweep" mode, sets the span of the frequency sweep range.

See Section 7.2.1, "Correlating parameters in sweep mode", on page 143.

Remote command:
`[:SOURce<hw>]:FREQuency:SPAN` on page 492

Spacing
In "RF and LF Frequency Sweep" mode, "Spacing" selects the mode for calculating the frequency interval, which increases or decreases the current frequency at each step.

To determine the step size, select the parameter Step Linear/Step Logarithmic.

In "RF Combined Sweep" mode, the parameter indicates that the step intervals are linearly (straight proportional) distributed, i.e. the intervals have the same size. The frequency / level range and the Dwell Time time determine the calculated step size.

"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:
RF frequency sweep:
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 549
RF combined sweep: n.a.
LF frequency sweep:
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing on page 507

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 Section 7.2.1, "Correlating parameters in sweep mode", on page 143.

"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.

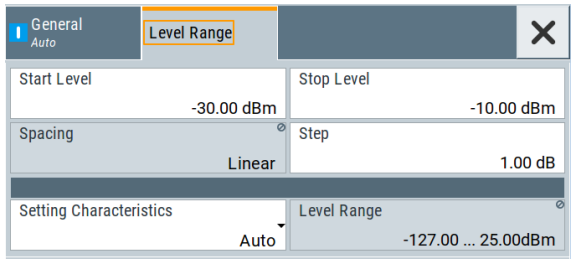
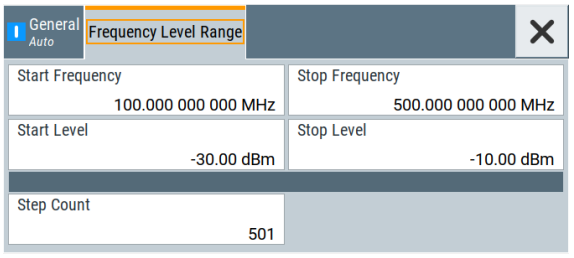
Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] on page 551
[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic on page 551
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] on page 507
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic on page 507

7.5.3 Level range settings

Access:

1. Select "Sweep" > "RF Level Sweep"
2. Select for example "Level Range".

Table 7-8: Range settings dialog: Examples of RF Level and RF Combined Sweep dialogs

> "Level Range"	> "Frequency / Level Range"
	

Settings

Start Level / Stop Level 158
Step Count 158
Spacing 158
Step 158
Setting Characteristics 158
Level Range 159

Start Level / Stop Level
Defines the RF level sweep range by setting the start and end values.

See Section 7.2.1, "Correlating parameters in sweep mode", on page 143.

Remote command:
RF level sweep:
`[:SOURce<hw>]:POWer:STARt` on page 531
`[:SOURce<hw>]:POWer:STOP` on page 531
RF combined sweep:
`[:SOURce<hw>]:COMBined:POWer:STARt` on page 552
`[:SOURce<hw>]:COMBined:POWer:STOP` on page 553

Step Count
In "RF Combined Mode", defines the number of sweeps to be executed in Mode > Single.

To start the sweep cycles, select Execute Single.

Remote command:
`[:SOURce<hw>]:SWEep:COMBined:COUNt` on page 553

Spacing
Indicates that the instrument distributes the level steps linearly (straight proportional), i.e. the level steps have the same size.

To determine the step size, use the parameter Step.

Remote command:
n.a.

Step
Sets the step width for the RF level sweep in dB.

The "RF level sweep" mode increases or decreases the level value linearly by the set value.

Remote command:
`[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic]` on page 548

Setting Characteristics
Selects additional quality characteristics to optimize the behavior of the RF signal level for the specific application.

"Auto" Sets the RF output level automatically according to the selected mode.
In this mode, the instrument provides the highest dynamic range and fastest setting times.
The RF signal is shortly blanked when the step attenuator is switching.

For more information, refer to the specifications document.

"Uninterrupted"
Suppresses blanking at level transitions. Frequency transitions can lead to an RF level blanking due to hardware-specific switching points.
This mode reduces the dynamic range of the instrument. The step attenuator is fixed.

"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 can 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 50 Ω output connector, due to changed level settings.

"User" Selects this entry automatically when you change one of the following parameters from the default setting:
- "Attenuator" > Mode
- "ALC" > State or Detector Sensitivity

Note: If you select another setting characteristic, the R&S SMB100B presets the modified attenuator and ALC parameters.

Remote command:
`[:SOURce<hw>]:POWer:LBEHaviour` on page 529

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 536
`[:SOURce<hw>]:POWer:RANGe:UPPer?` on page 536

7.6 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 generating the RF signal based on these values.

Access:

► Select "Sweep" > "List mode".

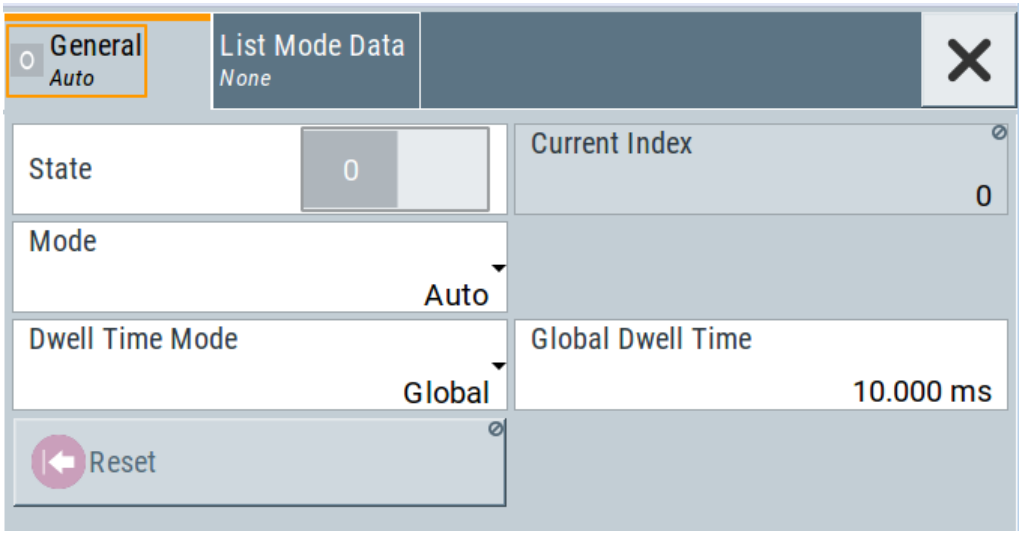
The dialog contains parameters for configuring the list mode processing, entering list mode data and transferring data files from or to the instrument.
The remote commands required to define these settings are described in Section 13.16.7, "SOURce:LIST subsystem", on page 508.

- General settings....160
- List mode data settings....162
- Import/export settings....163

7.6.1 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....161
Current Index....161
Mode....161
Dwell Time Mode....161
Global Dwell Time....162
Trigger Slope....162
Reset....162
Execute Single....162

State
Activates the list mode and processes the currently selected list.

Note: Active RF frequency, RF level or RF combined sweep modes deactivate the LF sweep or List mode and vice versa.

Remote command:
`[:SOURce<hw>]:FREQuency:MODE` on page 488

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 513

Mode
Selects the mode for list processing.

See Section 7.1, "Signal generation and triggering in the sweep and list modes", on page 135.

"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 515
`[:SOURce<hw>]:LIST:MODE` on page 513

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 Section 7.7, "List data editor", on page 166.

Remote command:
`[:SOURce<hw>]:LIST:DWELl:MODE` on page 511

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 147.

Remote command:
`[:SOURce<hw>]:LIST:DWELl` on page 511

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 494

Reset
Resets the list to the starting point.

Remote command:
`[:SOURce<hw>]:LIST:RESet` on page 517

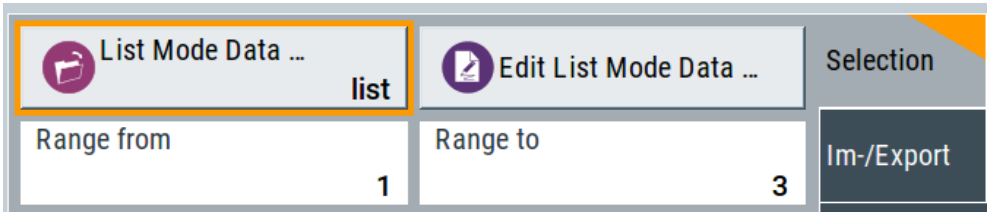
Execute Single
Manually starts list processing in "Single" mode.

Remote command:
`[:SOURce<hw>]:LIST:TRIGger:EXECute` on page 515

7.6.2 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....163
Edit List Mode Data....163
List Range from/to....163

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 146.

Remote command:
`[:SOURce<hw>]:LIST:CATalog?` on page 516
`[:SOURce<hw>]:LIST:SELect` on page 518
`[:SOURce<hw>]:LIST:DELete` on page 516
`[:SOURce<hw>]:LIST:DELete:ALL` on page 517

Edit List Mode Data
Opens the build.-in table editor to define a new list data table or edit an exisitng one.

See also: Section 7.7, "List data editor", on page 166.

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.

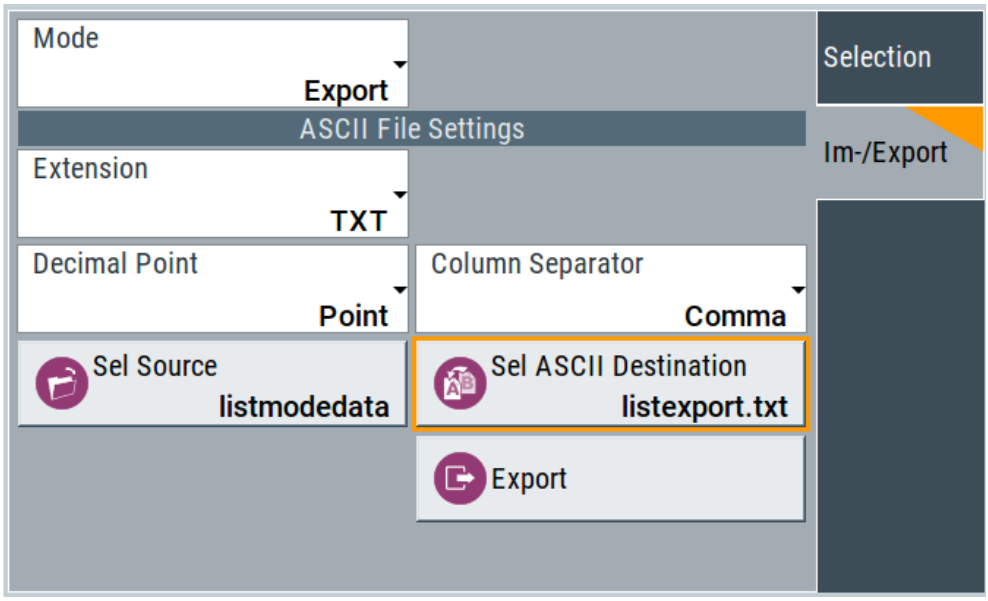
Remote command:
`[:SOURce<hw>]:LIST:INDex:STARt` on page 513
`[:SOURce<hw>]:LIST:INDex:STOP` on page 513

7.6.3 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 164
ASCII File Settings 164
Select (ASCII) Source/Select (ASCII) Destination 165
Select Source/Select ASCII Destination 165
Import / Export 165

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 520
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 483
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 466

ASCII File Settings
Defines the format and the separators of the associated data file.

"Extension" Selects `*.csv` or `*.txt` format.

"Decimal Point" Sets "Point" (dot) or "Comma" as the decimal separator used in the 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 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal on page 519
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 519
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 482
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal on page 483
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn on page 467

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 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 519
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 482
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 468

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 520
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 484
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 468

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

Remote command:
[:SOURce<hw>]:LIST:DEXChange:EXECute on page 519
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 468

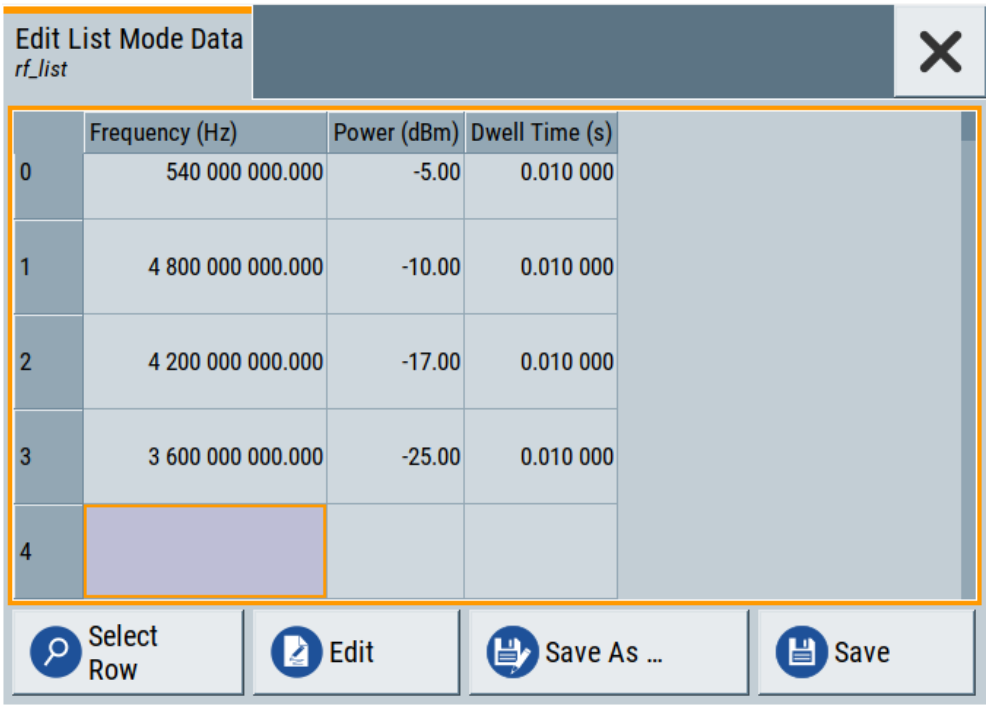
7.7 List data editor

The "List Mode" dialog provides a build-in list editor for defining the corresponding frequency and level value pairs. Prerequisite to define list mode data is that you have selected a file.

Access:

► "Sweep" > "List Mode" > "List Mode Data" > "Edit List Mode Data"

The editor for list mode provides a table with RF frequency and power values, a column for defining variable dwell times, and standard navigation functions.



The remote commands required to define the list mode data are described in Section 13.16.7, "SOURce:LIST subsystem", on page 508.

All columns in a row must contain values. Cells with missing values are therefore filled automatically, using the value of the previous row.

Once you enter a value, the editor automatically adds preset values in the other columns. This functionality protects against data loss, otherwise incomplete rows are lost when saving. You can simply override these values.

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.

Settings:

Frequency (Hz)..... 167
Power (dBm)..... 167
Dwell Time (s)..... 167
Data handling keys.....167
└ Select Row.....167
└ Edit.....167
└ Save As/Save..... 167
Fill.....167

Frequency (Hz)
Sets the frequency values for list mode operation.

Remote command:
`[:SOURce<hw>]:LIST:FREQuency` on page 512

Power (dBm)
Sets the level value for the selected frequency in list mode.

Remote command:
`[:SOURce<hw>]:LIST:POWer` on page 514

Dwell Time (s)
Sets the dwell time values for the frequency power value pairs in list mode operation.

Remote command:
`[:SOURce<hw>]:LIST:DWELl:LIST` on page 511

Data handling keys
Standard functions for file and data handling.

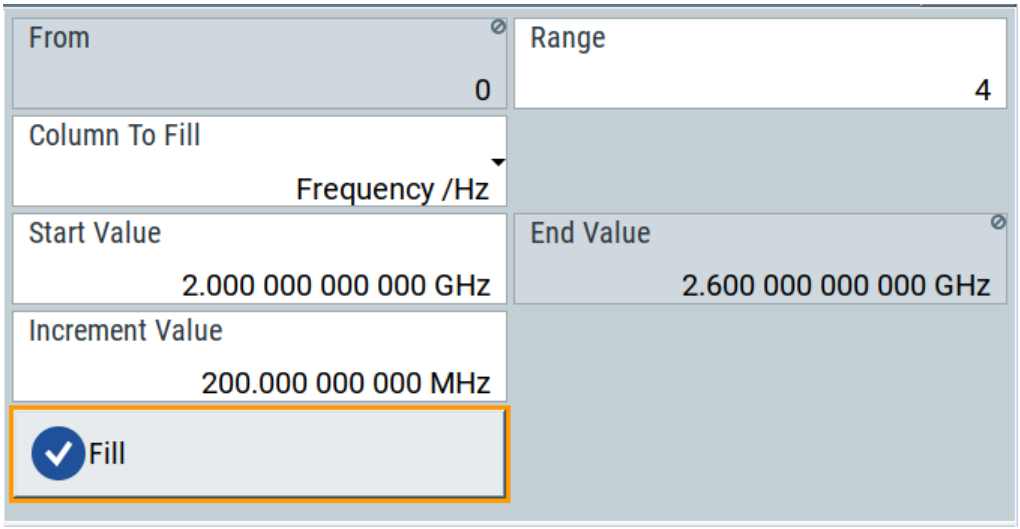


Select Row ← Data handling keys
Selects a row for editing.

Edit ← Data handling keys
Enables you to insert, or delete a row or ranges within the table, and provides access to a dialog for automatic filling, see "Fill..." on page 94.

Save As/Save ← Data handling keys
Saves the table 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.



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".

7.8 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 Section 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?`.

8 Improving level performance

To adjust 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 171.
- **Automatic Level Control (ALC)**
  The automatic level control system provides stable RF signals with highest absolute level accuracy over temperature and time.
  See "About ALC" on page 174.
- **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 177.
- **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 Section 8.4, "Using power sensors", on page 189

8.1 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:

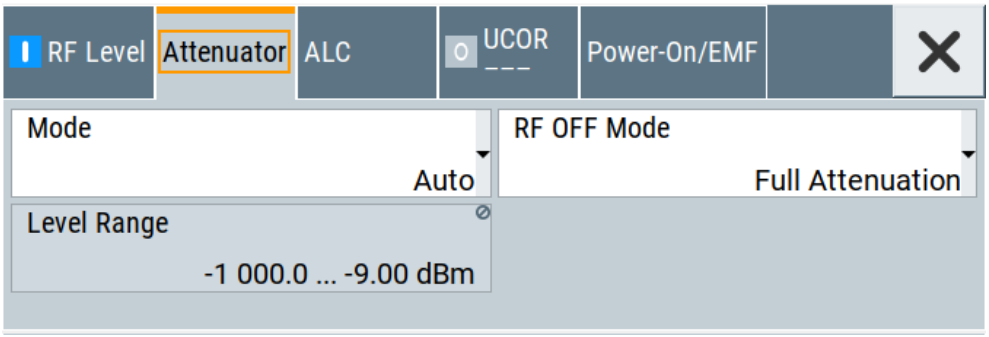
- Automatic configuration
  Select standard operation mode ("Auto"), in which the generator adjusts the attenuation of the RF output signal automatically.
- DUT tests under low signal to noise conditions
  Low output power is suitable to test the behavior of a DUT under low signal to noise conditions.

- 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.

8.1.1 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 Section 13.13, "OUTPut subsystem", on page 419 and Section 13.16.11, "SOURce:POWer subsystem", on page 524.

Settings

Mode 172
Level Range 173
RF OFF Mode 173
Readjust 173

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 173.

Remote command:
`:OUTPut<hw>:AMODe` on page 420

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 421
`:OUTPut<hw>:AFIXed:RANGe:UPPer?` on page 421

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 528

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

The R&S SMB100B provides the "Readjust" function when you change one of the following parameters from the default setting:
- "RF Level" > Setting Characteristics
- "Attenuator" > Mode > FixedSetting Characteristics

Remote command:
`[:SOURce<hw>]:POWer:ALC:SONCe` on page 528

8.1.2 Reverse power protection

R&S SMB100B RF instruments only

The instrument 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 421
:OUTPut<hw>:PROTection:CLEar on page 421

8.2 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 monitors 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 multiple generators are coupled, reverse power can affect the ALC readings, which leads to an incorrect RF output power.

ALC states and their effects

The following description basically explains the ALC states and their principle of operation:

- "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 conditions.
  Note: This mode is not useful for pulse modulation with narrow pulses and low repetition rates, since the automatic level control cannot settle in time. Set ALC "Auto" or "Table & On" instead.
- "Off (Sample & Hold)"
  R&S SMB100B RF instruments only
  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 fast and strictly monotonic, but not quite as precise level adjustment.
- "Table & On"

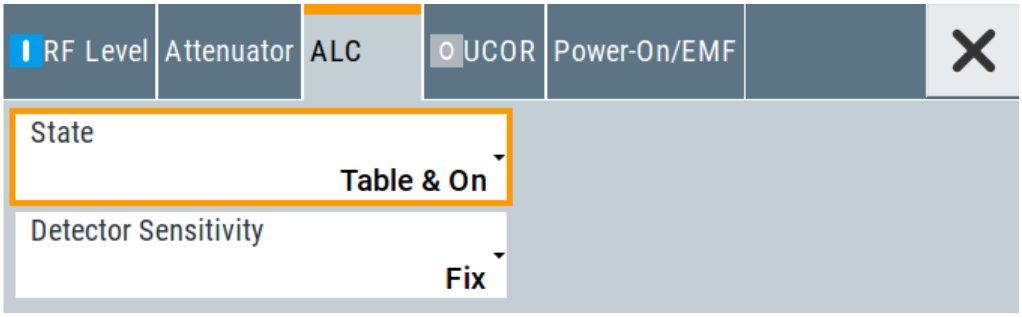
Starts with the associated value of the internal level table and then activates the automatic level control. This mode achieves maximum level accuracy and fast setting times.
If pulse modulation is applied, this mode ensures fast level settings even with narrow pulses at low repetition rate.

The R&S SMB100B displays the level control setting as a status message in the info line.

8.2.1 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 Section 13.16.11, "SOURce:POWer subsystem", on page 524.

Settings

State 175
Detector Sensitivity 176

State
Selects the internal level control mode.

"Auto" Selects the most appropriate ALC mode automatically.

"On" Activates ALC permanently.

"Off (Sample & Hold)"
R&S SMB100B RF instruments only
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 internal ALC table and continues with automatic level control.

For further details on the individual settings, an overview of the functionality and details on what is to be considered, see "ALC states and their effects" on page 174.

Remote command:
[:SOURce<hw>]:POWer:ALC[:STATe] on page 527

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 527

8.3 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.

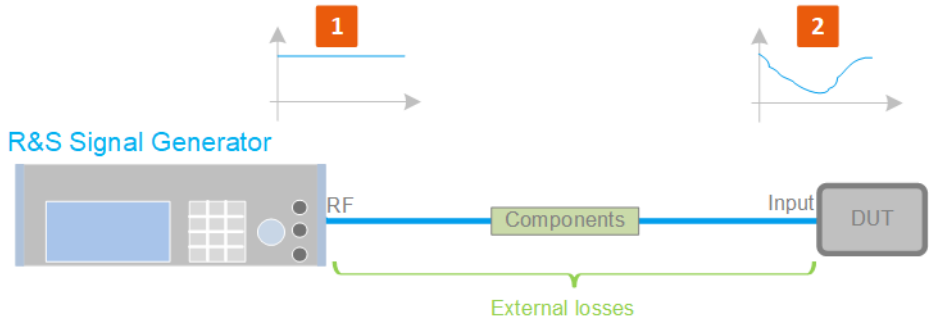


Figure 8-1: Effect of external losses on the signal flatness at the DUT input

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 of the RF output signal over a frequency range in advance, see Figure 8-2.

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 specifications document.

For more information, refer to the specifications document.

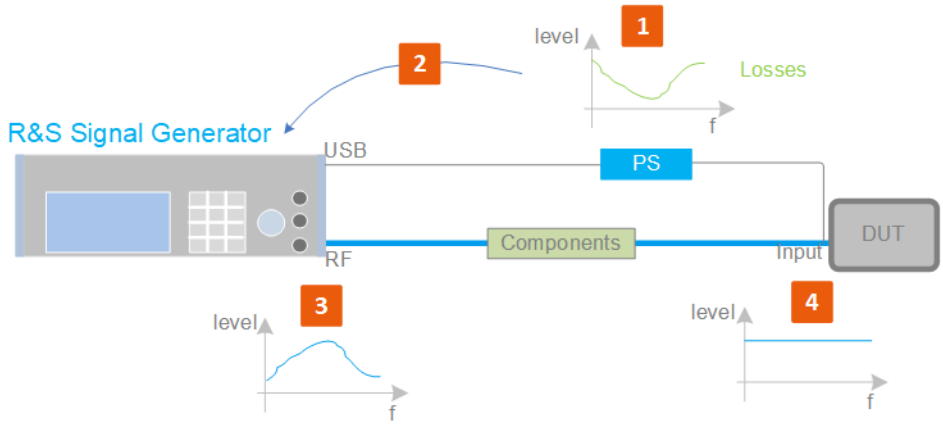


Figure 8-2: Understanding the principle of user correction

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 Notepad or a similar tool and save it with the predefined extension. Transfer the file to and load it into the instrument.

UCOR file format

Files containing correction data are simple files in text or comma-separated value (CSV) file format. The filename is user-definable; the file extension is `*.ucor`.

The file contains a list of correction values, one row per frequency and correction value pair; a new line indicator separates the correction values.

For file handling, use the standard functions in the "File Manager", see Section 10.9, "Using the file manager", on page 237.

Collecting correction data

To fill the frequency and power values in the correction table, use one of the following options:

- **Manually**, row by row.
- Fill the table **automatically** with linearly interpolated values, calculated from value range and step size.
- Acquire the real frequency response characteristics of the used component with the **R&S NRP power sensor**, see Understanding the principle of user correction.

Using a power sensor for frequency response measurements

Consider the following when using R&S NRP power sensors to measure the correction values:

- Measure the level directly at the input of the DUT.
- Use the internal correction functions of an R&S NRP power sensor to increase the measurement accuracy.
- Use S-parameter to consider the impact of any two-port device like an adapter between the signal generator and the sensor input.

For information on the various possibilities of interoperability between Rohde & Schwarz power sensors and Rohde & Schwarz signal generators, see the application note 1GP141.

Interactions and characteristics

You can enable user correction in all operating modes.

The RF output level ($Level_{RF}$) is the sum of the level value and the correction for the particular frequency:

$Level_{RF}$ = "Status bar > Level" + "UCOR"

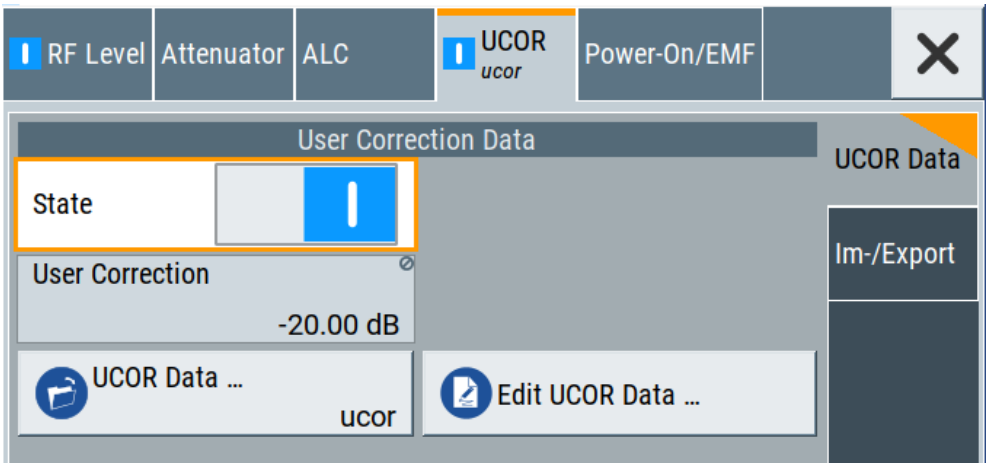
If enabled, the R&S SMB100B indicates user correction by the "Lev Ucor" icon in the "Level" tile.

8.3.1 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 Section 8.3.2, "Ucor data editor", on page 181.
4. Select "UCOR" > "State" > "On".

5. Select "Level" > "RF 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 Section 13.16.2, "SOURce:CORRection subsystem", on page 476.

Settings

State....180
User Correction....180
UCOR Data....180
Edit UCOR Data....181
UCOR Info....181

State
Enables user correction.

The R&S SMB100B displays the status icon "Lev Ucor" in the "Level" panel.

Remote command:
`[:SOURce<hw>]:CORRection[:STATe]` on page 481

User Correction
Indicates the corrected level value for a specific frequency point.

Remote command:
`[:SOURce<hw>]:CORRection:VALue?` on page 480

UCOR Data
Opens 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`. If you select a file, 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 your user correction file and select the file.

- Use the general editor function to create a file or to edit an existing one.
- Use the standard file manager function to load externally created files to the instrument.

Remote command:
`[:SOURce]:CORRection:CSET:CATalog?` on page 481
`[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 480
`[:SOURce]:CORRection:CSET:DELete` on page 482

Edit UCOR Data
Opens the build-in table editor to define a new correction table or edit an existing one.

See also:
- Section 8.3.2, "Ucor data editor", on page 181
- "Fill..." on page 94
- Section 8.3.3, "Fill with sensor", on page 184

UCOR Info
Opens a window with information on the user correction file.

The window shows the metadata of the file and the output level parameters that are relevant for user correction.

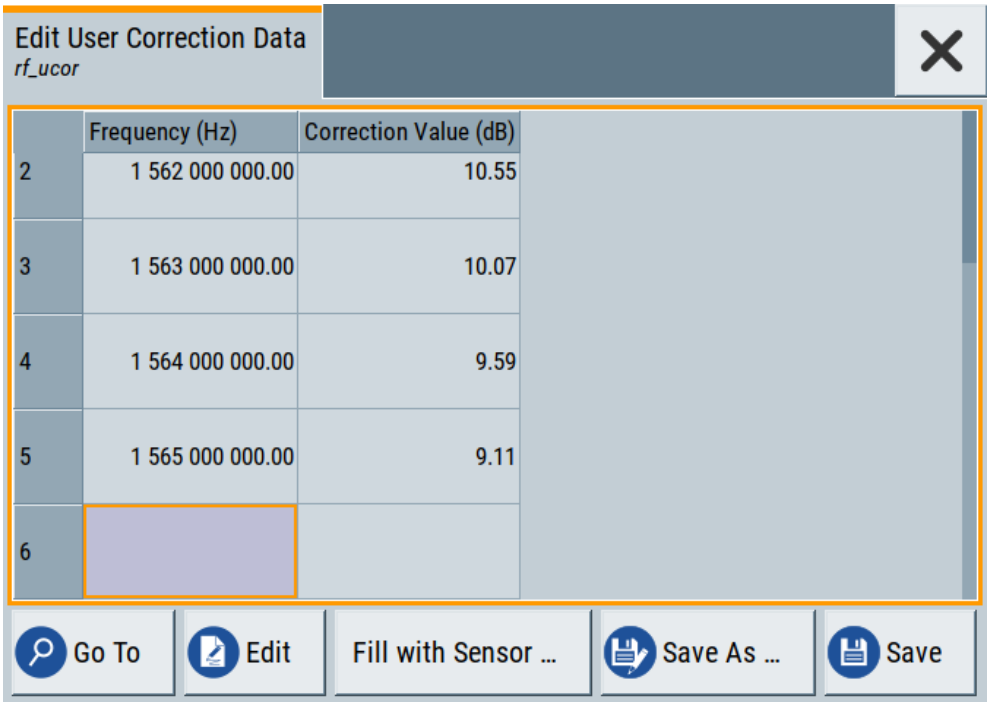
Remote command:
n.a.

8.3.2 Ucor data editor

The "User Correction" dialog provides a build-in list editor for defining the corresponding value pairs. Prerequisite to define correction values is that you have selected a file.

Access:

► "Level" > "User Correction" > "Edit UCOR Data".



The editor for user correction data provides a table with RF frequency and level values and standard navigation functions.
The remote commands required to define the user correction data are described in Section 13.16.2, "SOURce:CORRection subsystem", on page 476.

All columns in a row must contain values. Cells with missing values are therefore filled automatically, using the value of the previous row.

Once you enter a value, the editor automatically adds preset values in the other columns. This functionality protects against data loss, otherwise incomplete rows are lost when saving. You can simply override these values.

Since the table and navigation functions can be assumed to be known, the following description contains a brief overview.

Settings:

Frequency (Hz)..... 183
Correction Value (dB)..... 183
User correction data handling keys..... 183
└ Select Row..... 183
└ Edit..... 183
└ Fill with Sensor..... 183
└ Save As/Save..... 183
Fill..... 183

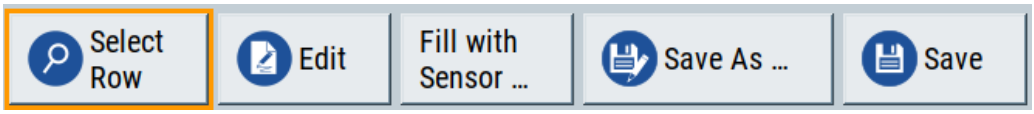
Frequency (Hz)
Sets the frequency for level correction.

Remote command:
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency on page 479

Correction Value (dB)
Sets the level correction value for the selected frequency.

Remote command:
[:SOURce<hw>]:CORRection:CSET:DATA:POWer on page 479

User correction data handling keys
Standard functions for handling user correction data and files.



Select Row ← User correction data handling keys
Selects a row for editing.

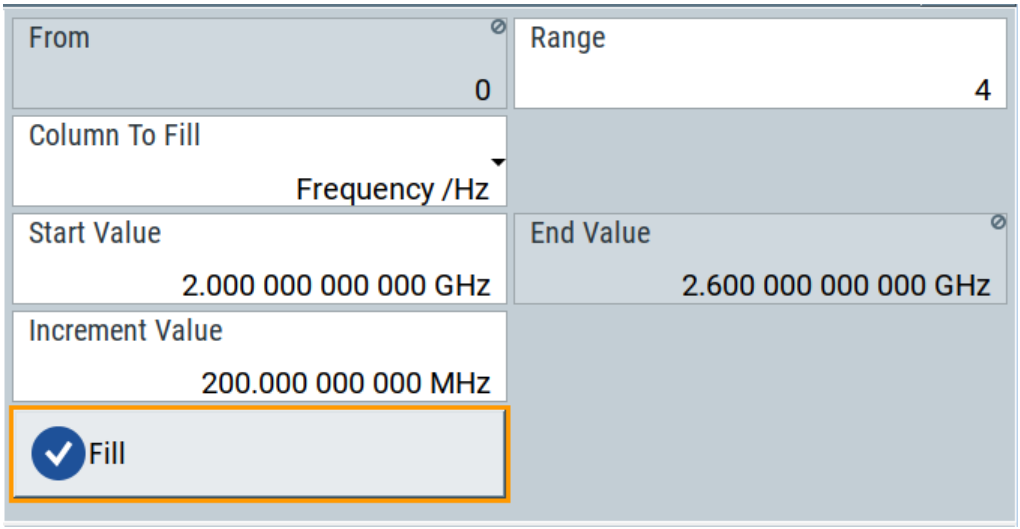
Edit ← User correction data handling keys
Enables you to insert, or delete a row or ranges within the table, and provides access to a dialog for automatic filling, see "Fill..." on page 94.

Fill with Sensor ← User correction data handling keys
Opens a dialog to configure the automatic filling of user correction data with an R&S NRP power sensor.

See Section 8.3.3, "Fill with sensor", on page 184

Save As/Save ← User correction data handling keys
Saves the table 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.



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".

8.3.3 Fill with sensor

The fill with sensor function requires that you have connected a power sensor and also selected a file for user correction data before.

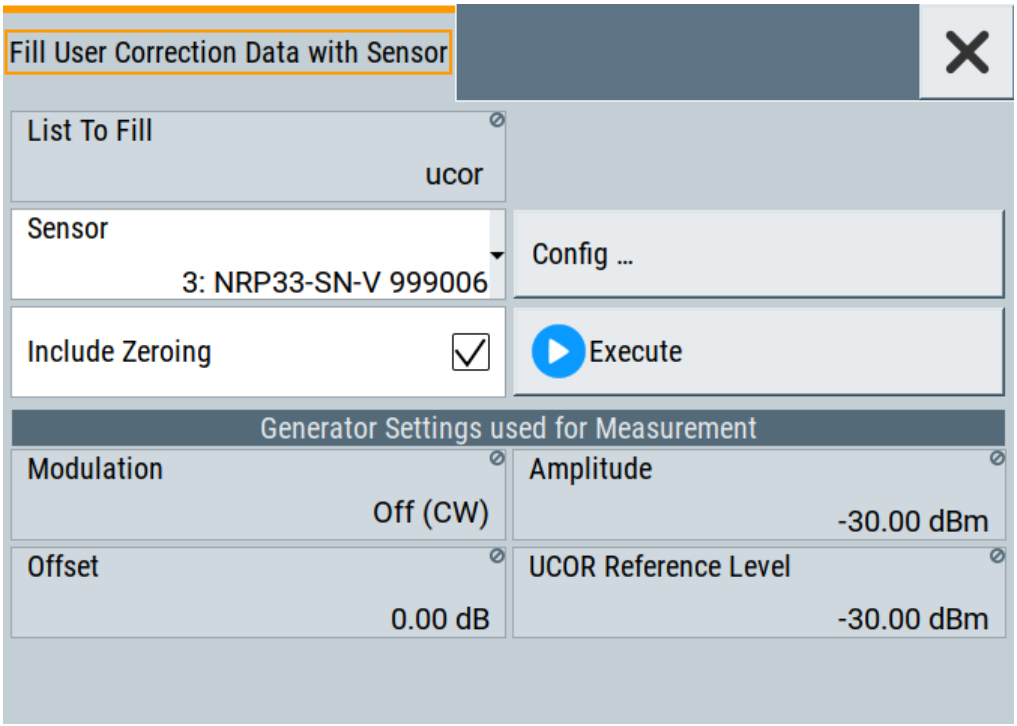
See:

- Section 8.4, "Using power sensors", on page 189
- "To create user correction data with an R&S NRP and the R&S SMB100B" on page 207

Access:

1. Select "Level" > "User Correction".
2. Select "UCOR Data > navigate to the file *.ucor > Select".

3. Select "Edit UCOR Data > Fill With Sensor...".



This dialog contains parameters for filling a table automatically with sensor readings.

To fill the table, select "Execute".

For information on power sensors and how to use them, see Section 8.5, "Improving the RF signal performance", on page 206.

Settings:

Fill User Correction Data with Sensor 185
Generator Settings used for Measurement 186

Fill User Correction Data with Sensor

The "Execute" button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

"Sensor"	Displays connected sensors for selection.
"List To Fill"	Indicates the used list.
"Config"	Opens the sensor configuration dialog to set the parameters for the selected power sensor.

"Include Zeroing"
Performs a zeroing procedure before acquiring the user correction data to improve precision.
No signal is applied to the sensor during zeroing. RF output is temporarily switched off during that time.
When unchecked, the zeroing procedure is skipped. However, the RF signal level can be blanked shortly. This setting is useful if blanking of RF is undesirable or the absence of power at the sensor cannot be guaranteed.

Remote command:
`[:SOURce<hw>]:CORRection:ZERoing:STATe` on page 481

"Execute" Triggers the sensor to measure and to return the data for user correction.
The "Execute" button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

Remote command:
`[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` on page 480

Generator Settings used for Measurement
Displays the settings relevant for the measurement.

"Modulation" Indicates that modulation is off.
The R&S SMB100B disables modulation for the "Fill with sensor" process, even if you have enabled a modulation and if you have started "Fill with sensor".

"Amplitude" Displays the RF level amplitude.

Remote command:
`[:SOURce<hw>]:POWer:POWer` on page 530

"Offset" Displays the RF level offset.

Remote command:
`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet` on page 535

"UCOR Reference Level"
Displays the reference level for user correction.
This level is the sum of the RF level amplitude and RF level offset.

Remote command:
`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:REFLevel` on page 536

8.3.4 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".

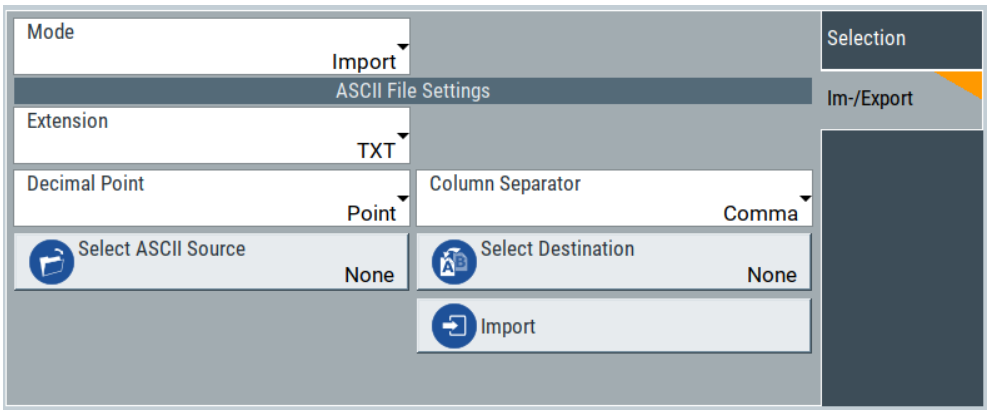


Figure 8-3: Im-/Export dialog (example with UCOR settings)

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 187
ASCII File Settings 187
Select (ASCII) Source/Select (ASCII) Destination 188
Select Source/Select ASCII Destination 188
Import / Export 188

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 520
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 483
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 466

ASCII File Settings
Defines the format and the separators of the associated data file.

"Extension" Selects `*.csv` or `*.txt` format.

"Decimal Point" Sets "Point" (dot) or "Comma" as the decimal separator used in the 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 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal on page 519
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 519
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 482
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal on page 483
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn on page 467

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 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 519
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 482
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 468

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 520
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 484
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 468

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

Remote command:
[:SOURce<hw>]:LIST:DEXChange:EXECute on page 519
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 483
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 468

8.4 Using power sensors

The R&S SMB100B works with any of the R&S NRP power sensors and thus supports various application tasks. Using power sensors, you can for example determine attenuation characteristics of downstream equipment or cables. You can use the measured values to compensate the losses with internal control functions or with an external control circuit in real time.

For information on the various possibilities of interoperability between Rohde & Schwarz power sensors and Rohde & Schwarz signal generators, see the application note 1GP141.

R&S NRP power sensors are highly accurate standalone measuring devices, suitable for a wide range of applications. The power sensors communicate directly with the signal generator, calculate the average or peak power internally, include S-parameter correction and return the measurement results to the generator.

The R&S SMB100B supports up to four power sensors, allowing up to four power measurements simultaneously.



Check the firmware version of the R&S NRP sensors regularly. Update the firmware, if necessary.

For updates, see the Rohde & Schwarz website www.rohde-schwarz.com in section "Power Meters & Voltmeters".

For information on working with power sensors, see the following topics:

- Section 8.4.2, "Connecting R&S NRP power sensors to the R&S SMB100B", on page 191
  Overview on the supported connectors, connection options and the required accessories.
- Section 8.4.3, "NRP power viewer", on page 192
  A function for measuring and monitoring the RF output power or a user-defined singnal source.
- Section 8.4.4, "NRP power control", on page 193
  Controls a downstream closed loop power control circuit, to compensate frequency response characteristics.
- Section 8.4.5, "NRP sensor configuration", on page 198
  Parameter settings of the specific R&S NRP power sensor.
- Section 8.4.6, "NRP sensor mapping", on page 203
  Shows all R&S NRP sensors connected to the instrument, or in the LAN.

8.4.1 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 too much noise in your setup, by a bad suppression of harmonics or non-harmonics or when you reach the sensitivity level of your power sensor.

Measurements are continuously repeated in a predefined time window. The measurement result is obtained by averaging the measured values for the last 2N time windows. This approach is referred as a **two-step averaging process**.

The factor of 2 in the formula arises because the output signals from the microwave detector are chopped at the same rate as the time windows to suppress low-frequency noise. An independent measured value can only be obtained from two consecutive values.

The variable N in the formula indicates the **filter length**. The filter length then directly influences the measurement time. The filter length can be selected automatically or it can be manually set to a fixed value.

Follow the following general recommendation to find out the **optimum filter length**:

- Always start a measurement in auto mode ("Filter > Auto").
  Check if the measurement results are sufficient.
- If the power is not constant, select the filter length manually ("Filter > User").
  Trigger the "Auto Once" function to search for the optimum filter length for the current measurement conditions.
  The estimated value is indicated as filter length.
- If the target measurement accuracy value is known, select "Filter > Fixed Noise".
  The averaging factor is selected automatically and so that the sensor's intrinsic noise (two standard deviations) does not exceed the specified noise content.
- Depending on the R&S NRP power sensor type, the manual setting of the filter length varies in resolution.
- Different sensor types achieve the same filtering result with different filter and time window lengths.
  For most sensors, the time window length is fixed to 20 ms, whereas, e.g., for the R&S NRP-Z81 sensor, the time window length is 10 µs.

For more information, refer to the specifications document.

About zeroing

Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor. If a Rohde & Schwarz power sensor receives an input power during the zeroing process, it aborts zeroing and generates an error message. Zeroing takes a few seconds, depending on the sensor model. Refer to the documentation of your power sensor for more information.

Tips for zeroing

When to perform zeroing:

- During warm up after switching on or connecting the instrument
- After a substantial change of the ambient temperature
- After fastening the power sensor module to an RF connector at high temperature
- After several hours of operation
- When low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
- Switch off the RF power source for zeroing, but do not disconnect it from the power sensor. This proceeding keeps the thermal equilibrium, and the zeroing process also compensates the noise that superimposes the measured signal (e.g. from a broadband amplifier).

Related settings and functions

- Measurements-related settings, like results, filter, filter length:
  Section 8.4.5, "NRP sensor configuration", on page 198
- Software version of the connected power sensor:
  `:SENSe<ch>[:POWer]:TYPE?` on page 436
- Acquisition of level correction data:
  Section 8.3, "User correction", on page 176

Additional information

See the Rohde & Schwarz website www.rohde-schwarz.com, section "Power Meters & Voltmeters" for:

- R&S NRP power sensor manual.
- Information on the R&S NRP-Z5 sensor hub and the available accessories.
- Sensor software updates.

8.4.2 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.
Requires additional standard USB cable (USB type A to USB type B) to any USB type A connector of the R&S SMB100B. This connection supports internal 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 Power Sensors getting started.

Detection and mapping

The R&S SMB100B either detects a R&S NRP power sensor automatically or you can scan for available power sensors manually. The "NRP Sensor Mapping" dialog lists all detected R&S NRP power sensors, see Section 8.4.6, "NRP sensor mapping", on page 203. The dialog enables you to add, remove and map the sensors manually.

Depending on the connection interface, the R&S SMB100B detects and maps connected R&S NRP power sensors differently:

- USB interface
  Detects a sensor automatically and maps it with index "1" to index "4" according to the sequence of connection.
- LAN interface
  To detect sensors that are connected in the LAN, the instrument provides a scan function. When you start the function, scan searches in the LAN for available R&S NRP power sensors and adds all detected sensors to list. Assigning a mapping index activates the sensor for the measurement.



On connection, the R&S SMB100B immediately starts the measurement of the R&S NRP power sensor. If you preset the instrument ([Preset] key or `*RST`), the R&S SMB100B stops the measurement. The connection and the mapping of the power sensors remain.

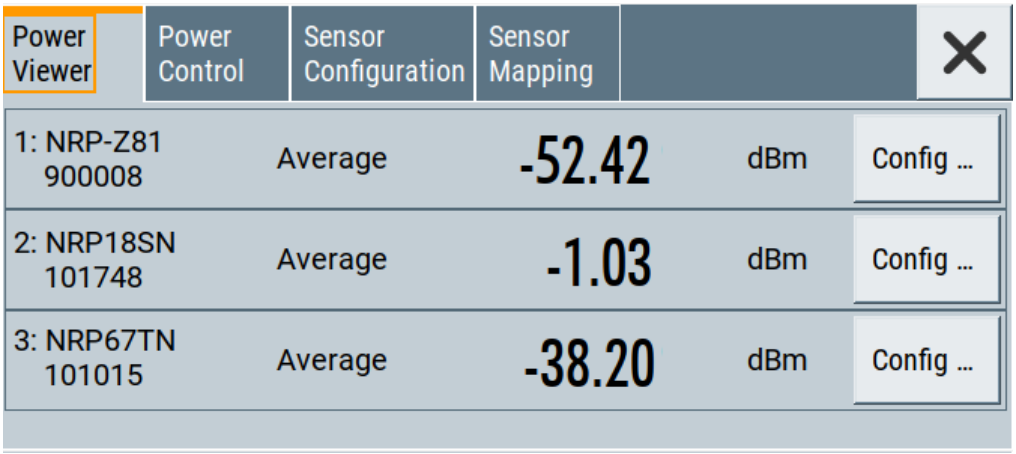
8.4.3 NRP power viewer

The R&S SMB100B features the power viewer function for measuring or monitoring signals with R&S NRP power sensors.

8.4.3.1 NRP power viewer settings

Access:

► Select "Power Sens" > "NRP Power Viewer".



The "Power Viewer" tab lists the mapped R&S NRP power sensors with the measured parameter mode and the current readings. The "Config" button leads you to the configuration dialog to set the parameters for each sensor.

The remote commands required to define these settings are described in Section 13.14, "SENSe, READ, INITiate and SLISt subsystems", on page 422, including the triggering of the measurement and the retrieval of measurement results. See also Section 8.5, "Improving the RF signal performance", on page 206.

Settings

Config.....193

Config
Opens the "Sensor Configuration" dialog.

See also Section 8.4.5, "NRP sensor configuration", on page 198.

8.4.4 NRP power control

The NRP power control function enables you to apply stable and accurate RF power to the DUT. For example, you can set up a downstream closed loop power control circuit to compensate spurious effects or losses caused by power amplifiers or cables.

Example: How to set up a closed loop power control

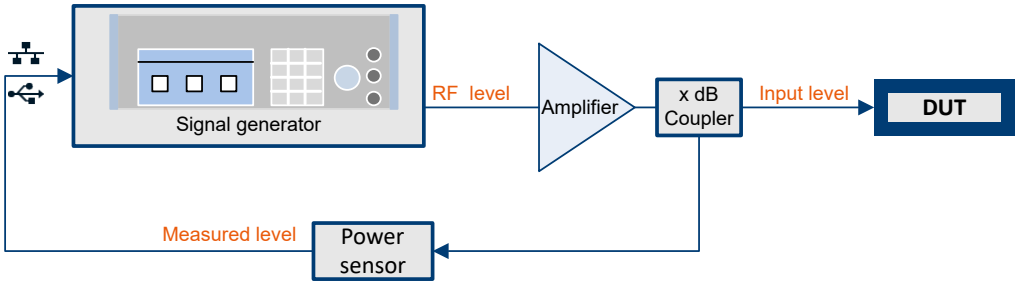


Figure 8-4: Example of a test setup with NRP power control

The signal generator applies the RF output signal to an amplifier and to the DUT. An intermediately connected coupler derivates the output power from the output signal and forwards it to the power sensor. Thus, the power sensor measures a proportional power in defined time intervals, and returns the results to the signal generator. If supported, the power sensor also includes given S-parameters. The signal generator compares the measured power with the set level value and adjusts the level of the output signal accordingly.

This closed loop power control enables you to control the external signal level continuously and reliably achieve a constant input power at the DUT in real time.

Impact of NRP power control and operating modes

Since the frequency and level of the RF output signal are continuously adjusted during "NRP Power Control", this operating mode interferes signal generation modes with varying frequency and level values. In addition, the setting time increases. The reason is the interaction between the signal generator and the R&S NRP power sensor in the control loop.

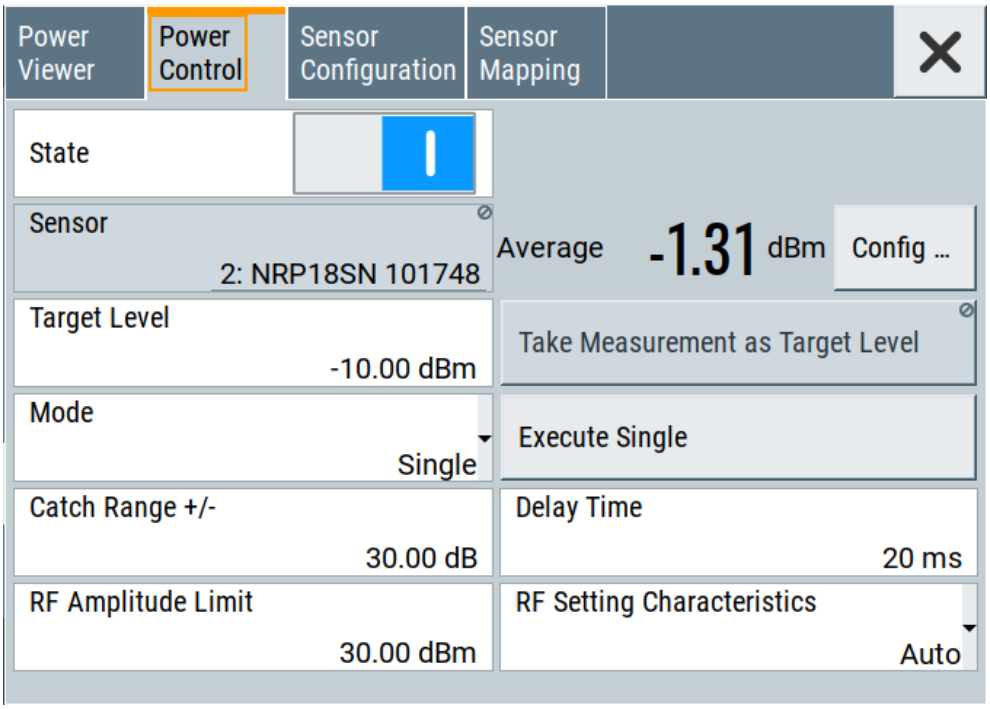
The operating modes impact each other as follows:

- Enabling the RF frequency sweep, RF level sweep or the list mode disables a running "NRP Power Control".
- A running list or RF sweep mode blocks "NRP Power Control".
- Modulated signals can deviate from the CW signal in mean power and peak power, and thus affect the "NRP Power Control".

8.4.4.1 NRP power control settings

Access:

► Select "Power Sens" > "NRP Power Control".



In this dialog you can configure the parameters of the power control setup for the selected power sensor.
The remote commands required to define these settings are described in Section 13.16.11, "SOURce:POWer subsystem", on page 524.

Settings

State....195
Sensor....196
Measured Level....196
Target Level....196
Take Measurement as Target Level....196
Mode....196
Execute Single....196
Catch Range +/-....197
Delay Time....197
Limit....197
Setting Characteristics....197

State
Enables power control with the selected sensor.

The control loop periodically adjusts the generator output. After switching off, the running loop is completed.

Note: If you want to use another sensor, you must disable power control before. It is not possible to switch between sensors when power control is active.

Remote command:
`[:SOURce<hw>]:POWer:SPC:STATe` on page 533

Sensor
Indicates the R&S NRP power sensor that is selected for power control.

To configure the power sensor parameters, see Section 8.4.5, "NRP sensor configuration", on page 198.

Remote command:
`[:SOURce<hw>]:POWer:SPC:SELect` on page 532

Measured Level
Indicates the current reading of the selected power sensor.

Remote command:
`:READ<ch>[:POWer]?` on page 428
`:SENSe<ch>:UNIT[:POWer]` on page 429

Target Level
Specifies the nominal level expected at the input of the sensor. The signal generator adjusts the output power accordingly, to meet the target value at the sensor input, and thus the power required at the DUT.

Remote command:
`[:SOURce<hw>]:POWer:SPC:TARGet` on page 533

Take Measurement as Target Level
Uses the currently measured level as reference and applies the value as target level, see "Target Level" on page 196.

This feature simplifies setting up the control loop after manual adjustment of the measurement configuration. To assign the measured level as reference level, you must switch off "NRP Power Control". It is not possible when the control loop is running.

Remote command:
`[:SOURce<hw>]:POWer:SPC:MEASure` on page 532

Mode
Selects the measurement mode for acquiring the power values measured by the sensor.

"Auto"	Immediately starts and measures the power continuously.
"Single"	Starts when you manually select Execute Single, and executes one power measurement cycle. Note, that you can achieve the expected target power level at the DUT only with linear test setups. Non-linear test setups, for example, setups including an amplifier do not work.

Remote command:
`[:SOURce<hw>]:POWer:SPC:MODE` on page 532

Execute Single
In mode "Single", starts one measurement cycle manually.

Remote command:
`[:SOURce<hw>]:POWer:SPC:SINGle` on page 533

Catch Range +/-
Sets the capture range of the control system.

Within the range:

Target Level +/- Catch Range

the power control locks and tries to achieve the target level. Readings outside the range are not considered.

Remote command:
`[:SOURce<hw>]:POWer:SPC:CRANge` on page 531

Delay Time
Sets a waiting period between the level adjustment of the generator and the next measurement of the power sensor.

With this parameter, you can bypass idle times in the controlled system.

Remote command:
`[:SOURce<hw>]:POWer:SPC:DELay` on page 531

Limit
Sets an upper limit for the output power.

Note: The parameter "RF level" > **"Limit"** and "NRP power control" > **"RF Amplitude Limit"** are identical.

You can use this value to protect your DUT from damage due to high input power. If you enter an RF level above this value, the instrument limits the output power to this specified value, and generates the warning message:

"Pep value greater than the defined limit." However, the level indication in the status bar is not affected.

The setting is not affected by an instrument preset ([Preset] key or `*RST`) and the "Save/Recall" function. It is reset only by factory preset.

Remote command:
`[:SOURce<hw>]:POWer:LIMit[:AMPLitude]` on page 529

Setting Characteristics
Selects additional quality characteristics to optimize the behavior of the RF signal level for the specific application.

"Auto" Sets the RF output level automatically according to the selected mode.
In this mode, the instrument provides the highest dynamic range and fastest setting times.
The RF signal is shortly blanked when the step attenuator is switching.

For more information, refer to the specifications document.

"Uninterrupted"
Suppresses blanking at level transitions. Frequency transitions can lead to an RF level blanking due to hardware-specific switching points.
This mode reduces the dynamic range of the instrument. The step attenuator is fixed.

"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 can 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 50 Ω output connector, due to changed level settings.

"User" Selects this entry automatically when you change one of the following parameters from the default setting:
- "Attenuator" > Mode
- "ALC" > State or Detector Sensitivity

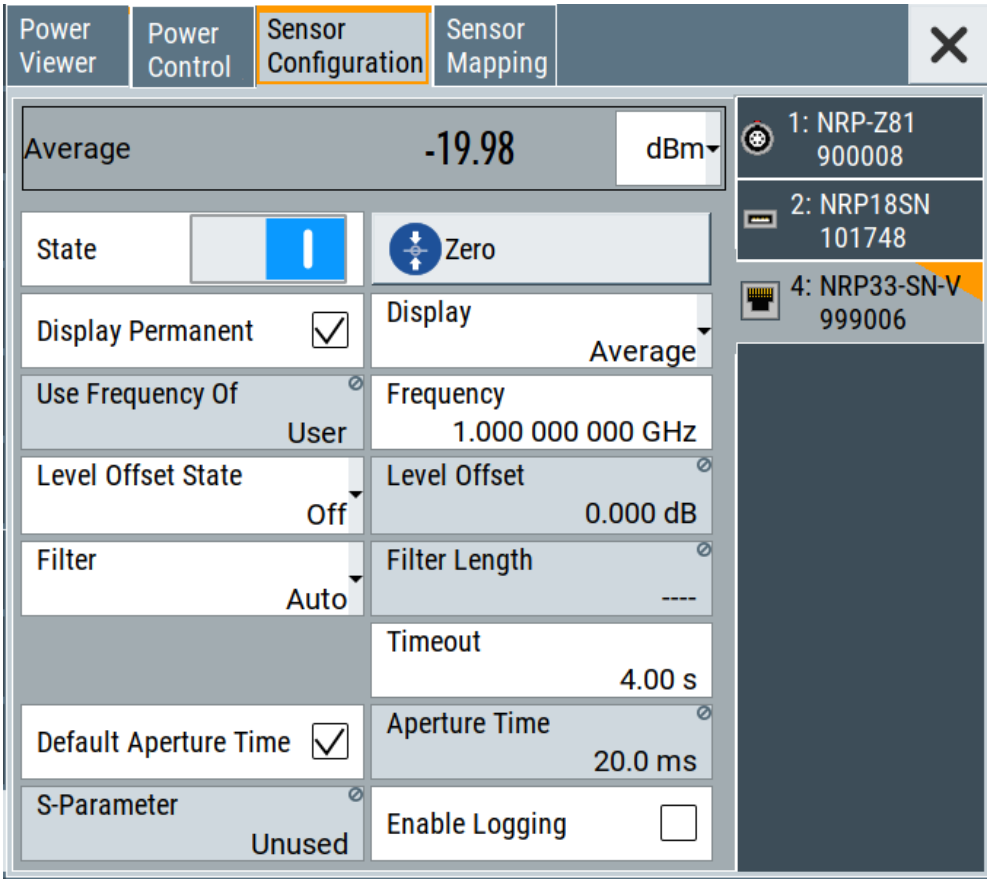
Note: If you select another setting characteristic, the R&S SMB100B presets the modified attenuator and ALC parameters.

Remote command:
`[:SOURce<hw>]:POWer:LBEHaviour` on page 529

8.4.5 NRP sensor configuration

Access:

► Select "Power Sens" > "NRP Sensor Configuration".



In this dialog you can configure the parameters for each mapped R&S NRP power sensor in separate tabs.

The remote commands required to define these settings are described in Section 13.14, "SENSe, READ, INITiate and SLISt subsystems", on page 422, including the triggering of the measurement and the retrieval of measurement results.

Settings:

Sensor type and serial number 200
Level (Peak) / Level (Average) 200
State 200
Zero 200
Display 200
Display Permanent 200
Use Frequency Of 201
Frequency 201
Level Offset State,Level Offset 201
Filter 201
Filter Length 202
Auto Once 202
Noise/Signal Ratio 202
Timeout 202
Default Aperture Time 202

Aperture Time....202
S-Parameter....203
Enable Logging....203

Sensor type and serial number
The side tab label indicates type and serial number of an R&S NRP power sensor and its mapping index.

The Level (Peak) / Level (Average) values display the current readings of the sensor.

Remote command:
`:SENSe<ch>[:POWer]:TYPE?` on page 436
`:SENSe<ch>[:POWer]:SNUMber?` on page 435

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 428
`:SENSe<ch>:UNIT[:POWer]` on page 429

State
Enables level measurement of the R&S NRP power sensor.

Remote command:
`:INITiate<hw>[:POWer]:CONTinuous` on page 428
To query the availability of a sensor at a given connector, use the command `:SENSe<ch>[:POWer]:STATus[:DEVice]?` on page 435.

Zero
Activates the auto zeroing.

For details, see "About zeroing" on page 190.

Remote command:
`:SENSe<ch>[:POWer]:ZERO` on page 436

Display
Sets the display of results on mean or peak power.

Remote command:
`:SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority` on page 430

Display Permanent
Enables the display of the power sensor with the currently measured value in the status bar of the home screen.

You can activate the permanent display for several sensors.

Remote command:
`:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe` on page 431

Use Frequency Of
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 435

Frequency
Defines the frequency value if "Source > User" is used.

Remote command:
`:SENSe<ch>[:POWer]:FREQuency` on page 433

Level Offset State,Level Offset
Activates and defines a level offset which is considered in the power measurement result. The level offset value is always expressed in dB, irrespective of the display of the measurement result.

This function allows you to consider, for example, an attenuator in the signal path.

Remote command:
`:SENSe<ch>[:POWer]:OFFSet` on page 434
`:SENSe<ch>[:POWer]:OFFSet:STATe` on page 434

Filter
Selects the way the length of the used filter is defined.

See also "About the measuring principle, averaging filter, filter length, and achieving stable results" on page 190.

"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 433

Filter Length
Sets or indicates the filter length, depending on the selected filter mode.
- "Filter > Auto" indicates the automatically adjusted filter length.
- "Filter > User" enables you to set the filter length manually.
- "Filter > Fixed Noise" hides the setting parameter.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?` on page 431
`:SENSe<ch>[:POWer]:FILTer:LENGth[:USER]` on page 431

Auto Once
Searches the optimum filter length for the current measurement conditions. The result is indicated with the parameter Filter Length.

See also "About the measuring principle, averaging filter, filter length, and achieving stable results" on page 190.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:SONCe` on page 432

Noise/Signal Ratio
For Filter > Fixed Noise, sets the noise content.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio` on page 432

Timeout
Sets a time limit for the averaging process.

The setting is bound to the timeout of the connected sensor.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe` on page 432

Default Aperture Time
The sensor default setting is sufficient. Disable this parameter to specify a user-defined aperture time per sensor, if, for example, the readings vary.

To obtain stable readings, set the Aperture Time exactly to one modulation period.

Remote command:
`:SENSe<ch>[:POWer]:APERture:DEFault:STATe` on page 429

Aperture Time
If "Use Default Aperture Time > Off", defines the acquisition time per sensor.

For example, to obtain a sufficient low average value, set the aperture time exactly to one modulation period.

Remote command:
:SENSe<ch>[:POWer]:APERture:TIMe on page 429

S-Parameter
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 430
:SENSe<ch>[:POWer]:CORRection:SPDevice:LIST? on page 430
:SENSe<ch>[:POWer]:CORRection:SPDevice:SELect on page 430

Enable Logging
Activates recording of R&S NRP power sensor readings in a log file.

There is 1 log file per sensor. The log files are created automatically and filled in continuously. They are text files with predefined filename `SensLog<n>.txt`, where `<n>` indicates the connected sensor. Log files are stored on the internal memory, in the directory `/var/user/SensorLogging`.

Each log file contains the measured value (2 readings when you work with peak sensors), the sensor type, and the measurement time (timestamp). Logged data is not overwritten. When a new measurement is started, the collected logging data is appended in the log file.

Check the used disc space regularly and remove log files to maintain storage capacity.

Note: The logging function is intended for measurements with long time intervals. It is suitable source for data reconstructions if the connection to the sensor was interrupted.

Remote command:
:SENSe<ch>[:POWer]:LOGGing:STATe on page 434

8.4.6 NRP sensor mapping

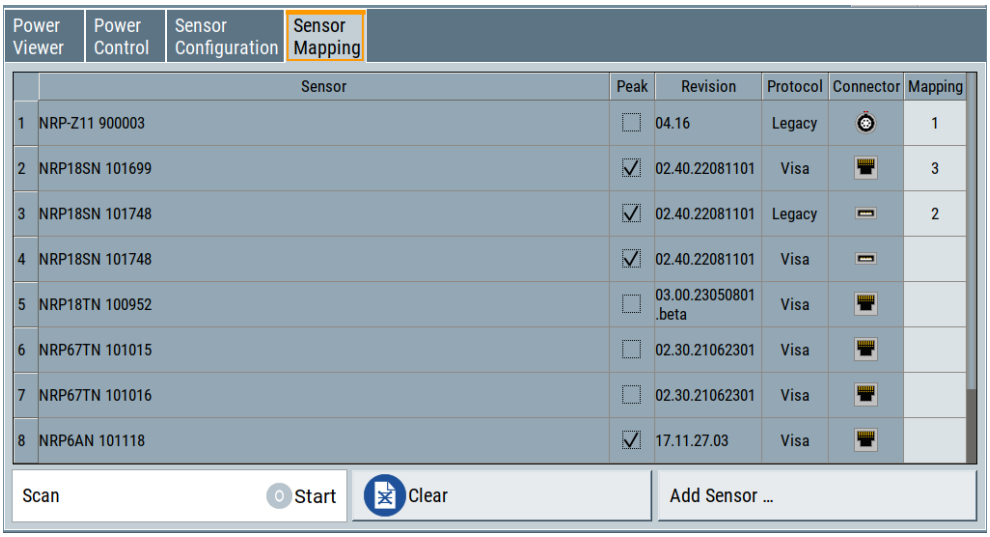
The "NRP Sensor Mapping" lists the sensors detected by the instrument.

Any R&S NRP sensor that supports the USB legacy protocol and is connected to one of the USB interfaces, is detected automatically and added to the list. When you disconnect a power sensor, the R&S SMB100B removes it from the list accordingly.

R&S NRP power sensors that are connected in the LAN or use the USBTMC protocol are only detected by the scan search function.

Access:

► Select "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 list informs on the sensor type with serial number, specific features and the revision of the sensor firmware.
For each sensor, you find the used protocol and the connector icon of the interface.
In the "Mapping" column, you can assign a mapping index to enable the sensor for use. The list can contain several entries but the R&S SMB100B can only use up to four sensors simultaneously.
The remote commands required to define these settings are described in Section 13.14, "SENSe, READ, INITiate and SLISt subsystems", on page 422.

Settings

Sensor Mapping List 204
Scan 205
Clear 205
Add Sensor 205
Add LAN Sensor 205
Add USBTMC Sensor 206

Sensor Mapping List

Shows the sensors that are connected to the R&S SMB100B.

The table informs on the sensor type, specific features and the installed sensor firmware. It also shows the interface the sensor is connected to, including the communication protocol and the mapping index.

Remote command:
`:SLISt[:LIST]?` on page 425
`:SLISt:ELEMent<ch>:MAPPing` on page 427
`:SLISt:SENSor:MAP` on page 427

Scan
Scans the network and the USB connections for sensors connected using the VISA communication protocol, i.e. sensors that are addressed over LAN or USBTMC.

The instrument detects sensors communicating over the USB legacy protocol automatically.

Remote command:
`:SLISt:SCAN[:STATe]` on page 425

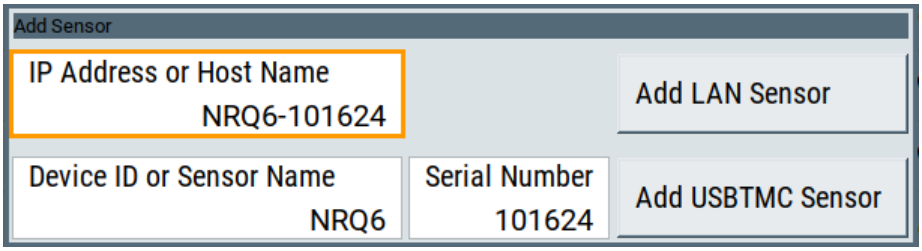
Clear
Removes all entries of R&S NRP power sensors using the VISA communication protocol (USB or LAN) from the sensor mapping list.

The setting does not affect sensors communicating over USB legacy protocol. To remove a USB legacy sensor from the list, disconnect it from the interface.

Note: With the remote control commands `:SLISt:CLEar:LAN` and `:SLISt:CLEar:USB`, you can remove the power sensors of the corresponding VISA interface selectively.

Remote command:
`:SLISt:CLEar:LAN` on page 426
`:SLISt:CLEar:USB` on page 426
`:SLISt:CLEar[:ALL]` on page 427

Add Sensor
Shows or hides the "Add Sensor" dialog to configure power sensors connected to the R&S SMB100B over USB or LAN.



Add LAN Sensor
Configures settings to add sensors connected to the R&S SMB100B over LAN.

"IP Address or Host Name"
Displays the host name or the IP address of a R&S NRP power sensor.
If the R&S SMB100B does not detect a connected R&S NRP sensor, you can assign the address information manually.

"Add LAN Sensor"
Adds a detected R&S NRP sensor connected in the LAN to the list of sensors, including its device ID or name and its serial number.

Remote command:
`:SLISt:SCAN:LSENsor` on page 425

Add USBTMC Sensor
Configures settings to add sensors connected to the R&S SMB100B over USB.

If the R&S SMB100B does not detect a connected R&S NRP sensor, you can assign the device ID manually.

"Sensor"
Selects the name of the R&S NRP power sensor.
If the R&S SMB100B does not contain the R&S NRP power sensor you use, select "<from Device ID". The "Device ID" entry field switches in edit mode where you can enter the ID of your product manually.

"Device ID"
Displays the device identifier of a selected R&S NRP power sensor.
If you want to assign the device ID manually, get the information in the user documentation of your power sensor.

"Serial Number"
Displays the serial number of the R&S NRP power sensor.
If the R&S SMB100B does not detect a connected R&S NRP sensor, you can assign the serial number manually.

"Add USBTMC Sensor"
Adds a detected R&S NRP sensor connected at the USB interface to the list of sensors, including its device ID or name and its serial number.

Remote command:
`:SLISt:SCAN:USENsor` on page 426

8.5 Improving the RF signal performance

To achieve an accurate input level at the DUT, you can compensate losses, e.g. caused by cables between the RF output and the DUT over a frequency range.

Using the user correction function and e.g., a R&S NRP power sensor, the R&S 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 Section 8.4.2, "Connecting R&S NRP power sensors to the R&S SMB100B", on page 191.
2. Select "Power Sens" > "NRP Sensor Mapping".
3. If the sensor is not detected automatically, select "Scan > Start".

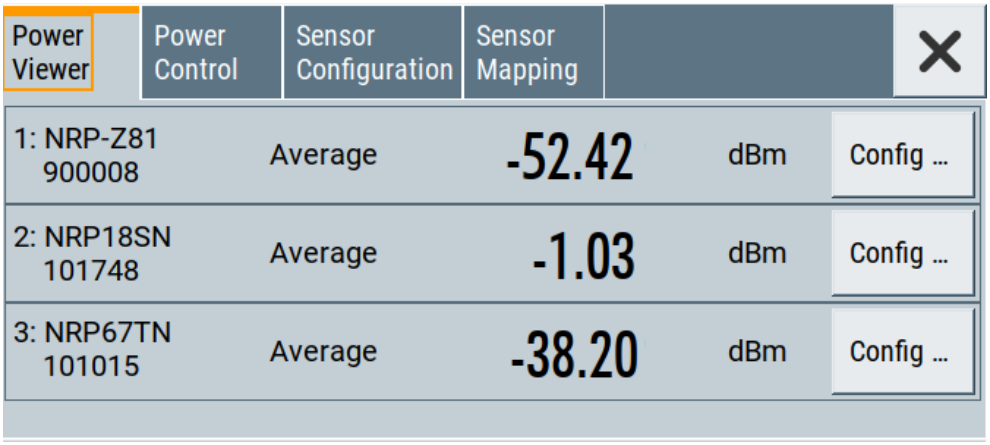
   The instrument scans the network and the USB connections for connected sensors and lists all detected R&S NRP sensors in the mapping table.

4. In the "Mapping" column, assign the sensor to a sensor channel, see Section 8.4.6, "NRP sensor mapping", on page 203.
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.

1. Select "Level" > "RF ON > Off"
2. Select "Power Sens" > "NRP Power Viewer".

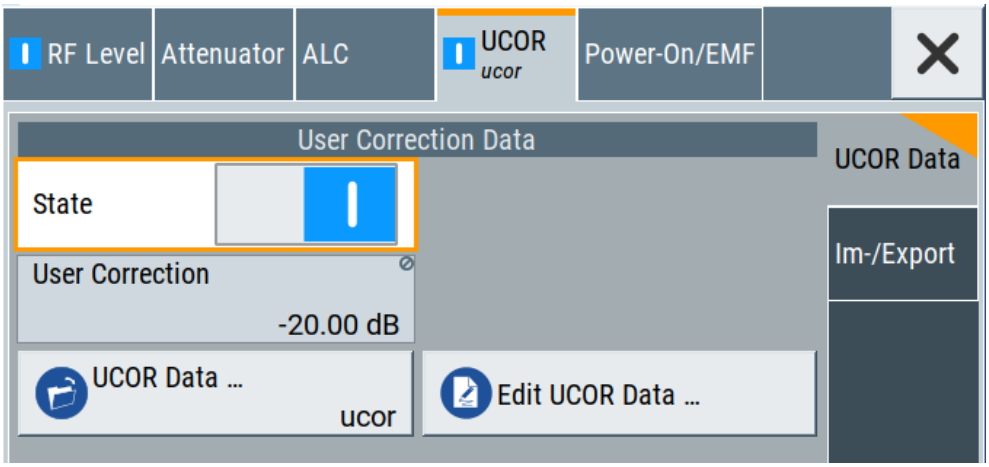


3. To configure a sensor, select "Config".
4. Select "Zero" to start zeroing of the sensor.
   Note: Always turn the RF power off or disconnect the sensor from RF before zeroing, since the function calibrates the power sensor at zero signal power.
   The zeroing process takes a few seconds, depending on the power sensor type.
5. Configure additional parameters for the selected sensor as required.
6. Select "State > On".
7. Close the dialog.

To create user correction data with an R&S NRP and the R&S SMB100B

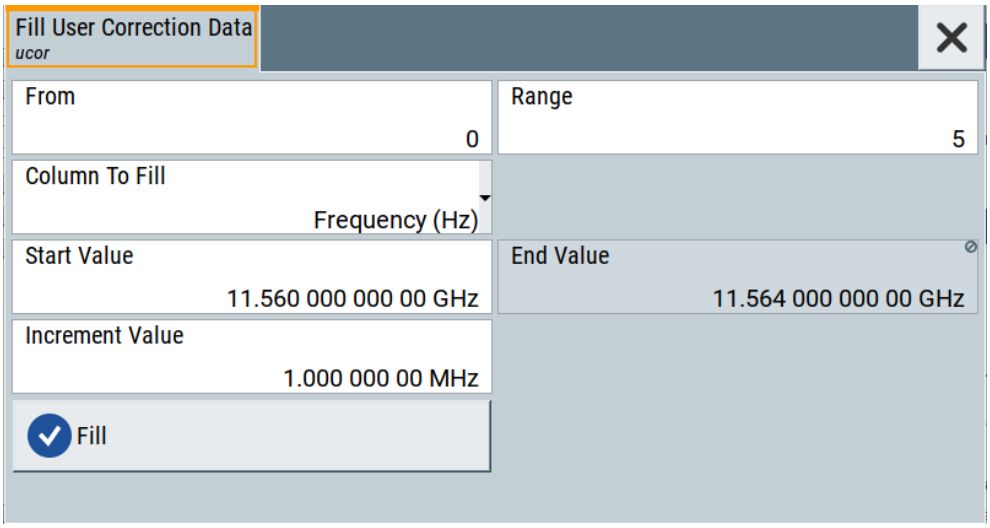
We assume, that the power sensor is connected, assigned and ready for operation.

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.

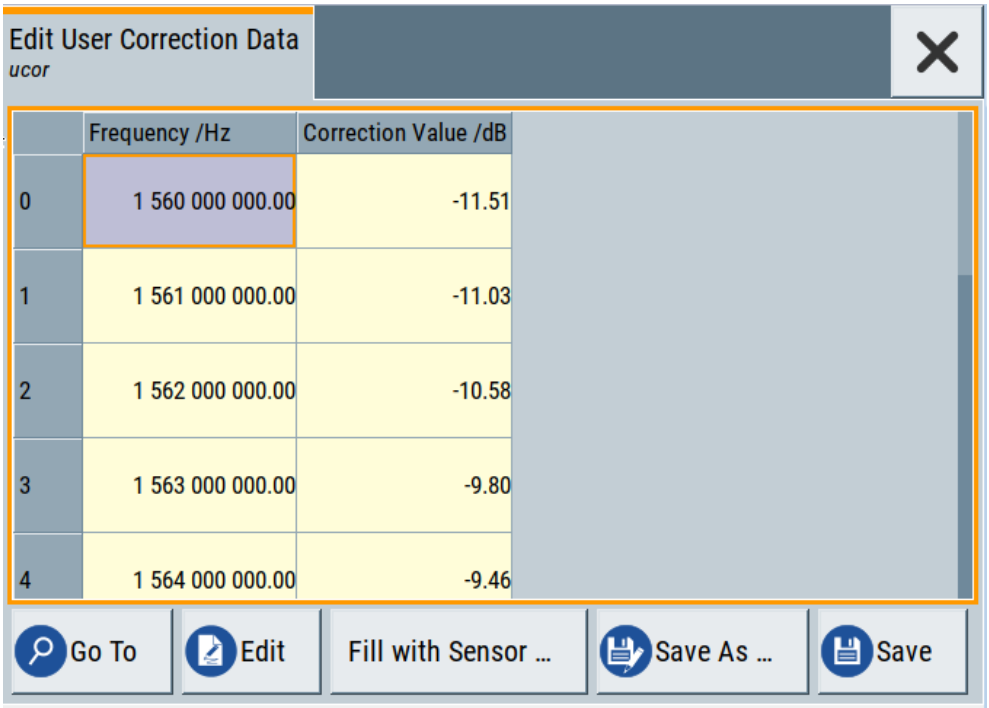
The "Fill" function also fills the column of the "Correction Value / dB" values with a predefined value, since empty cells lead to the data loss of the entire line. If you need different values, you can change them manually, or you can use the automatic function "Fill with Sensor" as described in the 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 calibrate the power level 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.

9 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 provides the configured reference frequency at the output. You can use it, for example to synchronize several interconnected instruments, see Section 9.5, "Using the reference frequency for instruments synchronization", on page 216, 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 "Set To Default" in the corrresponding refererence frequency dialog or by a factory preset.

9.1 Required options

R&S SMB100B base unit equipped with the following options:

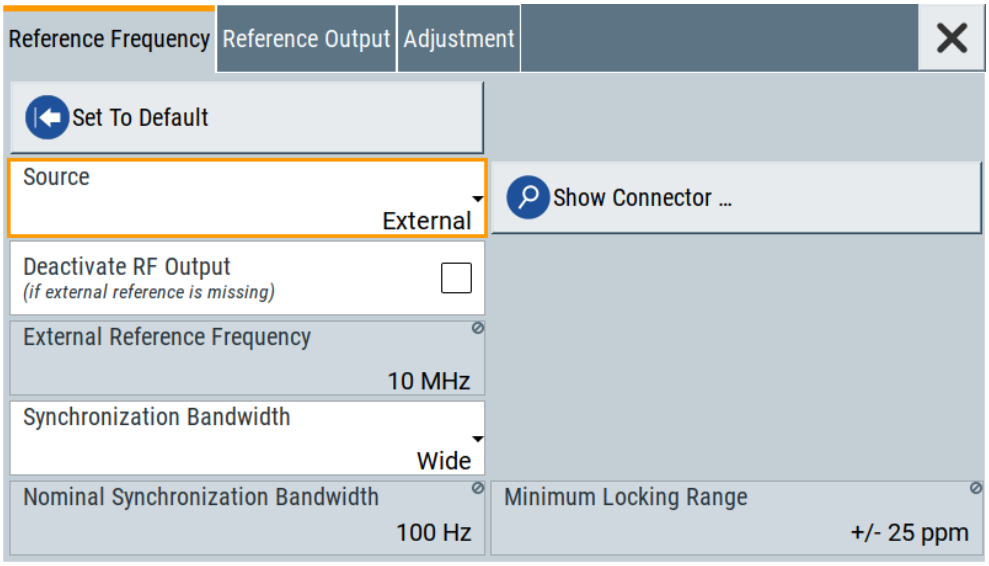
- Reference oscillator (R&S SMBB-B1/-B1H)
- 1 GHz reference (R&S SMBB-B3)
- 1 MHz to 100 MHz flexible reference input (R&S SMBB-K704)

For more information, refer to the specifications document.

9.2 Reference frequency settings

Access:

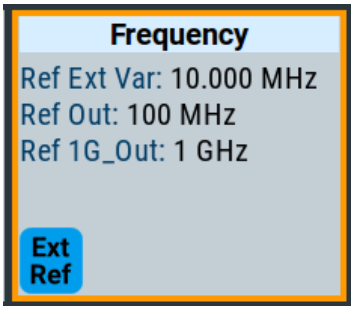
1. Select "Frequency" > "Reference Frequency".



In the "Reference Frequency" tab, you can select the reference frequency signal source and the frequency and synchronization bandwidth mode of an external reference signal.

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 Section 13.16.12, "SOURce:ROSCillator subsystem", on page 537.

Settings:

Set to Default 213
Source 213
Show/Show Connector 213
Deactivate RF Output (if external reference is missing) 213
External Reference Frequency 213
Variable Reference Frequency 214
Synchronization Bandwidth 214
Nominal Synchronization Bandwidth 214
Minimum Locking Range 214

Set to Default
Resets the reference oscillator settings to default.

Remote command:
[:SOURce]:ROSCillator:PRESet on page 539

Source
Selects the reference frequency source.

"Internal" Uses the internal reference oscillator, either with calibrated or a user-defined Adjustment Value.

Note: The internal reference frequency automatically uses Synchronization Bandwidth > Narrow. Thus, if you preset this parameter, or set the reference source from "External" to "Internal" manually, the R&S SMB100B sets the bandwidth to "Narrow".

"External" Uses an external reference signal.

Note: If the external reference is missing, the R&S SMB100B issues a warning message and indicates the icon (external reference missing).

To set the frequency of the external reference, see "External Reference Frequency".

Remote command:
[:SOURce]:ROSCillator:SOURce on page 539

Show/Show Connector
Opens a dialog that displays the location of the connector on the front panel or rear panel of the instrument. A blinking rectangle shows the connector.

Deactivate RF Output (if external reference is missing)
Turns off the RF output when the external reference signal is selected, but no signal is supplied.

This function prevents that no improper RF signal due to the missing external reference signal is used for measurements. A message indicates that the RF output is deactivated.

Remote command:
[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] on page 540

External Reference Frequency
Selects the frequency of the external reference input signal.

"10 MHz" 10 MHz external reference frequency

"100 MHz"/"1 GHz"
Option: R&S SMBB-B3
The R&S SMB100B locks its internal 500 MHz reference oscillator on the 100 MHz or 1 GHz reference.
Selects the external reference frequency.

"Variable" Requires R&S SMBB-K704.
The external reference signal has an arbitrary frequency, within the permissible range from 1 MHz to 100 MHz.

Remote command:
[:SOURce]:ROSCillator:EXTernal:FREQuency on page 540

Variable Reference Frequency
Requires R&S SMBB-K704 and "External Reference Frequency" > "Variable".

Sets a variable value for the external reference frequency.

For more information, refer to the specifications document.

Remote command:
[:SOURce]:ROSCillator:EXTernal:FREQuency:VARiable on page 540

Synchronization Bandwidth
Selects the synchronization bandwidth for an external reference signal, set with "Source > External".

The resulting bandwidth is indicated by the parameter Nominal Synchronization Bandwidth.

"Narrow" The internal reference oscillator is synchronized to the external signal with narrow bandwidth.
This setting is recommended if the phase noise of the external signal is worse than the phase noise of the internal OCXO.

"Wide" Synchronizes the internal oscillator to the external signal with the maximum possible bandwidth.
This mode is the recommended standard mode and for precise reference sources of high spectral purity.

Note: If the frequency of the external reference signal is outside the locking range of the internal reference oscillator, spurs due to the difference of the internal and external reference frequency are generated in the reference PLL.
The R&S SMB100B issues an error message.

For more information, refer to the specifications document.

Remote command:
[:SOURce]:ROSCillator:EXTernal:SBANdwidth on page 540

Nominal Synchronization Bandwidth
Indicates the nominal synchronization bandwidth for the selected external reference frequency and the synchronization bandwidth.

Remote command:
[:SOURce]:ROSCillator:EXTernal:NSBandwidth? on page 541

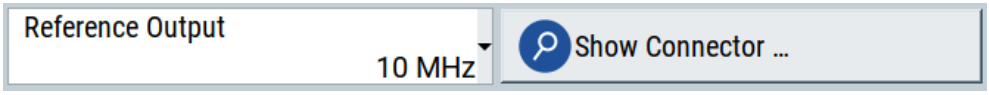
Minimum Locking Range
Indicates the minimum locking range for the selected external reference frequency and the synchronization bandwidth.

Remote command:
[:SOURce]:ROSCillator:EXTernal:MLRange? on page 541

9.3 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 Section 13.16.12, "SOURce:ROSCillator subsystem", on page 537.

Settings:

Reference Output/1 GHz Reference Output..... 215
Show/Show Connector.....215

Reference Output/1 GHz Reference Output
Selects frequency reference output signal for downstream instruments.

"Off" Deactivates the reference signal output.

"10 MHz" Derives a signal with 10 MHz frequency from the internal reference oscillator and provides this signal at the output.

"100 MHz" Option: R&S SMBB-B3
Provides the 100 MHz reference frequency signal at the output.

"1 GHz" Option: R&S SMBB-B3
Provides the 1 GHz reference frequency signal at the output.

"Input Signal (loop through)"
Passes the external reference frequency to the output directly.

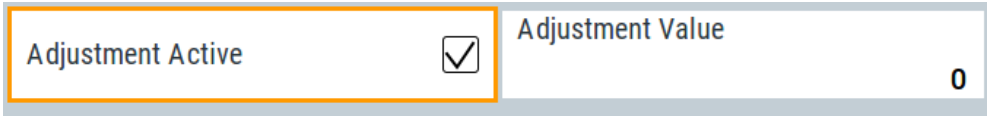
Remote command:
`[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE` on page 541
`[:SOURce]:ROSCillator:OUTPut:ALTernate:FREQuency:MODE` on page 542

Show/Show Connector
Opens a dialog that displays the location of the connector on the front panel or rear panel of the instrument. A blinking rectangle shows the connector.

9.4 Adjustment settings

Access:

1. Select "Frequency" > "Reference Frequency".
2. Select "Adjustment".



Settings:

Adjustment Active 216
Adjustment Value 216

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 543

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 542

9.5 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 217)
- **Clean external reference source** with quality exceeding the quality of the built-in reference oscillator
  (see "Using external reference source" on page 218)
- **Interfered or noisy external reference signal**
  (see "Deriving 10 MHz from the external reference frequency" on page 219)
- **1 GHz reference coupling** for phase coherence of the RF signals with enhanced long-term phase stability
  (see "Sharing the 1 GHz reference frequency to obtain phase-coherent signals" on page 217)

Connectors overview

Use the "Show Connector" function to indicate the connector on the front/real panel:

- "Ref In/Ref Out" on page 38
- 1GHz "Ref In/Ref Out" on page 38

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/1 GHz Reference Output = "10 MHz"

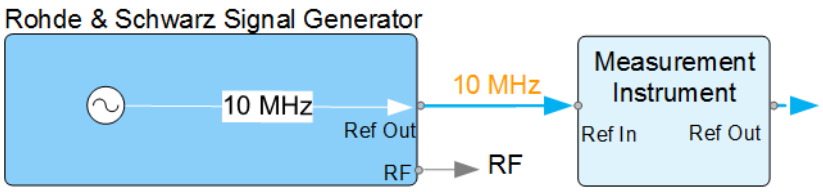


Figure 9-1: Synchronizing instruments using the internal 10 MHz reference signal of the R&S SMB100B

Ref In, Ref Out = Connectors

For more information, refer to the specifications document.

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 frequency 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
  (*earlier RF hardware versions*: 5 MHz, 10 MHz, 13 MHz)
- Source = "External"
- Reference Output = "10 MHz, 100 MHz" or "Input Signal (loop through)"
  (*earlier RF hardware versions*: 5 MHz, 10 MHz, 13 MHz)
- Set the synchronization bandwidth according to the requirements of the application.

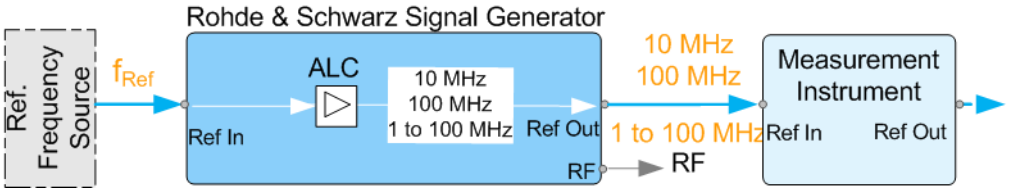


Figure 9-2: Synchronizing instruments with a 10 MHz external reference signal

Ref. Frequency Source = e.g., Rohde & Schwarz signal analyzer
f_{Ref} = 10 MHz, 100 MHz, 1 MHz 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.

For more information, refer to the specifications document.

- 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)

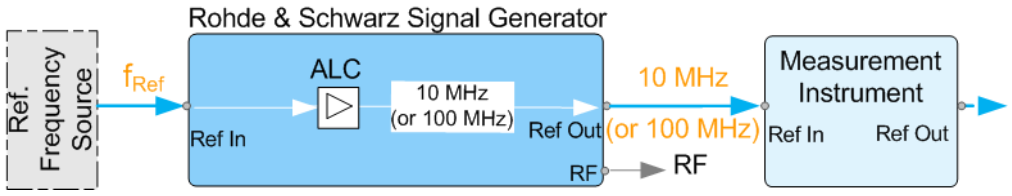


Figure 9-3: Synchronizing instruments with 10 MHz (derived from an external reference frequency)

Ref. Frequency Source = e.g., Rohde & Schwarz signal analyzer
f_{Ref} = 10 MHz, 100 MHz, 1 MHz to 100 MHz, 1 GHz** external reference frequency
** = 1 GHz uses Ref In 1 GHz connector
Ref In, Ref Out = Connectors

1 GHz, 1 MHz 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/1 GHz Reference Output = "10 MHz"
- Synchronization Bandwidth = "Narrow"

10 File and data management

The R&S SMB100B uses files to save all instrument data. The instrument allows you to save and to load instrument settings, and to import and to export user data for processing in another instrument or later. Finally, you can create a screenshot of the current settings displayed on the screen and save it as a file.

This section focuses on the functions provided for managing of user data files and covers the topics listed below.

For information on the related remote control commands, see Section 13.5, "MMEMory subsystem", on page 382.

For information on how to save the displayed setting in a file, see Section 10.11, "Creating screenshots of current settings", on page 249.

- Accessing, retrieving and handling data 220
- About the file system 221
- Restoring an instrument configuration 224
- Protecting data 229
- Saving and recalling settings 230
- Accessing files with user data 234
- Exporting and importing remote command lists 236
- Loading, importing and exporting lists 237
- Using the file manager 237
- Transferring files from and to the instrument 243
- Creating screenshots of current settings 249

10.1 Accessing, retrieving and handling data

Depending on the origin and content, this description distinguishes between the following data types:

- Operational data
- Non-operational data

Operational data (data for intended use)

Your instrument uses and generates this data because of its intended use and according to the settings and configuration you have made. Thus, this data makes up most of the data that the R&S SMB100B creates, such as user files that contain user-defined configurations or data, like instrument settings or measurement data. See also "Types of user data" on page 222.

You can access, retrieve and delete user files, see Section 10.9, "Using the file manager", on page 237.

Non-operational data (usage data)

The R&S SMB100B generates this data during and through its use. Such data is collected e.g. for troubleshooting, to help our customer support center find solutions

quickly, or if you have purchased and activated the Health and Utilization Monitoring Service (HUMS).

The R&S SMB100B does not generate this data continuously and in real-time; this data is saved on the product. You can store the data on a remote server, for example via a network connection.

The R&S SMB100B generates the following data:

- User and authentication data
- Network and communication data
- Software and firmware update data
- Diagnostic and troubleshooting data
- Environmental conditions
- Hardware component metadata
- User behavior (HUMS only)

On demand, this data is stored in a ZIP file containing files in TXT format. The volume of the non-operational data depends on the usage of the product and typically amounts to about 30 Mbyte.

You can access, retrieve and delete this data, see:

- Network and communication data, see Section 10.5, "Saving and recalling settings", on page 230.
  The R&S SMB100B displays the network address data on the screen.
- Hardware component metadata, see Section 14.8.1, "Hardware configuration settings", on page 626.
- User behavior, monitored by HUMS, see Section 12.5.8, "HUMS settings", on page 320.
  The R&S Health and Utilization Monitoring Service user manual is available on the Rohde & Schwarz internet.
- For all other data stored in the instrument, see Section 14.9, "Collecting information for technical support", on page 629.

For additional information on the different memory types of your product and on how to protect sensitive data, see:

- Section 10.4, "Protecting data", on page 229.
- Instrument security procedures document.

10.2 About the file system

Depending on their content, this description distinguishes between system files and user files. System files and the system directory are protected and not accessible. User files contain user-defined configurations or data.

This section focuses on user files. It provides an overview of the R&S SMB100B file system and covers the following topics:

- "Types of user data" on page 222

- "File storage location" on page 222
- "File handling" on page 223
- "File naming conventions" on page 223
- "File extensions" on page 223
- "File contents" on page 224

Types of user data

The following data types contain user data:

- Settings or configuration files, for example, you save the current instrument settings and load these settings on another instrument.
  See Section 10.5, "Saving and recalling settings", on page 230.
- SCPI scripts that contain a series of commands. You can run the script to perform a task.
  See Section 10.7, "Exporting and importing remote command lists", on page 236.
- Externally or internally generated lists, for example, user correction lists. You can load these list files on the instrument.
  See Section 10.8, "Loading, importing and exporting lists", on page 237 and Section 10.6, "Accessing files with user data", on page 234.

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 Section 10.9, "Using the file manager", on page 237. 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 Section 10.9, "Using the file manager", on page 237.

To *transfer files* from and to the instruments or to exchange files, use one of the following alternatives:

- Connect a memory stick to one of the USB interfaces.
  The instrument automatically recognizes a connected memory stick and assigns the `/usb/` drive to it.
- Connect the instrument to a LAN.

  An instrument connected to a LAN supports two standard file transfer methods from a remote client:
  - FTP (file transfer protocol)
  - File sharing according to the SAMBA/SMB (server message block) protocol.

  Both file transfer methods open the folder `/user` that is the `/var/user/` folder on the instrument.
  For a step-by-step description, see Section 10.10, "Transferring files from and to the instrument", on page 243.
- Map a network folder or a computer to an instrument connected to a LAN.
  A mapped network folder is indicated as `/shares/<"Local Folder">`.
  For a step-by-step description, see Section 10.9.4, "Mapping a network folder", on page 241.

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 Section A.2, "Available user files and file extensions", on page 653 for an overview of the supported file extensions.

File contents

To maintain the file size and to accelerate processing times, the instrument saves settings that deviate from their default values. Considered is also configuration data for the operating elements and lists with user data, e.g. dialog positions and a list of user correction data. However, if a list data is part of the instrument settings, a reference to this list is saved, not the list itself.

This approach ensures that the created files contain only relevant information and allows you to transfer instrument settings even between different equipped signal generators. During the recall process, the instrument interprets only the relevant settings; all non-referenced parameters are set to their preset values. Error messages indicate the settings which cannot be implemented, like referencing non-existing lists or the attempt to activate settings which are not supported by the instrument.

10.3 Restoring an instrument configuration

The R&S SMB100B has various options to set default settings. 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 during troubleshooting when unusual results arise.

The figure Figure 10-1 shows the impact of the particular reset functions.

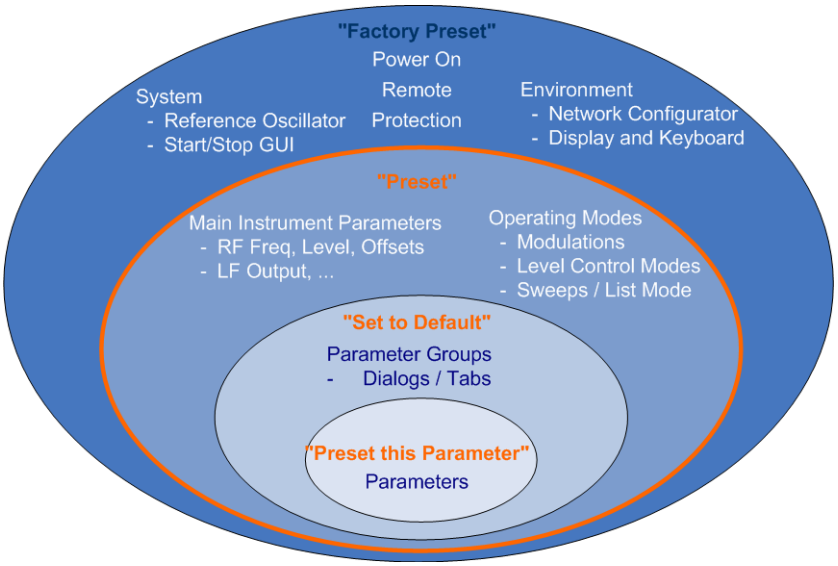


Figure 10-1: Preset functions for parameters and operating modes

Overview of the characteristics of the preset functions

Select the preset option that most fits to your particular application:



- [Preset]
  It is the most frequent function. A preset executes a defined instrument setup to provide an initial instrument state as a basis for a new configuration.
  It resets all parameters and switching states including the states of inactive operating modes. Also, it resets external instruments connected to the R&S SMB100B.
  A preset does not change network settings, remote access settings or system settings.

► To execute a preset, press the [Preset] key at the front panel.



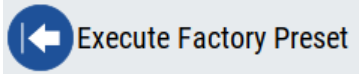
- "Set to Default"
  This function relates to individual dialogs or tabs and resets the associated settings of the corresponding dialog. All other settings are retained.

► To reset the settings, click "Set To Default".



- "Preset this parameter"
  Sets a single parameter to its default value.

1. To reset an individual parameter, open its context-sensitive menu.
2. Select "Preset This Parameter".



- "Factory Preset"
  A factory preset is the most profound preset function that resets almost all instrument settings, including reference oscillator, network and remote access settings.
  A factory preset does not change the following settings:
  – Security, password, and settings protected by these passwords
  – User-defined data, like setups or data lists
  – Settings that relate to an integration of the instrument in a measurement setup.

► **NOTICE!** Execute a "Factory Preset" only if it is necessary. After a "Factory Preset", the network connection to the instrument no longer exists.
  To restore the factory defaults, select "System Config" > "Setup" > "Settings" > "Factory Preset".

Presetting the instrument to a user-defined state

The reset functions set the parameters and operating modes to default values predefined by the factory. Alternatively to the instrument default settings, you can preset the instrument to a user-defined state:

- Save and reload user-defined settings as preset, see Section 10.3.3, "Presetting the instrument to a user-defined state", on page 227.
- Save and reload user-defined instrument states, see Section 10.5.2, "Saving and recalling instrument settings", on page 233.

Marking parameters with non-default values

To check 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 Section 10.3.2, "Identifying parameters with non-default values", on page 227.

10.3.1 Preset, set to default and factory preset settings

Preset....226
Set To Default....226
Preset this Parameter....226
Execute Factory Preset....227

Preset
Resets all parameters and switching states, and closes all opened dialogs.

Note:
In contrast to the [Preset] key, the SCPI commands `*RST` and `:SYSTem:PRESet` do not close open dialogs in the GUI.

Consider also the following possibilities:

- You can define the settings that are restored when you preset the instrument (see Section 10.3.3, "Presetting the instrument to a user-defined state", on page 227)
- You can reset the instrument to the factory state (see "Execute Factory Preset" on page 227)

See also Table 10-1 that contains the key parameters that are reset by the corresponding preset functions.

Remote command:
`*RST` on page 378

Set To Default
Resets the associated settings of the corresponding dialog or tab.

Preset this Parameter
Restores the default value of a single parameter.

Execute Factory Preset
Resets the instrument to its factory settings.

Note: "Factory Preset" retains all security settings and does not delete any user files like setups or user data.
See also Table 10-1 that contains the key parameters that are reset by the corresponding preset functions.

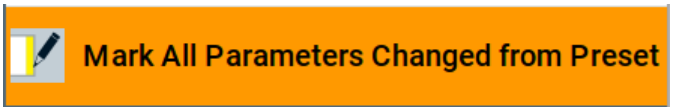
Remote command:
`:SYSTem:FPReset` on page 381

10.3.2 Identifying parameters with non-default values

To recognize the current state of the settings related to their default values at the first glance, enable a function that visually identifies parameters in states different than preset.

To enable this display:

1. To open the context-sensitive menu, touch and hold the screen anywhere in the GUI of the R&S SMB100B.
2. Select "Mark All Parameters Changed from Preset".



If enabled, marks the parameters that deviate from their default values.

Example:

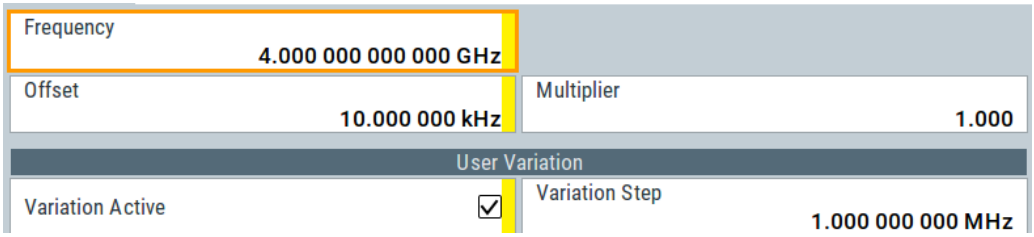


Figure 10-2: Marked parameters show that the value deviates from its default

Frequency = changed (default = 1 GHz)
Offset = changed (default = 0 kHz)
Multiplier = unchanged
Variation active = changed (default = disabled)
Variation step = unchanged

10.3.3 Presetting the instrument to a user-defined state

You can define the settings that are restored when you preset the instrument.

Note: The preset of the instrument to a user-defined state does not include all modified settings. For information, see the corresponding description of the settings.

1. Configure the settings as required.
2. Save them as described in Section 10.5.2, "Saving and recalling instrument settings", on page 233:
   a) Save the settings as a file with the predefined filename `UserPreset` without file extension.
   The save function assigns the file extension `.savrcltxt` automatically.
   b) Save this file in the directory **`/var/user/`**.

   The filename `UserPreset` and the directory `/var/user/` are mandatory.
3. Press the [Preset] key.
   When operating the instrument remotely, send the `*RST` command.

   The instrument restores the user-defined settings. An "Info" message appears and confirms loading of a file with user-defined preset settings.

10.3.4 Reference

See Table 10-1 for an overview of the main generator settings that are affected by the corresponding preset functions. While the regular [Preset] key primarily resets the signal relevant parameters of the instrument, the "Factory Preset" affects almost all instrument settings.

For information on the default values of further parameters, see the description of the corresponding remote commands.

Table 10-1: Key parameters affected by preset and factory preset

Parameter	Preset value	Preset	Factory Preset
RF frequency	1 GHz	x	x
RF level (RF output)	off	x	x
RF level limit	30 dBm	-	x
Offsets	0	x	x
Modulation state	off	x	x
LF output state	off	x	x
Sweep state	off	x	x
List mode state	off	x	x
Reference frequency settings	-	-	x
Network settings	-	-	x
Hostname	-	-	x
GPIB address	-	-	x

Parameter	Preset value	Preset	Factory Preset
Start or stop display update	-	-	x
Display and keyboard settings	-	-	x
Password and password-protected settings	-	-	-
Security settings	-	-	-
User files (setups, user correction, etc.)	-	-	-
HUMS	off	-	x

10.4 Protecting data

During operation, the R&S SMB100B saves user data permanently in the user directory, see "File storage location" on page 222.

To protect any classified data and to avoid saving any sensitive data on the R&S SMB100B permanently, you have the following options:

- Activate the **volatile mode**. This mode redirects user data to the volatile memory, see "Volatile Mode" on page 279.
  The internal memory is write-protected.
  Once you power off the instrument for at least five minutes, all volatile memory modules lose their contents.
  To avoid loosing this data, connect an **external memory device**, for example, a USB flash drive.

  See also:

  - "Default storage location" on page 222
  - "Volatile Mode" on page 279
  - Section 10.10.4, "Using a USB storage device for file transfer", on page 247
- If the R&S SMB100B is equipped with the **removable memory** R&S SMBB-B85 and an SD card is inserted:
  - If the volatile mode is disabled (default setting) the R&S SMB100B **saves user data permanently and only on this storage medium**.
    You can access data saved on the removable memory just as data saved in the `/var/user/`.
  - If the volatile mode is enabled, the R&S SMB100B redirects user data to the **volatile memory** (SDRAM).
    The volatile memory loses its contents when you power off the instrument.
- Save user files **temporarily in the `/var/volatile` directory**, which remains available only until the instrument is turned off.
  You can access data in the volatile memory just as data that is saved permanently in the `/var/user/`.
  See also Section 10.9.3, "Displaying all saved files", on page 241.

To remove the µSD card

This step-by-step instruction holds for R&S SMB100B microwave instruments only.

1. **NOTICE!** You can damage the instrument and loose data when removing the µSD card during operation.

   Switch off the R&S SMB100B.
   See "To shut down the product" on page 29.

2. Remove the µSD card from the instrument.

For detailed information on how to protect the instrument and to protect sensitive data from unauthorized access, refer to the document Instrument Security Procedures.

10.5 Saving and recalling settings

You can save and recall instrument settings, user settings and other related data for the following use cases:

- Reload or repeat a specific signal generation task on the instrument.
- Transfer a specific configuration of your instrument to another instrument, for example in multi-intrument setups.
- Save or load complete instrument settings to or from a file.

Save or recall the complete instrument settings

Two different methods are available for managing *complete instrument settings*:

- Quick (immediate) Save/Recall
  A defined set of instrument settings are saved or recalled quickly in just one step, without defining a filename or storage location. This function enables a fast switching between different instrument settings.
- Save/Recall in files with user-defined names
  The defined set of instrument settings are saved to a definable storage location. The file extension is `*.savrcltxt`.
  Settings files created in this way are visible in the file system and accessible with the supported methods for file handling.

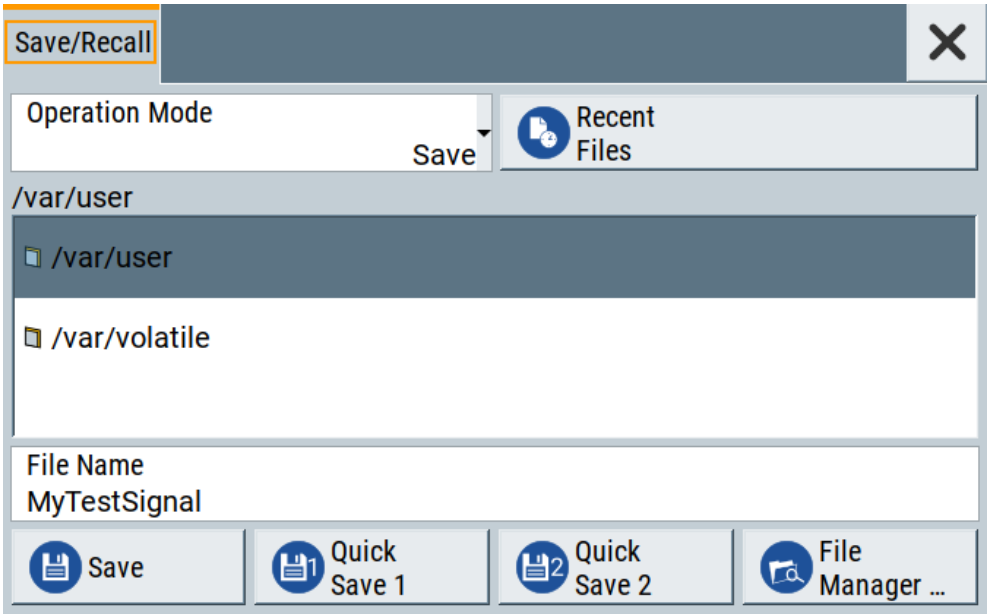
In the general case, a recall process replaces the instruments settings with the saved values. An exception is the frequency and level settings. During recall of the instrument settings, it is possible to retain the current settings or to overwrite them with the saved values.

10.5.1 Save/Recall settings

Access:

1. Select "System Config > Save/Recall".

2. Select "Operation Mode" > "Save" or "Recall" to open the corresponding settings.



The settings for both operation modes are similar and related.

Settings:

Operation Mode 231
Directory, File List and Filename 231
Recent files 232
Show SCPI List 232
SCPI List 232
Save 232
Quick Save x 232
Exclude Frequency 232
Exclude Level 232
Recall 233
Quick Recall x 233
File Manager 233

Operation Mode
Accesses the settings for storing ("Save") and loading ("Recall") of the instrument settings. Also, you can import SCPI-Files ("SCPI-Import") or export SCPI files ("SCPI-Export").

See Section 10.7, "Exporting and importing remote command lists", on page 236.

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 table editor, use the "Edit" button
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see Section 10.9, "Using the file manager", on page 237).

Remote command:
To list all files in a directory:
`:MMEMory:CDIRectory` on page 387
`:MMEMory:CATalog?` on page 386
`[:SOURce]:CORRection:CSET:CATalog?` on page 481

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
Provides a list of all SCPI commands corresponding to the current instrument settings.

Save
Saves the current instrument settings under the defined filename.

Remote command:
`:MMEMory:STORe:STATe` on page 391

Quick Save 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 379

Exclude Frequency
The current frequency is retained when a stored instrument setting is loaded.

Remote command:
`[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL` on page 490

Exclude Level
The current level is retained when a stored instrument setting is loaded.

Remote command:
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL on page 535

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 389

Quick Recall 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 378

File Manager
Accesses the "File Manager" dialog, see Section 10.9, "Using the file manager", on page 237.

10.5.2 Saving and recalling instrument settings

Instrument settings can be saved to a file and loaded again later, so that you can repeat the tests with the same settings.

To access and recall instrument setups quickly

► Assign the appropriate action to the [★ (User)] key.
See Section 11.2.2, "How to assign actions to the [★ (User)] key", on page 264.

To save and recall instrument settings

1. Select "System Config > Save/Recall" > "Operation Mode" > "Save".
2. Select "Quick Save 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 "Quick Save 2"
4. To restore the settings, select the "Operation Mode > Recall"
5. Select "Quick Recall 1"

   The instrument is restored to the previous state.
6. Select "Quick Recall 2" to switch to the settings saved 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 an instrument configuration

Save the configuration as described in "To save complete instrument settings" on page 234.

1. To restore settings, select "System Config > Save/Recall" > "Operation Mode > Recall".
2. To retain the current frequency settings, enable "Save"/"Recall" > "Exclude Frequency",
3. To retain the current level settings, enable "Save"/"Recall" > "Exclude Level",
4. In the file select dialog, select the filename and storage location of the settings file.

   The settings are restored, but the frequency and level settings are retained. You can repeat the signal generation with the same settings.
   See also Section 10.3.3, "Presetting the instrument to a user-defined state", on page 227.

10.6 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.

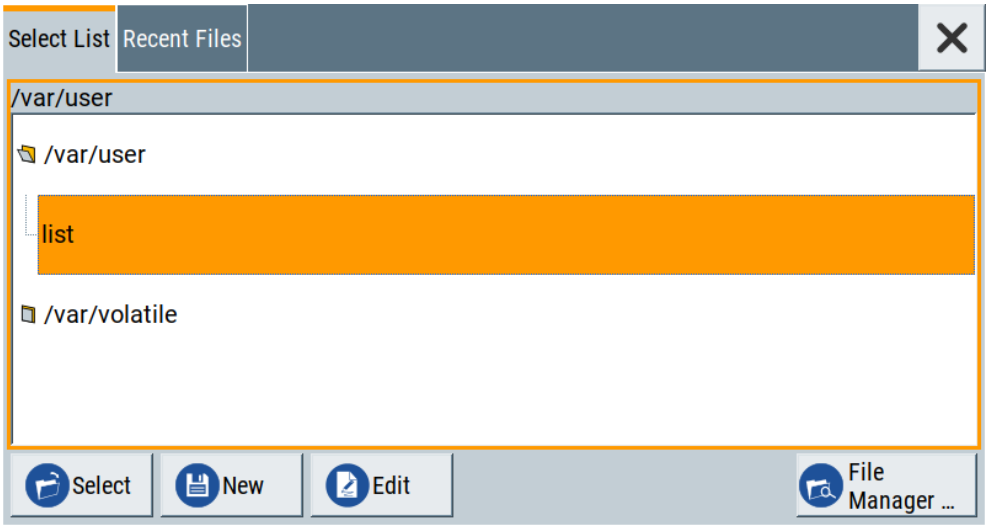
10.6.1 File select settings

The "File Select" dialog opens automatically each time the signal generation requires a list file as a 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 opens.



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....235
Functions for handling of data lists....236
Recent files....236
File Manager....236

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 table editor, use the "Edit" button
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see Section 10.9, "Using the file manager", on page 237).

Remote command:
To list all files in a directory:
`:MMEMory:CDIRectory` on page 387
`:MMEMory:CATalog?` on page 386
`[:SOURce]:CORRection:CSET:CATalog?` on page 481

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 518 `[:SOURce<hw>]:PULM:TRAin:SELect` on page 466 `[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 480
"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 Section 10.9, "Using the file manager", on page 237.

10.7 Exporting and importing remote command lists

To set specific instrument settings or perform tasks automatically, you can create scripts or import scripts that contain the settings in the form of remote control command sequences.

The R&S SMB100B also offers a SCPI macro recorder with code generator to record manual settings and create an executable script.

Completed scripts are saved in files and possibly converted to different formats, depending on the language of the source code.

The R&S SMB100B supports the following commonly used languages:

- Plain SCPI: `*.txt`
- MATLAB: `*.m`
- NICVI: `*.c`
- Python: `*.py`

It is also possible to convert the SCPI command list to a user-specific language.

How to: Section 12.9, "Using remote command scripts", on page 354

10.8 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 saved in the "User Correction" dialog.

10.9 Using the file manager

The "File Manager" is a tool similar to a standard Windows Explorer. It helps you manage mass storage media and files saved on the R&S SMB100B.

You can perform the following tasks:

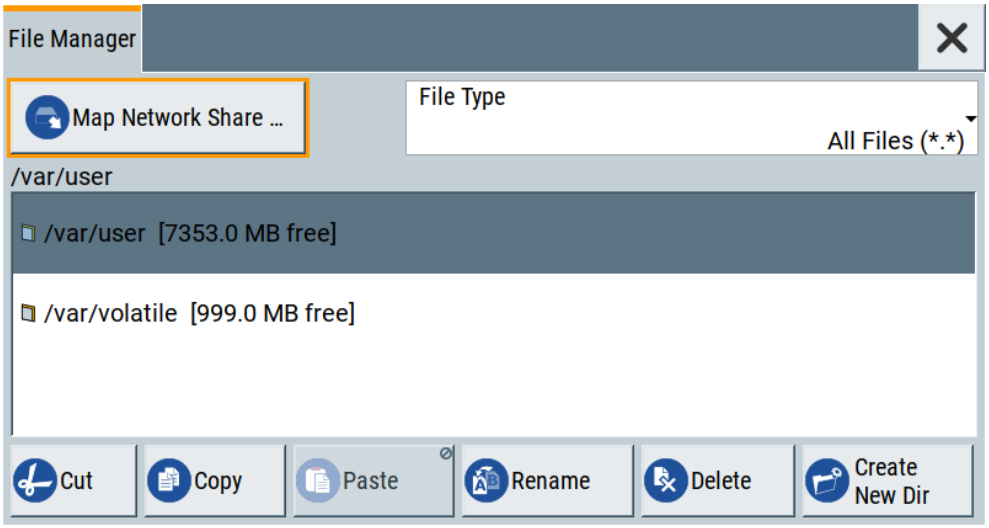
- Copying multiple files from disk to other media
  See Section 10.10, "Transferring files from and to the instrument", on page 243
- Copying files into another directory
  See Cut, Copy&Paste and Delete
- Renaming and deleting files
- Creating directories
  See Create New Directory
- Mapping shared network folders
  See Section 10.9.4, "Mapping a network folder", on page 241
- Displaying saved files
  See Section 10.9.3, "Displaying all saved files", on page 241

10.9.1 File manager settings

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".



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.

Settings:

Map Network Share 238
File Type 238
Directory and Filename 239
Cut, Copy&Paste and Delete 239
Rename 239
Create New Directory 239

Map Network Share
Opens a dialog where you can map one or more network folders. See Section 10.9.2, "Map network share settings", on page 239.

See also Section 10.9.4, "Mapping a network folder", on page 241.

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 Section A.2, "Available user files and file extensions", on page 653 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 387

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 389
`:MMEMory:COPY` on page 387

Rename
Renames the selected file or directory.

Remote command:
`:MMEMory:MOVE` on page 390

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 390

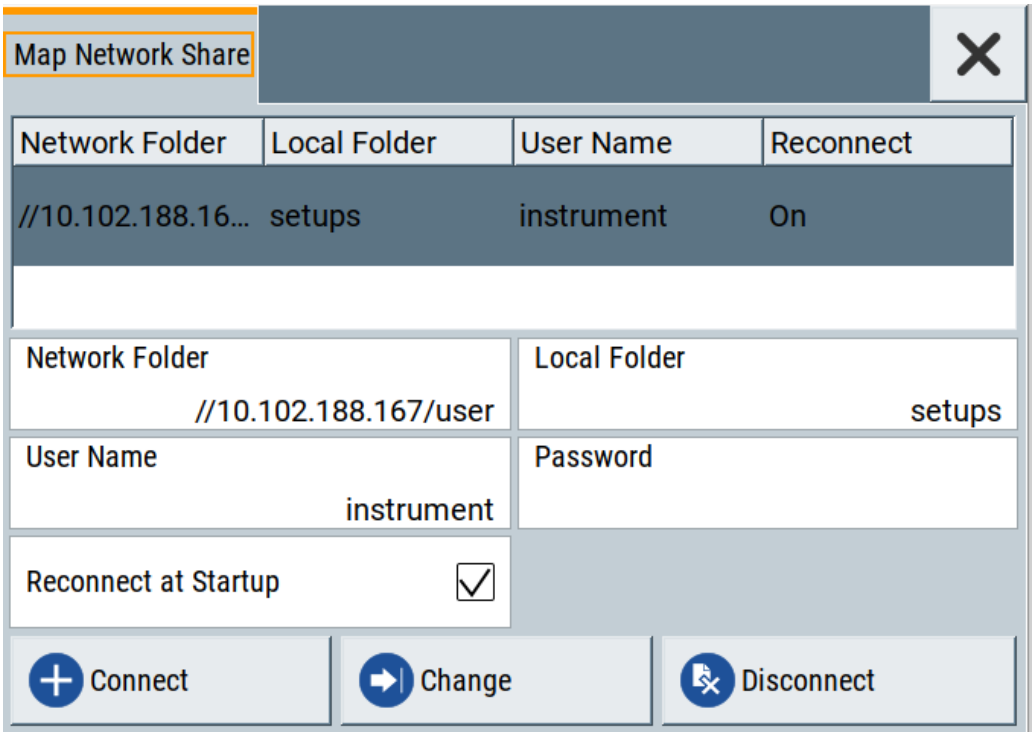
10.9.2 Map network share settings

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 Section 10.9.4, "Mapping a network folder", on page 241.

Settings:

Network Folder....240
Local Folder....240
User Name....240
Password....241
Reconnect at Startup....241
Connect....241
Change....241
Disconnect....241

Network Folder
Enter the path of the folder or computer, e.g. `//<IP Address>/user` or `//<server name>/user`.

Local Folder
Enter a letter or an alias name to describe the folder.

In the directory tree, a mapped network folder is indicated as `/shares/<"Local Folder">`.

User Name
Enter a user name of a user that has the permission to access the selected network folder.

Password
Enter the user password of the selected user.

Reconnect at Startup
Enables reconnecting every time you start up the instrument.

Connect
Triggers the instrument to prove the credential and to map (i.e. connect) the selected network folder or computer to the instrument.

You can map up to 10 network folders.

Change
Applies the changes.

Disconnect
Disconnects the network drive.

10.9.3 Displaying 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/`.

10.9.4 Mapping 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.

How to: Section 3.1.7, "Connecting to LAN", on page 25

To map a network folder, proceed as follows:

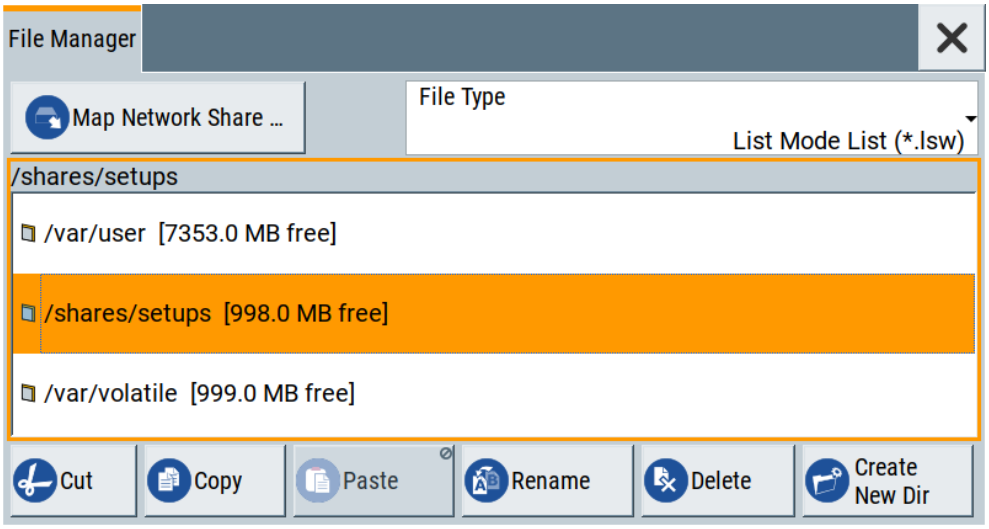
1. On the computer or the network folder you want to map, enable remote access. You can specify a list of users allowed for remote access.

Note: The remote access settings depend on the operating system the remote computer is using. For step-by-step instructions, refer to the documentation of the particular operating system.

2. On the R&S SMB100B, enable file transfer via SMB (samba).
3. Select "System Config" > "Setup" > "Remote Access" > "Network" to configure the following network settings:
   a) Select "Address Mode" > "Auto (DHCP)".
   b) Check that the "DNS Suffix" and "DNS Server" are correct.
4. In the "Save/Recall" dialog, select "File Manager" > "Map Network Share".
5. In the "Map Network Share" dialog, select:
   a) In the "Network Folder" field, enter `//<IP Address>/user` or `//<Server Name>/user`.
   b) In the "Local Folder" field, enter an alias name, e.g. *setups*.
   c) Enter the "User Name" and "Password" of a user with a remote access permission to the selected network folder.
   d) If necessary, enable "Reconnect at Startup".
   e) Select "Connect".

   The selected network folder is mapped to your instrument. The list of mapped network folders is updated.
6. Close the "Map Network Share" dialog.

   The navigation tree in the "File Manager" dialog displays the mapped network folder as `/shares/Setups`.



If the connection does not succeed, consider to check the following:

- Is the network folder or computer you try to map turned on?
- Is the network folder or computer enabled for remote access?
- Does the selected user name have the necessary permissions?

See also Section 10.10.5, "Using a file server for test files exchange", on page 248.

10.10 Transferring files from and to the instrument

As explained in "File handling" on page 223, you access the file system of the R&S SMB100B via one of the following ways:

- Via the built-in "File Manager"
  See Section 10.9, "Using the file manager", on page 237.
- On an instrument connected to a LAN:
  - Via one of the standard functions FTP or SMB (samba)
    See Section 10.10.2, "Accessing the file system using FTP", on page 245 and Section 10.10.3, "Accessing the R&S SMB100B file system using SMB (Samba)", on page 246
  - Via mapped network drives
    See Section 10.9.4, "Mapping a network folder", on page 241.
- Via a connected USB storage device
  See Section 10.10.4, "Using a USB storage device for file transfer", on page 247

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 Section 10.10.1, "Removing file system protection", on page 243 for description of the required steps.

This section provides an introduction to the topic. For comprehensive information, refer to the application note 1GP72: Connectivity of Rohde&Schwarz Signal Generators.

- Removing file system protection 243
- Accessing the file system using FTP 245
- Accessing the R&S SMB100B file system using SMB (Samba) 246
- Using a USB storage device for file transfer 247
- Using a file server for test files exchange 248

10.10.1 Removing file system protection

Before you try to access the file system via FTP, SMB (samba) or USB, fulfill the following:

- Disable write protection on the file system
- Enable the corresponding service or interface

To enable write permission on the file system

1. Select "System Config" > "Setup" > "Security" > "Security".
2. Select "General" > "Disk & Memory".
3. Enable "Volatile Mode".

4. Enter the "Security Password".
   The default password is *123456*. For more information, see Section 11.4, "Using the security settings", on page 277.

   The R&S SMB100B requests a reboot.

5. Confirm the request.

   The system reboots. The enabled settings are active.

To enable file transfer over FTP

1. Select "System Config" > "Setup" > "Security" > "Security".
2. Select "LAN Services" > "Common Services" > "LAN" > "On".
3. Enable "FTP"
4. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Section 11.4, "Using the security settings", on page 277.
5. Select "Accept".

To enable file transfer over SMB (samba)

1. Select "System Config > Setup > Security > Security > LAN Services"
2. Enable "LAN Interface"
3. Select "Samba Services".
4. Enable the "SMB 1.0/2.0 Client".
5. Enable the "SMB 1.0/2.0 Server".
6. Enter the "Security Password".
   The default password is *123456*. For more information, see Section 11.4, "Using the security settings", on page 277.
7. Select "Accept".

To enable file transfer over USB

1. Select "System Config > Setup > Security > Security > General"
2. Select "Disk & Memory".
3. Enable "USB Storage"
4. Enter the "Security Password".
   The default password is *123456*. For more information, see Section 11.4, "Using the security settings", on page 277.
5. Select "Accept".

10.10.2 Accessing the file system using 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.

How to: Section 3.1.7, "Connecting to LAN", on page 25

To access the file system over FTP

We assume that the instrument and the remote PC are connected to a LAN.

1. Enable file transfer via FTP
2. Enable write permission on the file system
3. On the remote PC, start the Windows Explorer.
4. In the address field, enter `ftp://<"IP Address" of the Instrument>`, e.g. *ftp://10.124.0.166*.
   Tip: The R&S SMB100B indicates its IP address on the home screen.

   A log-on dialog opens and requests a password.

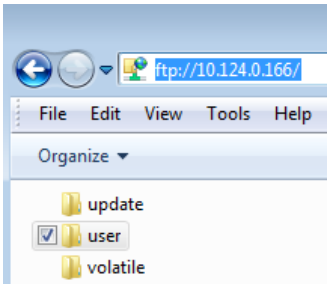
   The default user name and password is *instrument*.

   Tip:
   Default password

   The FTP and SAMBA file access use the user "instrument" with default password "instrument".

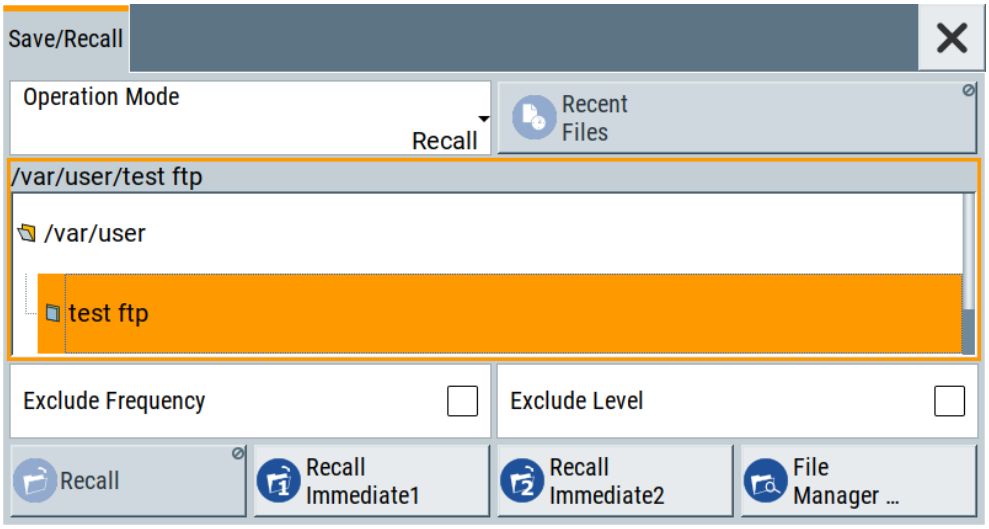
   We recommend that you change this password in the "Setup > Security > Password Management > Change User Password" dialog before connecting the instrument to the network.

   See Section 11.4.5, "Password management", on page 287.
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.



10.10.3 Accessing the R&S SMB100B file system using SMB (Samba)

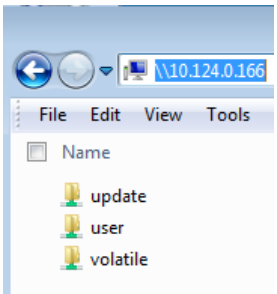
The SMB (Samba) protocol is an alternative way to access the file system of the instrument from a remote PC. This protocol works if both the instrument and the PC are connected to a LAN.

How to: Section 3.1.7, "Connecting to LAN", on page 25

To access the file system over SMB

We assume that the instrument and the remote PC are connected to a LAN.

1. Enable file transfer via FTP
2. Enable write permission on the file system
3. On the remote PC, start the Windows Explorer.
4. In the address field, enter `//<"IP Address" of the Instrument>`, e.g. *ftp://10.124.0.166*.
   Tip: The R&S 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.

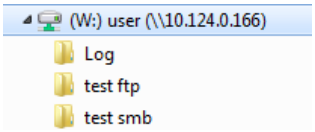
   Tip:
   Default password

   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 Section 11.4.5, "Password management", on page 287.
4. Enter the user name and the password of your instrument.

   The `/var/user/` directory of the instrument is mapped to and displayed as a network drive of the remote PC.



   You can access the files in the `/var/user/` directory, perform standard function like creating directory, or saving files.

10.10.4 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.

10.10.5 Using a file server for test files exchange

You can use a central file storage location like a file server in your company network to save setup files, SCPI scripts, application programs, or waveform files on it. Usually, you would like to distribute the files to several instruments. If the R&S 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 Section 10.9.4, "Mapping a network folder", on page 241.
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.

10.11 Creating screenshots of current settings

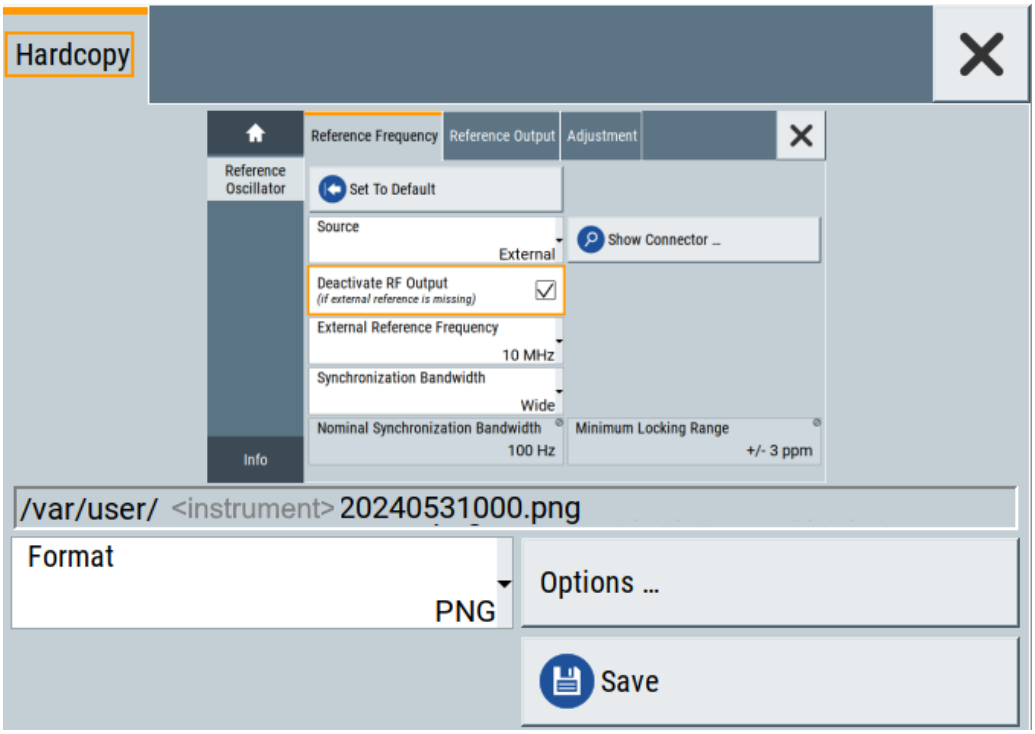
The save/recall function enables you to save current settings in a file. To document the most important settings for a performed signal generation, you can also save a hard-copy of the current display.

- Hardcopy settings 249
- Creating a hardcopy of the display 252

10.11.1 Hardcopy settings

Access:

► Select "System Config" > "Setup" > "User Interface" > "Hardcopy".



The remote commands required to define these settings are described in Section 13.11, "HCOPy subsystem", on page 412.

Settings:

File 250
Format 250
Options 250
Save 250
Hardcopy Options > Common 250
└ Automatic Naming 251

└ Format....251
└ Region....251
Hardcopy Options > Automatic Naming....251
└ Path....251
└ Clear Path....252
└ Prefix, Year, Month, Day....252
└ Current Auto Number....252

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 414

Format
Selects the output file format, for example `*.bmp`, `*.jpg*.xpm` and `*.png`.

Remote command:
`:HCOPy:IMAGe:FORMat` on page 414
`:HCOPy:DEVice:LANGuage` on page 414

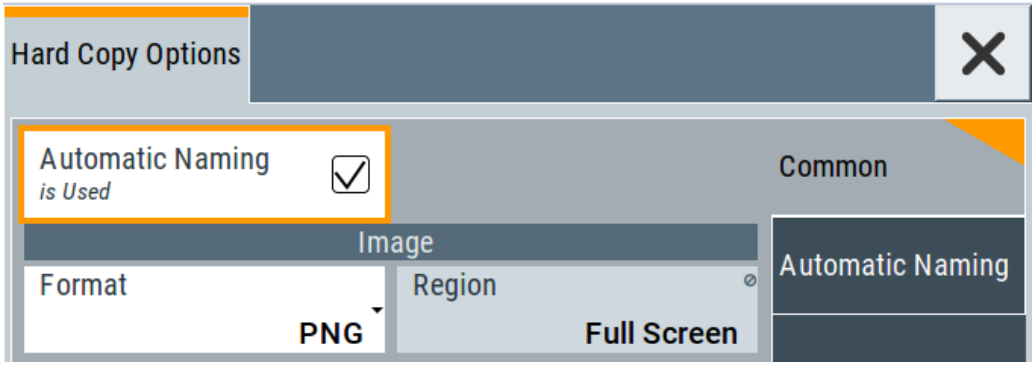
Options...
Accesses Hardcopy Options dialog.

Save
Saves a hardcopy of the current display as a file.

Remote command:
`:HCOPy[:EXECute]` on page 415

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 416

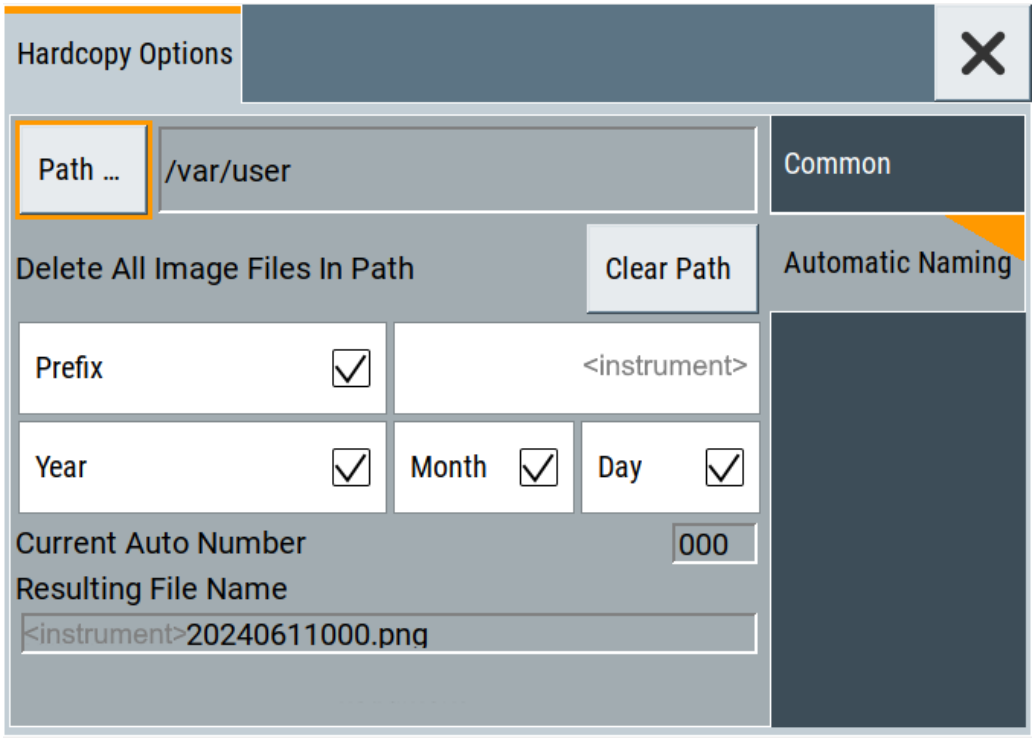
Format ← Hardcopy Options > Common
Selects the output file format, for example `*.bmp`, `*.jpg*.xpm` and `*.png`.

Remote command:
`:HCOPy:IMAGe:FORMat` on page 414
`:HCOPy:DEVice:LANGuage` on page 414

Region ← Hardcopy Options > Common
Displays the snapshot area.

Remote command:
`:HCOPy:REGion` on page 414

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 415

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 416

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 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe on page 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe on page 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe on page 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe on page 417

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 417

10.11.2 Creating a hardcopy of the display

To create a hardcopy

► Select "System Config" > "Setup" > "User Interface" > "Hardcopy".

Alternatively, you can use the following controls to create a hardcopy quickly:
- On the screen, select context-sensitive menu > (print).
- On an external keyboard, press the [Print] key.

- Assign the hardcopy function to the [User] key.

See Section 11.2.2, "How to assign actions to the [★ (User)] key", on page 264.

The R&S SMB100B creates a snapshot of the screen and opens the "Hardcopy" dialog for saving it in a file.

To configure and save the hardcopy

1. To define the output format, select "Format" > "JPG".
2. To enable the instrument to create output filenames, select "Automatic Naming" > "On".
3. Select "Options ...".
4. In the "Hardcopy Options" dialog:
   a) To change the default storage directory, select "Automatic Naming Settings" > "Path".
   b) Define a path and a filename.
   For example, select the default directory `/var/user`.
   c) If necessary, modify the parameters in the "Automatic Naming Settings".
   d) Close the "Hardcopy Options" dialog.
5. In the "Hardcopy" dialog, select "Save".

   The instrument saves a hardcopy of the current instrument display as a `*.jpg` file. Also, creates the filename automatically.

To export a hardcopy

1. Connect the instrument to the LAN.
2. Transfer the file to a remote computer
   See Section 10.10, "Transferring files from and to the instrument", on page 243.
3. On the remote computer, select the file.

11 General instrument functions

The general instrument functions include basic instrument settings, regardless of the selected operating mode and measurement. Some of these settings like screen display and peripherals are initially configured at the setup of the instrument, according to personal preferences and requirements. However, you can individually adjust the settings at any time, for example, if necessary for specific applications.

The following special functions help you in service and basic system configuration:

- Section 11.1, "Customizing the user interface", on page 254
  Allows you to adjust the display and keyboard language settings.
- Section 11.2, "Organizing frequently used settings as favorites", on page 260
  Enables you to group user defined settings in a favorites list or to assign actions to the [★ (User)] as quick access for later retrieval.
- Section 11.3, "Managing licenses and license keys", on page 268
  If you have purchased an additional option for the R&S SMB100B, you can enable it using a license key.
- Section 10.3, "Restoring an instrument configuration", on page 224
  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.
- Section 16.3, "Performing maintenance tasks", on page 633
  Special functions like calibration routines and self-tests put your instrument to an initial state.
- Section 11.4, "Using the security settings", on page 277
  Special security and protection functions protect your instrument from unauthorized use or activate specific test routines.

11.1 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.

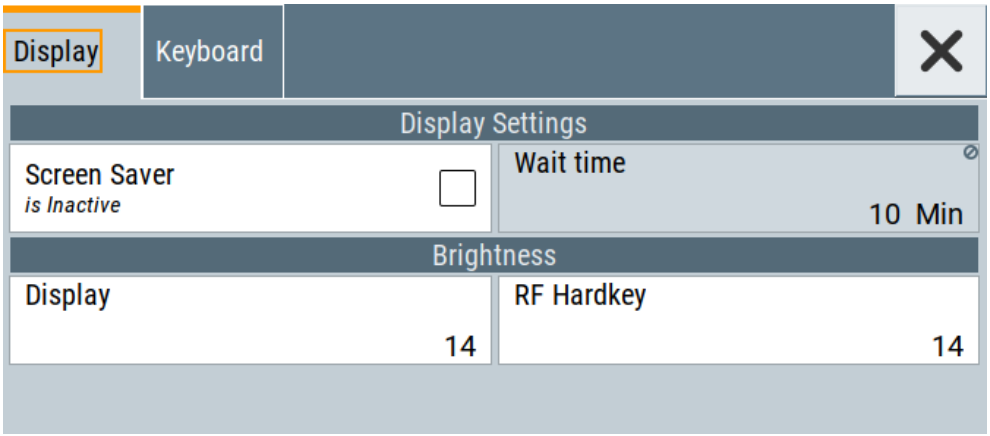
In detail described in the following paragraphs, you can:

- Set display and keyboard language, see Section 11.1.1, "Display and keyboard settings", on page 255
- Set date and time for the system clock, see Section 16.3.2, "Date and time", on page 637
- Configure and activate a Screen Saver
- Deactivate display update to improve performance, see Section 11.1.2, "Display update settings", on page 257
- Determine the state of the RF signal, and the level display in the status bar when you turn on the R&S SMB100B, see Section 11.1.3, "Defining the RF signal state on power on", on page 258.

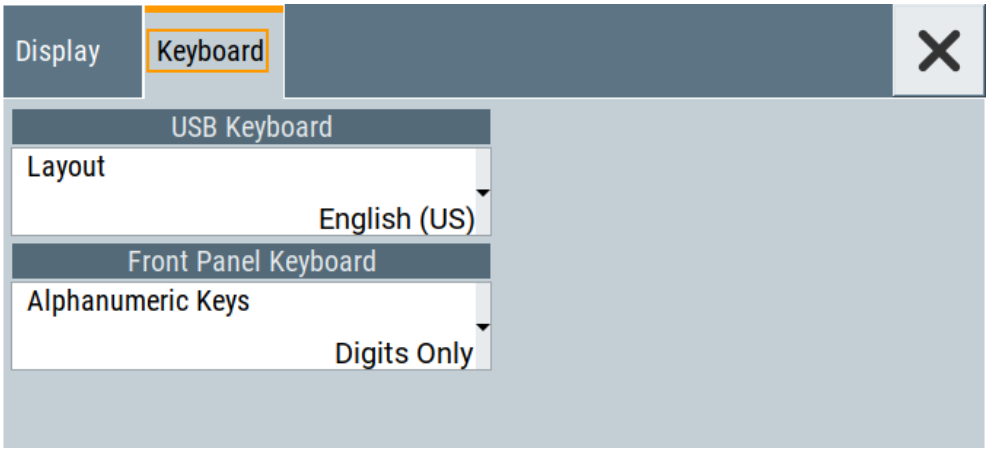
11.1.1 Display and keyboard settings

Access:

1. Select "System Config > Setup > User Interface > Display".



2. Select "Keyboard".



In the "Display" and "Keyboard" dialogs, you can enable the screen saver function and configure the language for the key assignment of an external keyboard and the keypad.

The remote commands required to configure the display and keyboard are described in Section 13.9, "DISPlay subsystem", on page 406 and Section 13.12, "KBOard subsystem", on page 418.

Screen Saver 256
Wait Time 256
Display 256
RF Hardkey 257
Layout 257
Alphanumeric Keys 257

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 407

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 407

Display
Adjusts the brightness of the display.

Increase the value to turn up the display brightness.

Remote command:
`:DISPlay:BRIGhtness` on page 408

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 408

Layout
Selects the language of an external keyboard connected over USB. The function assigns the corresponding keys automatically.

Remote command:
`:KBOard:LAYout` on page 418

Alphanumeric Keys
Selects the layout of the numeric keypad on the front panel.

"Digits Only" Assigns only numeric keys.

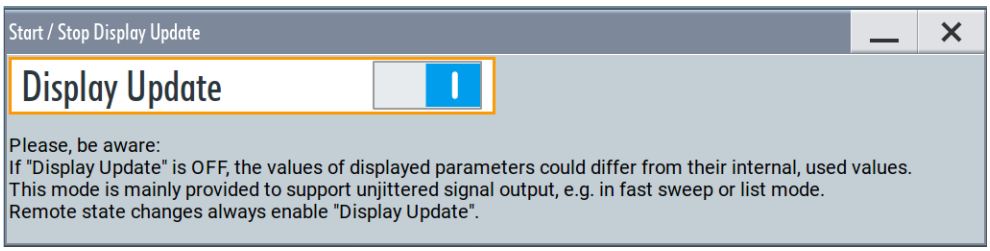
"Digits and Letters" Enables numeric and alphanumeric keys.

Remote command:
`:FPANel:KEYBoard:LAYout` on page 418

11.1.2 Display update settings

Access:

► Select "System Config > Setup > User Interface > Start/Stop Display Update".



This dialog enables you, to deactivate updating the display.

The remote command to switch off the display update is described in Section 13.9, "DISPlay subsystem", on page 406.

Display Update is
Disables the automatic refreshing of the displayed values.

Remote command:
`:DISPlay:UPDate[:STATe]` on page 408

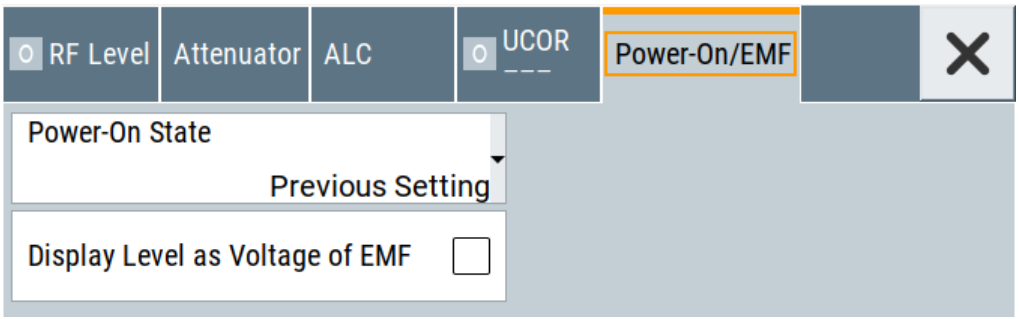
11.1.3 Defining the RF signal state on power on

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....258
Display Level as Voltage of EMF....258

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 419

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 528

11.1.4 How to set the initial instrument settings

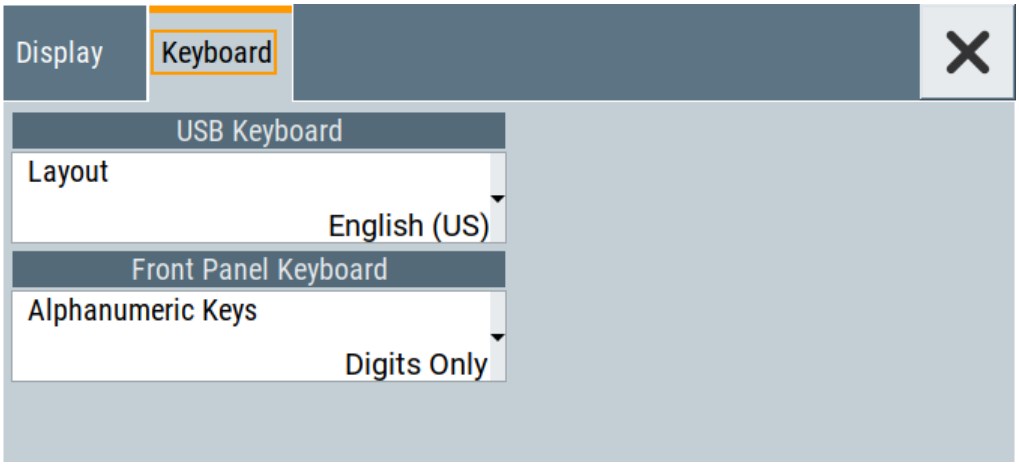
This section describes how to set up the R&S SMB100B initially.

11.1.4.1 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".

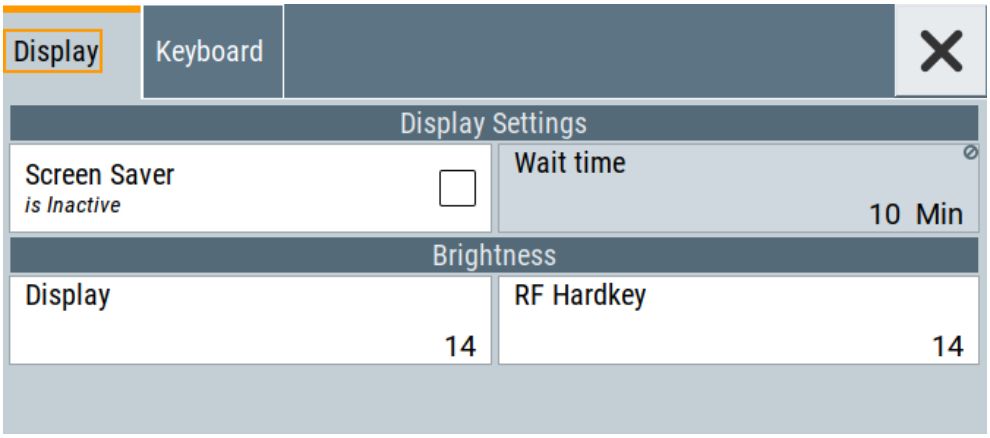
   The dialog closes and the changes take effect immediately.

11.1.4.2 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.

11.2 Organizing frequently used settings as favorites

The R&S SMB100B provides two possibilities to define frequently used settings and procedures for later retrieval individually.

User menu and [★ (User)] key

These two functions work similar to the favorites function of a browser or other programs. They allow you to create a list of frequently used actions or to group frequently used settings in one dialog.

You can collect the parameters of your configuration in a favorites list, i.e. in the "User Menu", or define settings and actions with the [★ (User)] key:

- "User Menu" to group settings of specific tasks.

  Similar to a favorites function, you can use this menu for:
  - Grouping the settings required for a task in one dialog.
  - Saving and recalling the settings of a task.
  - Transferring the settings for use on multiple instruments.
- [★ (User)] key, with customizable function.

  You can perform the following steps using this key:
  - Open the "User Menu" (default functionality).

– Add or remove settings and functions.
– Execute actions and access functions.

Possible applications

The ★ (User) key and the "User Menu" are useful for the following situations:

- There are functions or tasks you have to perform in a defined order but the setting parameters are distributed across several dialogs.
- There are functions or tasks you have to perform frequently but they are not accessible via the front panel keys.
- The required functions are grouped in a dialog that is not directly accessible from the home screen.
- Your task involves loading and executing of SCPI scripts.
  See Section 12.9, "Using remote command scripts", on page 354.
- A quick access to saved setups is required.
- There are functions and tasks you have to perform on several instruments.

Dialog identification

To identify each dialog, the instrument uses a dedicated dialog ID. The dialog ID contains the dialog position on the display and the current active tab. The action that triggers the instrument to open a dialog uses this identification.

Save/Recall vs. recall setup

If you need to restore a specific signal generation setup and perform further configurations based on this particular instrument state, the R&S SMB100B provides two options:

- "Save/Recall" function
  For a detailed description, refer to Section 10.5, "Saving and recalling settings", on page 230.
- "Recall Setup" function
  If the "Recall Setup" is the only user action assigned to the [★ (User)] key, pressing this key triggers the R&S SMB100B to load the user-defined preset file immediately.

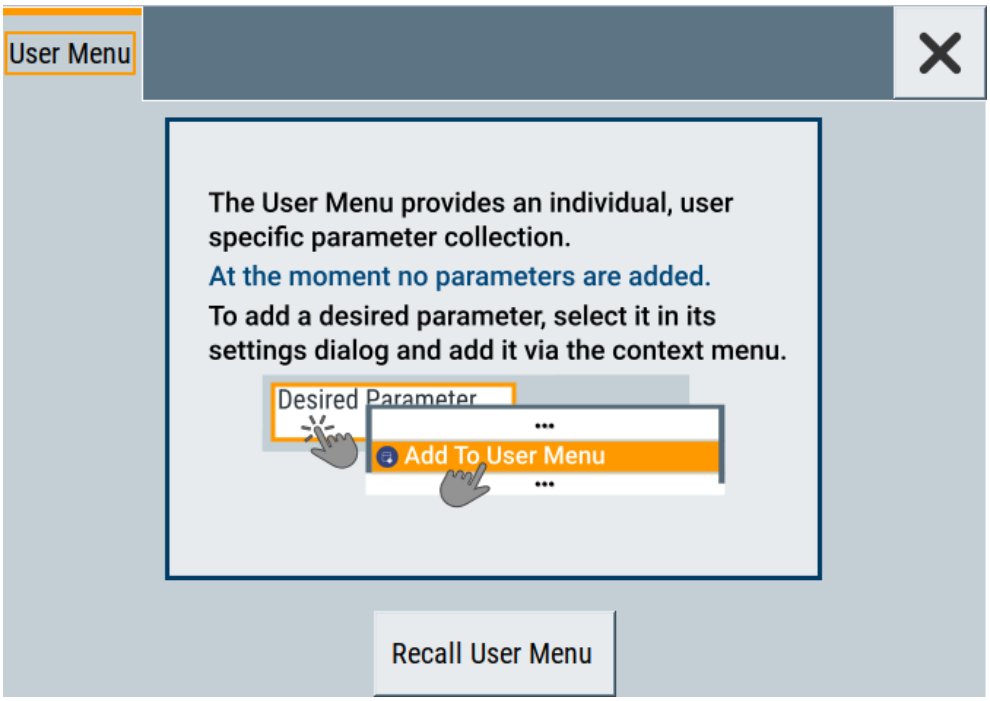
11.2.1 Configuring settings quickly with the user menu

Access:



1. Press the [★ (User)] key.

   The "User Menu" dialog opens.



   If you execute this action for the first time, the dialog displays instructions on how to use the "User Menu".

2. If you already have a saved user menu file on the instrument, you can load with "Recall User Menu".

Creating a user menu

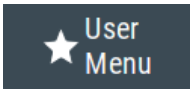
To create your own user dialog with settings:

1. Open a dialog with settings you frequently use.
2. Select a parameter.
3. Open the context menu and select "Add to User Menu".





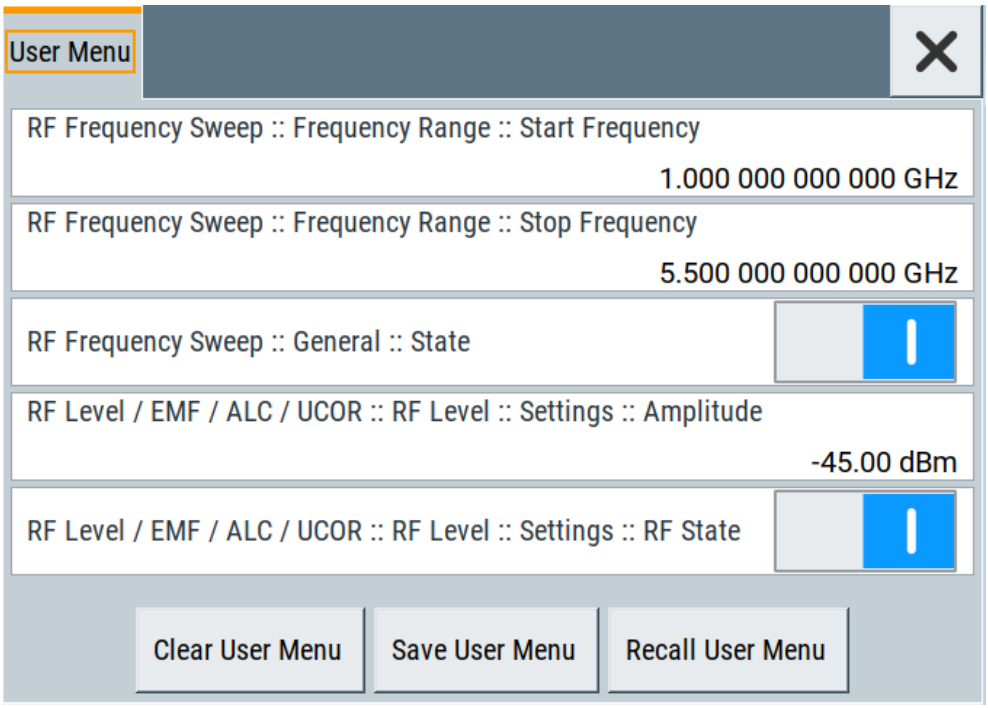
A favorites icon ★ indicates that the parameter is used in the "User Menu".



The "User Menu" button in the taskbar confirms that you have created a "User Menu" with at least one entry.

4. Press the [★ (User)] key.

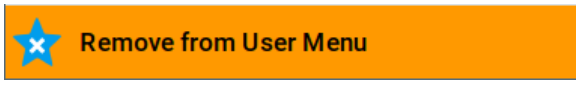
   The "User Menu" dialog shows all parameters that you have added to the list.



   You can modify the parameter settings directly in this dialog, e.g .change a state or set values, as you do in the particular dialog the parameter originally belongs to.

5. To remove an entry, select the parameter either in the "User Menu" or in the dialog where it originally belongs to.

   a) Open the context menu and select "Remove from User Menu".



6. To remove all entries at once, select "Clear User Menu".
7. To save your individual favorites list, select "Save User Menu", and follow the file managing instructions.
   The file system automatically assigns the file extension `*.user_menu`.
8. To recall a previously saved user menu, select "Recall User Menu" and proceed accordingly.

Providing a user menu favorites list for several instruments

To transfer files from or to an instrument:

1. Create the favorites list, as described in "Creating a user menu" on page 262.
2. Save the favorites list.
3. To tansfer a file from or to an instrument, the R&S SMB100B provides several options, see "File handling" on page 223.

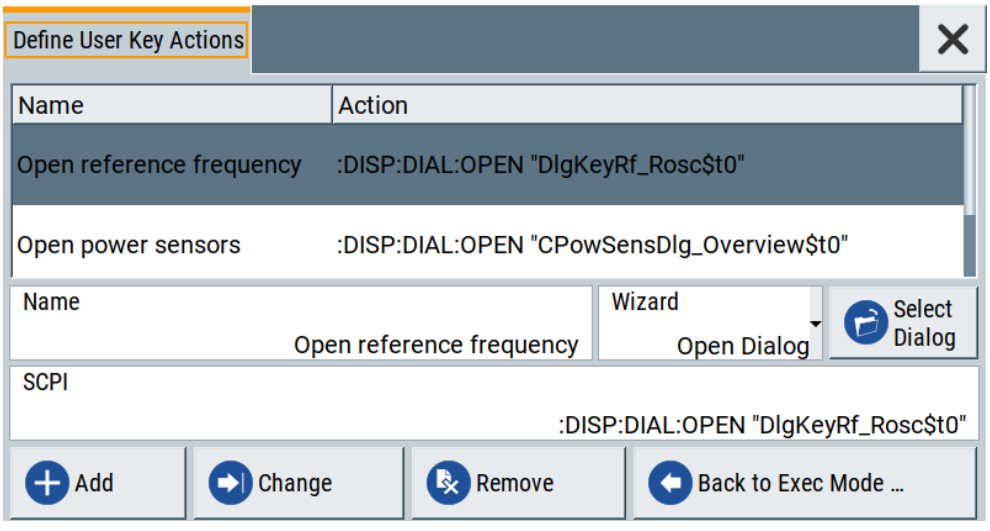
11.2.2 How to assign actions to the [★ (User)] key

The customizable [★ (User)] key has no predefined function assigned. You can individually define actions to be executed or functions to be accessed when pressing this key.

To assign a frequently used dialog to the [★ (User)] key:

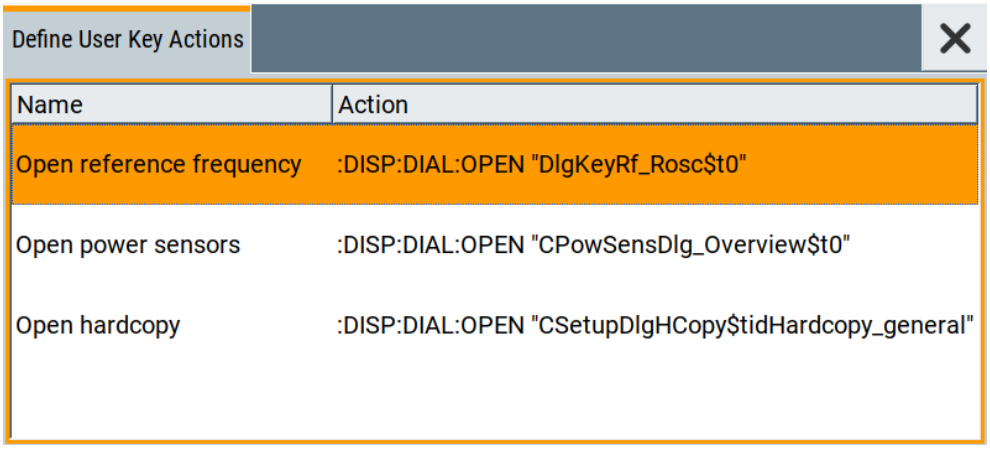
1. Open the dialog you want to quickly access.
   For example, select "Frequency" > "Reference Frequency"
2. Select "System Configuration" > "Setup" > "User Interface" > "Define User Key".
3. To create an action:
   a) Specify the "Name".
      E.g. *Open reference frequency*.
   b) Select "Wizard" > "Open Dialog"
   c) Select "Select Dialog" and select a settings dialog from the list

   The corresponding SCPI command is automatically displayed and can be modified.
4. Select "Add" to save the new action in the list of user key actions.



5. To execute the created action, press ★ (User).
   In the list of actions ("Define User Key Actions" dialog), navigate to the required action.

In this example, this is "Open reference frequency".



The R&S SMB100B opens the dialog.

Tip: If you have assigned only one action to the user key, the R&S SMB100B performs the action immediately.

11.2.3 User menu settings

The "User Menu" dialog contains function keys to organize, save and load a favorites list. You can also modify, add or delete list entries directly in the dialog.

Clear User Menu
Removes all entries from the "User Menu" at once.

Save User Menu
Saves the current "User Menu" under the defined filename.

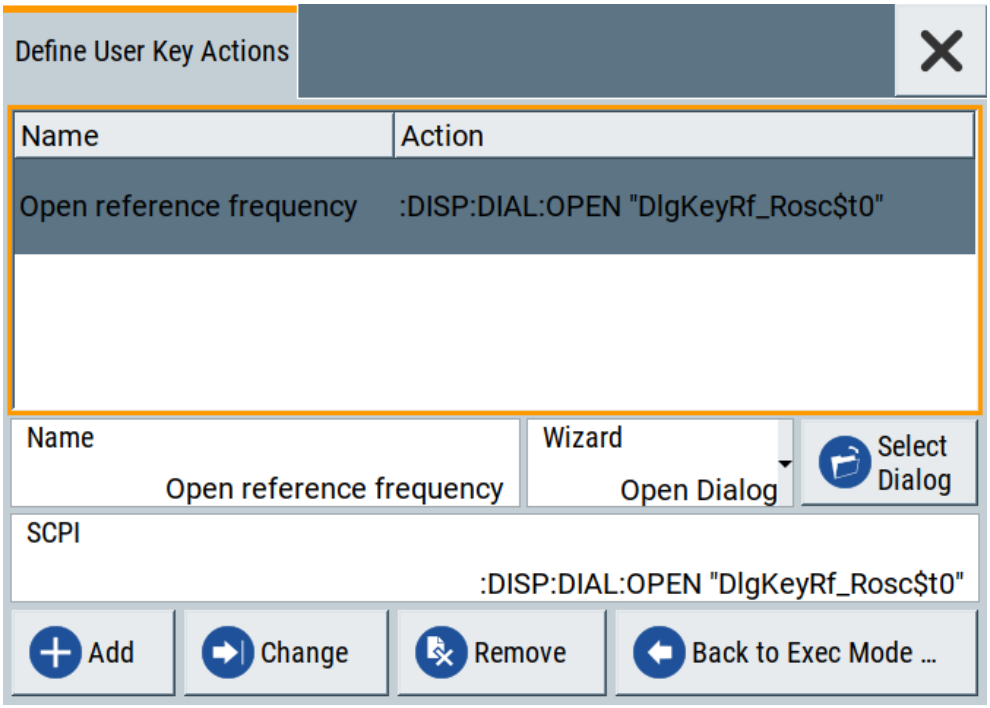
Recall User Menu
Loads the selected "User Menu" file.

This function enables you to use the user specific favorites file on another instrument. However, if functions or parameters are not provided due to varying configuration of the instrument, the settings of these particular parameters take no effect.

11.2.4 Define user key actions settings

Access:

► Select "System Config" > "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 Section 11.2.2, "How to assign actions to the [★ (User)] key", on page 264.

The remote commands required to define these settings are described in Section 13.9, "DISPlay subsystem", on page 406.

Name
Enters a user-defined name for the action.

Wizard
Defines the action to be executed.

"Load SCPI Script"
Selects and executes the SCPI script.

"Recall Setup" Opens the file dialog for selecting a saved setup with user-defined settings.

"Open Dialog"
Selects an open settings dialog or menu.

Select
Depending on the selected "Wizard", provides access to:
- the standard "File Select" function for loading an SCPI script or setup file
- a list of all currently opened dialogs.
  See SCPI.

SCPI
For the currently selected action, displays the corresponding SCPI command with the associated parameter for dialog identification (dialog ID). The automatically displayed SCPIs are enabled for subsequent modification.

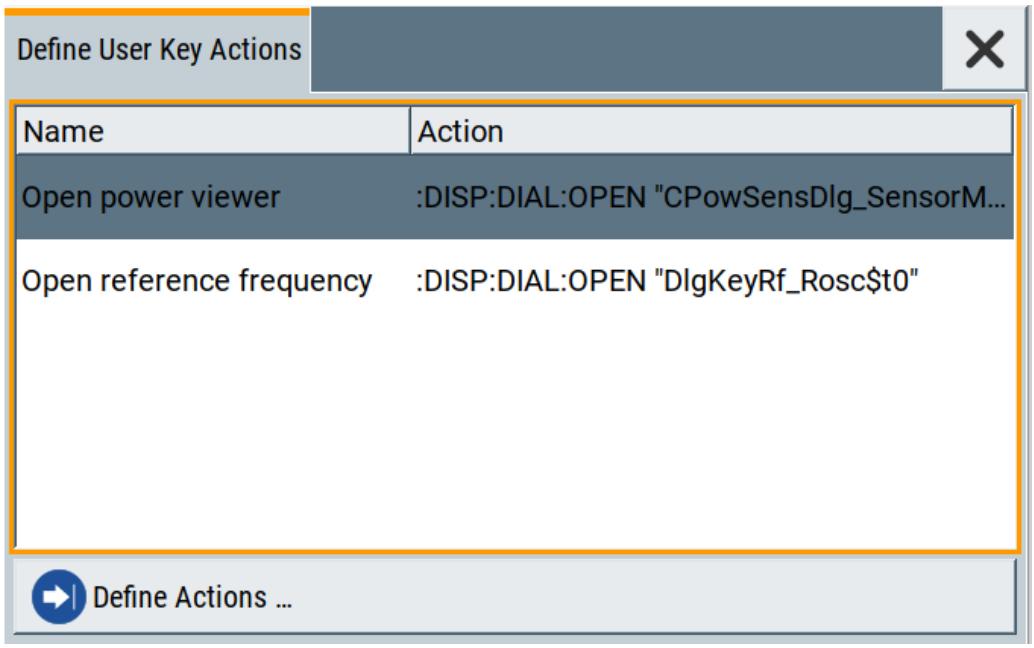
Remote command:
`:DISPlay:DIALog:OPEN` on page 410
See also `:DISPlay:DIALog:ID?` on page 409

Add, Change, Remove
Standard functions for managing of the actions.

Back to Execute Mode
Opens the "Select Action to Execute" dialog. Select an Action form the list to execute it.

To return to the "Define User Key Actions" dialogs, select Select Action to Execute > Define Actions.

Select Action to Execute > Define Actions



Opens the "Define User Key Actions" settings dialog.

11.3 Managing licenses and license keys

An option is ready to operate after it is enabled with a license keycode supplied with the option. The license key is delivered as a file or on paper. Unregistered licenses must be registered for a particular instrument before the corresponding option can be enabled for operation.

For reliable operation, a software option usually requires the latest firmware version. The required version is specified in the delivery. If your instrument works with a former firmware version, update the firmware before enabling the software option.

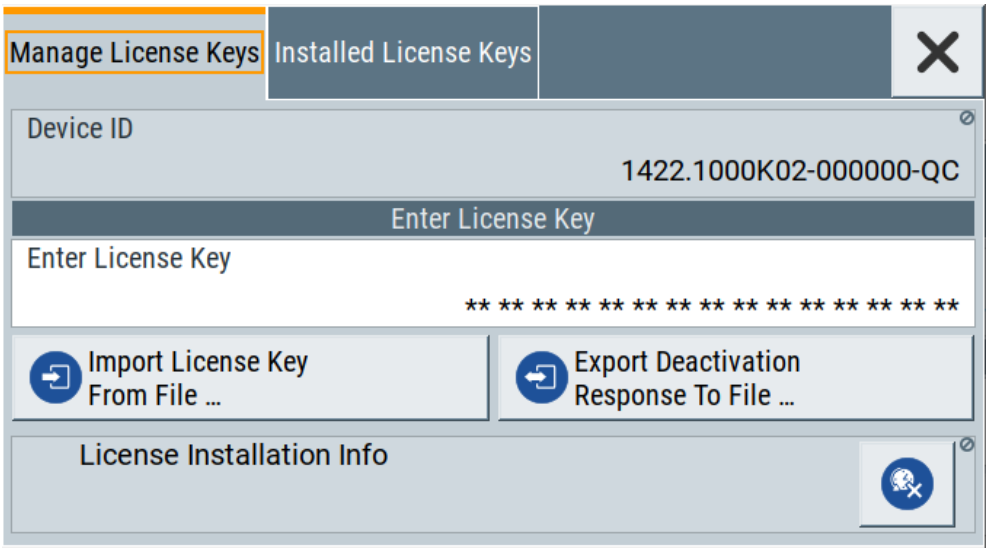
The firmware update is described in the release notes provided on the product page of the R&S SMB100B.

11.3.1 Manage license keys settings

The "Manage Licnese Keys" dialog provides all information on the available licenses. Instrument-related steps guide you through the process of registering or deactivating licenses.

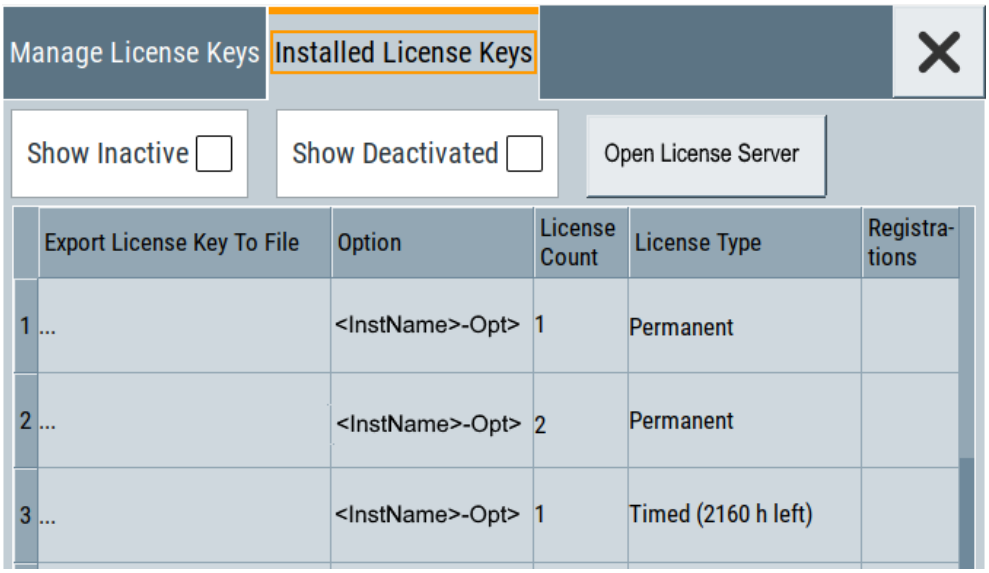
Access:

1. Select "System Config" > "Setup" > "Instrument Assembly" > "Manage License Keys" > "Manage License Keys".



   In this tab, you can activate licenses for newly purchased or newly registered options.

2. Select "Installed License Keys".



This tab lists all active options, with information on the available number of an option, the license type and registration. You can query inactive or disabled options also.

3. Select "Open License Server".

   The "Manage License Keys" dialog covers all required parameters for activating or deactivating newly purchased or newly registered options, and provides access to the onboard license server, see Section 11.3.2, "Using the license server", on page 271.

Settings:

Device ID....269
Enter License Key....269
Import License Key from File....270
Export Deactivation Response to File....270
License Installation Info....270
Installed License Keys....270
  └ Show Inactive....270
  └ Show Deactivated....270
  └ Installed License Keys Table....270
Open License Server....271

Device ID
Displays the instrument-specific identification number. The device ID is a unique string with the following structure:

`<stock number>-<serial number>-<checksum>`

Enter License Key
Type here the license key provided with the option.

For license keys delivered as a file, use Import License Key from File....

Import License Key from File...
Opens a dialog for selecting the file with the license key.

Use this function also to import the deactivation key file generated by the R&S License Manager online tool (see How to move a portable license).

Export Deactivation Response to File...
Exports the generated deactivation response key to a file and opens a file management dialog to save the file.

This key is required during the unregistration process, e.g. when you want to deinstall an option or have a portable option, which you want to register later on another instrument (see How to move a portable license).

License Installation Info
Indicates status information on the performed actions.

Installed License Keys
Access: select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys".

Comprises information on the installed options.

Show Inactive ← Installed License Keys
Enables the display of the inactive (expired) licenses in the Installed License Keys Table.

Show Deactivated ← Installed License Keys
Enables the display of the deactivated licenses in the Installed License Keys Table.

See How to move a portable license for information on how to activate deactivated licenses.

Installed License Keys Table ← Installed License Keys
Shows information on the currently installed options.

"Export License Key to File"
: Opens a dialog to save the generated license key file. This file is required during the unregistration process.
If you have a portable unregistered option, you can register it later on another instrument (see How to move a portable license).

"Option"
: Displays the short designation of the option.

Note: 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)

Open License Server
Opens the R&S License Server of the R&S SMB100B, see Section 11.3.2, "Using the license server", on page 271.

11.3.2 Using the license server

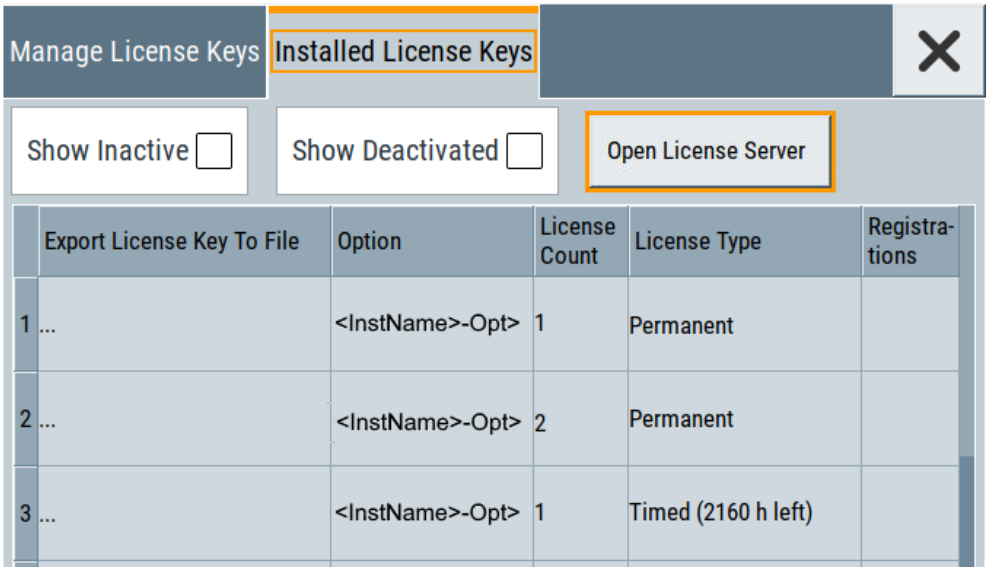
The R&S SMB100B now supports handling of software licenses using the license server from Rohde & Schwarz.

The R&S License Server is a browser application you can access directly in the R&S SMB100B. The onboard license server is integrated in the instrument firmware with connection to a *local smartcard* memory. The local smartcard holds local licenses, i.e. licenses used on this specific instrument.

To open the license server

Access:

1. Select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys".



2. Select "Open License Server".

   The license server browser opens in a browser window and starts initially in the "Configuration" view.

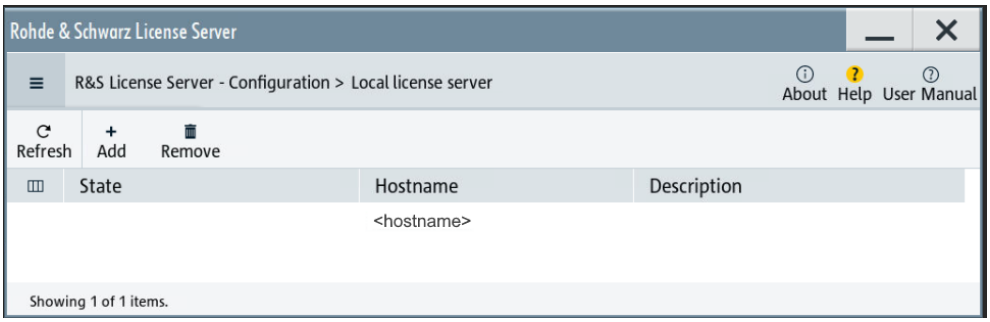


Figure 11-1: R&S license server dialog

   The selection button in the status bar on the left enables you to access the "Analytics" or "Licenses" views, see "Short glance at the main views" on page 272.

The icons in the status bar on the right lead you to information on the license server:

- "About": shows the software version.
- "User Manual": opens the embedded license server user manual.
- "Help": provides the functional description on a specific dialog and its settings.

Short glance at the main views

The section provides a brief insight into the main windows of the license server. For details and handling of the application, refer to the embedded user documentation.



1. To access a view, select the menu button.

2. Select "Configuration".

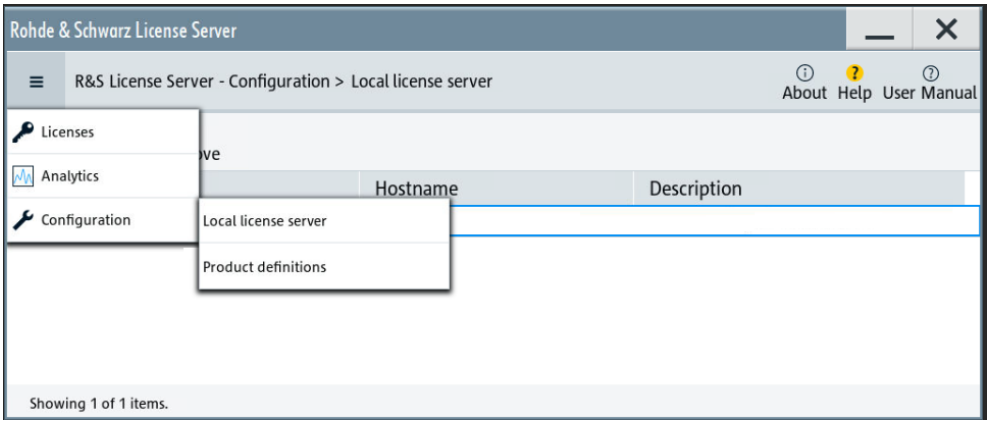


Figure 11-2: Configuration menu

   Accesses the license server, access lists and installed product definitions.

a) Select "Local license server".

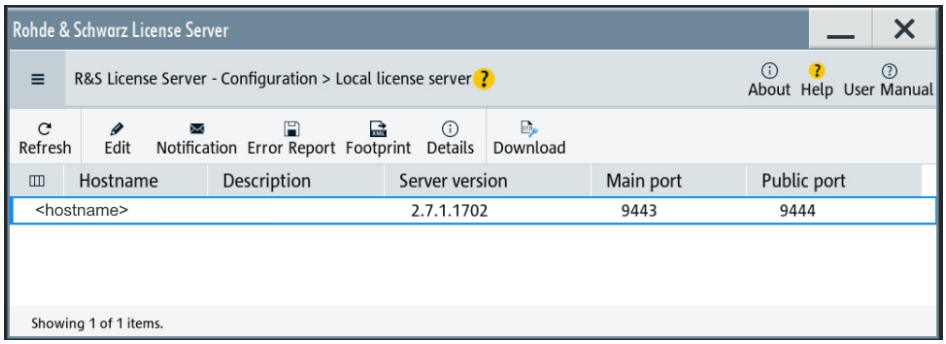


Figure 11-3: Example of a local license server view

Shows the onboard license server of the instrument. With the column selection, you can indicate or unhide characteristics of the available server. The task bar buttons provide access to the corresponding functions and access lists.

b) Select "Product definitions".

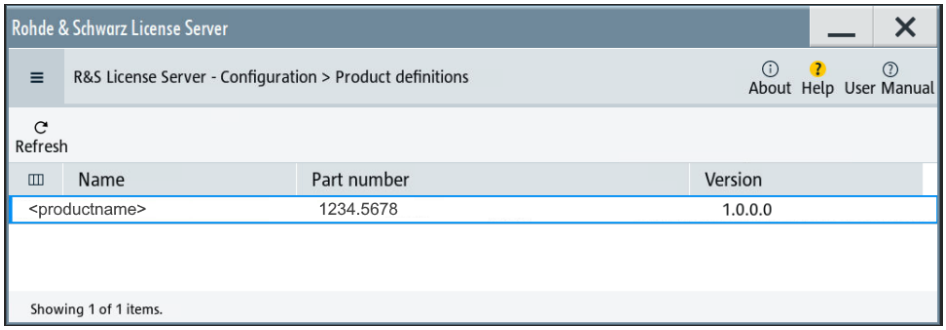


Figure 11-4: Example of a product definition view

Shows installed product definitions. To view the available characteristics, use the column selection.

3. Select "Licenses".
   Provides access to the available license servers.

   The "License keys" view lists the license key options that are available on the selected server. To show additional information, use the column selection.
   The task bar functions enable you to activate or deactivate a license, to get details on an option and export license keys or information on the selected product.

4. Select "Analytics".

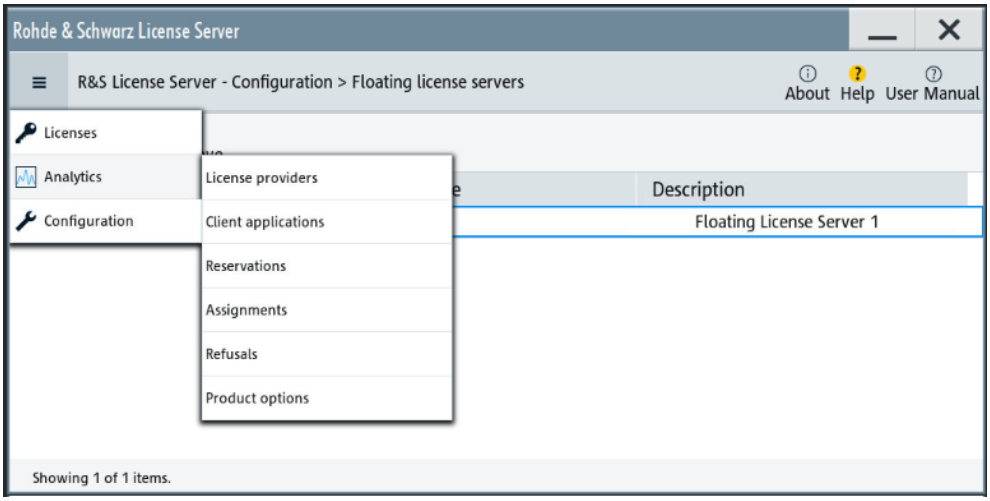


Figure 11-5: Analytics menu

Provides access to the license providers, client applications and enables you to export statistics data for evaluation in external applications.

Shows information on configured client applications, license providers and license types. To show additional information, use the column selection.

To manage licenses on the R&S SMB100B

To request or return a license, proceed as follows:

1. Access: see "To open the license server" on page 271.

   The browser application opens.

2. Select "Licenses"
3. Select a license server in the menu list, e.g. "R&S SMB100B".

   The "License keys" view lists the enabled options available on the selected server.

4. Select "Status" > "Select all" to list also options that are currently deactivated.

   The "Licenses" view shows all active, inactive and time limited options.

5. To get detailed information on a specific option:

   a) Select the option in the list.

b) In the task bar, select "Details".



Figure 11-6: Example of the license characteristics of an option

6. To enable a discontinued license: , select Activate in the taskbar.
   a) Select the license you want to activate.
   b) In the task bar, select Activate.
7. To return a license, proceed the same way:
   a) Select the license.
   b) Deactivate the license with Discontinue.
8. Follow the instructions on the screen.

11.3.3 How to move a portable license

This example is intended to explain how to perform the required steps at the instrument.

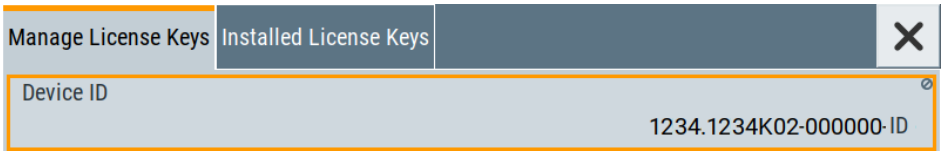
Use a USB flash drive to transfer the license key files between the instruments and the browser.

We assume knowledge about the handling of the R&S License Manager online tool and the description of the whole process.

1. Open your browser. Enter https://extranet.rohde-schwarz.com/service.
   Select "Manage Licenses > Move Portable License".

   The first step requires the Device IDs of the source and target instruments.
2. To find out the Device IDs, proceed as follows:

a) On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Manage License Keys > Device ID".



b) On the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys".
c) In the "Mange License Keys" tab, select "Device ID".
d) In the browser, select "Manage Licenses > Move Portable License > Select Devices".
e) Enter the Device IDs.

3. On the source instrument, select "System Config > Setup > Instrument Assembly > Installed License Keys > License Keys Table".
   a) Navigate to the portable license that you want to move.
   b) Select the "Export License to File" column.

   A standard file manager dialog opens.
4. Enter a filename.
5. Save the exported license key, e.g. `k123_portable_key_to_move.xml`.
6. In the browser, select "Manage Licenses > Move Portable License > Select License (from file)":
   a) Select the exported license key.
   b) Check the selection.
   c) Create the deactivation key.
   d) Save it to file.
7. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Import License Keys from File".
   Select the transferred deactivation key.
8. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Export Deactivation Response to File".
9. In the browser, go to "Manage Licenses > Move Portable License > Install Deactivation Key (from file)".
10. Enter the deactivation response of the instrument.

    The license is deactivated for the source instrument.
11. In the "Manage Licenses > Move Portable License", go to step "Create License" to generate a license key for this portable option and the selected target instrument.
    a) Download the license key as a file.
    b) Transfer it to the target instrument.

12. In the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New License > Import License Keys from File".
13. Select the created license key file.

    The portable option is installed on the target instrument.

11.4 Using the security settings

The protection function of the R&S SMB100B provides several levels to activate particular functions like self-test or tests for service purposes specifically.

Protection

The five protection levels are automatically active on startup that means all protected functions are locked.

To unlock a protection level:

► In the "System Config > Setup > Security > Protection" dialog, enter the correct password.

To lock a protection level:

► Clear the corresponding checkbox.

Protection levels

The following functions are protected in the respective levels:

- Protection level 1
  Protects against accidental changes, like, for example, the clock and date, several internal adjustments functions and the self-test, as well as network settings or the instrument hostname.
  You can access this level with the password 123456.
- Protection level 2
  Unlocks protected service functions. It is accessible to authorized personnel of Rohde & Schwarz service department only.
- Protection level 3 to 5
  Are reserved for internal use.

Security

The security concept of the R&S SMB100B helps you to protect your instrument against uncontrolled access and changes.

All modified security settings require that you enter the Security Password and confirm with Accept.

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.
  - **User interface** prevent manual operation and reading the display.
- **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 Section 11.4.5, "Password management", on page 287.
- **LAN services** secure controlled network access
  You can individually lock and unlock supported LAN interface services, including the SMB client and SMB server that use versions 1.0 and 2.0 of the SMB protocol. Remote control over LAN requires you have enabled the interface, but you can disable not needed LAN services individually.
  Note: Disabling LAN services needed for remote control over LAN locks the instrument access persistently. You cannot address the instrument any longer.
  See Section 11.4.4, "Configuring LAN services", on page 283.
- **User interface** prevents front panel operation and/or reading the display.

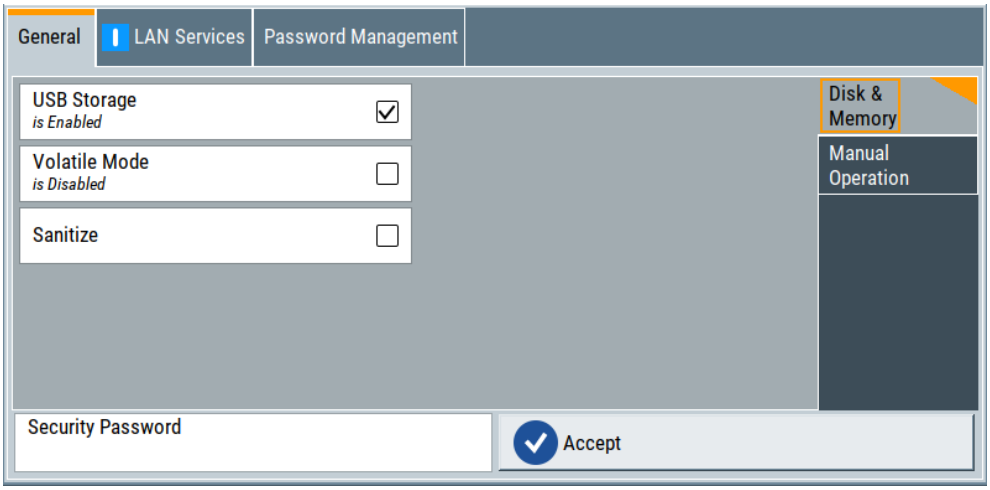
For more information, see the document R&S SMB100B Instrument Security Procedures.

- Disk & memory security settings....278
- Manual operation security settings....280
- Protection level settings....282
- Configuring LAN services....283
- Password management....287
- Preventing unauthorized access....290

11.4.1 Disk & memory security settings

Access:

1. Select "System Config" > "Setup" > "Security" > "Security".
2. Select "General" > "Disk & Memory".



The "Disk & Memory" tab secures controlled access to the mass memory and prevents information from leaving a secure environment.

The remote commands available to control security settings are described in Section 13.17, "SYSTem subsystem", on page 555.

USB Storage
Activates the access to external USB storage media.

To apply the change enter the security password and confirm with "Accept".

See Section 10.10.4, "Using a USB storage device for file transfer", on page 247.

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.
The microSD card is also considered a USB memory device and must be removed. If you have sealed the SD card slot, you can not disable the USB storage.

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 Section 10.4, "Protecting data", on page 229.
- 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 apply the change enter the security password and confirm with "Accept".

Enabling the volatile mode also requires a reboot, prompted by the instrument.

The icon indicates the enabled volatile mode.

Remote command:
:SYSTem:SECurity:VOLMode[:STATe] on page 578

Sanitize
Executes the erase procedure that sanitizes the internal memory.

The sanitizing function makes sure that no user information is stored on the instrument when it leaves the secure environment.

To apply the change enter the security password and confirm with "Accept".

Note: If the instrument is subject to high security, and you have disabled volatile mode, the internal memory holds user-data, and thus poses a security risk.

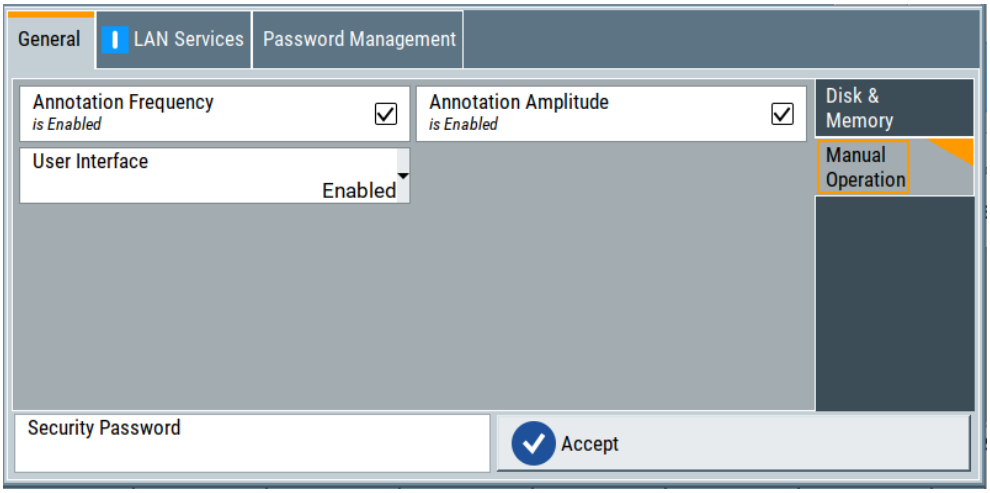
See also Section 11.4, "Using the security settings", on page 277 for more information on the security concept.

Remote command:
:SYSTem:SECurity:SANitize[:STATe] on page 577

11.4.2 Manual operation security settings

Access:

1. Select "System Config" > "Setup" > "Security" > "Security".
2. Select "General" > "Manual Operation".



The "Manual Operation" tab enables you to lock front panel operation and/or reading the display.

The remote commands available to control security settings are described in:

- Section 13.9, "DISPlay subsystem", on page 406
- Section 13.17, "SYSTem subsystem", on page 555.

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".

How to: see "To disable frequency and level indication in the status bar" on page 293.

Remote command:
:DISPlay:ANNotation:FREQuency on page 409

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".

How to: see "To disable frequency and level indication in the status bar" on page 293.

Remote command:
:DISPlay:ANNotation:AMPLitude on page 408

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".

How to: see "To disable the user interface" on page 293.

See also Section 11.4, "Using the security settings", on page 277.

"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.
How to unlock: see "Unlocking (reactivating) the user interface for manual operation" on page 293.

"Disabled" Locks the display and all controls for the manual operation of the instrument.
This security feature protects the instrument against unauthorized reading and access, for example when you operate the instrument via remote control.

The function disables:
- The display
- The touchscreen
- The keys at the front panel of the instrument
- The external mouse and keyboard

The screen shuts off and displays a padlock symbol instead.
How to unlock: see "Unlocking (reactivating) the user interface for manual operation" on page 293.

Remote command:
`:SYSTem:ULOCk` on page 564
`:SYSTem:DLOCk` on page 563
`:SYSTem:KLOCk` on page 563

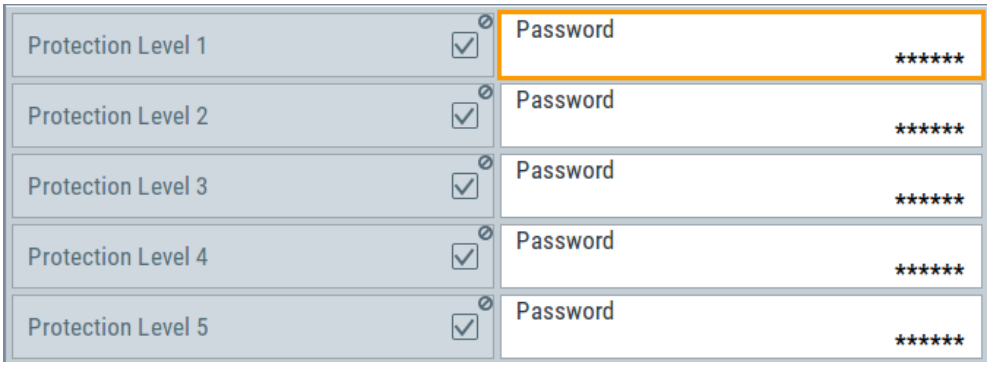
Enabling a locked user interface for manual operation
Follow the instructions listed in "Unlocking (reactivating) the user interface for manual operation" on page 293.

Remote command:
`:SYSTem:ULOCk` on page 564
`:SYSTem:DLOCk` on page 563
`:SYSTem:KLOCk` on page 563

11.4.3 Protection level settings

Access:

► Select "System Config" > "Setup" > "Security" > "Protection".



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 277.

The remote commands required to unlock a protected stage are described in Section 13.17, "SYSTem subsystem", on page 555.

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.

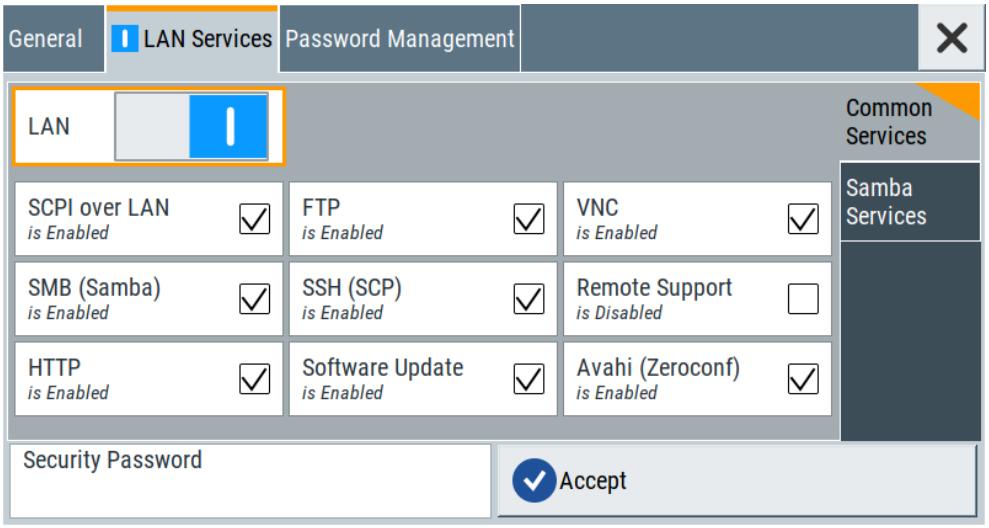
Remote command:
`:SYSTem:PROTect<ch>[:STATe]` on page 566

11.4.4 Configuring LAN services

Access:

1. Select "System Config > Setup > Security > Security > LAN Services > Common Services".
2. **NOTICE!** Risk of loosing access over LAN. Disabling the LAN interface or the common services "SCPI over LAN", "VNC" and "HTTP" locks the remote access to the instrument.

   Do not disable the LAN interface or LAN services needed for remote control while you operate the instrument remotely.
   Proceed with step step 4 for troubleshooting disabled services.

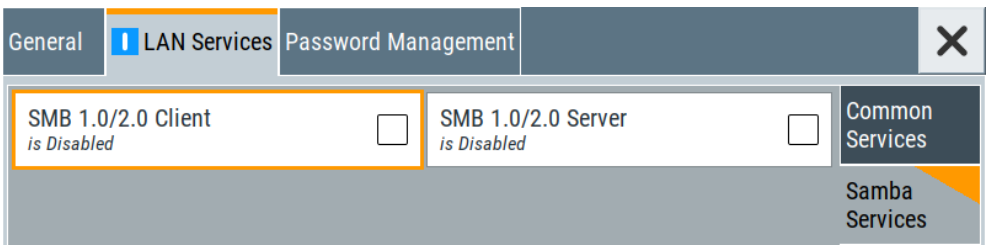


In the "Common Services" side tab, you can individually disable the supported services of the LAN interface.

3. Disable LAN services as needed.
   a) Disable the service.
   b) To confirm disabling, enter the security password.
   c) Select "Accept".

4. If you have locked the access accidentally, you have the following options:
   - Update the instrument firmware using ISO image (`<instrument>_<version-number>.iso`).
     Note: A firmware update with the ISO image resets the instrument. The instrument reset dismisses user-specific configurations and deletes user data. Contact the Rohde & Schwarz (https://www.rohde-schwarz.com/support) to get the ISO image.
   - Ship the instrument to your local service department. The service center experts can enable the remote access over LAN without loosing user-specific settings and data.
     See www.services.rohde-schwarz.com.

5. Select "System Config > Setup > Security > Security > LAN Services > Samba Services".



In the "Samba Services" side tab, you can activate former versions of the SMB client and SMB server.

The remote commands available to control security settings are described in Section 13.17, "SYSTem subsystem", on page 555.

How to:

- "To disable LAN access in general" on page 291
- "To disable LAN services individually" on page 291
- "To enable SMB version 1.0/2.0 client and server" on page 292

Common Services....285
└ LAN....285
└ LAN Services....285
Samba Services....286
└ SMB 1.0/2.0 Client....286
└ SMB 1.0/2.0 Server....287
Security Password....287
Accept....287

Common Services
Enables the LAN interface and supported LAN interface services.

LAN ← Common Services
Enables the LAN interface in general, and thus provides remote access over all unlocked services.

Remote command:
`:SYSTem:SECurity:NETWork[:STATe]` on page 577

LAN Services ← Common Services
Enables the supported LAN interface services individually.

"SCPI over LAN"
Access over LAN to control the instrument remotely, by using SCPI (Standard Commands for Programmable Instruments) commands.
See also "To set up the controller with R&S VISA" on page 346 and "To start remote control with R&S VISA" on page 348

Remote command:
`:SYSTem:SECurity:NETWork:SOE[:STATe]` on page 576

"VNC"
Access over VNC (Virtual Network Computing) interface, a graphical desktop sharing system that uses RFB protocol to control the instrument remotely.
See also Section 12.10, "Setting up remote operation over VNC", on page 364.

Remote command:
`:SYSTem:SECurity:NETWork:VNC[:STATe]` on page 577

"SSH (SCP)" Access over SSH (Secure Shell), a network protocol for secure data communication.

Remote command:
:SYSTem:SECurity:NETWork:SSH[:STATe] on page 576

"Remote Support"
Remote support over SSH (SCP).
The service provides communication for service purposes only.

Remote command:
:SYSTem:SECurity:NETWork:REMSupport[:STATe]
on page 575

"HTTP" Access with HTTP (Hyper Text Transfer Protocol), the application protocol for hypermedia information systems.

Remote command:
:SYSTem:SECurity:NETWork:HTTP[:STATe] on page 574

"FTP" Access with FTP (File Transfer Protocol), used to transfer files from a host to the instrument and vice versa.
See also Section 10.10.2, "Accessing the file system using FTP", on page 245.

Remote command:
:SYSTem:SECurity:NETWork:FTP[:STATe] on page 574

"SMB (Samba)"
Access to SMB (Server Message Block), used for providing shared access to files, printers and serial ports of a network.
See also Section 10.10.3, "Accessing the R&S SMB100B file system using SMB (Samba)", on page 246.

Remote command:
:SYSTem:SECurity:NETWork:SMB[:STATe] on page 576

"Avahi (Zeroconf)"
Avahi, a service for automatic configuration of the instrument in a network environment.

Remote command:
:SYSTem:SECurity:NETWork:AVAHi[:STATe] on page 574

"Software Update"
Allows updating the software.

Remote command:
:SYSTem:SECurity:NETWork:SWUPdate[:STATe] on page 576

Samba Services
Enables support of SMB client and SMB server version 1.0 and 2.0 of the SMB protocol.

Support of version 1.0 and 2.0 is additional to the current SMB protocol version supported in the firmware. This firmware supports SMB protocol up to version 3.1.1.

SMB 1.0/2.0 Client ← Samba Services
Enables support of the SMB client compatible with SMB protocol versions 1.0 and 2.0.

SMB 1.0/2.0 Server ← Samba Services
Enables support of the SMB server compatible with SMB protocol versions 1.0 and 2.0.

Security Password
Enters the password that is required to enable or to disable the settings protected by a security password. Default is *123456*.

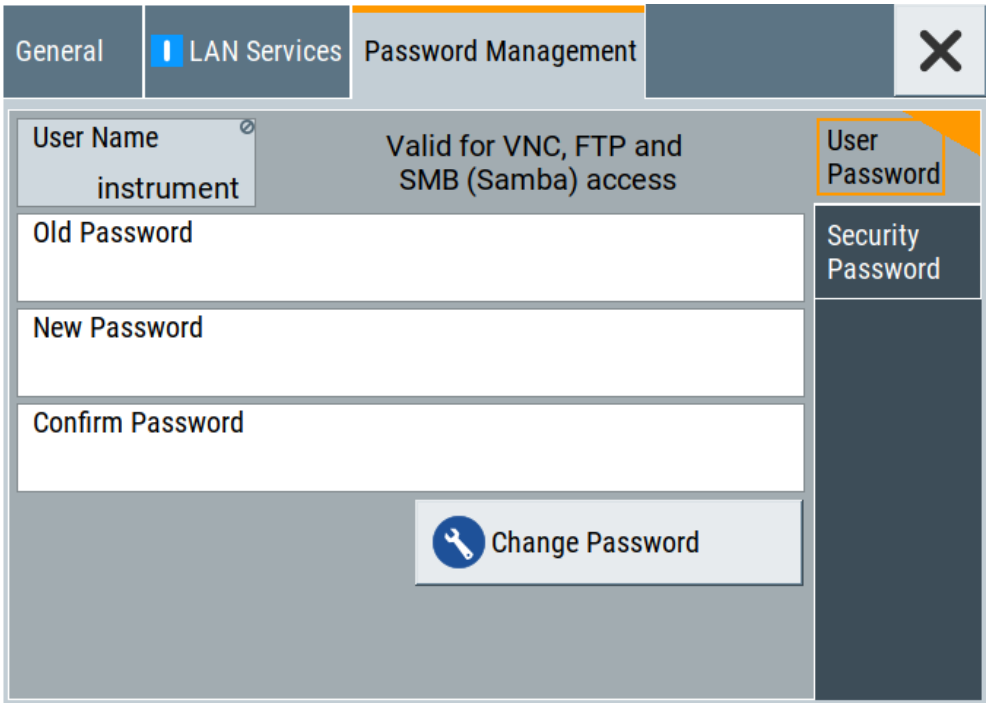
How to: "To change the security password" on page 290

Accept
Applies the modified settings, provided the security password is entered and correct.

11.4.5 Password management

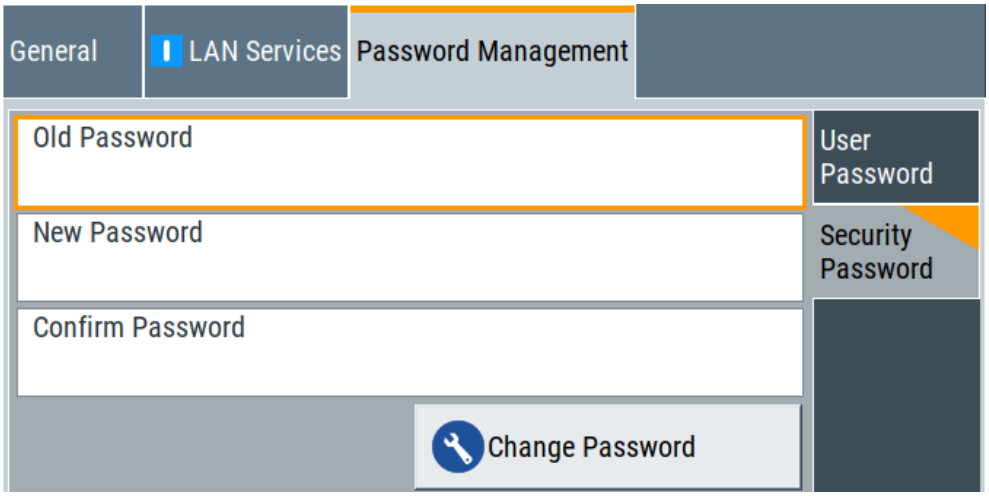
Access:

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".



How to:

- "To change the user password of the instrument" on page 290.
- "To change the security password" on page 290.

Settings:

User Name....288
User Password....288
└ Old Password....288
└ New Password....289
└ Confirm Password....289
└ Change Password....289
Security Password....289
└ Old Password....289
└ New Password....289
└ Confirm Password....289
└ Change Password....290

User Name
Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SMB (Samba) access.

User Password
Access: select "System Config > Setup > Security > Security > Password Management > User Password".

Allows you to change and confirm the user password.

Old Password ← User Password
Enters the current user password. The default password is "instrument".

Note: We recommend that you change the default password before connecting the instrument to a network.

How to:

- "To change the user password of the instrument" on page 290.

- "To change the security password" on page 290.

Note: Note that you cannot reset the password to factory state.
If you encounter problems with the password, contact the Rohde & Schwarz customer support, see Section 14.10, "Contacting customer support", on page 630.

New Password ← User Password
Enters the new user password.

The security password can contain decimal characters only.

Confirm Password ← User Password
Confirms the new user password by repeating.

How to:
- "To change the user password of the instrument" on page 290.
- "To change the security password" on page 290.

Change Password ← User Password
Changes the user password accordingly.

Security Password
Access: select "System Config > Setup > Security > Security > Password Management > Security Password".

Enables you to change and confirm the security password.

Old Password ← Security Password
Enters the currently used security password. The default password is '123456'.

Note: We recommend that you change the default password before connecting the instrument to a network.

How to:
- "To change the user password of the instrument" on page 290.
- "To change the security password" on page 290.

The security password is required when changing the status of the USB and LAN interface or other security settings.

Note: Note that you cannot reset the password to factory state.
If you encounter problems with the password, contact the Rohde & Schwarz customer support, see Section 14.10, "Contacting customer support", on page 630.

New Password ← Security Password
Enters the new security password.

The security password can contain decimal characters only.

Confirm Password ← Security Password
Confirms the new security password by repeating.

How to:
- "To change the user password of the instrument" on page 290.
- "To change the security password" on page 290.

Change Password ← Security Password
Changes the password accordingly.

11.4.6 Preventing unauthorized access

The default computer name and user password are *instrument*. The user password is the password required for VNC, FTP and SMB (samba) connections. If for example, the VNC service or FTP are enabled, anyone in the network who knows the computer name and user password of the instrument can access it.

The default security password is *123456*. The security password is required when changing the status of the USB and LAN interfaces.

To prevent unauthorized access, use the following configurations exclusively or complementary:

- "To change the user password of the instrument" on page 290
- "To change the security password" on page 290
- "To disable LAN access in general" on page 291
- "To disable LAN services individually" on page 291
- "To enable SMB version 1.0/2.0 client and server" on page 292
- "To disable frequency and level indication in the status bar" on page 293
- "To disable the user interface" on page 293

If security is a concern, see the document instrument security procedures for comprehensive description.

To change the user password of the instrument

► **Note:** We recommend that you change the default password before connecting the instrument to a network.

How to:
- "To change the user password of the instrument" on page 290.
- "To change the security password" on page 290.

a) Select "System Config > Setup > Security > Security > Password Management > User Password".
b) Enter the current password in the "Old Password" field.
c) Enter the new password in the "New Password" and "Confirm Password" fields.
d) Select "Change Password".

The user password is changed; the user name is displayed ("Security > Password Management > User Password > User Name").

To change the security password

► **Note:** We recommend that you change the default password before connecting the instrument to a network.

How to:
- "To change the user password of the instrument" on page 290.

- "To change the security password" on page 290.

a) Select "System Config > Setup > Security > Security > Password Management > Security Password".
b) Enter the current password in the "Old Password" field.
The default password is *123456*.
c) Enter the new password in the "New Password" and "Confirm Password" fields.
d) Select "Change Password".

To disable LAN access in general

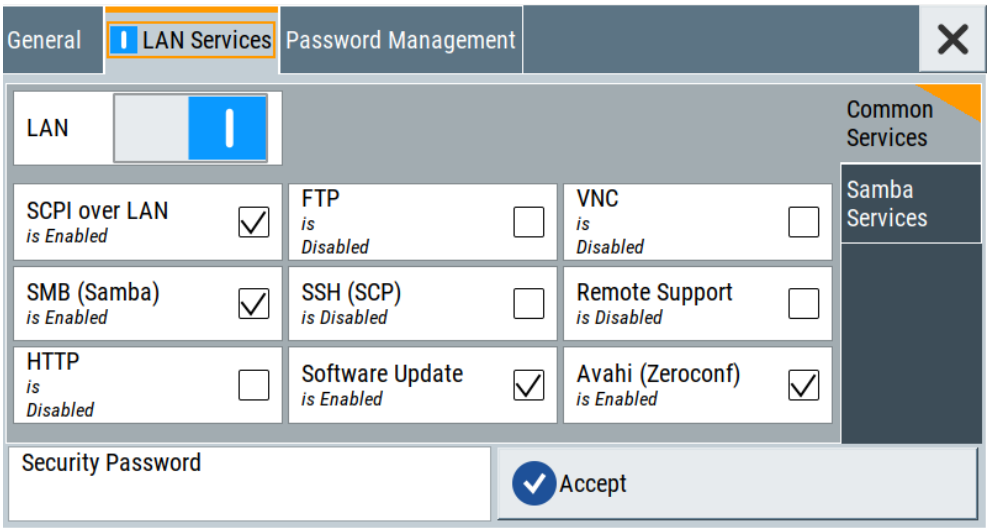
1. **NOTICE!** Risk of loosing access over LAN. Disabling the LAN interface or certain services lock the remote access to the instrument.
The following services lock the remote access when disabled: "LAN", "SCPI over LAN", "VNC" and "HTTP".

   If you have locked the access accidentally, you have the following options:
   - Update the instrument firmware using ISO image (`<instrument>_<version-number>.iso`).
     Note: A firmware update with the ISO image resets the instrument. The instrument reset dismisses user-specific configurations and deletes user data. Contact the Rohde & Schwarz (https://www.rohde-schwarz.com/support) to get the ISO image.
   - Ship the instrument to your local service department. The service center experts can enable the remote access over LAN without loosing user-specific settings and data.
     See www.services.rohde-schwarz.com.
2. Select "System Config > Setup > Security > Security".
3. Select "LAN Services > Common Services".
4. Disable "LAN" state.
5. Enter the Security Password.
6. Select "Accept".

   All LAN connections are blocked, including the LAN services. Communication over LAN is not possible.

To disable LAN services individually

1. Select "System Config > Setup > Security > Security".
2. Select "LAN Services > Common Services".
3. Uncheck all services you want to block, for example "FTP > Off" or "VNC > Off".



4. Uncheck the services you want to block, for example "FTP" and "VNC".
5. Enable "LAN" state, if disabled.
6. Enter the Security Password.
7. Select "Accept".

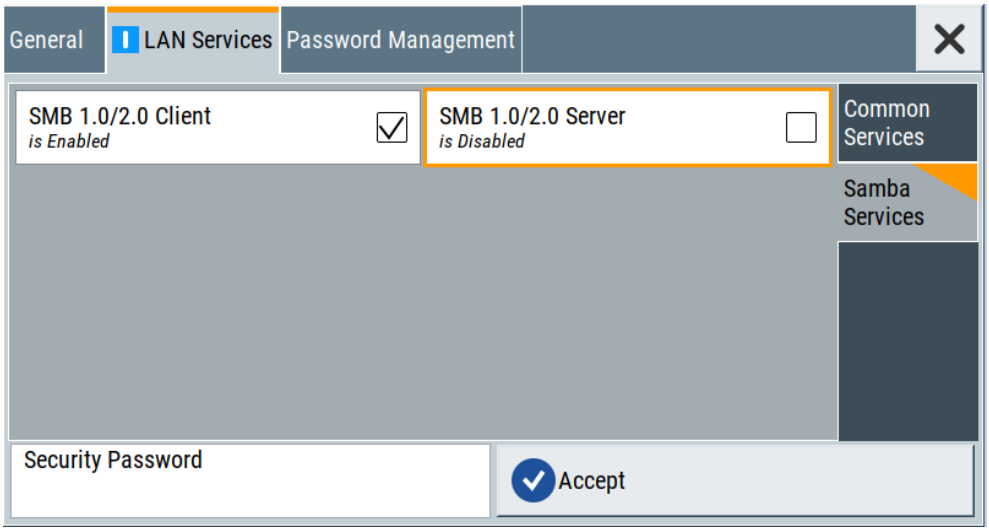
   Communication over LAN is possible for the enabled services only.

To enable SMB version 1.0/2.0 client and server

By default, support of SMB client and SMB server of the SMB protocol versions 1.0 and 2.0 is disabled.

Activate support only, if needed:

1. Select "System Config > Setup > Security > Security".
2. Select "LAN Services > Samba Services".



3. For example, check "SMB 1.0/2.0 Client".
4. Select "SMB 1.0/2.0 Client > On" and "SMB 1.0/2.0 Server > On".
5. Enter the Security Password.
6. Select "Accept".

   Enables the access for the SMB Samba client, the access for the SMB Samba server remains blocked.

To disable frequency and level indication in the status bar

These settings are useful to prevent unauthorized personnel from reading the display, when you remotely control the instrument from a different location.

1. Select "System Config > Setup > Security > General > Manual Operation".
2. Select "Annotation Frequency > Off" or "Annotation Amplitude > Off".
3. Enter the Security Password.
4. Select "Accept".

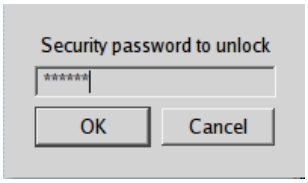
To disable the user interface

1. Select "System Config > Setup > Security > General > Manual Operation".
2. Select "User Interface > Disabled".
3. Enter the Security Password.
4. Select "Accept".

   The screen shuts off and displays a padlock symbol instead.
   There are further possible configurations. For details, see "User Interface" on page 281.

Unlocking (reactivating) the user interface for manual operation

1. In manual operation:
   a) On the instrument's keypad or external keyboard, press any key.
   The instrument prompts you to enter the security password for unlocking.

   If you press the character of the first key, the input field accepts the character immediately.
   b) Delete the entry before inserting the password.
   Enter the security password *123456*.
2. In remote control mode:

a) Send the command `SYST:ULOC ENABled` to release all locks at once.
b) Send the command `SYST:KLOC OFF` to unlock the keyboard and touchscreen.
c) Send the command `SYST:DLOC OFF` to release all locks.

Via remote control, there is no password required.

11.5 Undoing or restoring actions

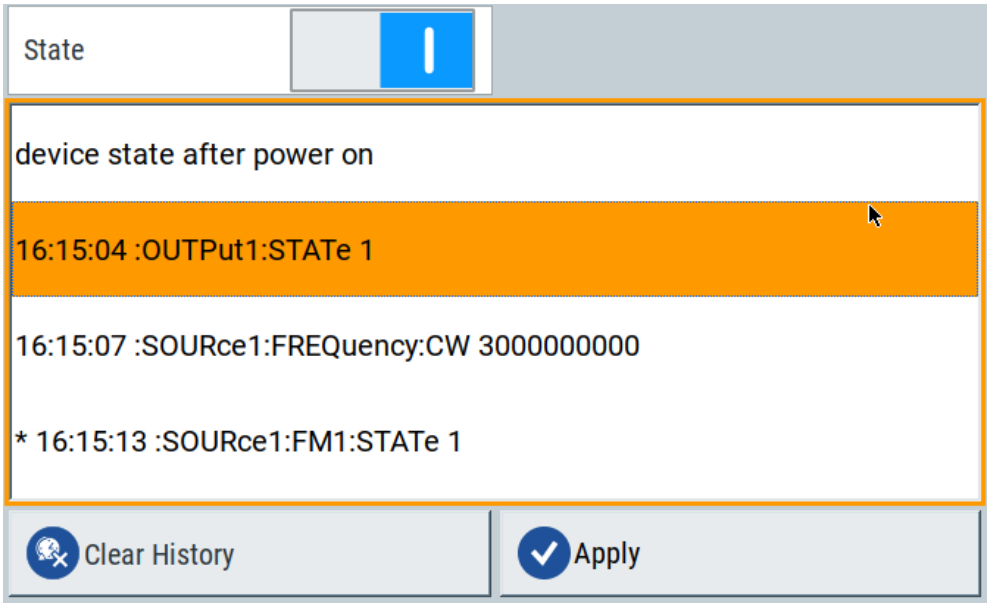
"Undo" is a function that removes the effect of the last action on the instrument and reverts it to an older state. Conversely, "Redo" restores a previously undone action.

You can "Undo/Redo" actions according to two criteria:

- Step by step
  Gradually undo/redo the actions in reverse order as previously performed. Depending on the available memory the "Undo/Redo" steps may restore all actions.
- Multiple steps at once
  Select any specific action in the history list to "Undo/Redo" multiple actions in a single step.
  Note: This mode requires a system restoration file on the instrument.

Access:

► Select "Setup > Settings > Undo/Redo".



The dialog contains all functions for enabling the "Undo/Redo" functionality.

Settings:

State 295
History List 295
Clear History 295
Apply 295

State
Enables the recording of the performed actions.

History List
Lists the performed actions, provided "Undo/Redo" state is "On".

Clear History
Deletes the recorded list of the performed steps.

Apply
Performs the "Undo/Redo".

If you select a previously performed action of the list, all subsequent actions are undone. The list entries remain.

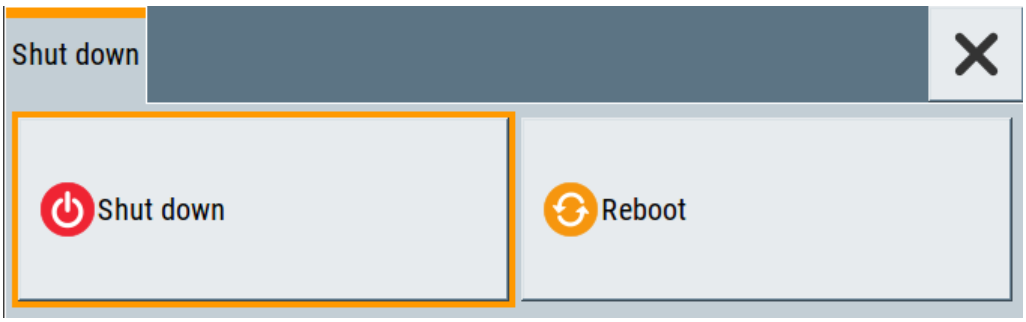
If you select a subsequently executed action, you can restore all the actions undone up to this state.

11.6 Shutting down and rebooting the instrument

The [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".



- `:SYSTem:REBoot` on page 584
- `:SYSTem:SHUTdown` on page 585

12 Network operation and remote control

As an alternative to the interactive operation directly at the instrument, you can operate the R&S SMB100B also from a remote location.

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, as described in Section 12.1, "Overview of remote access modes", on page 297.

Figure 12-1 shows the possibilities of the physical connection (interfaces) for remote access.

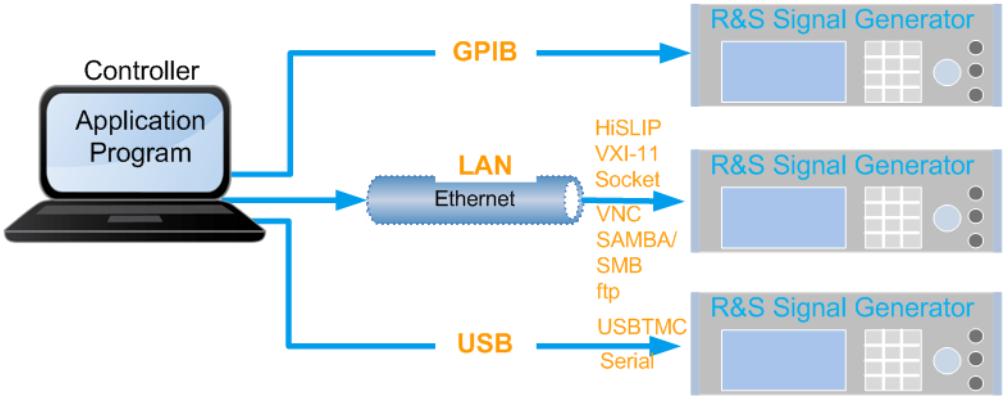


Figure 12-1: Supported remote connections

The following descriptions provide information required for operating the R&S SMB100B remotely. The information applies to all applications and operating modes supported by the instrument. Definitions specified in the SCPI standard are not provided.

For basic knowledge on remote control operation and additional information, see the following documents, available on the Rohde & Schwarz website:

- Getting started: Remote control via SCPI
- Application note 1GP72: "Connectivity of Rohde&Schwarz Signal Generators"
- Application note 1MA208: "Fast Remote Instrument Control with HiSLIP"
- Application note 1GP98: "SCPI Recorder Test Automation on a Fingertip"

- Overview of remote access modes 297
- Remote control interfaces and protocols 298
- Remote control programs and libraries 303
- Status reporting system 306
- Remote access settings 309
- LXI status settings 332
- LXI browser settings 333
- Setting up remote control 340

- Using remote command scripts....354
- Setting up remote operation over VNC....364
- References....370

12.1 Overview of remote access modes

This section outlines the possible access modes and their major characteristics.

Remote control (SCPI)

- A remote PC controls the instrument, usually via VISA (Virtual Instrument Software Architecture) interfaces.
- Remote control disables the manual operation of the instrument; you can set different lock states.
- The GUI is not visible.
- Remote control commands (SCPI) perform the settings, either individually or in sequences (SCPI programs).
- Using SCPI programs is faster than the manual operation, since they automate repeating applications.

Remote operation (VNC)

- A remote device accesses the instrument via the common platform technology VNC (Virtual Network Computing).
- The protocol allows simultaneous operation from several remote devices and the instrument nevertheless remains locally operable.
- The GUI is visible.
- To perform the settings, you can operate the instrument as with the manual control.
- During remote operation via VNC, the direct control of the instrument is not disabled.
  You can control the instrument from the front panel and via the remote computer alternately.
- Clients supporting remote operation depend on the used remote device, see Table 12-1.
- How to: see Section 12.10, "Setting up remote operation over VNC", on page 364.

Table 12-1: 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.

Remote device	VNC client	Requirements	Characteristics
	• Web browser with HTML5	*Web sockets* must be supported.	Slower than the other modes. No additional installation or activation required. No security concern.
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`.

How to:

Section 10.10.2, "Accessing the file system using FTP", on page 245.

Section 10.10.3, "Accessing the R&S SMB100B file system using SMB (Samba)", on page 246

"To enable SMB version 1.0/2.0 client and server" on page 292

12.2 Remote control interfaces and protocols

The instrument supports various interfaces for remote control. Table 12-2 gives an overview on the connectivity:

Table 12-2: Remote control interfaces and protocols

Interface	Protocols, VISA*) address string and library	Remarks

Local area network (LAN)	• **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 at the rear panel of the instrument.
		The interface is based on TCP/IP, see Section 12.2.1, "LAN interface", on page 299 for details on the address information.

USB	• **USBTMC** `USB::<vendor ID>::<product ID>::<serial number>[::INSTR]` VISA	The USB In connector is at the rear panel of the instrument. For a description of the interface, see Section 12.2.2, "USB interface", on page 301

Interface	Protocols, VISA*) address string and library	Remarks
GPIB (IEC/IEEE Bus Interface)	• VISA*) address string: `GPIB::<address>[::INSTR]` (no secondary address) VISA (optional)	The optional GPIB bus interface according to standard IEC 625.1/IEEE 488.1 is at the rear panel of the instrument. For a description of the interface, see Section 12.2.3, "GPIB interface (IEC/IEEE bus interface)", on page 302.
*) 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. When using socket communication or the GPIB interface, VISA installation is optional. For basic information, see Remote control via SCPI.		



www.rohde-schwarz.com/rsvisa provides the standardized I/O software library R&S VISA for download at the Rohde & Schwarz website www.rohde-schwarz.com/rsvisa.

How to: Section 12.8, "Setting up remote control", on page 340 describes how to configure the remote control interfaces.

- LAN interface 299
- USB interface 301
- GPIB interface (IEC/IEEE bus interface) 302
- LXI browser interface 303

12.2.1 LAN interface

The LAN interface of the instrument consists of a connector, a network interface card and protocols.

For remote control, the instrument and the controller PC must be connected to a common network with TCP/IP network protocol.

There are two methods to establish a LAN connection to the instrument:

- A non-dedicated network (Ethernet) connection from the instrument to an existing network.
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer.

How to: Section 3.1.7, "Connecting to LAN", on page 25



Identifying instruments in a network

If several instruments are connected to the network, each instrument has its own IP address and associated resource string. The controller identifies these instruments by the resource string.

VISA resource strings

The VISA resource string is required to establish a communication session between the controller and the instrument in the LAN. The resource string is a unique identifier,

composed of the specific IP address of the instrument and some network and VISA-specific keywords.

TCPIP::<host address>[::<LAN device name>][::INSTR]

TCPIP = designates the network protocol
host address = designates the IP address or hostname of the instrument
[::LAN device name] = defines the protocol and the instance number of a subinstrument
[::INSTR] = indicates the instrument resource class (optional)

The **IP address** (host address/computer name) is used by the programs to identify and control the instrument. It is automatically assigned by the DHCP server the first time the device is registered in the network. Optionally, you can also assign its **LAN device name**.

If assigned, the IP address is displayed in the home screen.

The following section lists the characteristics of the VISA resource strings for the corresponding interface protocols. The emphasized characters determine the protocol.



For description of the interface protocols, control commands and messages, refer to Remote control via SCPI.

HiSLIP

TCPIP::<host address>::hislip0[::INSTR]

hislip0 = HiSLIP device name, designates that the interface protocol HiSLIP is used (mandatory)

hislip0 is composed of `[::HiSLIP device name[,HiSLIP port]]` and must be assigned.

Example:

```
TCPIP::192.1.2.3::hislip0
```

VXI-11

TCPIP::<host address>[::inst0][::INSTR]

[::inst0] = LAN device name, indicates that the VXI-11 protocol is used (optional)

inst0 currently selects the VXI-11 protocol by default and can be omitted.

Example:

```
TCPIP::192.1.2.3::INSTR
```

Socket communication

TCPIP::<host address>::<port>::SOCKET

port = determines the used port number
SOCKET = indicates the raw network socket resource class

Socket communication requires the specification of the port (commonly referred to as port number) and of "SOCKET" to complete the resource string.

Basically, instruments from Rohde & Schwarz use port number 5025 for socket communication.

Example:

```
TCPIP::192.1.2.3::5025::SOCKET
```

12.2.2 USB interface

Option: R&S SMBB-K986

For remote control using USB, the controller PC and the instrument must be connected over the USB type B interface. Software for instrument control and the VISA program library must be installed on the controller.

The serial interface "RS232" enables you to connect the instrument over serial interface. You can connect to the interface by using the external USB/serial-adapter R&S TS1-USB and a serial crossover (null modem) cable.

For more information, refer to the specifications document.

VISA detects and configures the Rohde & Schwarz instrument automatically when the USB connection is established. You do not have to install a separate driver.

USBTMC (USB Test & Measurement Class Specification) is a protocol that is built on top of USB for communication with USB devices. It defines class code information of the instrument, that identifies its functionality to load the respective device driver. Using VISA library, the protocol supports service request, trigger, and other specific operations.

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 at the rear of the instrument
[::INSTR] = indicates the instrument resource class (optional)

RS232 resource string

The RS232 resource string represents the addressing scheme for a device connected to the serial interface of the instrument.

The USB resource string syntax is as follows:

ASRL<port number>[::INSTR]

`ASRL` is the name of the serial interface

`<port number>` is the number of the serial interface

Example:

`ASRL1::INSTR`

12.2.3 GPIB interface (IEC/IEEE bus interface)

Option: R&S SMBB-K986

To control the R&S SMB100B over the GPIB bus, the instrument and the controller PC must be connected with a GPIB bus cable. A GPIB bus card, the card drivers and the program libraries for the used programming language must be installed on the controller.

For description of the characteristics, control commands and messages of the GPIB interface, refer to Remote control via SCPI.

GPIB address

The controller PC addresses the instrument with the GPIB bus channel, see Section 12.5.3, "GPIB address settings", on page 314. GPIB provides channel addresses from 0 to 30.

The GPIB resource string syntax is as follows:

GPIB::<channel>[::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.

Example:

`GPIB::28::INSTR`

28 is the selected GPIB bus channel

12.2.4 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 Section 12.11.1, "LXI functionality", on page 370 for more about LXI.

The LAN settings are configured using the instrument's LXI browser interface described in Section 12.7.1, "LAN configuration", on page 335.

For LXI status information in the R&S SMB100B, see Section 12.6, "LXI status settings", on page 332.

12.3 Remote control programs and libraries

This section shows how the remote-control programs access the instrument, and the libraries they require for the corresponding interface protocols.

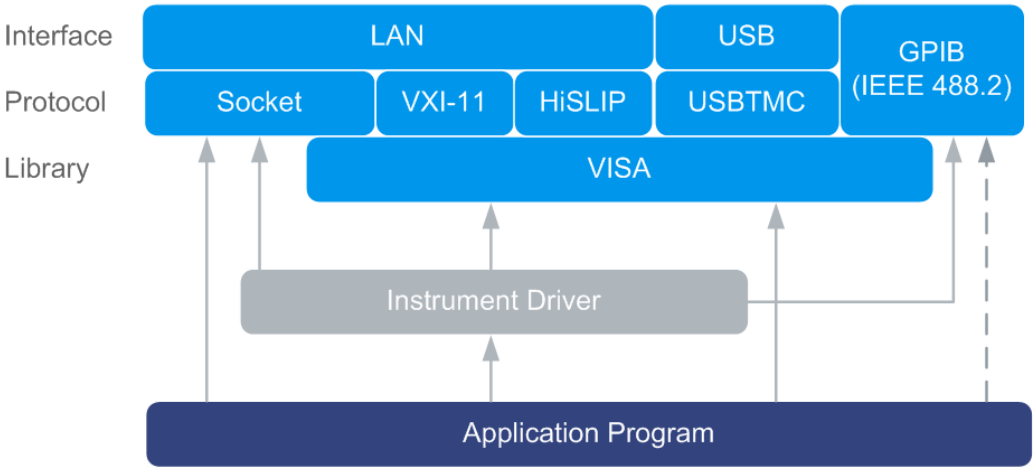


Figure 12-2: Overview of remote control interfaces, protocols and libraries

Possible setups and access functions

The following examples give an overview of dependencies between the available libraries, the possible interfaces and protocols, and whether an instrument driver is provided. For detailed information, see the application note 1GP72.

Example: Remote control (application) program using VISA

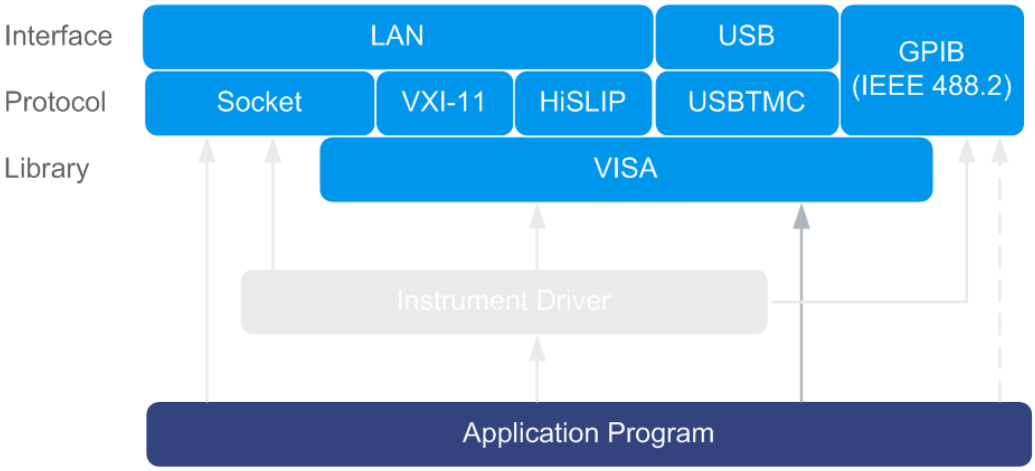


Figure 12-3: Application program using VISA

Protocol	Remote control program
Socket	`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")`

Example: Remote control program using instrument driver (VISA available)

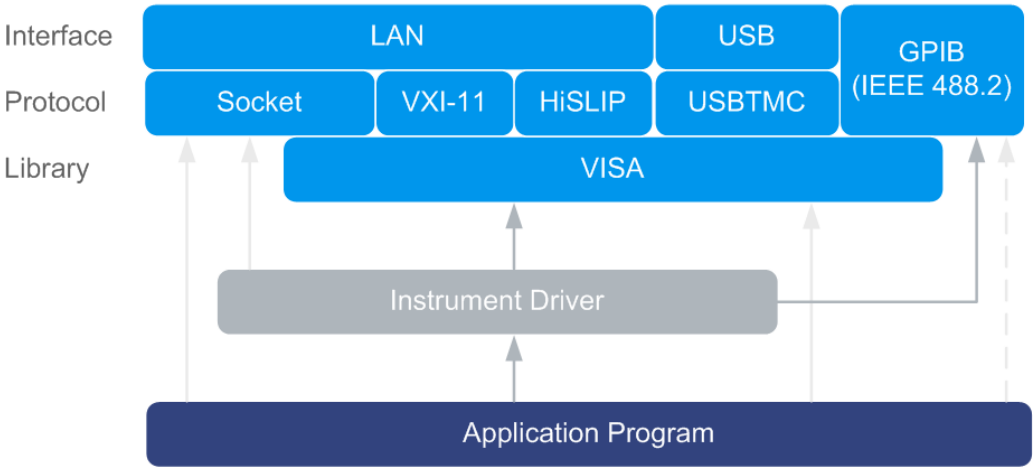


Figure 12-4: Application using instrument driver (VISA available)

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)`

Example: Remote control program using instrument driver (VISA not available)

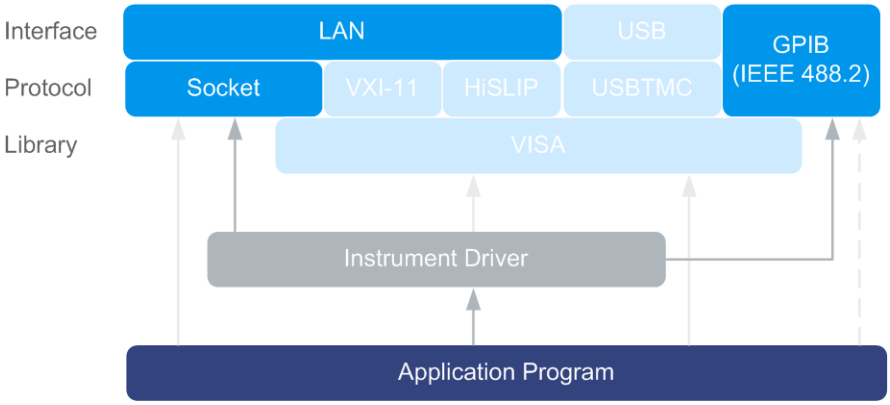


Figure 12-5: Remote control program using instrument driver (VISA not available)

Protocol	Remote control program
Socket	`rssmb_init ("TCPIP:SMB100B-102030::5025::SOCKET", ...)` `rssmb_SetFrequency (..., 2e9)`
GPIB	`rssmb_init ("GPIB::28::INSTR", ...)` `rssmb_SetFrequency (..., 2e9)`

12.4 Status reporting system

The status reporting system stores all information on the current operating state of the instrument and on errors which have occurred. This information is stored in the status registers and in the error queue. You can query the status of the registers with the remote commands of the Section 13.18, "STATus subsystem", on page 585.

12.4.1 Overview of the status registers

The Figure 12-6 shows the hierarchical structure of information in the status registers (ascending from left to right).

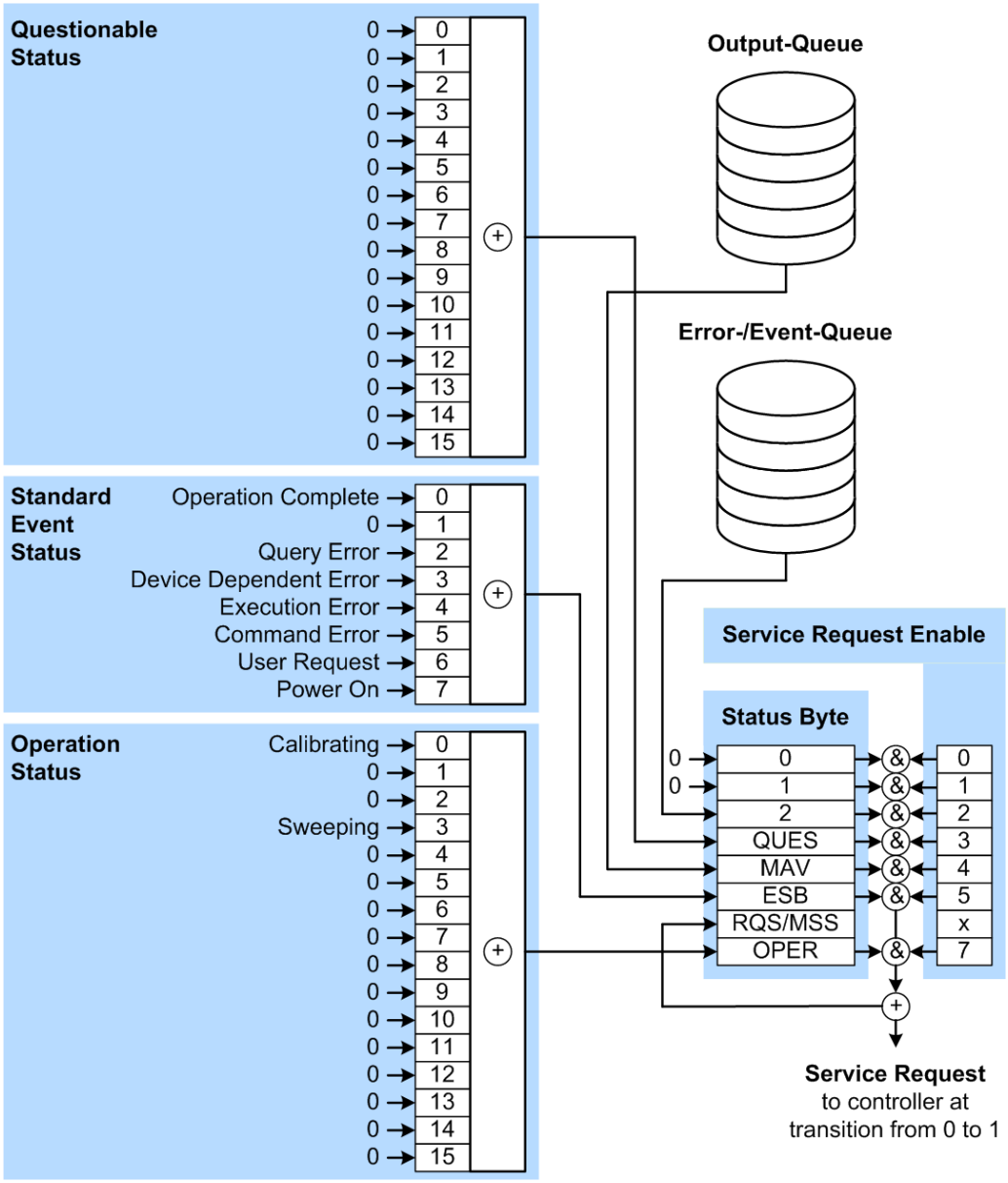


Figure 12-6: Graphical overview of the status registers hierarchy

OPER = Operation Status Summary Bit
RQS/MSS = Service Request Generation
ESB = Standard Event Status Summary Bit
MAV = Message Available in Output Queue
QUES = Questionable Status Summary Bit
2 = Error- /Event-Queue
1, 0 = not used

The following sections describe the instrument-specific bit assignments of the operation status and the questionable status registers.

For more information, see:

- Remote control via SCPI: provides general information on the status reporting system of Rohde & Schwarz instruments. This document also provides information on the standard event status register and the error queue.
- SCPI standard documentation for comprehensive information on the standard

12.4.2 Instrument-specific status operation register

The condition part contains information on currently executed actions. The event part covers information on the actions performed since the last readout of the register.

To read the register, use the query commands `:STATus:OPERation:CONDition?` on page 586 and `:STATus:OPERation[:EVENt]` on page 587.

The remote commands for the status questionable register are described in Section 13.18, "STATus subsystem", on page 585.

Table 12-3: Assignment of the bits used in the operation status register

Bit No.	Meaning
0	Calibrating The bit is set during the calibration phase.
1–2	Not used
3	Sweeping This bit is set during a sweep in automatic or single mode.
4–15	Not used

12.4.3 Instrument-specific status questionable register

This status register contains information on questionable instrument states. Questionable states occur when the instrument is not operated in compliance with its specifications.

To read the register, use the query commands `:STATus:QUEStionable:CONDition` on page 588 or `:STATus:QUEStionable[:EVENt]` on page 588.

The remote commands for the status questionable register are described in Section 13.18, "STATus subsystem", on page 585.

Table 12-4: Assignment of the bits used in the questionable status register

Bit No.	Meaning
0–15	Not used

12.4.4 Reset values of the status reporting system

The following table contains the different commands and events causing the status reporting system to be reset. None of the commands, except for `*RST` and `SYSTem:PRESet` affect the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table 12-5: Resetting the status reporting system

Event	**Switching on supply voltage** **Power-On-Status-Clear**		`DCL`, `SDC` **(Device Clear, Selected Device Clear)**	`*RST` **or** `SYSTem:PRESet`	`STATus:PRESet`	`*CLS`
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.						

12.5 Remote access settings

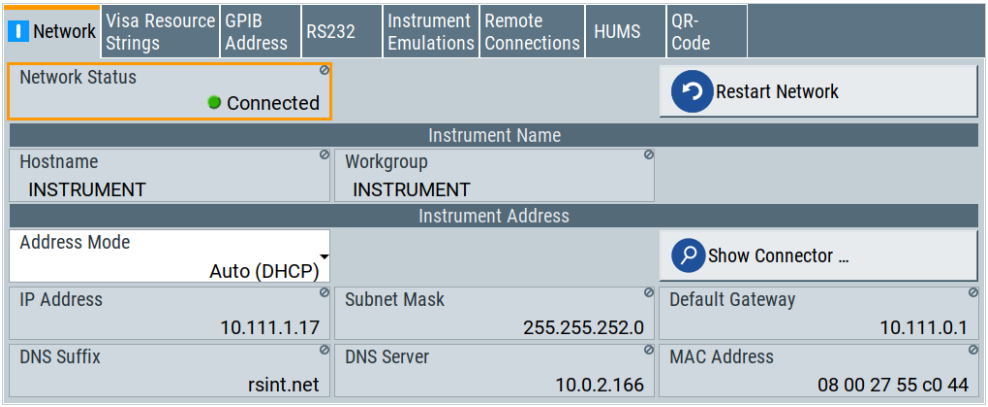
This section describes the settings required for accessing and configuring the provided remote control interfaces. It includes network settings, access addresses, emulation settings for using the command sets of other generators, and the access with smart devices.

- Network settings....310
- VISA resource strings settings....313
- GPIB address settings....314
- RS232 settings....315
- Instrument emulations settings....316
- Active remote connection settings....318
- Closed remote connection settings....319
- HUMS settings....320
- HUMS enhanced settings....322
- QR code....331

12.5.1 Network settings

Access:

► Select "System Config" > "Remote Access" > "Network".



The "Network" dialog provides settings of the general network environment, and specific identification parameters of the instrument in the network. If necessary, you can configure the instrument address settings manually.
How to: "To assign the instrument address manually" on page 342.

The remote commands required to configure the network remotely are described in Section 13.17, "SYSTem subsystem", on page 555.

Settings:

Network Status....310
Restart Network....310
Hostname....311
Workgroup....311
Address Mode....311
IP Address....311
Subnet Mask....311
Default Gateway....312
DNS Suffix....312
DNS Server....312
MAC Address....312

Network Status
Indicates that the instrument is connected to the network.

Remote command:
`:SYSTem:COMMunicate:NETWork:STATus?` on page 569

Restart Network
Terminates the network connection of the instrument and sets it up again. You can use this function to fix network problems.

Note: This function restarts only the connection of the instrument to the network. It does not impact the network itself.

Remote command:
:SYSTem:COMMunicate:NETWork:RESTart on page 569

Hostname
Displays the hostname.

Each instrument is delivered with an assigned hostname, a logical name which can be used instead of the IP address. With the default network settings, the IP address is allocated by the DHCP server. This address can change each time the instrument is reconnected. Unlike the IP address, the hostname name does not change.

Note:
This function is password-protected. Unlock the protection level 1 to access it.

- We recommend that you do not change the default network settings or the hostname to avoid problems with the network connection.
  If you change the hostname, be sure to use a unique name.

Remote command:
:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname on page 569

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 570

Address Mode
Selects the mode for assigning the IP address.

"Auto (DHCP)"
Assigns the IP address automatically, provided the network supports DHCP (Dynamic Host Configuration Protocol).

"Static" Enables you to assign the IP address manually.

Remote command:
:SYSTem:COMMunicate:NETWork:IPADdress:MODE on page 568

IP Address
Displays the IP address of the instrument in the network.

To assign the IP address manually, see "To assign the instrument address manually" on page 342.

Remote command:
:SYSTem:COMMunicate:NETWork:IPADdress on page 568

Subnet Mask
Displays the bit group of the subnet in the host identifier.

The TCP/IP protocol is preinstalled with the subnet mask 255.255.255.0. If the DHCP server is available Address Mode A AUTO (DHCP), the setting is read-only. The subnet mask consists of four number blocks separated by dots. Each block contains 3 numbers in maximum (e.g. 100.100.100.100), but also one or two numbers are allowed in a block (as an example see the preinstalled address).

To assign the subnet mask manually, select Address Mode > Static.

Note: When assigning the subnet mask manually, make sure that the address matches with the subnet mask of the controlling host interface.

How to: "To assign the instrument address manually" on page 342.

Remote command:
`:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK` on page 570

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 570

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 569

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 570

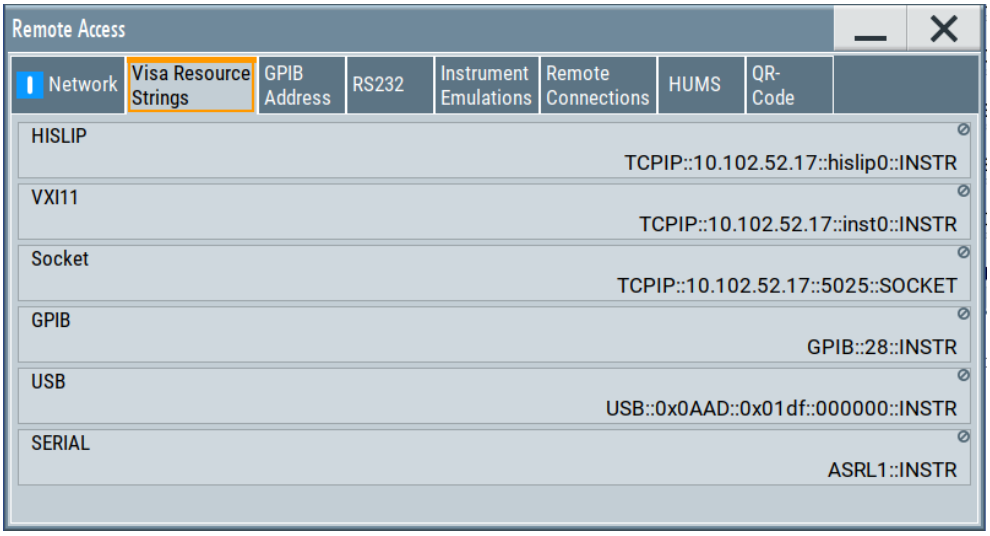
MAC Address
Indicates the MAC (Media Access Control) address, a unique identifier of the network adapter in the R&S SMB100B.

Remote command:
`:SYSTem:COMMunicate:NETWork:MACaddress` on page 568

12.5.2 VISA resource strings settings

Access:

► Select "System Config" > "Remote Access" > "Visa Resource Strings".



The "Visa Resource String" dialog displays the VISA resource strings provided for remote control over the different interfaces.

The remote commands required to query the address information remotely are described in Section 13.17, "SYSTem subsystem", on page 555.

Settings:

HISLIP....313
VXI11....313
Socket....314
GPIB....314
USB....314
SERIAL....314

HISLIP
Displays the visa resource string for remote control with HiSLIP protocol.

See also Section 12.2.1, "LAN interface", on page 299.

Remote command:
`:SYSTem:COMMunicate:HISLip:RESource?` on page 567

VXI11
Displays the visa resource string for remote control over LAN.

See also Section 12.2.1, "LAN interface", on page 299.

Remote command:
`:SYSTem:COMMunicate:NETWork:RESource?` on page 568

Socket
Displays the visa resource string for remote control over LAN, using the socket communication protocol.

See also Section 12.2.1, "LAN interface", on page 299.

Remote command:
`:SYSTem:COMMunicate:SOCKet:RESource?` on page 571

GPIB
Displays the visa resource string for remote control over the GPIB interface.

See also Section 12.2.3, "GPIB interface (IEC/IEEE bus interface)", on page 302.

Remote command:
`:SYSTem:COMMunicate:HISLip:RESource?` on page 567

USB
Displays the visa resource string for remote control over the USB interface.

See also Section 12.2.2, "USB interface", on page 301.

Remote command:
`:SYSTem:COMMunicate:USB:RESource?` on page 572

SERIAL
Displays the visa resource string for remote control over the serial interface.

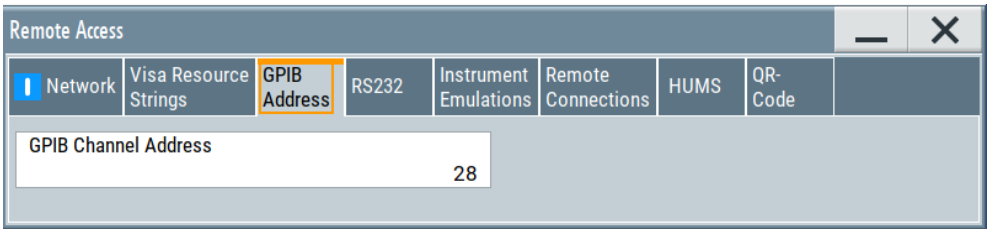
See also Section 12.2.2, "USB interface", on page 301.

Remote command:
`:SYSTem:COMMunicate:SERial:RESource?` on page 571

12.5.3 GPIB address settings

Access:

► Select "System Config" > "Remote Access" > "GPIB Address".



The "GPIB Address" enables you to select the channel for remote control over the IEC/IEE bus interface.

The remote command to configure the setting remotely is described in Section 13.17, "SYSTem subsystem", on page 555.

Settings:

GPIB Channel Address 315

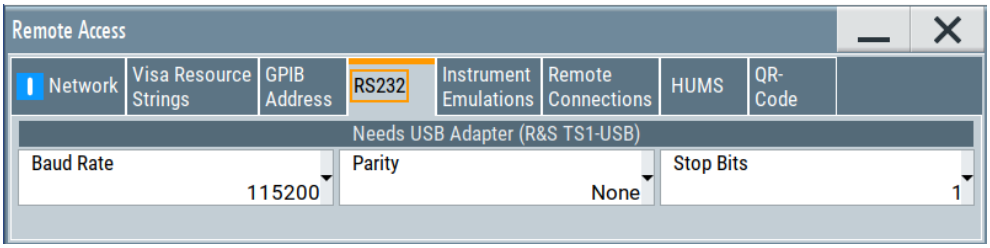
GPIB Channel Address
Sets the GPIB (IEC/IEEE bus) channel address for the connected instrument.

Remote command:
`:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` on page 567

12.5.4 RS232 settings

Access:

► Select "System Config > Remote Access > RS232".



The "RS232" dialog enables you to control the instrument over a serial interface using a USB adapter. The controller and the instrument must be connected with the external USB/serial-adapter R&S TS1-USB and a serial crossover (null modem) cable. The 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.

For more information, refer to the specifications document.

The remote commands required to configure the parameters remotely are described in Section 13.17, "SYSTem subsystem", on page 555.

Settings:

Baud Rate
Sets the baudrate for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:BAUD` on page 570

Parity
Sets the parity for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:PARity` on page 571

Stop Bits
Sets the number of stop bits for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:SBITs` on page 571

12.5.5 Instrument emulations settings

About instrument emulations

You can remotely control the R&S SMB100B using the command set of another signal 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 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`.

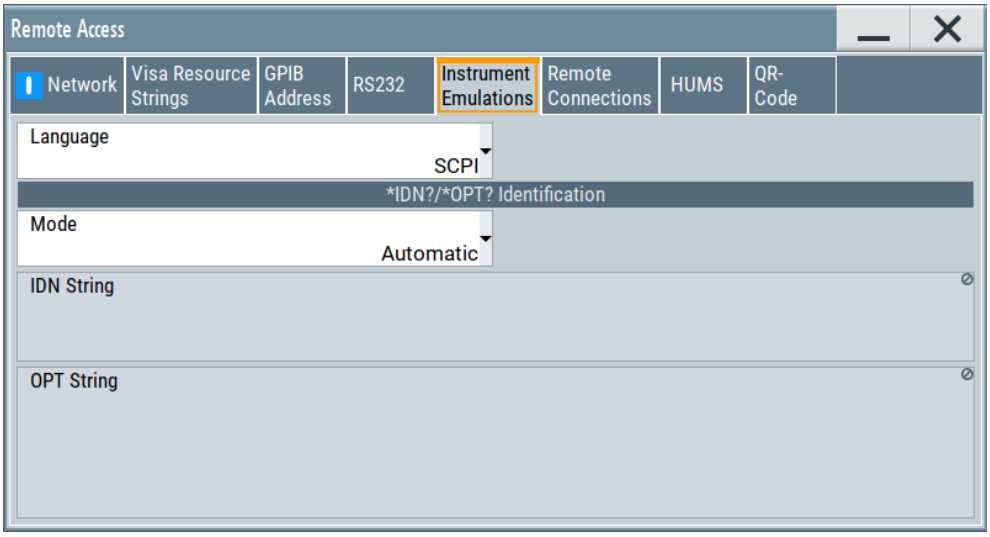
While working in an emulation mode, the R&S SMB100B specific command set is disabled and the SCPI command `:SYSTem:LANGuage` is discarded.

To return to the SCPI command set of the R&S SMB100B, use the corresponding 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.

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 Section 13.17, "SYSTem subsystem", on page 555.

Settings:

Language
Selects the instrument whose remote command set is emulated by the R&S SMB100B.

Remote command:
`:SYSTem:LANGuage` on page 573

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 572

Set to Default
In "Mode > User Defined", resets the `*IDN` and `*OPT` strings.

Remote command:
`:SYSTem:IDENtification:PRESet` on page 572

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 377
`:SYSTem:IRESponse` on page 573

OPT String
Indicates the option string of the instrument as queried with common command `*OPT?`.

In Mode > "User Defined", you can define your own option string. A query responds with this option string instead of the automatically created option string.

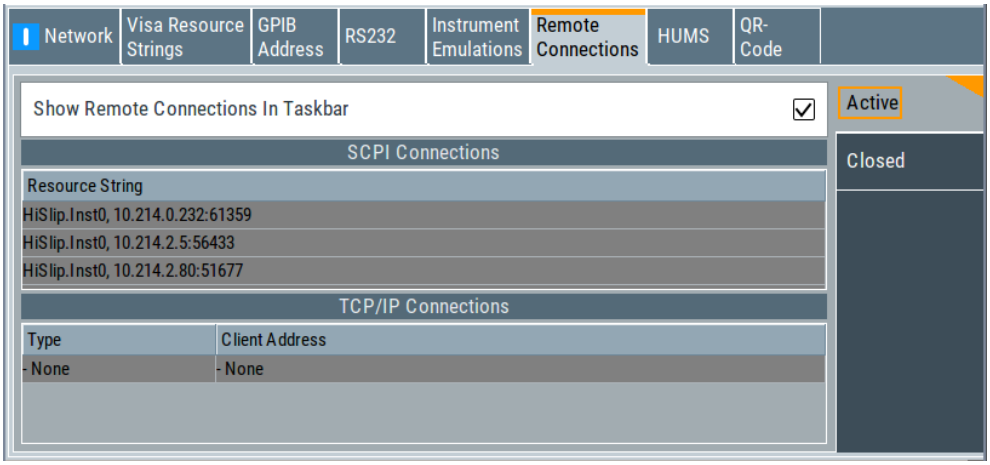
Remote command:
`*OPT?` on page 377
`:SYSTem:ORESponse` on page 573

12.5.6 Active remote connection settings

This dialog displays the active SCPI and TCP/IP connections.

Access:

1. Select "System Config" > "Remote Access" > "Remote Connections".
2. Select "Active".



The "Active" tab shows the currently active remote connections, and you can enable the display of the active connections in the task bar.

Settings:

Show Remote Connections in Taskbar 319
SCPI Connections 319
TCP/IP Connections 319

Show Remote Connections in Taskbar
Displays the currently active connections in the taskbar.

SCPI Connections
Displays the VISA resources strings of the remote connections currently controlling the instrument via the LAN interface.

Remote command:
n.a.

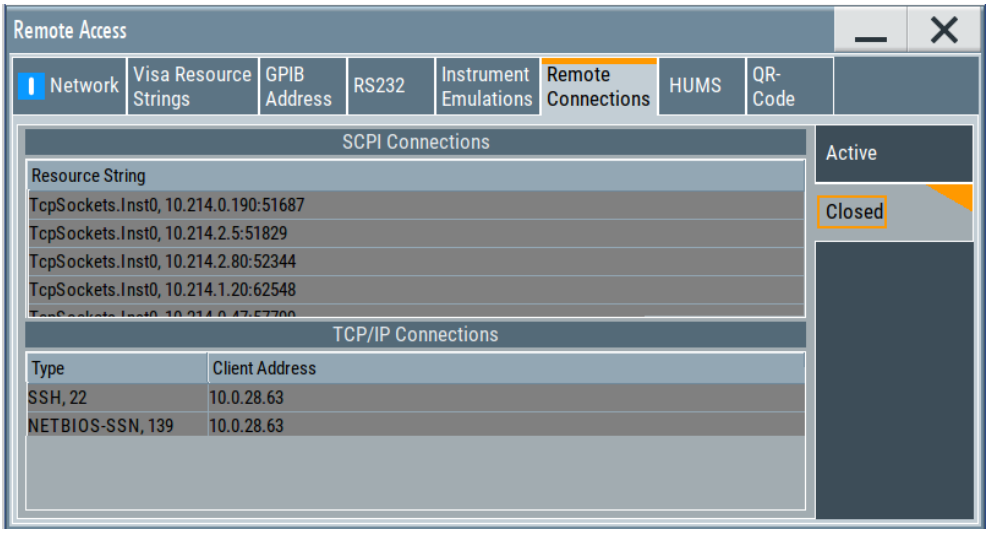
TCP/IP Connections
Displays the types and client addresses of the remote connections currently controlling the instrument via the LAN interface.

Remote command:
n.a.

12.5.7 Closed remote connection settings

Access:

1. Select "System Config" > "Remote Access" > "Remote Connections".
2. Select "Closed".



This dialog displays a history list of the connections that have accessed the instrument before.

Settings:

SCPI Connections.....320
TCP/IP Connections.....320

SCPI Connections
Lists the VISA resource strings of the last remote connections that have accessed the instrument via the LAN interface before.

Remote command:
n.a.

TCP/IP Connections
Lists the types and client addresses of the last remote connections that had accessed the instrument via the LAN interface before.

Remote command:
n.a.

12.5.8 HUMS settings

Requires R&S SMBB-K980.

About health and utilization monitoring system (HUMS)

The R&S SMB100B comes with a health and utilization monitoring system (HUMS) providing information about the R&S SMB100B. Aim is to increase the overall utilization, to avoid downtime and to increase the overall security level of a fleet of instruments.

HUMS provides, for example, information about:

- Instrument identification, hardware components, software packages, licenses
- Usage of remote control, usage via keyboard / mouse, usage of test applications
- Hardware utilization and status, including S.M.A.R.T. data of the system drive
- User-defined static information, for example, an inventory code

Interfaces and protocols

The HUMS installation on the R&S SMB100B includes an SNMP agent and a REST service with HTTP endpoints. So you can access the health and usage information via LAN, using the SNMP protocol or the REST protocol. Accessing the data does not interfere with remote control via SCPI commands or with measurement execution.

Reference information for both protocols is available on the R&S SMB100B at the address *http://<instrument>/api/hums/v1/documents?name=<interface>*.

For *<instrument>*, enter the hostname (e.g. *SMB100B-102030*) or the IP address (e.g. *10.121.0.34*) of your instrument, as for access to the GUI.

For *<interface>* = *snmp*, you get a `.zip` file containing the MIB files for SNMP. For *<interface>* = *rest*, you get a web page with the OpenAPI specification of the REST API.

Address example: *http://SMB100B-102030/api/hums/v1/documents?name=snmp*.

The following table lists the REST endpoints and the SNMP MIB file names.

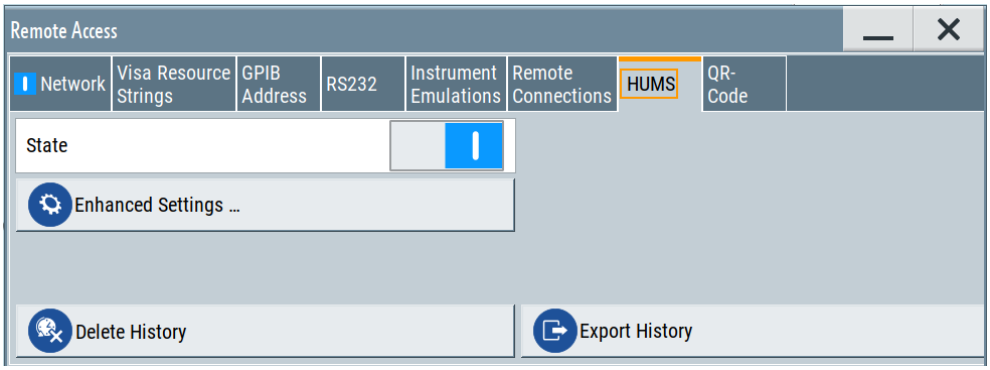
REST endpoint /api/hums/v1/...	SNMP MIB	Description	Typical data
documents	---	developer information	SNMP MIB files, swagger specification of HUMS REST endpoints
greetings	RS-GREETINGS-MIB	identity information	manufacturer, model, serial number, version
equipment/bios	RS-BIOS-INFO-MIB	BIOS information	BIOS manufacturer, version and release date
date-time	RS-TIME-DATE-MIB	time and date information	UTC and local time, timezone, dst (daylight savings time)
device-history	RS-DEVICE-HISTORY-MIB	history events	instrument-specific event information and notifications
device-tags	RS-DEVICE-TAGS-MIB	customer information	user-definable key information, associated with the instrument, e.g. asset number, owner, location
equipment	RS-EQUIPMENT-MIB	footprint information	hardware and software configuration, licenses
hums-info	RS-HUMS-INFO-MIB	basic information on the HUMS service	HUMS version, counter of SNMP and REST requests, amount of collected data, HUMS database size
storage	RS-STORAGE-MIB	S.M.A.R.T. data of drive	system drive temperature, drive health
system-info	RS-SYSTEM-INFO-MIB	a system overview	OS and BIOS version, IP address, locale
system-status	RS-SYSTEM-STATUS-MIB	system status information	global system status, static notifications
utilization	RS-UTILIZATION-MIB	utilization information	instrument activity, e.g., power on time, RF on time, option utilization, remote interface traffic

For detailed information about HUMS and its applications, refer to:

- The R&S®HUMS Health and Utilization Monitoring Service user manual, available on the Rohde & Schwarz website.
- The application note GFM336

Access:

► Select "System Config" > "Remote Access" > "HUMS".



The dialog provides settings to configure the health and utilization monitoring system (HUMS) of the R&S SMB100B.

The remote commands required to define these settings are described in Section 13.8, "HUMS remote control commands", on page 399.

Settings:

State....322
Enhanced Settings....322
Delete History....322
Export History....322

State
Activates HUMS.

Data is only recorded if HUMS is enabled. If disabled, already recorded data can still be retrieved.

The setting is reset by a factory preset to "off".

Remote command:
`DIAGnostic:HUMS:STATe` on page 401

Enhanced Settings
Opens a dialog for configuring enhanced protocol settings, see Section 12.5.9, "HUMS enhanced settings", on page 322.

Access is only available, when HUMS is enabled, see State.

Delete History
Deletes all information from the HUMS service including the device history.

Note: Regarding the instrument security, the sanitization procedure also deletes the history of the HUMS service, see Section 11.4.1, "Disk & memory security settings", on page 278.

Remote command:
`DIAGnostic:HUMS:DEVice:HISTory:DELete:ALL` on page 400

Export History
Triggers an export of the logged data of the HUMS service into a `*.zip` file.

A standard file dialog opens, to save the log file. By default, the file is saved to the directory /var/user/.

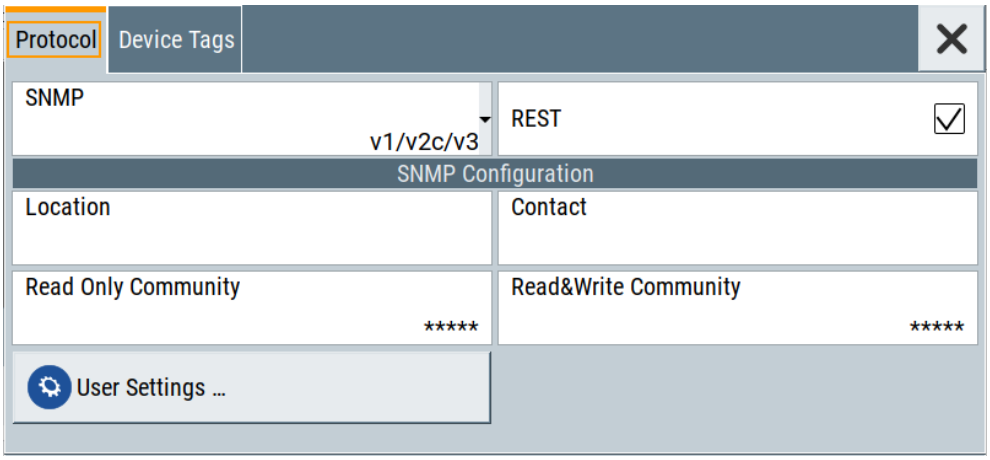
Remote command:
`DIAGnostic:HUMS:DEVice:HISTory?` on page 399
`DIAGnostic:HUMS:SAVE` on page 401

12.5.9 HUMS enhanced settings

Access:

1. Select "System Config > Remote Access > HUMS".
2. Select "State > ON".

3. Select "Enhanced Settings".



The dialog provides enhanced settings for configuring protocol settings and device tags.

The remote commands required to define these settings are described in Section 13.8, "HUMS remote control commands", on page 399.

- Protocol settings....323
- SNMP user settings....325
- Device tag settings....329

12.5.9.1 Protocol settings

The "Protocol" tab of the "Enhanced HUMS Settings" dialog provides protocol settings for SNMP or REST protocol.

Access:

1. Select "System Config > Remote Access > HUMS".
2. Select "State > ON".
3. Select "Enhanced Settings".
4. Select "Protocol".

   The dialog provides enhanced settings for configuring protocol settings and device tags.

Settings:

SNMP....324
REST....324
SNMP Configuration....324
└ Location....324
└ Contact....324

└ Read Only Community....324
└ Read&Write Community.... 325
User Settings....325

SNMP
Enables the SNMP agent and selects the supported SNMP version to communicate with the service.

The setting is reset by a factory preset to "v1/v2c".

"Off"	The SNMP agent is disabled.
"v1/v2c"	Selects SNMP version 2, which also enables version v1.
"v1/v2c/v3"	Selects all SNMP version v1, v2c and v3.
"v3"	Selects SNMP version v3.

Remote command:
`SYSTem:COMMunicate:SNMP:VERSion` on page 405

REST
Enables the REST API protocol.

The setting is reset by a factory preset to "On".

Remote command:
`SYSTem:COMMunicate:REST:ENABle` on page 403

SNMP Configuration
For SNMPv1 and SNMPv2c authentication, you can assign a community password for read only and/or read and write access. For SNMPv3 authentication, you can define "User" profiles.

Location ← SNMP Configuration
Defines the SNMP location information. This information complies with the server's physical location and is used for identification of the SNMP server. By default, this input field is empty.

Remote command:
`SYSTem:COMMunicate:SNMP:LOCation` on page 404

Contact ← SNMP Configuration
Sets the SNMP contact information. This information complies with the person who manages the SNMP server and is used for identification of the SNMP server. By default, this input field is empty.

Remote command:
`SYSTem:COMMunicate:SNMP:CONTact` on page 404

Read Only Community ← SNMP Configuration
Sets a password for read only access of SNMPv1 or SNMPv2 communities.

The setting is reset by a factory preset to the "<serial number>" of the instrument.

Remote command:
`SYSTem:COMMunicate:SNMP:COMMunity:RO` on page 403

Read&Write Community ← SNMP Configuration
Sets a password for read and write access of SNMPv1 or SNMPv2 communities.

The setting is reset by a factory preset to the "<serial number>" of the instrument.

Remote command:
`SYSTem:COMMunicate:SNMP:COMMunity:RW` on page 403

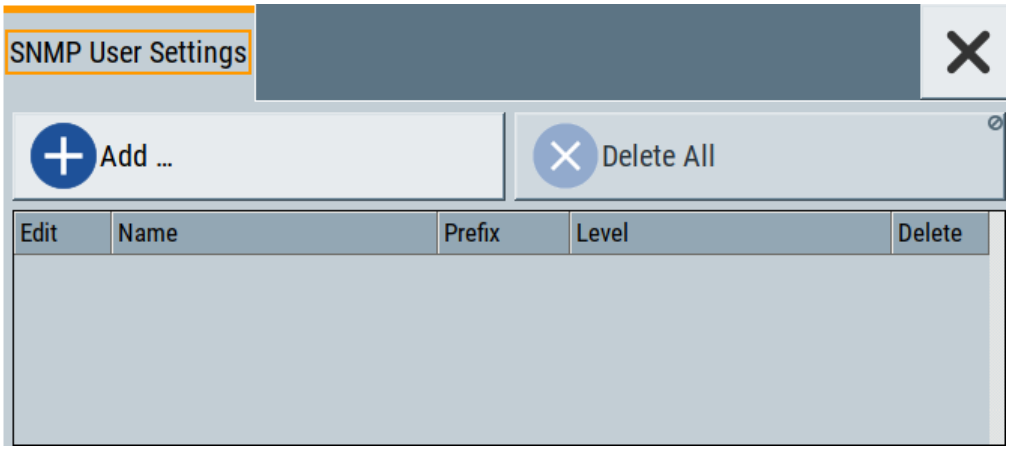
User Settings
Accesses the "Configure SNMP Users for HUMS" dialog.

12.5.9.2 SNMP user settings

For SNMPv3 authentication, you can define user profiles.

Access:

1. Select "System Config > Remote Access > HUMS".
2. Select "State > ON".
3. Select "Enhanced Settings".
4. In the protocol tab, select SNMP communication with SNMPv3, e.g. "SNMP > v1/v2c/v3".
5. Select "User Settings".



The "Configure SNMP User for HUMS" dialog provides an overview of all defined SNMP users and their profiles. With the "Add" and "Delete All" controls, you can add or remove users.

Settings:

Add....326
Delete All....326
User table....326
└ Edit....326
└ Name....327
└ Prefix....327

└ Level 327
└ Delete 327
Add SNMP User for HUMS 327
└ SNMP User Name 328
└ SNMP User Prefix 328
└ SNMP User Level 328
└ SNMP User Public Passphrase 329
└ SNMP User Encrypted Passphrase 329
└ Add / Update 329

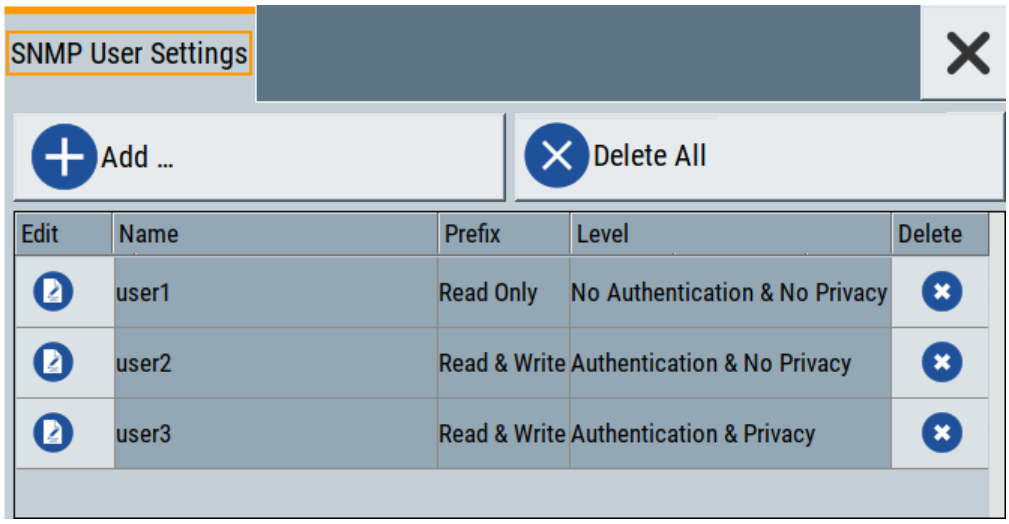
Add
Accesses the "Add SNMP User for HUMS" dialog.

In this dialog, you can define a user and its profile, see "Add SNMP User for HUMS" on page 327.

Delete All
Removes all users from the list.

Remote command:
`SYSTem:COMMunicate:SNMP:USM:USER:DELete:ALL` on page 405

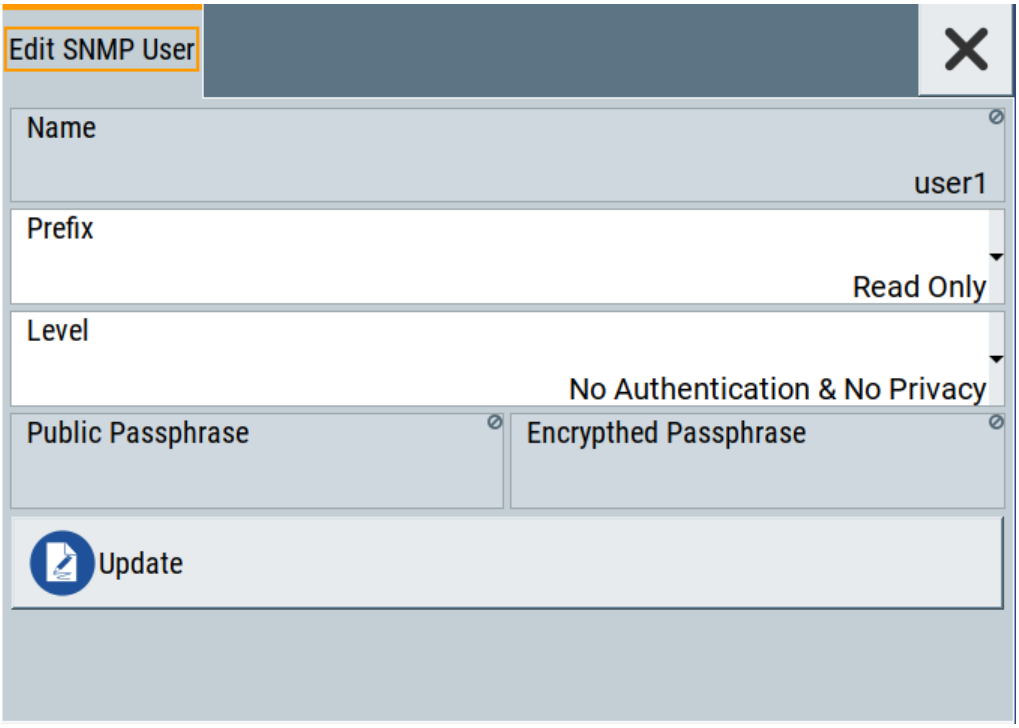
User table
Lists all defined SNMP users.



The table informs on the user name and its specified user profile.

Remote command:
`SYSTem:COMMunicate:SNMP:USM:USER:ALL?` on page 405

Edit ← User table
Accesses the "Edit SNMP Users for HUMS" dialog, where you can modify an already defined user profile.



For description on the entry fields, see Add SNMP User for HUMS.

Name ← User table
Shows the user name of the user who should have specific user rights.

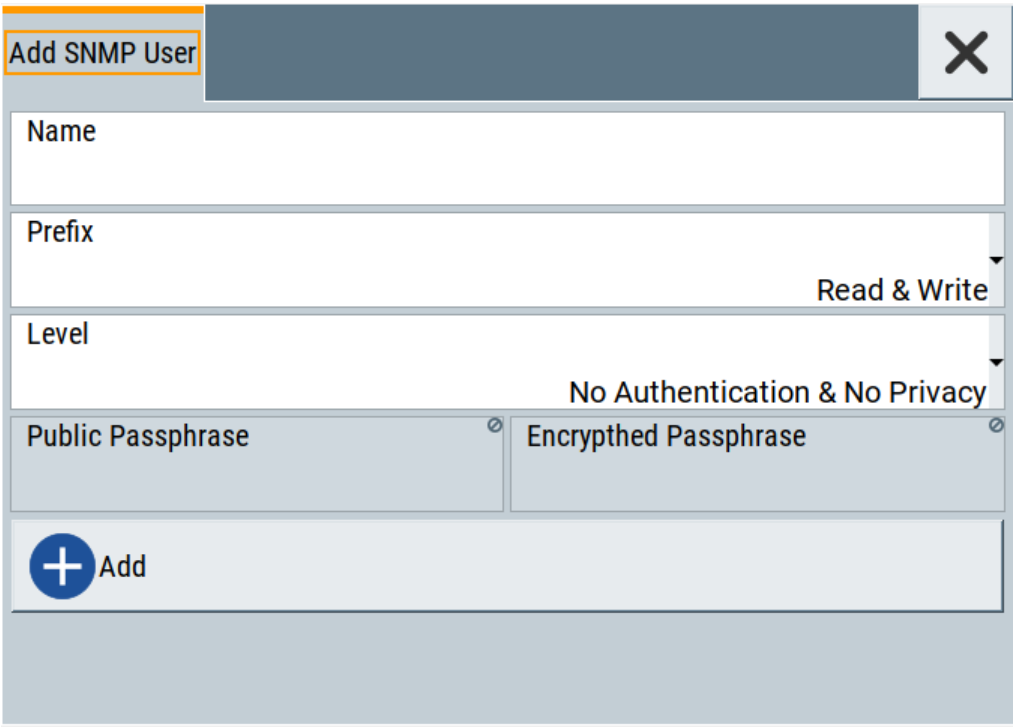
Prefix ← User table
Shows the access right of the selected user.

Level ← User table
Shows the security level of the selected user.

Delete ← User table
Removes the selected user from the list.

Remote command:
`SYSTem:COMMunicate:SNMP:USM:USER:DELete` on page 405

Add SNMP User for HUMS
Configuration dialog for defining SNMP users and their profiles.



Remote command:
SYSTem:COMMunicate:SNMP:USM:USER on page 404

SNMP User Name ← Add SNMP User for HUMS
Defines the name of the user for assigning specific user rights. Entering a user name is mandatory.

SNMP User Prefix ← Add SNMP User for HUMS
Defines the access right for a user.

"Read Only" Allows the user to only read information.

"Read & Write" Allows the user to read and modify information.

SNMP User Level ← Add SNMP User for HUMS
Defines the security level of the SNMP user. Depending on the security level, the service requests user name and passphrases for authentication and encryption.

"No Authentication & No Privacy"
Low security level. Using this level, the service queries the user name only. Password authentication and password for encrypted data transfer is not requested.
See "SNMP User Public Passphrase" on page 329 and "SNMP User Encrypted Passphrase" on page 329 for data transfer is not requested.

"Authentication & No Privacy"
Medium security level: Requests the user name and password authentication, but no data transfer encryption.

"Authentication & Privacy"
High security level: Requests the user name, and both, the password authentication and the password for data transfer encryption.

SNMP User Public Passphrase ← Add SNMP User for HUMS
Defines the password for authentication. The password must have of 8 to 12 characters with any combination of ASCII characters.

SNMP User Encrypted Passphrase ← Add SNMP User for HUMS
Defines the password for encryption. This password must have at least 8 characters with any combination of ASCII characters. When encryption is defined, the R&S SMB100B supports the DES (directed enhanced services) protocol.

Add / Update ← Add SNMP User for HUMS
Assigns the defined user with its profile to the list.

If you change an already defined user profile, the instrument provides the "Update" button to apply the modifications.

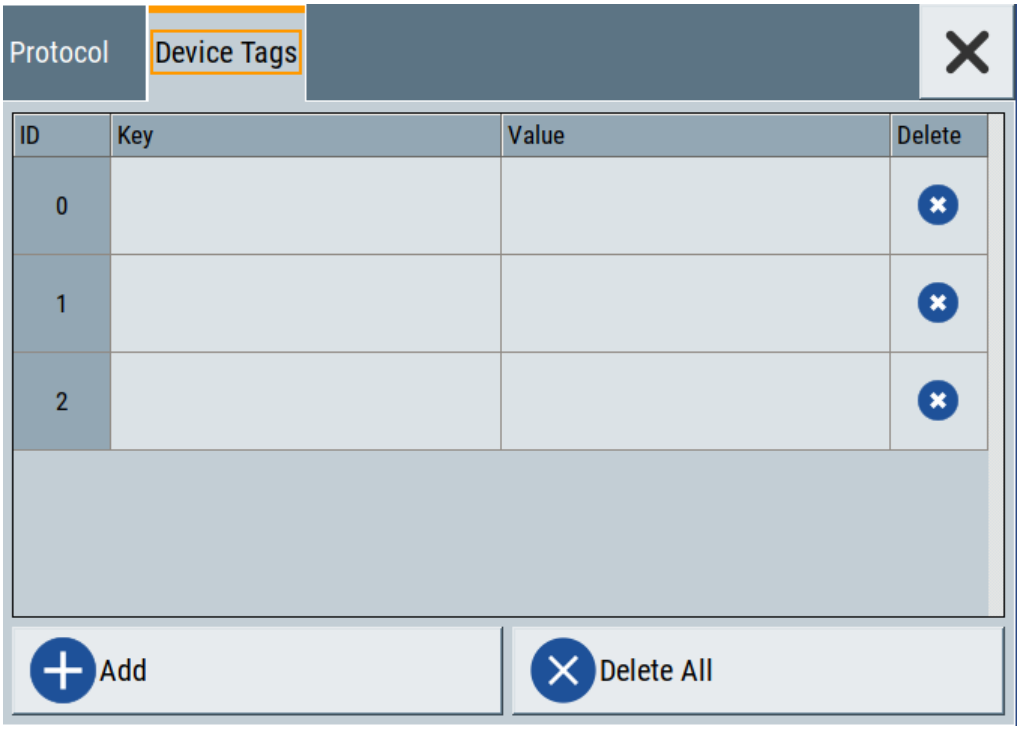
12.5.9.3 Device tag settings

The "Device Tags" tab of the "Enhanced HUMS Settings" dialogs displays the defined device tags. You can also add or delete device tags here.

A device tag is a label to assign to your instrument. You can create any device tag for your instrument and define it by a specific key and value.

Access:

1. Select "System Config > Remote Access > HUMS".
2. Select "State > ON".
3. Select "Enhanced Settings".



Configures device tags for tagging user-defined information of the instrument in a table. You can define up to 32 device tags, e.g., for HUMS history evaluation.
To add a device tag, define "Key" and "Value" of the device tag in the table. Click "Add" to add all device tags of the table to the HUMS history.

Settings:

ID....330
Key....330
Value....330
Delete....331
Add....331
Delete All....331

ID
Identification count of a device tag entry.

Key
Sets the identification key of a device tag.

Remote command:
`DIAGnostic:HUMS:TAGS[:VALue]` on page 402

Value
Sets the value of the identification key of a device tag.

Remote command:
`DIAGnostic:HUMS:TAGS[:VALue]` on page 402

Delete
Deletes the selected device tag from the HUMS history.

Remote command:
`DIAGnostic:HUMS:TAGS:DELete` on page 402

Add
Adds a new device tag to the HUMS service.

Remote command:
`DIAGnostic:HUMS:TAGS[:VALue]` on page 402
`DIAGnostic:HUMS:TAGS:ALL?` on page 401

Delete All
Removes all device tags from the HUMS history.

Remote command:
`DIAGnostic:HUMS:TAGS:DELete:ALL` on page 402

12.5.10 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 Section 12.10.2, "Using a smart device", on page 367

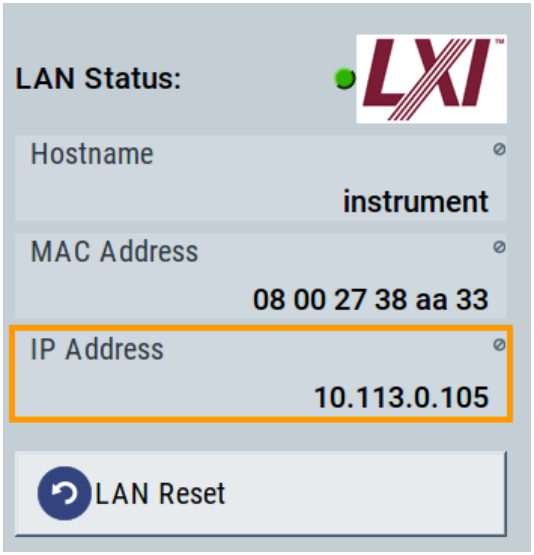
12.6 LXI status settings

On the R&S SMB100B, an LXI functionality is already installed and enabled. Thus, you can access he instrument using any web browser.

See Section 12.7, "LXI browser settings", on page 333.

Access:

► Select "System Config > Setup > Remote Access > LXI Status".



The LXI "LAN Status" dialog shows the parameters of the LAN connection.

Alternatively, you can change the LAN settings using the LXI web browser interface, see Section 12.7.1, "LAN configuration", on page 335.

Settings:

LAN Status....332
Hostname / MAC Address / IP Address....332
LAN Reset....333

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 311.

LAN Reset
Initiates the network configuration reset mechanism for the instrument and resets the hostname, MAC address, and IP address.

According to the LXI standard, a LAN reset must set the following network parameters to a default state:

Parameter	Value
TCP/IP mode	DHCP + Auto IP address
Dynamic DNS	Enabled
ICMP ping	Enabled
Password for LAN configuration	LxiWebIfc

The LAN reset also resets the following parameters for the R&S SMB100B:

Parameter	
Hostname	`Instrument-specific hostname`
Description	signal generator
Negotiation	Auto detect
VXI-11 discovery	Enabled

12.7 LXI browser settings

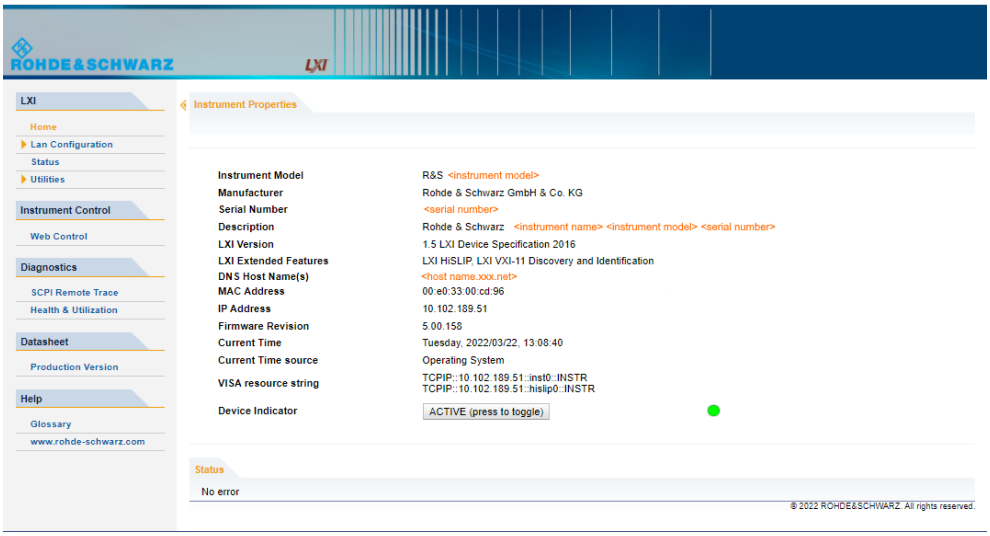
Accessing the R&S SMB100B over the LXI browser inerface, you can perform the following tasks:

- Modifying network configurations, see Section 12.7.1, "LAN configuration", on page 335.
- Accessing the instrument remotely
- Analyzing SCPI remote diagnostics
- Monitoring the use and status of the instrument
  This service requires option R&S SMBB-K980 "Health and utilzation monitoring service (HUMS)".

Access:

► In the address field of the browser, enter the URL address, composed of the instrument's IP address or host name, for example *http://10.113.1.151*.
Note: Do not add the missing zeros in the IP address, while opening the instrument homepage.

The instrument homepage (welcome page) opens.



The navigation pane of the browser interface contains the following elements:

- "LXI"
  - "Home" opens the instrument homepage.
    The homepage displays the device information required by the LXI standard, including the VISA resource string in read-only format.
  - "Device Indicator" activates or deactivates the LXI status indication.
    When activated, the LXI LED flashes. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates that no LAN cable is connected.
  - "Lan Configuration" allows you to configure LAN parameters and to initiate a ping, see Section 12.7.1.3, "Ping client", on page 337.
  - "Status" displays information about the LXI status of the instrument.
  - "Utilities" provides access to the LXI event logging functionality required by the LXI standard.
- "Instrument Control"
  "Web Control" provides remote access to the instrument.
  See "To start remote control with the LXI browser" on page 344.
- "Diagnostics"
  - "SCPI Remote Trace" records messages exchanged via the remote control interface, see Section 12.7.2, "SCPI remote trace", on page 337.
  - "Health & Utilization" (option: R&S SMBB-K980) enables you to monitor the use and status of an instrument, see Section 12.7.3, "Health and utilization", on page 339.
- "Datasheet"
  Provides the Datasheet with the specification data of the instrument at the time of delivery, see Section 12.7.4, "Datasheet", on page 339.
- "Help"
  - "Glossary" explains terms related to the LXI standard.
  - www.rohde-schwarz.com opens the Rohde & Schwarz homepage.

12.7.1 LAN configuration

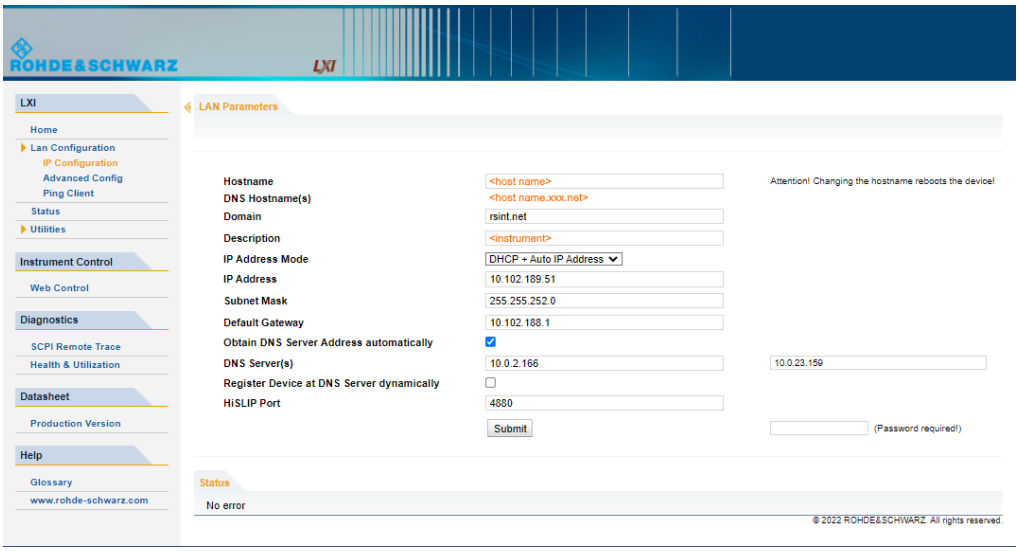
The "LAN Configuration" web page displays all mandatory LAN parameters and allows their modification.

It comprises the following navigation entries.

- IP configuration 335
- Advanced config 336
- Ping client 337

12.7.1.1 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.

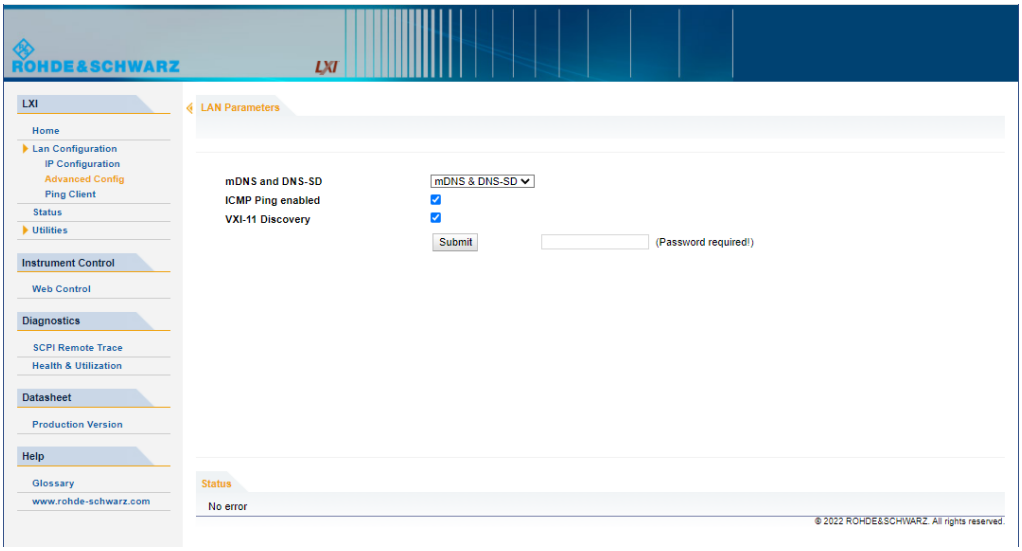
How to:

- "To change the user password of the instrument" on page 290.
- "To change the security password" on page 290.

See Section 11.4.5, "Password management", on page 287.

12.7.1.2 Advanced config

The "Advanced Config" web page provides LAN settings that are not declared mandatory by the LXI standard.



The following advanced parameters are available:

- "mDNS and DNS-SD": The additional protocols "multicast DNS" and "DNS service discovery" are used for device communication in zero configuration networks, working without DNS and DHCP.
- "ICMP Ping": Must be enabled to use the ping utility.
  If you disable this setting, the instrument does not answer ping requests. The setting does not affect the LXI ping client. You can ping other hosts from the instrument, even if the setting is disabled.
- "VXI-11 Discovery": Must be enabled to detect the instrument in the LAN.
  If you disable this setting, the instrument cannot be detected by the VXI-11 discovery protocol mechanism. The setting does not affect other detection mechanisms. Setting up a VXI-11 connection via the IP address or the host name is independent of this setting.

Changing the LAN configuration

This function is password-protected. Unlock the protection level 1 to access it.

Note: We recommend that you change the default password before connecting the instrument to a network.

How to:

- "To change the user password of the instrument" on page 290.
- "To change the security password" on page 290.

See Section 11.4.5, "Password management", on page 287.

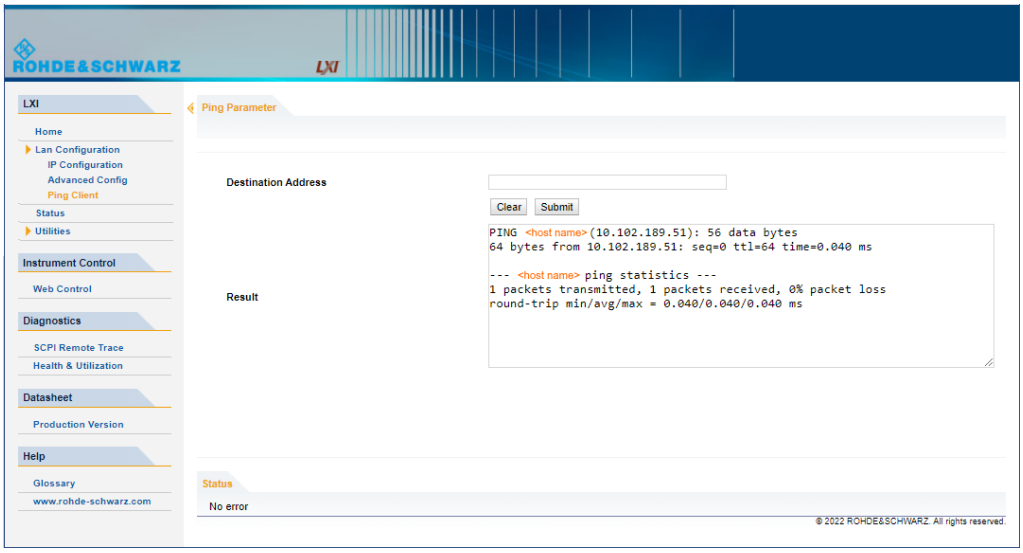
12.7.1.3 Ping client

The "Ping Client" page provides the ping utility to verify the connection between the LXI-compliant instrument and another device.

The ping is initiated from the instrument. Using the `ICMP` echo request and echo reply packets, this function checks whether the communication with a device via LAN is working. Ping is useful for the diagnosis of IP network or router failures.

To initiate a ping at the instrument:

1. On the "Ping Client" page, enter the IP address of the host in the "Destination Address" field (for example 10.113.1.151).
2. Select "Submit".



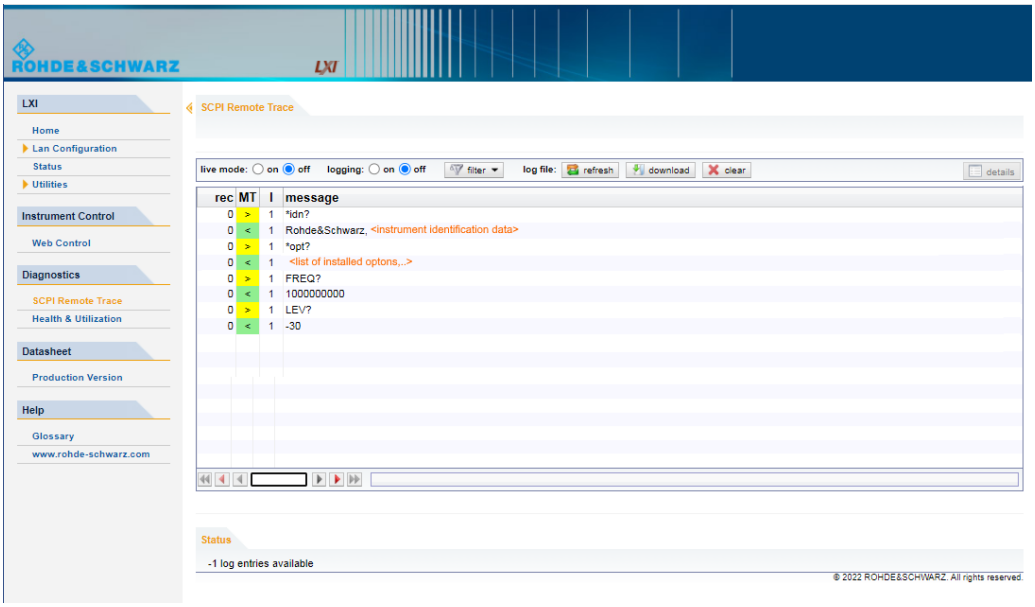
12.7.2 SCPI remote trace

The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S SMB100B.

See "To activate SCPI remote trace" on page 345

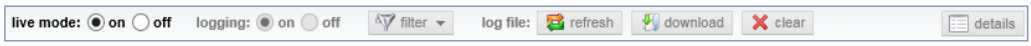
A recorded trace (message log) can be evaluated directly in the dialog. Use the highlighting and navigation functions provided by the lower toolbar to locate error messages and messages containing arbitrary search strings. You can also export the message log to a `*.csv` file and evaluate the file using a suitable program.

To trace and display messages, switch on "logging" and "live mode" in the toolbar.



Toolbars

The toolbar at the top of the dialog provides basic settings and functions.



- "Live mode" / "logging": If logging is switched on, messages are traced. They are stored in an internal database and can be displayed upon request, using the refresh button (live mode off) or they can be displayed automatically (live mode on).
- "Filter": applies a filter to columns and/or rows when working (live mode off)
- "Refresh": reads the message log from the internal database and displays it
- "Download": stores the SCPI trace log to a `*.csv` file
- "Clear": deletes all message log entries in the database and at the screen
- "Details": displays details of the selected message, for example an SCPI command in hex format (also possible by double\-clicking a message)

Columns

The following columns are available if no column filter is applied:

- "Rec": record number of the message within the message log
- "MT": indicates the type of the message. Possible values and related message contents are:
  - > = incoming command
  - < = outgoing response to a query
  - E = error message, highlighted by red color
  - T = execution time, i.e. time required by the instrument to process the command internally.
- **I**: number of the subinstrument

- "message": indicates the type of the message. Possible values and related message contents are:
  - > = incoming command
  - < = outgoing response to a query
  - E = error message, denoted in red
  - T = execution time, i.e. time required by the instrument to process the command internally

12.7.3 Health and utilization

Option: R&S SMBB-K980

The health and utilization monitoring service allows you to monitor the usage and status of the instrument, it's options, including S.M.A.R.T. data of the system drive. You can retrieve information on remote accesses over SCPI commands, web browsers or protocols, as for example SNMP or REST.

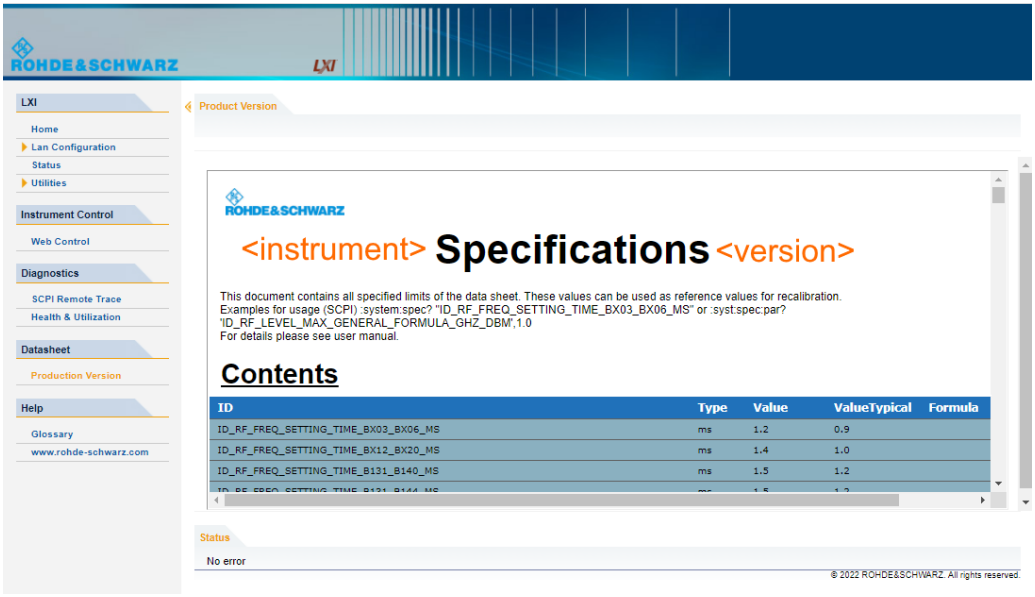
For detailed information on R&S HUMS, see the following documents, available on the Rohde & Schwarz website:

- User manual "R&S Health and Utilization Monitoring Service" , describing how to access and use the service.
- Application note GFM336, providing information on the SNMP and REST API, including a list of all SNMP variables and REST endpoints.

12.7.4 Datasheet

The datasheet 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 datasheet, for example important as reference values for recalibration.



For more information, refer to the specifications document.

12.8 Setting up remote control

When you switch on the R&S SMB100B, it is always in manual operation state ("local" state). You can operate the instrument over the touchscreen, the front panel and an external keyboard and/or mouse.

Prerequisites

For remote control, make sure that you have fullfilled the following prerequisites:

- The instrument and the controller PC are connected for remote control.
  See Section 3.1.7, "Connecting to LAN", on page 25.
- The instrument and the controller are switched on.
- The LAN interface and SCPI over LAN are enabled.
  See Section 11.4.4, "Configuring LAN services", on page 283.
- A remote control program is running on the controller.

If security is a concern, see:

- Document Instrument Security Procedures.
- Section 11.4.6, "Preventing unauthorized access", on page 290.

The following sections describe how to start remote control over the available interface protocols.

- Configuring remote access 341
- Starting remote control with LXI 344
- Starting remote control with VXI-11 345

- Starting remote control with socket communication....350
- Starting remote control over GPIB....351
- Starting remote control over USB....352
- Stopping remote control....352

12.8.1 Configuring remote access

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

- If the network supports dynamic TCP/IP configuration using the DHCP protocol, this service assigns all address information automatically (default setting).
- If the network does not support DHCP or if there is no server available, the instrument tries to obtain the IP address using the Zeroconf(Avahi) protocol.
  This protocol enables the instrument to self-configure an IP address and subnet mask. Zeroconf (Avahi) IP addresses start with the number blocks 169.254.*.*, with the subnet mask of 255.255.

The automatic address configuration establishes the physical connection to the LAN without any additional configuration.

An IP address that is assigned with the Zeroconf protocol although the network requires an IP address assigned from the DHCP server can cause network connection failures.

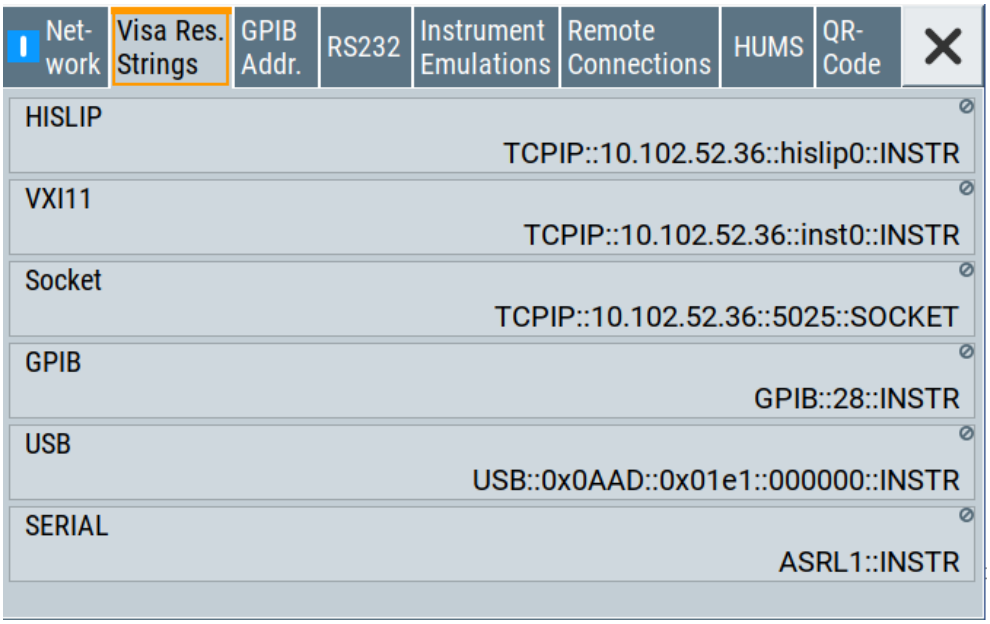
See Section 14.5, "Resolving network connection failures", on page 622.

If both services fail to connect, you must set the address information manually.

See also "To assign the instrument address manually" on page 342.

To find the VISA resource string

► Select "System Config > Remote Access > VISA Resource Strings".



The dialog shows the VISA resource strings that enable you to access the instrument for remote control.

Note: Using the RS232 serial interface via USB requires the USB serial adapter R&S TS-USB1.

To assign the instrument address manually

It is assumed that you have connected the instrument in the LAN.

1. Obtain the instrument address information for the R&S SMB100B and the IP address for the local default gateway from your network administrator. If necessary, also obtain the name of your DNS domain and the IP addresses of the DNS server on your network.
   Obtain the IP address and subnet mask for the R&S SMB100B and the IP address for the local default gateway from your network administrator. If necessary, also obtain the name of your DNS domain and the IP addresses of the DNS server on your network.
2. On the instrument, select "System Config > Remote Access > Network".
3. Select "Address Mode > Static".
4. Select the "IP Address".
5. Enter the IP address, for example *192.168.0.1.*

   The IP address consists of four number blocks separated by dots. Each block contains 3 numbers in maximum.
6. Select the "Subnet Mask" and enter the subnet mask, for example *255.255.255.0*.

   Note: The subnet mask must be the same for both, the R&S SMB100B and the host interface, the instrument is connected to.
7. Enter the "Default Gateway", "DNS Suffix", and "DNS Server" if necessary.

Using the hostname

In a LAN that uses a DNS server, each computer or instrument connected in the LAN can be addressed with an unambiguous Hostname (also referred to as computer name) instead of the IP address. The DNS server translates the hostname to the IP address.

Using the hostname is useful in networks with dynamic TCP/IP and DHCP protocol services, that assign the address information automatically. Thus, it can be that the services assign a new IP address each time the instruments restarts, but they do not change the hostname.

Each instrument is delivered with an assigned hostname, that remains constant as long as it is not explicitly changed.

This function is password-protected. Unlock the protection level 1 to access it.

The default *hostname* name follows the syntax `<INST>-<Serial Number>`, where:

- `<INST>` is the short name of your instrument, as stated on the front panel.
- `<Serial Number>` is the individual serial number of the instrument.
  You can find the serial number at the rear panel of instrument. It is the third part of the device ID printed on the barcode sticker.



To query and change the hostname

1. Select "System Config > Remote Access > Network".

   Section "Instrument Name" displays the assigned "Hostname".

   Note: This function is password-protected. Unlock the protection level 1 to access it.

2. Select "System Config > Setup > Security > Protection".

3. Enable the "Protection Level 1".
   The default protection level 1 password is *123456*.

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

4. Change the "Hostname".

Configuring LAN access and services

By default, the LAN interface and the supported LAN interface services are enabled. For security reasons, for example to protect the instrument against unauthorized access, you can block either the LAN services individually, or the access over LAN in general.

For information on how you configure the remote access individually, see the following sections:

- Section 11.4.4, "Configuring LAN services", on page 283
- "To disable LAN access in general" on page 291
- "To disable LAN services individually" on page 291
- "To enable SMB version 1.0/2.0 client and server" on page 292

Configuring access over GPIB

To control the instrument remotely over 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 change 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.

12.8.2 Starting remote control with LXI

Using the LXI browser interface you can access and control the R&S SMB100B instrument remotely from a controller PC without additional installation. Remote control over LXI supports file upload and download between the instrument and the controller PC.

It is assumed that the instrument is set up in the LAN.

See "Prerequisites" on page 340.

To start remote control with the LXI browser

1. On the controller PC, start a browser that supports HTML5 (W3C compliant).
2. Enter the IP address of the R&S SMB100B in the browser's address bar.

   The browser displays the R&S SMB100B's welcome page.
3. In the navigation pane, select "Instrument Control" > "Web Control".

   Remote access to the instrument requires the password. The default password is *instrument*.
4. Enter the password.
5. Confirm with [Enter].

The current screen of the R&S SMB100B appears in the browser window.

6. Use the mouse cursor and keyboard to access the functionality of the instrument as if you operate the instrument directly.

To activate SCPI remote trace

The remote trace functionality allows you to trace SCPI commands and messages exchanged over the LAN of the R&S SMB100B. To communicate with the instrument over SCPI, use a suitable remote control application.

1. Set up the remote control session as described under "To start remote control with the LXI browser" on page 344.
2. In the navigation pane, select "Diagnostics > SCPI Remote Trace".
3. In the toolbar bar of the "SCPI Remote Trace" page, select "live mode > on".
4. Using the remote control program, send your SCPI commands to the R&S SMB100B.

   The "SCPI Remote Trace" tab displays all sent commands and responses.
5. Select "logging > on".
   (Live mode and logging exclude each other).

   "logging > on" displays all commands and responses, and traces messages also.

   The SCPI remote trace function records all sent commands, received responses and messages, and saves them in an internal database. If "live mode" is disabled, you can display the recent traces on request, using the "refresh" button. You can also save the log in a file.
   Note: The diagnostics functionality is extended in later releases, e.g. to download or upload SCPI command files from / to the instrument.

12.8.3 Starting remote control with VXI-11

This connection uses the I/O software library R&S VISA from Rohde & Schwarz to setup a LAN remote control link to the instrument.

R&S VISA is running on a controller PC with Windows operating system. You can send commands to the instrument and receive the responses.

For information installing, operating and the utility applications the software provides, see R&S VISA product page www.rohde-schwarz.com/rsvisa.

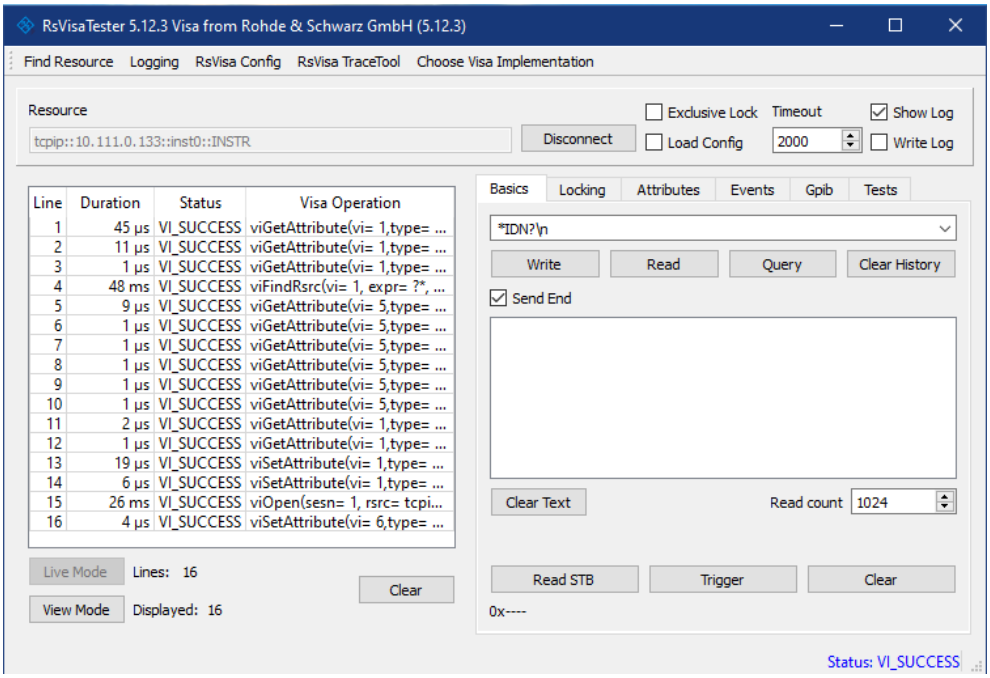
The remote control connection requires a VISA installation but no additional hardware on the controller PC. The LAN I/O channel is selected at initialization time using the VISA resource string (also referred to as "address string"). A VISA alias (short name) replaces the complete resource string. The host address is the R&S SMB100B's host-name or its IP address.

See Section 12.2.1, "LAN interface", on page 299.

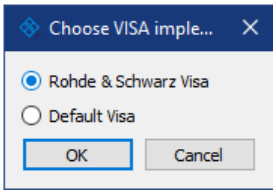
To set up the controller with R&S VISA

To remote control the R&S SMB100B, we use the R&S VISA Tester application. The application communicates over the TCP/IP protocol.

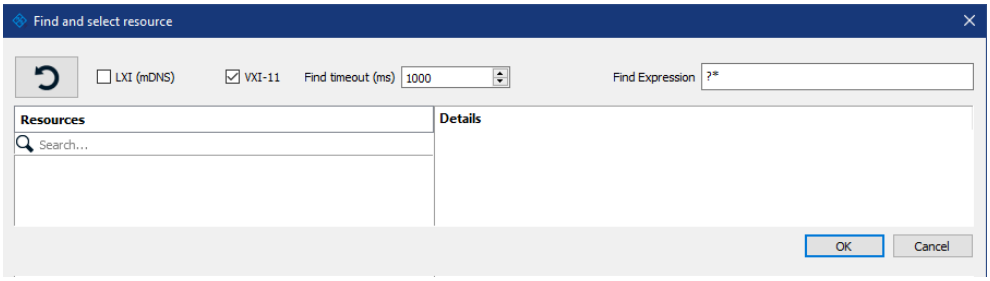
1. On the controller PC, install the R&S VISA program.
   See www.rohde-schwarz.com/rsvisa > "RS VISA release notes".
2. On the instrument, enable the LAN interface and "SCPI over LAN".
3. On the controller, start, e.g., "R&S VISA > Tester".



4. In the menu bar, select "Choose VISA Implementation > Rohde & Schwarz Visa"
5. Confirm with "OK".

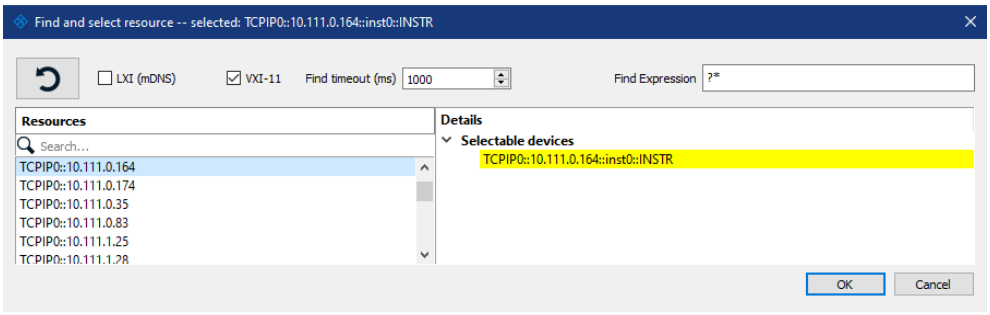


6. In the menu bar, select "Find Resource" to search for the instrument in the LAN.



7. Select "VXI-11".
8. Select the "refresh" button to start the search.

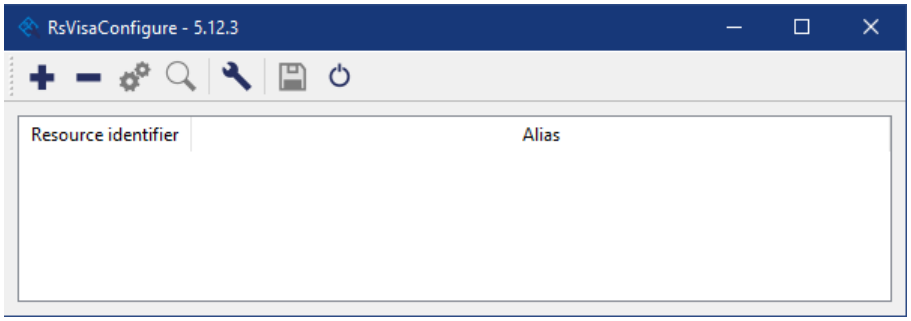
   R&S VISA scans the network for connected instruments and lists all detected instruments in the "Resource" list.
   Note: The search can take some time, particularly in large networks.
9. Select the required instrument.



10. Confirm with "Ok".

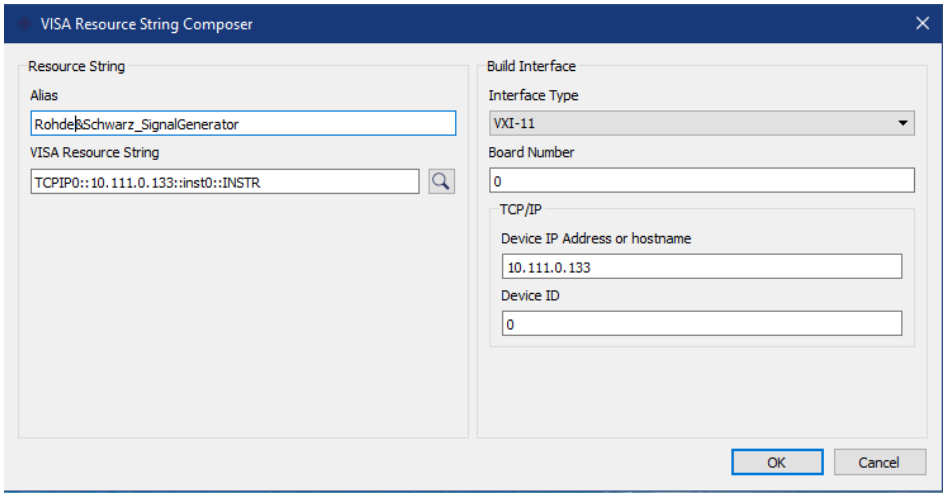
    The "Find and select resource" dialog closes and R&S VISA indicates the IP address in the "Resource" field of the main application window.
11. As an alternative to the IP address, you can assign an alias name to the R&S SMB100B:

    a) In the menu bar, select "RsVisaConfig".

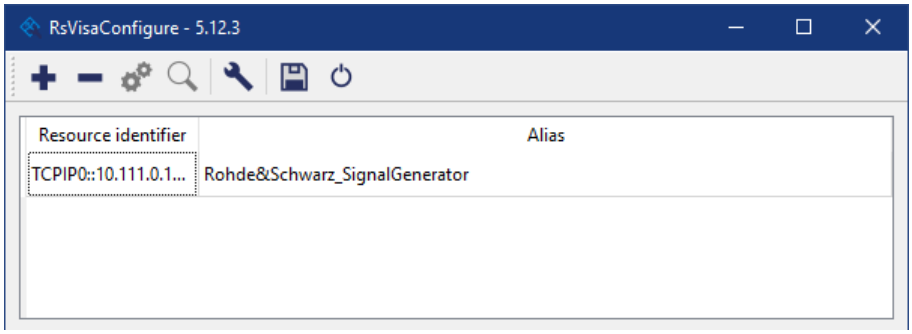


    b) In the toolbar, select "+" to access the "VISA Resource String Composer".

c) Fill in the "Alias" name, the "VISA Resource String" and the "Device IP Address or hostname" as shown in the figure.



R&S VISA indicates the assigned "Alias" name.



d) Confirm with "OK".
R&S VISA identifies the R&S SMB100B and you can address it either with the resource string or the alias name.

12. In the main window, select "Connect".

    R&S VISA establishes the connection to the R&S 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.
    See also Section 14.5, "Resolving network connection failures", on page 622.

To start remote control with R&S VISA

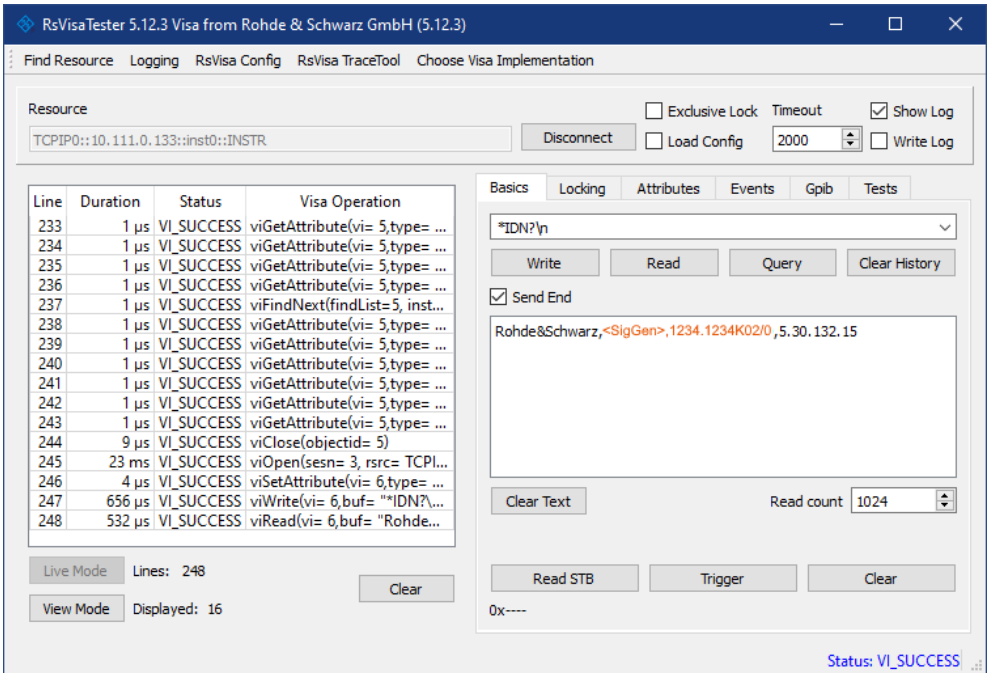
To set the instrument to remote control state, you can send any command from the controller.

1. Start the R&S VISA Tester.
   Establish the connection to the R&S SMB100B.
   See "To set up the controller with R&S VISA" on page 346.
2. In the R&S VISA "Basics" tab, enter a SCPI command, e.g. `*IDN?`.

3. Confirm with "Query".

   The instrument switches to remote control when it receives a command from the controller.

4. Select "Read" to obtain the instrument response.



   The instrument returns the response.
   Remote control over R&S VISA is enabled.

To check remote control with VISA

You can check the communication by sending a setting command and querying the response:

1. Set, e.g. the frequency with the command:
   `SOUR1:FREQ 3 GHz`.
2. Select "Write".
3. Enter the command `SOUR:FREQ?`.
4. Select "Query".

   If the R&S SMB100B responses with the frequency value xyou entered, remote control works properly.

To monitor the remote control operation

1. Check the "Show Log" checkbox on the top right.

   R&S VISA displays each VISA operation in the log-view on the left.

2. Check the "Write Log" checkbox.

R&S VISA saves all log-view entries to a log file.

You can operate the log-view in two modes:
- "Live Mode": shows only the most recent messages
- "View Mode" allows you to scroll the history

To return to manual operation, see Section 12.8.7, "Stopping remote control", on page 352.

12.8.4 Starting remote control with socket communication

This section provides an example on how to establish a remote control connection over Telnet client and a simple sockets-based program example that can be further developed.

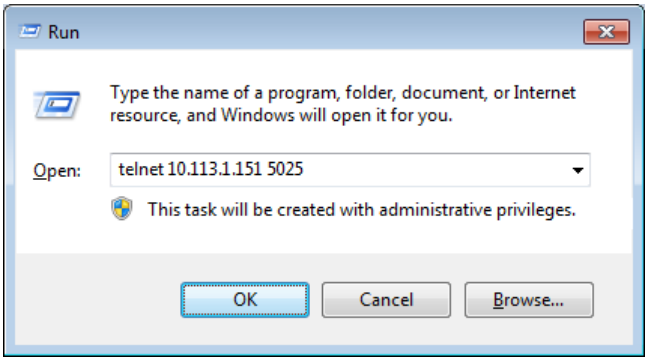
The telnet client transmits information unencrypted. Therefore, for sensitive information we recommend that you use a client which supports secure protocols, like SSH.

To set up a Telnet connection

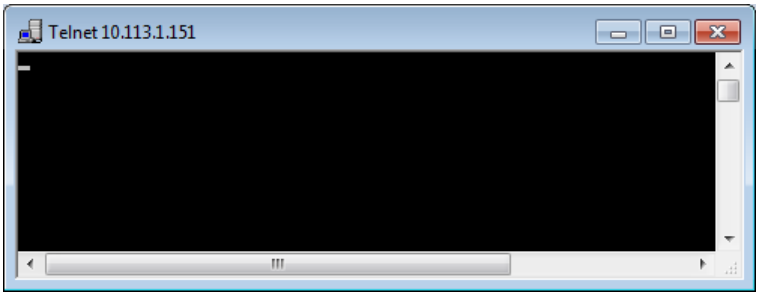
To control the software, only a Telnet program is required. The Telnet program is part of each operating system.

The controller PC and the instrument are connected in the same network.

1. On the instrument, enable the LAN interface and "SCPI over LAN".
   See Section 11.4.4, "Configuring LAN services", on page 283.
2. On the controller PC, start the Telnet program.
3. Enter the socket address.
   The socket address is a combination of the IP address or the hostname of the R&S 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.

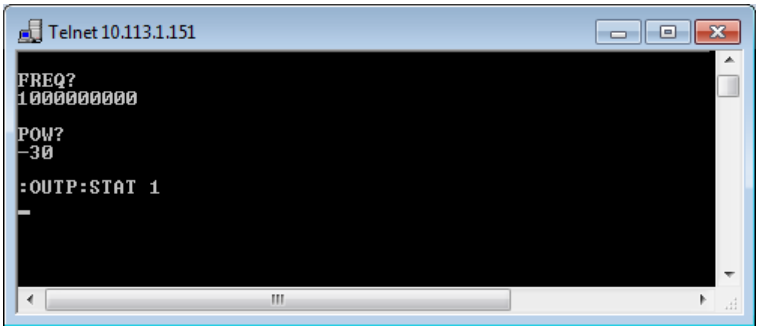


The connection to the instrument is set up and you can send remote-control commands.



4. Telnet does not reflect your first entry.
   Insert a command, e.g. `*IDN` and confirm with "Enter".
5. Observe the screen.

   A response on the query confirms that the connection is working. The client displays all subsequent inputs and responses.
6. Even if the cursor is not visible on the screen, just enter a remote-control command. Confirm with Enter.



12.8.5 Starting remote control 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/

To start remote control over GPIB

1. Connect instrument and controller using a GPIB cable.
   Switch them on.
2. Select "System Config > Remote Access > GPIB Address" > **"GPIB Channel Address = 28"**.
   The GPIB address of the instrument must be the default value of 28.

3. 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.
4. To return to manual operation, see Section 12.8.7, "Stopping remote control", on page 352.

12.8.6 Starting remote control over USB

For remote control, the PC and the instrument must be connected over 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.

To start remote control 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, see Section 12.8.7, "Stopping remote control", on page 352.

12.8.7 Stopping remote control

Before returning to manual control, command processing must be completed. Otherwise, the instrument switches back to remote control immediately.

You have the following options to switch from remote control to manual operation:

- Closing the remote control session
- Using remote control commands
- Selecting the remote icon in the status bar directly on the screen
- Using the "Local" key

To find out active remote connections

► Check the indication on the taskbar:



A softkey in the taskbar indicates if and what kind of remote connections are currently set up.
See also Section 12.5.6, "Active remote connection settings", on page 318

To return to manual operation

Depending on the used remote control state, the transition from remote control to manual operation requires different actions.

► Select the corresponding transition action as shown in the table.

Table 12-6: Remote control status icons

GUI symbol	Transition to remote control state...	Remote control state characteristics	Transition to manual operation...(local state)
	`&GTR` (controller PC)	Remote control, but usable front panel keys. The parameters are in read-only mode.	• `&GTL` (SCPI If `&NREN` has been set before `&GTL` is locked. Use `&GTR` instead. • `CALL IBLOC (generator%)`, (visual basic). • `viGpibControlREN()` (VISA function) • "Remote" icon in the status bar • [Local] (front panel or key emulation)
		The green arows indicate a currently performed setting.	The setting must be completed (white arrows) before you can return to manual operation.
	`&LLO` (controller)	Remote control with locked front panel keys to prevent user interaction. The parameters are in read-only mode. You can unlock LLO, and thus return to manual operation only over remote control commands.	• `&LOCS` • `&REMS` Changes from "Remote LLO" to "Remote" state. • `CALL IBLOC (generator%)` • `viGpibControlREN()`

12.9 Using remote command scripts

To configue a test setup quickly, or to make complex test setups or repeating measurements reproducible, you can automate the required settings with remote command scripts. A remote command script contains a sequence of SCPIs which configure the corresponding settings. When created, it is converted to an executable format, saved in a file and can be run whenever needed.

The graph shows the main steps required to create and execute a SCPI script.

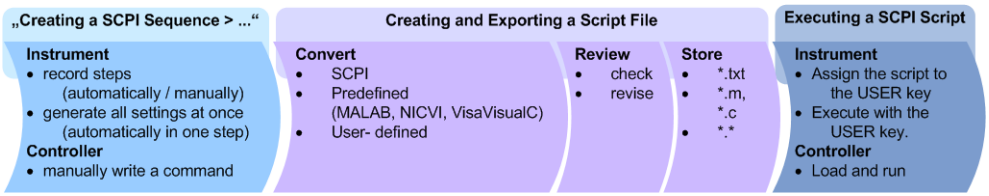


Figure 12-7: Steps for performing SCPI Scripts

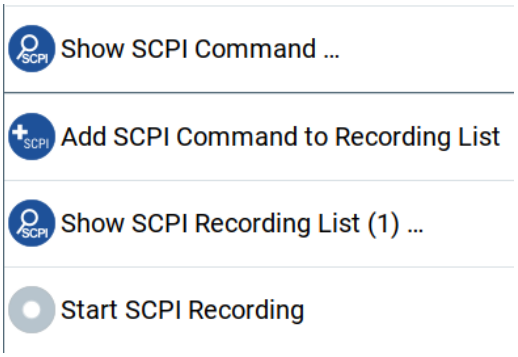
- SCPI recording settings 354
- Creating remote command lists 358
- Checking and verifying a remote command list 361
- Converting a remote command list to a script 362
- Running a remote command script 364

12.9.1 SCPI recording settings

The R&S SMB100B provides information on the required SCPI command for the available measurement settings, functions, and results in the context-sensitive menu.

Access:

1. Select a parameter.
2. Open the context-sensitive menu (tap and hold).



The context-sensitive menu provides the SCPI recording functions to help you create your script.

- Show SCPI command settings....355
- SCPI recording list settings....355
- SCPI recording export settings....356

12.9.1.1 Show SCPI command settings

Access:

1. Select the parameter.
2. Open the context-sensitive menu.
3. Select "Show SCPI Command".

This function provides the syntax of the remote command with the current setting.

Setttings:

Copy....355
Close....355

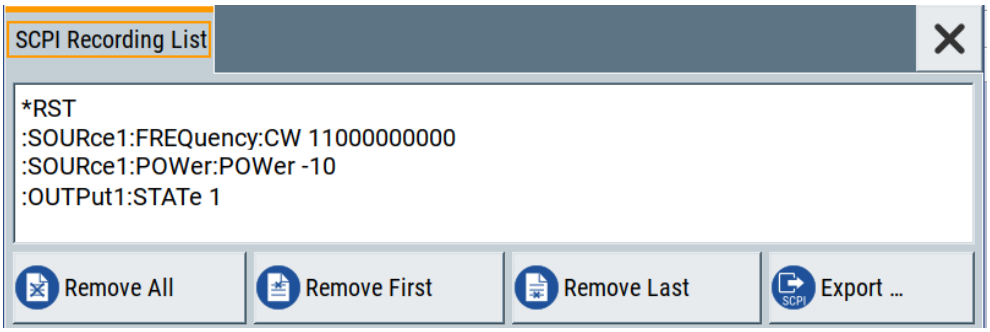
Copy
Copies the command and the current setting.

Close
Exits the "SCPI Command" dialog.

12.9.1.2 SCPI recording list settings

Access:

1. Select a parameter.
2. Open the context-sensitive menu.
3. Select "Show SCPI Recording List".



The "SCPI Recording List" shows the recorded commands.

Setttings:

SCPI Recording List....356
Remove All....356
Remove First....356
Remove Last....356
Export....356

SCPI Recording List
Lists the automatically or manually recorded SCPI commands.

Remove All
Deletes all entries in the SCPI command list.

Remove First
Deletes the first entry in the SCPI command list.

Remove Last
Deletes the last entry in the SCPI command list.

Export
Opens the "SCPI Recording Export" dialog for configuring the file parameters for the SPCI command script file.

See Section 12.9.1.3, "SCPI recording export settings", on page 356.

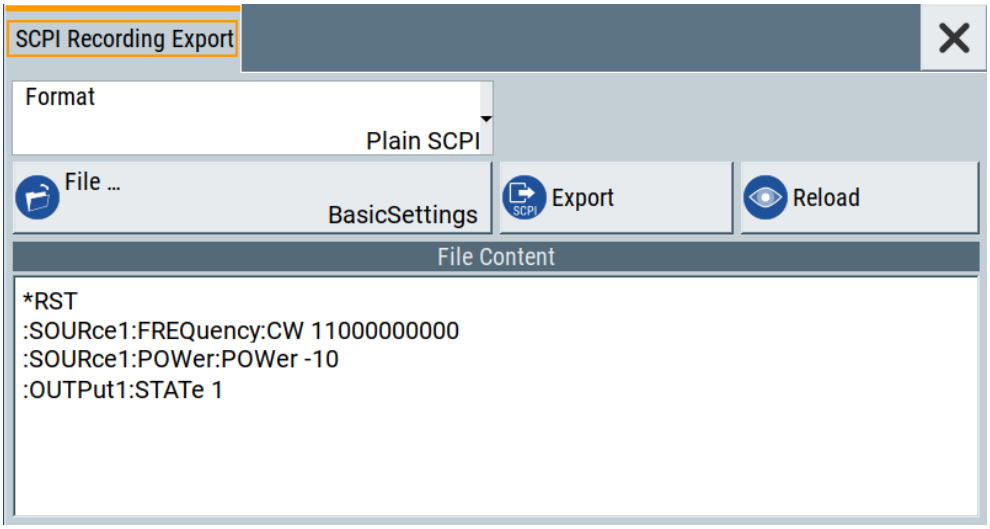
12.9.1.3 SCPI recording export settings

The R&S SMB100B displays recorded remote command lists in the "SCPI Recording Export" dialog. This dialog opens automatically, when you stop recording. To open the dialog manually, proceed as described.

Access:

1. Select a parameter.
2. Open the context-sensitive menu.
3. Select "Show SCPI Recording List".

4. Select "Export".



The "SCPI Recording Export" dialog contains all functions required for export of command lists to a file. It enables you to select the source code format, assign an individual filename and display the file content.

Setttings:

Format....357
Code Template....357
File....357
Export....358
Reload....358
File content....358

Format
Selects the source code format for the command list.

"Plain SCPI" Uses SCPI syntax.

"Predefined Code Generator"
Accesses the predefined templates for common source code generators that convert the recorded settings in the programming languages MATLAB or NICVI or Python.

"User Code Generator"
Use this setting to convert a script by a user-specific code generator.

Code Template
Opens a standard file handling dialog for saving or loading predefined or user-defined code templates.

See Section 10.6.1, "File select settings", on page 234.

File
Opens a standard file handling dialog for selecting the directory and file name for the output file.

See Section 10.6.1, "File select settings", on page 234.

Export
Saves the remote command list file in the selected directory.

Reload
Reloads a remote command list file.

File content
Displays the content of the remote command list in the selected format and code template.

12.9.2 Creating remote command lists

Using the SCPI recorder functions, you can create a SCPI command list directly on the instrument and then export the list for use on the controller PC. You can also edit or write a script manually, using a suitable editor on the controller. For manual creation, you can retrieve the command corresponding to a setting directly on the instrument.

You can create a SCPI list directly on the instrument at any time of operation, in the following ways:

- Recording settings automatically
  The "Start SCPI Recording" function adds the SCPI command of each step that you perform to the SCPI list. You can start, stop and resume automatic recording, and also add individual commands manually.
  See "To record settings automatically" on page 359.
- Recording settings manually
  The "Add SCPI Command to Recording List" function adds the SCPI command and settings value of an individual step to the SCPI list.
  See "To record settings manually" on page 359.
- Generating a SCPI command list of all settings in one step
  Adds the SCPI commands of the current instrument settings in one step in a SCPI list.
  See "To generate a SCPI command list of all settings in one step" on page 360.
  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. If a setting cannot be set by a SCPI command, *no SCPI command found* is entered instead of a command when generate all settings at once.
  Using this function can slow down the performance or cause errors during execution.
  Therefore, always check and revise a script if necessary.
  See "To display a remote command list" on page 361 and "To review a remote command list" on page 361.
- Copying and pasting individual SCPI commands manually
  "Show SCPI command" enables you to copy the SCPI command and the current setting and paste it into any suitable editor.
  See "To copy and paste SCPI commands" on page 359.

To record settings automatically

1. On the screen, open the context-sensitive menu.
2. Select "Start SCPI recording".



The R&S SMB100B now records all steps you take.

3. To stop SCPI recording, select "Stop SCPI recording" in the context-sensitive menu.

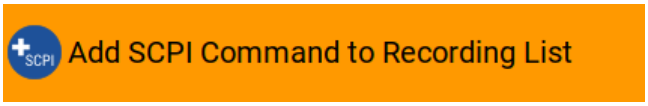


The "SCPI Recording List" dialog opens.

4. Proceed with "To review a remote command list" on page 361.

To record settings manually

1. Select the parameter or function.
2. Set the parameter.
3. Open the context-sensitive menu.
4. Select "Add SCPI Command to Recording List".



The R&S SMB100B adds the SCPI command of the setting including the value in a temporary SCPI command list.

Tip: "Context-Sensitive > Show SCPI Recording List" opens the dialog with the recorded settings.



5. Continue with the next setting accordingly whenever you want to record it.
6. Proceed with "To review a remote command list" on page 361.

To copy and paste SCPI commands

1. On the instrument, select the parameter or function.
2. Set the parameter.
3. Open the context-sensitive menu.
4. Select "Show SCPI Command".



The R&S SMB100B displays the syntax and the setting value of the SCPI command.

With the "Copy" function, you can copy and paste the SCPI command and setting value, e.g., in a command script on a PC.

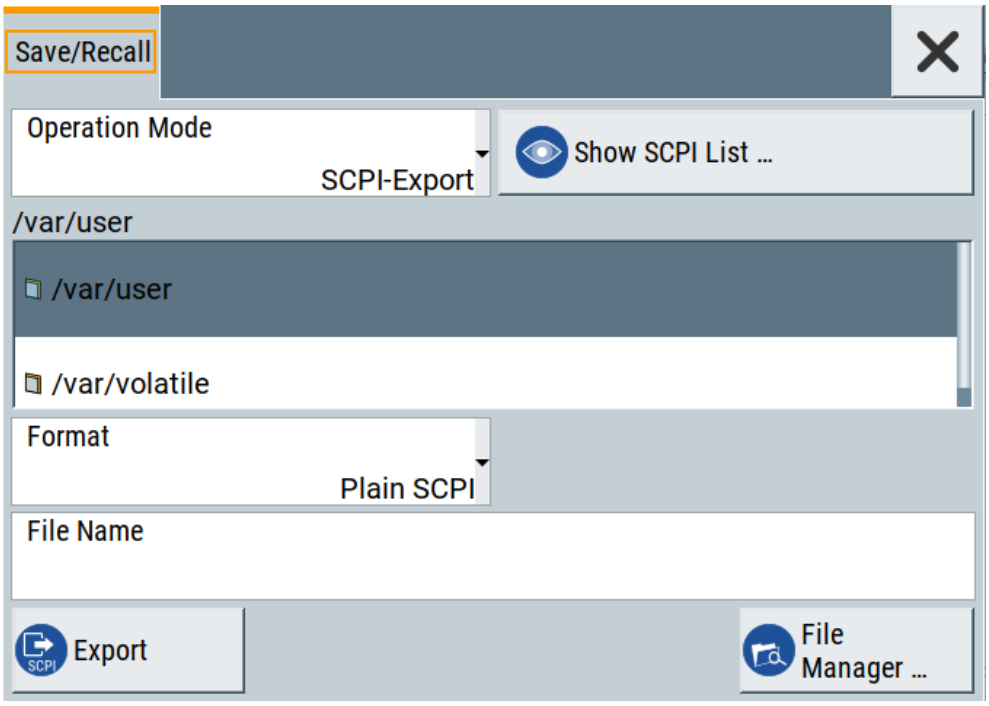
To generate a SCPI command list of all settings in one step

Using the save/recall function, you can create a SCPI command list for all settings in one step.

1. Press the [Save/Recall] key.

   The instrument opens the standard "Save/Recall" dialog.

2. Select "Operating mode" > "SCPI Export".



   The dialog adjusts the entry fields for configuring the command list file. "Show SCPI List" provides access to the list of all setttings the instrument has recorded.

3. Select the "/var/user" directory in which you want to save the SCPI command list.
4. In the "Format" entry field, select the source code format.
5. Enter a filename.
6. Select "Export".
   The R&S SMB100B saves the SCPI command list as `*.txt` file.

Note: Exporting the SCPI list of the instrument state in one step usually requires postprocessing on an external PC, as this function lists all instrument states and commands in alphabetical order.
In contrast, recording or manual creation of a SCPI command list considers the order the settings are configured.

12.9.3 Checking and verifying a remote command list

Before converting a command list to an executable script, we recommend that you check if the entries are correct and complete. It can be that ...

- a parameter has not assigned a SCPI command or an element of the user interface has not an assigned parameter. In these cases, `:SYST:INF:SCPI 'SCPI command not available'` is entered in the list instead.
  Such entries are also detected during execution. The instrument recognizes these incomplete commands and displays notification.
- a preset has been executed, but several standards then perform some internal settings that are also assigned to the list with "SCPI Export".
- after a preset some settings are still defined, which are then written to the list generated with "SCPI Export."

To display a remote command list

On the instrument, you have different options to access a remote command list.

1. During automatic or manual recording:
   a) Open the context-sensitive menu.
   b) Select "Show SCPI Recording List".
2. At the end of automatic recording:
   a) Open the context-sensitive menu.
   b) Select "Stop SCPI Recording".
3. After exporting a command list to a file.
   a) Select "SCPI Recording Export" > "Show file content".

   The "SCPI Recording List" opens.

To review a remote command list

To rework a remote command list, you must transfer it to a computer.

1. Export the list to a PC, using, for example, a USB flash drive.
2. Check the list, e.g. by comparing it with the modified settings in the manual mode.

   Tip: To find out your settings, you can use the "Mark all parameters changed from preset" function.
   See Section 10.3.2, "Identifying parameters with non-default values", on page 227.
3. Search for missing or incomplete command entries.
   a) Add missing commands.

b) Complete missing parts of commands.
c) Remove superfluous entries, e.g. `:SYST:INF:SCPI 'SCPI command not available'`.
d) Remove unnecessary content written after a preset.

4. Rearrange the commands to a reasonable order. For example, if you set a `STATe` command to the last position in a list, you can avoid intermediate calculations of the signal.

12.9.4 Converting a remote command list to a script

For conversion of a remote command list into an executable script, a code generator translates the commands into the source code of a proprietary programming language, based on a code template. Therefore, each progamming language requires a dedicated code template.

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.
- NICVI
  An ANSI C programming environment designed for measurements and tests (`*.c`).
  You can directly use this format with National Instruments LabWindows CVI.
- Python3
  A general-purpose and high-level programming language (`*.py`).

You can also convert a script to a user-specific format. In this case, you need a code template with the extension `*.expcodetmpl`.

When converted, you can save the script in a file with the extension corresponding to the programming language.

To configure a plain SCPI script file

1. Select "Show SCPI Recording List" in the context-sensitive menu.
2. Select "Export".
   The "SCPI Recording Export" dialog opens.
3. Select the "Format" > "Plain SCPI".
4. Select "File".
   A standard file handling dialog opens.
5. Configure filename and directory and confirm with "Ok".
6. In the "SCPI Recording Export" dialog, select "Export".

The R&S SMB100B saves the recorded data in `*.txt` format. The "File Content" section shows the SCPI commands of the script file.

To convert the command list to a predefined code template

1. Select "Show SCPI Recording List" in the context-sensitive menu.
2. Select "Export".
   The "SCPI Recording Export" dialog opens.
3. In the "SCPI Recording Export" dialog, select "Format" > "Predefined Code Generator".

   The "CodeTemplate" button appears.
4. Select "Code Template".

   The "SCPI Recording Export - Select Predefined Code Template" dialog opens.
5. Select a predefined code template, e.g., "MATLAB".
6. Confirm with "Select".

   The R&S SMB100B returns to the "SCPI Recording Export" dialog.
7. Select "File".
   A standard file handling dialog opens.
8. Configure filename and directory and confirm with "Ok".
9. In the "SCPI Recording Export" dialog, select "Export".
   The R&S SMB100B saves the recorded data in the corresponding format. The "File Content" section shows the content of the script file in the corresponding programming language.

To convert the command list to a user-defined code template

Before creating a script in a user-specific format, make sure that you have saved the code template with the file extension `*.expcodetmpl` in the instrument.

1. Select "Show SCPI Recording List" in the context-sensitive menu.
2. In the "SCPI Recording Export" dialog, select "Format" > "Use Code Generator".

   The "CodeTemplate" button appears.
3. Select "Code Template".

   The "SCPI Recording Export - Select User Code Template" dialog opens.
4. Select your user-defined code template.
5. Confirm with "Select".

   The R&S SMB100B returns to the "SCPI Recording Export" dialog.
6. Select "File".
   A standard file handling dialog opens.
7. Configure filename and directory and confirm with "Ok".

8. In the "SCPI Recording Export" dialog, select "Export".
   The R&S SMB100B saves the recorded data in the corresponding format. The "File Content" section shows the content of the script file in the corresponding programming language.

12.9.5 Running a remote command script

An executable script automates measurement tasks on the instrument. Usually controlled by a remote PC, you can also save and run a script directly in the instrument by assigning the script to the [★ (User)] key.

See Section 11.2.2, "How to assign actions to the [★ (User)] key", on page 264.

12.10 Setting up remote operation over VNC

VNC accesses the R&S SMB100B over LAN from a remote device using a web browser or a VNC client. With the screen displayed on the controller, you can control the instrument as if you operate it directly. Establishing the access depends on the used remote device and VNC client software.

See Section 12.1, "Overview of remote access modes", on page 297.

The following examples descibe how to set up remote operation with remote devices:

- Using a controller PC
  - "To operate the instrument from a web browser over VNC" on page 365
  - "To operate the instrument from a Linux/Unix client over VNC" on page 366
  - "To operate the instrument from a Windows client over VNC" on page 366
- Using a smart device
  - "To operate the instrument using a VNC App on a smart device" on page 369
  - "To operate the instrument from a web browser over VNC" on page 365
  - "To access the instrument with QR code on a smart device" on page 369

To enable VNC service on the R&S SMB100B

1. **NOTICE!** Enabled VNC service can lead to unauthorized access.
   Change the computer name and password of the instrument.
   See Section 11.4.6, "Preventing unauthorized access", on page 290.
2. Select "System Config > Setup > Security > Security".
3. Select "LAN Services > Common Services".
4. Enable "VNC".
5. Enter the Security Password.
6. Confirm with "Accept".

- Using a controller PC 365
- Using a smart device 367
- Stopping remote operation 370

12.10.1 Using a controller PC

Prerequisites

For remote operation, make sure that you have fullfilled the following prerequisites:

- The instrument and the controller PC are connected in the same network.
  See Section 3.1.7, "Connecting to LAN", on page 25.
- The instrument and the controller are switched on.
- The LAN interface and VNC LAN service is enabled.
  See Section 11.4.4, "Configuring LAN services", on page 283.
- A suitable application is running on the remote device.
  - Web browser
    The R&S SMB100B supports remote operation over VNC with any web browser, e.g., Windows Internet Explorer, Mozilla Firefox, or an HTML5 web browser.
  - VNC client software
    The software application provides remote operation of the R&S SMB100B.

VNC client software

Linux/Unix operating systems include a VNC client software by default.

For remote devices with windows operating system a VNC client software must be installed manually. Various free-of charge programs such as Ultr@VNC or similar VNC client programs are available for download on the Internet.

If security is a concern, see:

- Document Instrument Security Procedures.
- Section 11.4.6, "Preventing unauthorized access", on page 290.

To operate the instrument from a web browser over VNC

1. Install the *JRE (Java Runtime Environment)* on the remote computer.
   Note: Skip this step if you are working with an HTML5 web browser.
2. Enter the IP address of the instrument in the address field of the web browser, e.g. *http://10.113.1.151*

   The VNC authentication screen appears.
3. Enter the user password.
   The default password is *instrument*.

4. Confirm with with "OK".

   When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the remote computer.

To operate the instrument from a Linux/Unix client over VNC

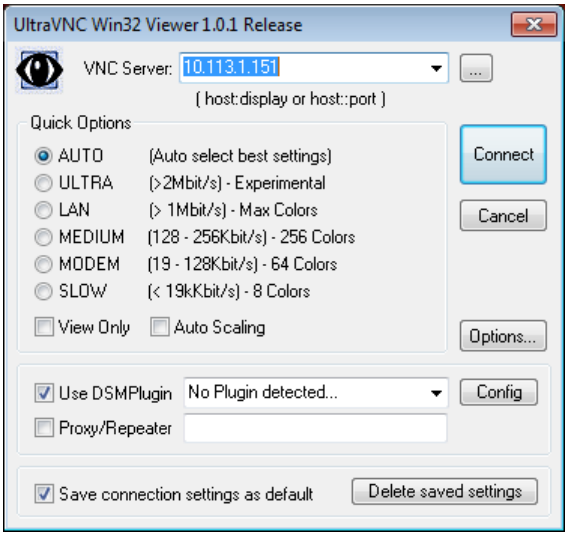
1. Start a web browser on the remote computer. Enter the IP address of the instrument.
2. Enter the following address:
   `vnc://<IP-address of the instrument>`, for example *vnc://10.113.1.151*.

   A dialog opens requesting the password for the remote VNC connection.
3. Enter the user password.
   The default password is *instrument*.
4. Confirm with with "OK".

   When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the remote computer.

To operate the instrument from a Windows client over VNC

1. Install the VNC viewer program component on the remote computer.
   a) Download a VNC client program from the Internet.
   For example the free of charge software Ultr@VNC (`vncviewer.exe` is available, see http://www.uvnc.com/download/index.html.
   b) Execute the VNC client installation.
   c) Select the VNC viewer program component and follow the installation instructions.
2. Start VNC viewer program component on the PC.



3. Select "VNC Server"

4. Enter the IP address of the instrument.
5. Confirm with "Connect".

   An authentication dialog opens.



6. Enter the user password for authentication.
   The default password is *instrument*.
7. Confirm with "LogOn".

   When the connection is established, the screen of the signal generator appears and you can operate the instrument from the remote computer.

12.10.2 Using a smart device

The R&S SMB100B supports remote operation over VNC from a smart device (remote client), like a tablet (tablet computer) or a smartphone. The smart device accesses the instrument over WLAN, either by a suitable App, or an HTML5 web browser with embedded *javascript*.

There are several possibilities to establish a WLAN connection between the smart device and the R&S SMB100B. This section gives an example of how a network environment can be built up, and some essential configuration steps.

For more information, see:

- 1MA216: Remote Operation of Windows Based Instruments with Apple iPad
- 7BM82: Apple iPad Remote Control of Broadcasting T&M Instruments

Example:

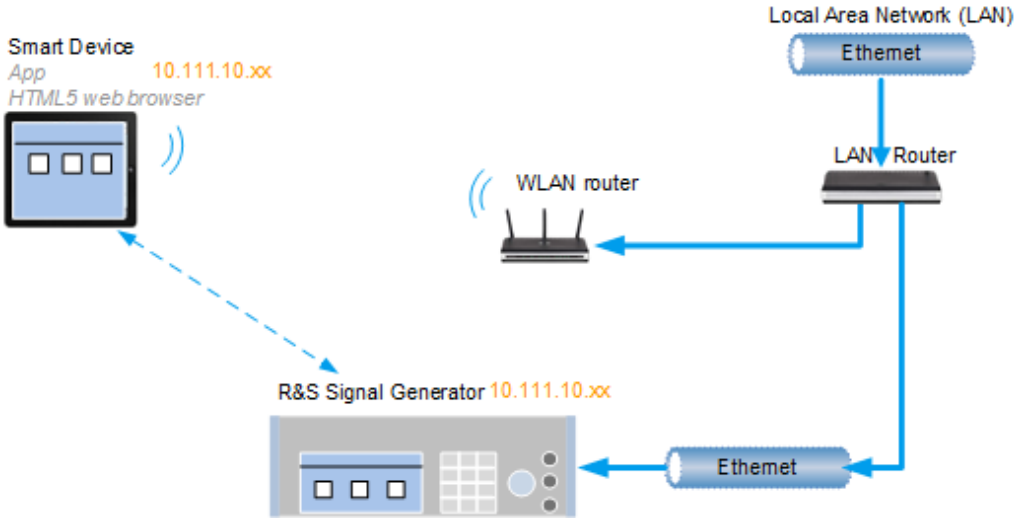


Figure 12-8: Example of a network configuration for remote operation with a smart device

As shown in the figure, the R&S SMB100B and the WLAN router are connected to the LAN router. The smart device accesses the Rohde & Schwarz instrument via the WLAN router.

The WLAN router as an additional access point enables you to operate the instrument even from a great distance.

Prerequisites

For the remote operaton, you need the following equipment and configuration:

- Equipment:
  - LAN router
  - WLAN router (hot spot) for accessing the instrument
  - Smart device
- The instrument and the smart device PC are connected in the same network.
- The instrument and the smart device are switched on.
- The LAN interface and VNC LAN service is enabled.
  See Section 11.4.4, "Configuring LAN services", on page 283.
- A suitable application is running on the smart device.
  - Web browser
    The R&S SMB100B supports remote operation over VNC with any HTML5 compliant web browser, e.g., Internet Explorer, Firefox, Google Chrome or Safari.
  - VNC app
    An application that implements the VNC functionality for remote operation. The VNC App must be suitable to the used smart device.
    Refer to the manufacturer's website to find a VNC App supported for your smart device, and how it is installed.
  - QR code

If your smart device is equipped with a camera and a QR code reader, you can scan the instrument's IP address or access the instrument with the Safari web browser.
Refer to the manufacturer's website to find a QR code reader supported for your smart device, and how it is installed.

We recommend that all components in the network use DHCP, which automatically assigns the relevant address information.

To operate the instrument using a VNC App on a smart device

1. Set up the network connection as shown in Figure 12-8
2. Configure the WLAN router according to the manufacturer's instructions.
3. Install the required *VNC App* on your smart device.
4. On the smart device, start the *VNC App*.
   Enter the IP address of the instrument in the address field of *VNC App*.

   The VNC authentication screen appears.
5. Enter the user password.
   The default password is *instrument*.
6. Enter the password to establish the remote access.
   The default user name and password is *instrument*.

   When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the smart device.

To operate the instrument from a web browser over VNC

1. Install the *JRE (Java Runtime Environment)* on the remote computer.
   Note: Skip this step if you are working with an HTML5 web browser.
2. Enter the IP address of the instrument in the address field of the web browser, e.g. *http://10.113.1.151*

   The VNC authentication screen appears.
3. Enter the user password.
   The default password is *instrument*.
4. Confirm with with "OK".

   When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the remote computer.

To access the instrument with QR code on a smart device

1. Set up the network connection as shown in Figure 12-8
2. Configure the WLAN router according to the manufacturer's instructions.
3. Install the required QR code reader software on your smart device.
4. On the smart device, start the QR code reader.

5. On the R&S SMB100B, select "System Config > Remote Access".
6. Select the "QR-Code" tab.
7. Scan the QR code of the instrument with your smart device.
8. On the smart device, decode the scanned QR code and forward it to the web browser.

   The VNC authentication screen appears.
9. Enter the user password.
   The default password is *instrument*.

   When the VNC connection is established, the screen of the signal generator appears and you can operate the instrument from the smart device.

12.10.3 Stopping remote operation

To stop remote operation

To terminate remote operation over VNC depends on the used client:

► Select the action that applies to the used client:

a) On an external Unix/Linux PC, close the Internet browser or the signal generator window.
b) On an external Windows PC, close the VNC viewer program.
c) On a smart device, close the application.

The connection is terminated but not disabled. It can be established again anytime.

12.11 References

12.11.1 LXI functionality

LAN Extensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology.

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 https://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. Using a web browser, you can configure the instrument. A LAN Configuration Initialize (LCI) mechanism resets the LAN configuration. The instrument also supports automatic detection in a LAN via the VXI-11 discovery protocol and programming by IVI drivers.

In addition, the R&S SMB100B provides the following LXI-related functionality:

- Integrated "LXI Status" dialog for LXI status indication and reset of the LAN configuration, see Section 12.6, "LXI status settings", on page 332.
- "LXI Browser Interface", as described in Section 12.7.1, "LAN configuration", on page 335.
- "SCPI Remote Trace" utility, see Section 12.7.2, "SCPI remote trace", on page 337.

Firmware update

To enable the full LXI functionality after a firmware update, shut down and restart the instrument.

12.11.2 Code generator templates

This section describes the main structure of the code generator templates, and shows the method with the NICVI template.

The code generation is controlled by templates with the following blocks:

Command	Function
`#EXTENSION_START` `#EXTENSION_END`	Defines the output file extension.
`#INIT_CODE_START` `#INIT_CODE_END`	Contains initial entries, such as included files and libraries, buffer size, commands for synchronization, or creating a VISA session. All entries between start and end are written once at the beginning of the output file.
`#COMMAND_CODE_START` `#COMMAND_CODE_END`	Frame for a SCPI command. A command is accessed with `%COMMAND`.
`#NO_COMMAND_CODE_START` `#NO_COMMAND_CODE_END`	Frame for a parameter with no SCPI command available. A parameter is accessed with `%PARAMETER`.
`#EXIT_CODE_START` `#EXIT_CODE_END`	Closes the visa session. All entries between start and end are written once at the end of the output file.

Templates are created in ASCII format with file extension `*.expcodetempl`.

Example:

Example to the code generator template `NICVI.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
```

13 Remote control commands

In the following, all remote-control commands are presented in detail with their parameters and the ranges of numerical values.

For an introduction to remote control and the status registers, see Section 12, "Network operation and remote control", on page 296.

- Conventions used in SCPI command descriptions 374
- Programming examples 375
- Common commands 376
- Preset commands 380
- MMEMory subsystem 382
- CALibration subsystem 392
- DIAGnostic subsystem 396
- HUMS remote control commands 399
- DISPlay subsystem 406
- FORMat subsystem 411
- HCOPy subsystem 412
- KBOard subsystem 418
- OUTPut subsystem 419
- SENSe, READ, INITiate and SLISt subsystems 422
- SCONfiguration subsystem 436
- SOURce subsystem 441
- SYSTem subsystem 555
- STATus subsystem 585
- TEST subsystem 589
- TRIGger subsystem 592
- UNIT subsystem 596
- Direct commands for the stereo/rds coder option R&S SMBB-B5 596

13.1 Conventions used in SCPI command descriptions

The following conventions are used in the remote command descriptions:

- *Command usage*
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- *Parameter usage*
  If not specified otherwise, a parameter can be used to set a value, and it is the result of a query.
  Parameters required only for setting are indicated as "Setting parameters".
  Parameters required only to refine a query are indicated as "Query parameters".
  Parameters that are only returned as the result of a query are indicated as "Return values".
- *Conformity*

Commands that are taken from the SCPI standard are indicated as "SCPI confirmed". All commands used by the R&S 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.

13.2 Programming examples

The corresponding sections of the same title provide simple programming examples for the R&S SMB100B. The purpose of these examples is to present all commands for a given task. Real applications require application-specific sets of commands and configurations.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the examples as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines start with two characters `//`, for example, comments.

At the beginning of the most remote control program, an instrument preset or reset is recommended to set the R&S 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 the following:

- A remote PC is connected to the instrument.
- The remote PC and the instrument are switched on.
- A connection between them is established.
- The security setting "System Config" > "Setup" > "Security" > "SCPI over LAN" is enabled.

13.3 Common commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different 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....376
*ESE....376
*ESR?....376
*IDN?....377
*IST?....377
*OPC....377
*OPT?....377
*PRE....378
*PSC....378
*RCL....378
*RST....378
*SAV....379
*SRE....379
*STB?....379
*TRG....379
*TST?....380
*WAI....380

***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 317
See "Hardware Options/Software Options" on page 628

***IST?**

Individual status query

Returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Return values:
<ISTflag> 0 | 1

Usage: Query only

***OPC**

Operation complete

Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query writes a "1" into the output buffer when all preceding commands have been executed, which is useful for command synchronization.

***OPT?**

Option identification query

Queries the options included in the instrument. For a list of all available options and their description, refer to the specifications document.

Return values:
<Options> The query returns a list of options. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.

Usage: Query only

Manual operation: See "OPT String" on page 318
See "Hardware Options/Software Options" on page 628

***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 "Quick Recall x" on page 233

***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 226

***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 `:MMEM:STOR:STAT`.

Manual operation: See "Quick Save x" on page 232

***SRE** <Contents>

Service request enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:

<Contents> Contents of the service request enable register in decimal form. Bit 6 (MSS mask bit) is always 0.

Range: 0 to 255

***STB?**

Status byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**

Trigger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal. This common command complements the commands of the `TRIGger` subsystem.

`*TRG` corresponds to the `INITiate:IMMediate` command.

Usage: Event

***TST?**

Self-test query

Initiates self-tests of the instrument and returns an error code.

Return values:

<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

13.4 Preset commands

The preset commands are not bundled in one subsystem. Therefore, they are listed separately in this section.

Four presetting actions are available:

- Activating the default state of all internal instrument functions (`*RST` on page 378). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. reference oscillator source settings.
- Activating the preset state of the parameters related to the selected signal path (`:SOURce<hw>:PRESet` on page 381)
- Activating the preset state of all parameters that are not related to the signal path (`:DEVice:PRESet` on page 381)
- Activating the original state of delivery (factory reset, `:SYSTem:FPReset` on page 381). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

When resetting, the following deviation between remote and manual control exists:
In contrast to the [Preset] key, the SCPI commands `*RST` and `:SYSTem:PRESet` do not close open dialogs in the GUI.

:DEVice:PRESet 381
:SOURce<hw>:PRESet 381
:SYSTem:PRESet 381
:SYSTem:FPReset 381

: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. This command has the same effect as:

- The [Preset] key.
  However, the command does not close open GUI dialogs like the key does.
- The `*RST` command

For an overview of the settings affected by the preset function, see Table 10-1

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 227

13.5 MMEMory subsystem

The MMEMory subsystem (Mass MEMory) contains the commands for managing files and directories as well as for loading and saving complete instrument settings in files.

Mass storage location

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 Section 10.9, "Using the file manager", on page 237. In remote control, you can query it with the command :SYSTem:MMEMory:PATH:USER?.

To query and change the default directory used for mass storage, use the command :MMEMory:CDIRectory.

13.5.1 File naming conventions

To enable files to be used in different file systems, consider the following file naming conventions:

- The *filename* can be of any length and *is case-sensitive*, i.e it is distinguished between uppercase and lowercase letters.
- All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the filename).
- Avoid using special characters.
- Do not use slashes "\" and "/". These symbols are used in file paths.
- Avoid using the following filenames: CLOCK$, CON, COM1 to COM4, LPT1 to LPT3, NUL or PRN
  They are reserved by the operating system.

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 Sec-

tion A.2, "Available user files and file extensions", on page 653 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.

13.5.2 Handling files in the default or in a specified directory

For better overview and easy file handling, you may not save all user files in the user directory `/var/user` but rather organize them into subdirectories.

The command syntax defines two general ways to access files with user data in a *specific* directory:

- **Change the current default directory** for mass memory storage and then directly access the files in this default directory, like saved list files, files with user data or save/recall files.
  The subsequent commands for file handling (select, delete, read out files in the directory, etc.) require only specification of the filename. File extension can be omitted; after syntax evaluation of the used command, the R&S SMB100B filters out the relevant files.
- Define the **complete file path**, including the user directory `/var/user`, created subdirectories and filename.
  As a rule, whenever an complete file path is determined, it overwrites a previously specified default directory.

The following example explains this rule as a principle. Exceptions of this general rule are stated in the description of the corresponding command. The Section 13.5.3, "Programming examples", on page 384 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 386.

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"
```

13.5.3 Programming examples

Example: Saving and loading current settings

This example shows two ways of how to save the current instrument setting in the file `settings.savrcltxt` in the directory `/var/user/savrcl`.

Before the instrument settings can be saved in a file, they have to be saved in an intermediate memory using common command `*SAV <number>`. The specified number is then used in the `:MMEMory:STORe:STATe` command.

Also, after loading a file with instrument settings with command `:MMEMory:LOAD:STATe`, these settings have to be activated with the common command `*RCL <number>`.

```
// Save the current settings in an intermediate memory with number 4
*SAV 4

// save the settings in a file in a specific directory;
// the complete path has to be specyfied
MMEMory:STORe:STATe 4,"/var/user/savrcl/settings.savrcltxt"

// save the settings in a file in the default directory;
// set the default directory; specify only the file name
MMEMory:CDIRectory  "/var/user/savrcl"
*SAV 4
```

```
MMEMory:STORe:STATe 4,"settings.savrcltxt"

// Load the saved settings in the intermediate memory 4 and activate them
MMEMory:LOAD:STATe 4,"/var/user/settings.savrcltxt"
*RCL 4
```

Example: Working with files and directories

This example shows how to list files in a directory, list the subdirectories, query the number of files in a directory, create directory, rename and delete files.

```
// Query the current default directory for mass storage,
// change the directory to the default user directory "/var/user"
// and read out the files in it
MMEMory:CDIRectory?
// "/var/user/temp"
MMEMory:CDIRectory
MMEMory:CDIRectory?
// "/var/user/"
MMEMory:CATalog?
// 1282630,8102817792,".,DIR,4096","..,DIR,4096","Log,DIR,4096",
// "settings.savrcltxt,BIN,16949","temp,DIR,4096","test,DIR,4096",
// "list.lsw,BIN,1245201"
// the directory "/var/user" contains the predefined directory "Log",
// the subdirectories "test" and "temp"
// as well as the files "settings.savrcltxt" and "list.lsw"

// query only the subdirectories of the current or specified directory
MMEMory:DCATalog? "/var/user"
// ".","..","Log","temp","test"

// query only number of subdirectories in the current or specified directory
MMEMory:DCATalog:LENGth? "/var/user"
// 5

// query number of files in the current or specified directory
MMEMory:CATalog:LENGth? "/var/user"
// 7

// Create a new directory for mass memory storage in the specified directory
MMEMory:MDIRectory "/var/user/new"

// Copy the file "settings.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 an empty directory, e.g. the "test" directory
MMEMory:RDIRectory "/var/user/test"
// Delete the entire directory, including files and subdirectories
:MMEMory:RDIRectory:RECursive "var/user/test"
```

Example: Working with files in the volatile memory

This example shows how to work with files in the `/var/volatile` directory.

```
// Change the default directory for mass storage,
// read out the files, load and play a file with the ARB
MMEMory:CDIRectory "/var/volatile"
MMEMory:CDIRectory?
// "/var/volatile"
MMEMory:CATalog?
//13928,525352960,".,DIR,60","..,DIR,4096","list.lst,BIN,9772"

SOURce1:LIST:SELect "/var/volatile/list"
SOURce1:FREQuency:MODE LIST
OUTPut1:STATe 1
```

13.5.4 Remote control commands

:MMEMory:CATalog? 386
:MMEMory:CATalog:LENGth? 387
:MMEMory:CDIRectory 387
:MMEMory:COPY 387
:MMEMory:DATA 388
:MMEMory:DCATalog? 389
:MMEMory:DCATalog:LENGth? 389
:MMEMory:DELete 389
:MMEMory:LOAD:STATe 389
:MMEMory:MDIRectory 390
:MMEMory:MOVE 390
:MMEMory:MSIS 390
:MMEMory:RDIRectory 390
:MMEMory:RDIRectory:RECursive 391
:MMEMory:STORe:STATe 391
:MEMory:HFRee? 391

:MMEMory:CATalog?

Returns the content of a particular directory.

Return values:
<Catalog> string
String parameter to specify the directory.
If you leave out the path, the command returns the contents of the directory selected with `:MMEMory:CDIRectory`.
The path may be relative or absolute.

Usage: Query only

Manual operation: See "Directory, File List and Filename" on page 231

:MMEMory:CATalog:LENGth? [<Path>]

Returns the number of files in the current or in the specified directory.

Query parameters:
<Path> string
String parameter to specify the directory. If the directory is omitted, the command queries the content of the current directory, queried with `:MMEMory:CDIRectory` command.

Return values:
<FileCount> integer
Number of files.

Usage: Query only

:MMEMory:CDIRectory <Directory>

Changes the default directory for mass memory storage. The directory is used for all subsequent `MMEM` commands if no path is specified with them.

Parameters:
<Directory> <directory_name>
String containing the path to another directory. The path can be relative or absolute.
To change to a higher directory, use two dots '..' .

Manual operation: See "Directory, File List and Filename" on page 231
See "Directory and Filename" on page 239

: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

Manual operation: See "Cut, Copy&Paste and Delete" on page 239

:MMEMory:DATA <Filename>, <BinaryData>
:MMEMory:DATA? <Filename>

The setting command writes the block data `<BinaryBlock>` to the file identified by `<Filename>`.

Tip: Use this command to read/transfer stored instrument settings or waveforms directly from/to the instrument.

Parameters:
<BinaryData>

Setting parameters:
<Filename> string

String parameter to specify the name of the file.

Query parameters:
<Filename> #<number><length_entry><data>

`#`: Hash sign; always comes first in the binary block
`<number>`: the first digit indicates how many digits the subsequent length entry has
`<length_entry>`: indicates the number of subsequent bytes
`<data>`: binary block data for the specified length.
For files with a size with more than nine digits (gigabytes), the instrument allows the syntax `#(<Length>)`, where `<Length>` is the file size in decimal format.

Example: `MMEMory:DATA '/var/user/test.txt',#15hallo`
Writes the block data to the file `test.txt`.
The digit `1` indicates a length entry of one digit; the digit `5` indicate a length of the binary data (`hallo`) in bytes.
`MMEMory:DATA? '/var/user/test.txt'`
Sends the data of the file `test.txt` from the instrument to the controller in the form of a binary block.
`Response: #15hallo`

:MMEMory:DCATalog?

Returns the subdirectories of a particular directory.

Return values:

<DCatalog> <file_entry>
Names of the subdirectories separated by colons. The first two strings are related to the parent directory.

Usage: Query only

:MMEMory:DCATalog:LENGth? [<Path>]

Returns the number of subdirectories in the current or specified directory.

Query parameters:

<Path> string
String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory, to be queried with `:MMEMory:CDIRectory` command.

Return values:

<DirectoryCount> integer
Number of parent and subdirectories.

Usage: Query only

:MMEMory:DELete <Filename>

Removes a file from the specified directory.

Setting parameters:

<Filename> string
String parameter to specify the name and directory of the file to be removed.

Usage: Setting only

Manual operation: See "Cut, Copy&Paste and Delete" on page 239

: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 233

:MMEMory:MDIRectory <Directory>

Creates a subdirectory for mass memory storage in the specified directory. If no directory is specified, a subdirectory is created in the default directory. This command can also be used to create a directory tree.

Setting parameters:

<Directory> string

String parameter to specify the new directory.

Usage: Setting only

Manual operation: See "Create New Directory" on page 239

:MMEMory:MOVE <SourceFile>, <DestinationFile>

Moves an existing file to a new location or, if no path is specified, renames an existing file.

Setting parameters:

<SourceFile> string

String parameter to specify the name of the file to be moved.

<DestinationFile> string

String parameters to specify the name of the new file.

Usage: Setting only

Manual operation: See "Rename" on page 239

:MMEMory:MSIS <Path>

Defines the drive or network resource (in the case of networks) for instruments with windows operating system, using `msis` (MSIS = Mass Storage Identification String).

Note: Instruments with Linux operating system ignore this command, since Linux does not use drive letter assignment.

:MMEMory:RDIRectory <Directory>

Removes an empty directory from the mass memory storage system. If no directory is specified, the subdirectory with the specified name is deleted in the default directory.

Setting parameters:

<Directory> string

String parameter to specify the directory to be deleted.

Example: See Example "Working with files and directories" on page 385.

Usage: Setting only

:MMEMory:RDIRectory:RECursive <Directory>

Removes the specified directory, including files and subdirectories from the mass memory storage system. If no directory is specified, the command removes the subdirectories of the default directory.

The command the entire directory without further prompt or notification.

Setting parameters:

<Directory> string
String parameter to specify the directory to be deleted.

Example: See Example "Working with files and directories" on page 385.

Usage: Setting only

: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 232

:MEMory:HFRee?

Returns the used and available memory in Kb.

Return values:

<TotalPhysMemKb> integer
Total physical memory.

<ApplicMemKb> integer
Application memory.

<HeapUsedKb> integer
Used heap memory.

<HeapAvailableKb> integer
Available heap memory.

Usage: Query only

13.6 CALibration subsystem

The `CALibration` subsystem contains the commands needed for performing internal adjustments. This procedure is triggered by the query commands.

Common suffixes

The following common suffixes are used in the remote commands:

Suffix	Value range	Description
`CALibration<hw>`	[1]	Optional suffix

Understanding the query response

- `0`: error-free execution of the adjustments
- `1`: indicates that an error occurred; the process has been canceled

Example: Querying the most recent internal adjustments

```
CALibration:ALL:DATE?
"2024-07-16"
CALibration:ALL:INFormation?
"" // no adjustment info available
CALibration:ALL:TEMP?
"-2.0 K"
CALibration:ALL:TIME?
"17 days"
```

:CALibration:ALL[:MEASure]? 392
:CALibration<hw>:ALL:DATE? 393
:CALibration<hw>:ALL:INFormation? 393
:CALibration<hw>:ALL:TEMP? 393
:CALibration<hw>:ALL:TIME? 394
:CALibration<hw>:CONTinueonerror 394
:CALibration:DATA:EXPort 394
:CALibration:DATA:FACTory:DATE? 394
:CALibration:DELay:MINutes 395
:CALibration:DELay:SHUTdown[:STATe] 395
:CALibration:DELay[:MEASure]? 395

:CALibration:ALL[:MEASure]? [<Force>]

Starts all internal adjustments that do not need external measuring equipment.

Query parameters:
<Force> string

Return values:
<Measure> 1 | ON | 0 | OFF

Example:
```
CAL:ALL:MEAS?
// Response: "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 634

:CALibration<hw>:ALL:DATE?

Queries the date of the most recently executed full adjustment.

Suffix:
<hw> [1]
Optional suffix

Return values:
<Date> string

Example: See Example "Querying the most recent internal adjustments" on page 392.

Usage: Query only

Manual operation: See "Last Full Adjustment" on page 634

:CALibration<hw>:ALL:INFormation?

Queries the current state of the internal adjustment.

Return values:
<CalInfoText> string

Example: See Example "Querying the most recent internal adjustments" on page 392.

Usage: Query only

Manual operation: See "Information" on page 635

:CALibration<hw>:ALL:TEMP?

Queries the temperature deviation compared to the calibration temperature.

Suffix:
<hw> [1]
Optional suffix

Return values:
<Temperature> string

Example: See Example "Querying the most recent internal adjustments" on page 392.

Usage: Query only

Manual operation: See "Temperature Offset" on page 635

:CALibration<hw>:ALL:TIME?

Queries the time elapsed since the last full adjustment.

Return values:
<Time> string

Example: See Example "Querying the most recent internal adjustments" on page 392.

Usage: Query only

Manual operation: See "Time" on page 635

:CALibration<hw>:CONTinueonerror <State>

Continues the calibration even though an error was detected. By default adjustments are aborted on error.

Suffix:
<hw> [1]
Optional suffix

Parameters:
<State> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 0)

Example:
```
CAL:CONT ON
// Continues calibration after an error
```

Manual operation: See "Continue Adjustment on Error" on page 635

:CALibration:DATA:EXPort

Collects the internal adjustment data and provides the data for export in a zip file. You can export the data for service and evaluation purposes.

Example:
```
:CALibration:DATA:EXPort
```

Usage: Event

:CALibration:DATA:FACTory:DATE?

Queries the date of the last factory calibration.

Return values:
<Date> string

Example:
```
CAL:DATA:FACT:DATE?
// "2016-01-01"
```

Usage: Query only

Manual operation: See "Last Full Factory Adjustment" on page 627

:CALibration:DELay:MINutes <Minutes>

Sets the warm-up time to wait before internal adjustment starts automatically.

Automatic execution starts only, if you have enabled the calibration with command `:CALibration:DELay[:MEASure]? ON`.

Parameters:

<Minutes> integer

Range: 30 to 120
*RST: n.a. (no preset. default: 60)

Example:
```
:CALibration:DELay:MINutes 30
// sets the time delay for warm-up of the instrument.
```

Manual operation: See "Warm Up Time" on page 636

:CALibration:DELay:SHUTdown[:STATe] <Shutdown>

Enables the instrument to shut down automatically after calibration.

Parameters:

<Shutdown> 1 | ON | 0 | OFF

*RST: 0

Example:
```
:CALibration:DELay:SHUTdown[:STATe] ON|1
// inititates that the instrument shuts down when the adjustments are com
```

Manual operation: See "Shutdown After Adjustment" on page 636

:CALibration:DELay[:MEASure]?

Starts the delayed adjustment process. When the warm-up time has elapsed (see `:CALibration:DELay:MINutes`, it executes the internal adjustments.

If you have enabled automatic shutdown, `:CALibration:DELay:SHUTdown[:STATe] ON`, the instrument shuts down when the adjustments are completed.

Return values:

<Error> 1 | ON | 0 | OFF

*RST: n.a. (no preset. default: 0)

Example:
```
:CALibration:DELay[:MEASure] ON|1
// enables the adjustment processs to start after the warm-up time automa
```

Usage: Query only

Manual operation: See "Adjust All Delayed" on page 636

13.7 DIAGnostic subsystem

The DIAGnostic subsystem contains the commands used for instrument diagnosis and servicing. SCPI does not define any DIAGnostic commands; the commands listed here are all device-specific. All DIAGnostic commands are query commands which are not affected by *RST.

The test functions are intended for services purposes.

They are thus password-protected functions. Unlock the corresponding protection level to access them, see :SYSTem:PROTect<ch>[:STATe].

For more information, see R&S 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

// Query the operating hours and number of power-on so far.
DIAGnostic:INFO:OTIMe?
// 112 h
DIAGnostic:INFO:POCount?
// 14
```

Commands

:DIAGnostic<hw>:BGINfo:CATalog? 397
:DIAGnostic<hw>:BGINfo? 397
:DIAGnostic:INFO:OTIMe? 397

:DIAGnostic:INFO:POCount? 398
:DIAGnostic<hw>:POINt:CATalog? 398
:DIAGnostic<hw>[:MEASure]:POINt? 398

: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 396.

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 396.

Usage: Query only

Manual operation: See "Assembly" on page 626

:DIAGnostic:INFO:OTIMe?

Queries the operating hours of the instrument so far.

Return values:

<OperationTime> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Programming example" on page 396.

Usage: Query only

Manual operation: See "Operation Time / h" on page 627

:DIAGnostic:INFO:POCount?

Queris how often the instrument has been turned on so far.

Return values:

<PowerOnCount> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Programming example" on page 396.

Usage: Query only

Manual operation: See "Power On Count" on page 627

: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 396.

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?` on page 398

Return values:

<Value> <value><unit>

Example: See Example "Programming example" on page 396.

Usage: Query only

13.8 HUMS remote control commands

The remote control commands for the health and utilizations monitoring system (HUMS) comprise commands of the `DIAGnostic` subsystem and the commands of the `SYSTem:COMMunicate:REST` and `SYSTem:COMMunicate:REST` subsystems.

For all HUMS-related remote control commands, see refer to the "R&S®HUMS Health and Utilization Monitoring Service" User Manual on the Internet.

Commands

DIAGnostic:HUMS:DELete:ALL 399
DIAGnostic:HUMS:DEVice:HISTory? 399
DIAGnostic:HUMS:DEVice:HISTory:DELete:ALL 400
DIAGnostic:HUMS:FORMat 400
DIAGnostic:HUMS:SAVE 401
DIAGnostic:HUMS:STATe 401
DIAGnostic:HUMS:TAGS:ALL? 401
DIAGnostic:HUMS:TAGS:DELete 402
DIAGnostic:HUMS:TAGS:DELete:ALL 402
DIAGnostic:HUMS:TAGS[:VALue] 402
SYSTem:COMMunicate:REST:ENABle 403
SYSTem:COMMunicate:SNMP:COMMunity:RO 403
SYSTem:COMMunicate:SNMP:COMMunity:RW 403
SYSTem:COMMunicate:SNMP:CONTact 404
SYSTem:COMMunicate:SNMP:LOCation 404
SYSTem:COMMunicate:SNMP:USM:USER 404
SYSTem:COMMunicate:SNMP:USM:USER:ALL? 405
SYSTem:COMMunicate:SNMP:USM:USER:DELete 405
SYSTem:COMMunicate:SNMP:USM:USER:DELete:ALL 405
SYSTem:COMMunicate:SNMP:VERSion 405

DIAGnostic:HUMS:DELete:ALL

Deletes the complete HUMS data. This includes device history, device tags, SCPI connections, utilization history and utilizations.

Example: //Delete HUMS data
`DIAG:HUMS:DEL:ALL`

Usage: Event

DIAGnostic:HUMS:DEVice:HISTory?

Queries the device history information of the connected instrument. Depending on the set data format, the queried data is either displayed in `XML` or `JSON` format. For more information about setting the data format, see `DIAGnostic:HUMS:FORMat` on page 400.

Return values:
<HistoryInfo> <block_data>

Device history information of the connected instrument as block data in a comma-separated list:
`#blockdata[{event1},{event2},{event3}...]`
With the following parameters:
`<eventID>,<eventTimestamp>,<eventMessage>,<eventDetails>,<eventSeverity>`
Binary block data with the following syntax:
`#<Digits><Length><Binarydata>`
#
Indicates the start of the binary block
<Digits>
Decimal value
Gives the number of decimal digits used for the `<Length>` value
<Length>
Decimal value
Number of bytes the follow in the `<Binary data>` part
<Binary data>
Binary data in ASCII format

Example: //Return device history
`DIAG:HUMS:DEV:HIST?`
Returns for example:
```
#44715[{"eventId":32,"eventTimestamp":
"2021-02-02T17:25:39Z","eventMessage":
"Deviation from Self Alignment Temperature",
"eventDetails":
"Deviations resolved","eventSeverity":0}
```

Usage: Query only

Manual operation: See "Export History" on page 322

DIAGnostic:HUMS:DEVice:HISTory:DELete:ALL

Deletes the complete device history information of the connected instrument.

Example: //Delete complete device history
`DIAG:HUMS:DEV:HIST:DEL:ALL`

Usage: Event

Manual operation: See "Delete History" on page 322

DIAGnostic:HUMS:FORMat <DataFormat>

Selects the format for the queried HUMS data. You can query the HUMS data either in `JSON` format or `XML` format.

The defined format affects all other commands that return block data.

Parameters:
<DataFormat> JSON | XML

JSON
Returns the HUMS data in JSON format.

XML
Returns the HUMS data in XML format.

*RST: JSON

Example: //Return data in JSON format
```
DIAG:HUMS:FORM JSON
```

DIAGnostic:HUMS:SAVE <path>

Saves the HUMS history as a ZIP file to your preferred path.

Setting parameters:
<path>

Example: //Save HUMS history data
```
DIAG:HUMS:SAVE 'C:\HUMS\hums_2021.zip'
```

Usage: Setting only

Manual operation: See "Export History" on page 322

DIAGnostic:HUMS:STATe <State>

Turns the HUMS service and data collection on and off.

Parameters:
<State> ON | OFF | 1 | 0

*RST: ON

Example: //Turn on HUMS service
```
DIAG:HUMS:STAT ON
```

Manual operation: See "State" on page 322

DIAGnostic:HUMS:TAGS:ALL?

Queries all key-value tags that you have assigend to the instrument. Depending on the set data format, the queried data is either displayed in XML or JSON format. For more information about setting the data format, see DIAGnostic:HUMS:FORMat on page 400.

Return values:
<ID> ID number of the defined tag.

<Key> String containing key name of the defined tag.

<Value> String containing value of the defined tag.

Example: //Return all tags
```
DIAG:HUMS:TAGS:ALL?
1,"location","building_11",2,"time zone","CET"
```

Usage: Query only

Manual operation: See "Add" on page 331

DIAGnostic:HUMS:TAGS:DELete <ID>

Deletes a certain tag you assigned to your instrument, including its key and value.

Setting parameters:

<ID> ID number of the tag you want to delete.
To identify the ID number, query all device tags from the system first. For more information, see `DIAGnostic:HUMS:TAGS:ALL?` on page 401.

Example: //Delete tag
```
DIAG:HUMS:TAGS:DEL 0
```

Usage: Setting only

Manual operation: See "Delete" on page 331

DIAGnostic:HUMS:TAGS:DELete:ALL

Deletes all key-value tags you have assigned to the instrument.

Example: //Delete all tags
```
DIAG:HUMS:TAGS:DEL:ALL
```

Usage: Event

Manual operation: See "Delete All" on page 331

DIAGnostic:HUMS:TAGS[:VALue] <ID>, <Key>, <Value>
DIAGnostic:HUMS:TAGS[:VALue]? <ID>

Adds or modifies a key-value pair (device tag).

The query returns the key-value pair for a given ID or an empty string if the ID is unknown.

Parameters:

<Key> String containing key name of the queried tag.

<Value> String containing value of the queried tag.

Parameters for setting and query:

<ID> 0 - 31
ID number of the tag you want to modify or query.
To identify the ID number, query all device tags from the system first. For more information, read here `DIAGnostic:HUMS:TAGS:ALL?` on page 401.

Example: //Add or modify a tag (tag 1)
```
DIAG:HUMS:TAGS 1,'location','building_11'
```

Manual operation: See "Key" on page 330
See "Value" on page 330
See "Add" on page 331

SYSTem:COMMunicate:REST:ENABle <RestState>

Turns communication via the REST API on and off.

Parameters:
<RestState> ON | OFF | 0 | 1

Example: //Return REST state
```
SYST:COMM:REST:ENAB?
```

Manual operation: See "REST" on page 324

SYSTem:COMMunicate:SNMP:COMMunity:RO <CommunityString>

Defines the SNMP community string for read-only access.

Prerequisites for this command:

- Select an SNMP version that supports communities (`SYSTem:COMMunicate:SNMP:VERSion` on page 405).

Setting parameters:
<CommunityString> String containing the community name.

Example: //Set community name
```
SYST:COMM:SNMP:VERS V12
SYST:COMM:SNMP:COMM:RO 'ABC'
```

Usage: Setting only

Manual operation: See "Read Only Community" on page 324

SYSTem:COMMunicate:SNMP:COMMunity:RW <CommunityString>

Defines the SNMP community string for read-write access.

Prerequisites for this command:

- Select an SNMP version that supports communities (`SYSTem:COMMunicate:SNMP:VERSion` on page 405).

Setting parameters:
<CommunityString> String containing the community name.

Example: //Set read-write access
```
SYST:COMM:SNMP:VERS V12
SYST:COMM:SNMP:COMM:RW 'ABC'
```

Usage: Setting only

Manual operation: See "Read&Write Community" on page 325

SYSTem:COMMunicate:SNMP:CONTact <SnmpContact>

Defines the SNMP contact information for the administrator.

You can also set the contact information via SNMP if you do not set it via SCPI.

Parameters for setting and query:

<SnmpContact> String containing SNMP contact.
*RST: "" (empty string)

Example: //Set SNMP contact
```
SYST:COMM:SNMP:CONT 'ABC'
```

Manual operation: See "Contact" on page 324

SYSTem:COMMunicate:SNMP:LOCation <SnmpLocation>

Defines the SNMP location information for the administrator.

You can also set the location information via SNMP if you do not set it via SCPI.

Parameters for setting and query:

<SnmpLocation> String containing SNMP location.
*RST: "" (empty string)

Example: //Return SNMP location
```
SYST:COMM:SNMP:LOC?
```

Manual operation: See "Location" on page 324

SYSTem:COMMunicate:SNMP:USM:USER <Name>, <Access>, <Level>[, <Auth_pwd>[, <Priv_pwd>]]

Defines an SNMP user profile.

Prerequisites for this command:

- Select SNMPv3 (`SYSTem:COMMunicate:SNMP:VERSion` on page 405).

Setting parameters:

<Name> String containing name of the user.

<Access> RO | RW
Defines the access right a user can have.

<Level> NOAuth | AUTH | PRIVacy
Defines the security level.

<Auth_pwd> String containing the authentication password.

<Priv_pwd> String containing the privacy password.

Example: //Create user profile
```
SYST:COMM:SNMP:VERS V123
SYST:COMM:SNMP:USM:USER 'Peter','RO','PRIV',
'1234','XYZ'
```

Usage: Setting only

Manual operation: See "Add SNMP User for HUMS" on page 327

SYSTem:COMMunicate:SNMP:USM:USER:ALL?

Queries the number of users and a list of all SNMP users for SNMPv3.

Prerequisites for this command:

- Select SNMPv3 (`SYSTem:COMMunicate:SNMP:VERSion` on page 405).

Return values:

<Count> Total number of registered SNMP users.

<Name> List of all user names as a comma-separated list.

Example: //Return all SNMP users
```
SYST:COMM:SNMP:USM:USER:ALL?
```

Usage: Query only

Manual operation: See "User table" on page 326

SYSTem:COMMunicate:SNMP:USM:USER:DELete <UserName>

Deletes a specific SNMP user profile.

Setting parameters:

<UserName> String containing name of SNMP user profile to be deleted.

Example: //Delete SNMP user profile
```
SYST:COMM:SNMP:USM:USER:DEL "Peter"
```

Usage: Setting only

Manual operation: See "Delete" on page 327

SYSTem:COMMunicate:SNMP:USM:USER:DELete:ALL

Deletes all SNMP user profiles.

Example: //Delete all SNMP user profiles
```
SYST:COMM:SNMP:USM:USER:DEL:ALL
```

Usage: Event

Manual operation: See "Delete All" on page 326

SYSTem:COMMunicate:SNMP:VERSion <SnmpVersion>

Selects the SNMP version.

Parameters for setting and query:

<SnmpVersion> OFF | V12 | V123 | V3 | DEFault

OFF
SNMP communication is off.

V12
SNMP communication with SNMPv2 or lower.

V123
SNMP communication with SNMPv2 and SNMPv3.

V3
SNMP communication with SNMPv3.

*RST: V123

Example: //Select the SNMP version
`SYST:COMM:SNMP:VERS V12`

Manual operation: See "SNMP" on page 324

13.9 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 "<password>", ON
// DISPlay:ANNotation:FREQuency "<password>", ON
// DISPlay:ANNotation:AMPLitude "<password>", ON

// Enable automatic update of the display at defined time intervals
DISPlay:UPDate[:STATe] ON
```

Example: Querying the dialog IDs, opening and closing dialogs

Use the following commands to query the dialog IDs of all currently open dialogs. The dialog ID is a prerequisite for opening and closing dialogs via the remote control.

The dialog ID is also required to define user key actions.
See Section 11.2.2, "How to assign actions to the [★ (User)] key", on page 264.

```
// 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 407
:DISPlay:PSAVe[:STATe] 407
:DISPlay:BRIGhtness 408
:DISPlay:BUTTon:BRIGhtness 408
:DISPlay:UPDate[:STATe] 408
:DISPlay:ANNotation:AMPLitude 408
:DISPlay:ANNotation:FREQuency 409
:DISPlay:ANNotation[:ALL] 409
:DISPlay:DIALog:ID? 409
:DISPlay:DIALog:OPEN 410
:DISPlay:DIALog:CLOSe 410
:DISPlay:DIALog:CLOSe:ALL 411

: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 406

Manual operation: See "Wait Time" on page 256

:DISPlay:PSAVe[:STATe] <State>

Activates the screen saver mode of the display.

We recommend that you use this mode to protect the display, if you operate the instrument in remote control.

To define the wait time, use the command `:DISPlay:PSAVe:HOLDoff`.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 0)

Example: See Example "Activating screen saver mode and display update" on page 406

Manual operation: See "Screen Saver" on page 256

: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 256

: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 257

:DISPlay:UPDate[:STATe] <Update>

Activates the refresh mode of the display.

Parameters:

<Update> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 406

Manual operation: See "Display Update is" on page 257

:DISPlay:ANNotation:AMPLitude <SecPassword>, <State>

Indicates asterisks instead of the level values in the status bar.

Parameters:

<SecPassword> string

<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 406

Manual operation: See "Annotation Amplitude" on page 281

:DISPlay:ANNotation:FREQuency <SecPassWord>, <State>

Indicates asterisks instead of the frequency values in the status bar.

Parameters:

<SecPassWord> string

<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 406

Manual operation: See "Annotation Frequency" on page 280

:DISPlay:ANNotation[:ALL] <SecPassword>, <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:

<SecPassword> string

<State> 1 | ON | 0 | OFF

*RST: 1

Example: See Example "Activating screen saver mode and display update" on page 406

: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 410
`:DISPlay:DIALog:CLOSe` on page 410

<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 406

Usage: Query only

Manual operation: See "SCPI" on page 267

: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 406

Usage: Setting only

Manual operation: See "SCPI" on page 267

: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 406

Usage: Setting only

:DISPlay:DIALog:CLOSe:ALL

Closes all open dialogs.

Example: See Example "Querying the dialog IDs, opening and closing dialogs" on page 406

Usage: Event

13.10 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.

Example: Configuring the format of data returned to a controller

```
// Select the format o be returned by the instrument
//
FORMat:BORDer SWAPped
// returns the most significant byte of each floating point
// number first and the least significant byte last

FORMat:SREGister: HEXadecimal
// returns the content of the status register
// as a hexadecimal number

FORMat:DATA ASCii
//  transfers the data in ASCII format
```

:FORMat:BORDer 411
:FORMat:SREGister 412
:FORMat[:DATA] 412

:FORMat:BORDer <Border>

Determines the sequence of bytes within a binary block. This only affects blocks which use the IEEE754 format internally.

Parameters:

<Border> NORMal | SWAPped

NORMal
Expects/sends the *least* significant byte of each IEEE754 floating-point number first and the *most* significant byte last.

SWAPped
Expects/sends the *most* significant byte of each IEEE754 floating-point number first and the *least* significant byte last.

*RST: NORMal

Example: `:FORM:BORD SWAP`
transfers the data with the most significant bit first.

:FORMat:SREGister <Format>

Determines the numeric format for responses of the status register.

Parameters:
<Format> ASCii | BINary | HEXadecimal | OCTal

ASCii
Returns the register content as a decimal number.

BINary|HEXadecimal|OCTal
Returns the register content either as a binary, hexadecimal or octal number. According to the selected format, the number starts with #B (binary), #H (hexadecimal) or #O (octal).

*RST: ASCii

Example: `:FORM:SREG HEX`
returns the register content as a hexadecimal number.

:FORMat[:DATA] <Data>

Determines the data format the instrument uses to return data via the IEC/IEEE bus.

The instrument automatically detects the data format used by the controller, and assigns it accordingly. Data format determined by this SCPI command is in this case irrelevant.

Parameters:
<Data> ASCii | PACKed

ASCii
Transfers numerical data as plain text separated by commas.

PACKed
Transfers numerical data as binary block data.
The format within the binary data depends on the command.
The various binary data formats are explained in the description of the parameter types.

*RST: ASCii

Example: `:FORM ASC`
transfers the data as ASCII data.

13.11 HCOPy subsystem

The `HCOPy` subsystem contains the commands to generate and save a hard copy of the display.

To access a stored hard copy file, use the commands of the MEMM subsystem.

Example: Store a hard copy of the display

The following example lists commands to configure and execute a hard copy to an automatic named file.

```
:HCOPy:DEVice:LANGuage PNG
:HCOPy:FILE:NAME:AUTO:STATe 1
// defines the output format
// sets the instrument to automatically create output file names

// *****************************************************************
// Configure hard copy options, set automatic naming rules
// An automatically generated file name consists of:
// <Prefix><YYYY><MM><DD><Number>.<Format>
// *****************************************************************
:HCOPy:DEVice:LANGuage BMP
// defines output format *.bmp
:HCOPy:REGion DIALog
// selects the region to be copied
:HCOPy:FILE:AUTO:DIR "/usb/HCopy"
// sets destination directory of automatic named file
:HCOPy:FILE:NAME:AUTO:FILE:PREFix:STATe 1
:HCOPy:FILE:NAME:AUTO:FILE:PREFix:"hardcopy"
:HCOPy:FILE:NAME:AUTO:FILE:YEAR:STATe 1
:HCOPy:FILE:NAME:AUTO:FILE:MONTh:STATe 1
// uses automatic naming prefix
// sets automatic naming prefix to "hardcopy"
// uses automatic naming date parameters year and month

// *****************************************************************
// Execute and transfer the hard copy
// *****************************************************************
:HCOPy:EXECute
:HCOPy:DATA
// generates a hard copy
// transfers the hard copy to the remote client
:HCOPy:FILE:AUTO:FILE?
// queries the automatic file name
// "hardcopy1607001.bmp"
:HCOPy:FILE:AUTO:NUMBer?
// queries the number in the automatic file name
// "001"
:HCOPy:FILE:AUTO?
// queries the path and file name of the automatically generated file
// "/usb/HCopy/hardcopy1607001.bmp"
```

13.11.1 Hard copy settings

With the following commands, you can configure the settings of a hard copy.

:HCOPy:DATA?....414
:HCOPy:IMAGe:FORMat....414
:HCOPy:DEVice:LANGuage....414
:HCOPy:REGion....414
:HCOPy:FILE[:NAME]....414
:HCOPy[:EXECute]....415

: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 413

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 413

Manual operation: See "Format" on page 250

: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 413

Manual operation: See "Region" on page 251

: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 Section 13.11.2, "Automatic naming", on page 415.

Parameters:
<Name> string

Example: See Example "Store a hard copy of the display" on page 413

Manual operation: See "File..." on page 250

: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 413

Usage: Event

Manual operation: See "Save" on page 250

13.11.2 Automatic naming

Use the following commands to automatically assign a file name.

:HCOPy:FILE[:NAME]:AUTO? 415
:HCOPy:FILE[:NAME]:AUTO:DIRectory 415
:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar 416
:HCOPy:FILE[:NAME]:AUTO:FILE? 416
:HCOPy:FILE[:NAME]:AUTO:STATe 416
:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer? 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe 417

: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 413

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 413

Manual operation: See "Path..." on page 251

: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 413

Usage: Event

Manual operation: See "Clear Path" on page 252

: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 413.

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO:STATe <State>

Activates automatic naming of the hard copy files.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 1

Example: See Example "Store a hard copy of the display" on page 413

Manual operation: See "Automatic Naming" on page 251

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

Uses the date parameters (year, month or day) for the automatic naming. You can activate each of the date parameters separately.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 1

Example: See Example "Store a hard copy of the display" on page 413

Manual operation: See "Prefix, Year, Month, Day" on page 252

: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 413

Usage: Query only

Manual operation: See "Current Auto Number" on page 252

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

Uses the prefix for the automatic generation of the file name, provided `PREF:STAT` is activated.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 1

Example: See Example "Store a hard copy of the display" on page 413

Manual operation: See "Prefix, Year, Month, Day" on page 252

13.12 KBOard subsystem

The KBOard subsystem contains the commands to set a connected keyboard.

Example: Configuring the keypad

```
KBOard:LAYout US
// sets the American keyboard assignment

FPANel:KEYBoard:LAYout LETTers
// enables the alphanumerical and the
// numerical assignment of the front panel keys.
```

:FPANel:KEYBoard:LAYout 418
:KBOard:LAYout 418

:FPANel:KEYBoard:LAYout <Layout>

Selects the layout of the front panel keypad.

Parameters:

<Layout> DIGits | LETTers

DIGits
Enables numerical keys only.

LETTers
Enables numerical and alphanumerical keys.

*RST: n.a. (factory preset: DIGits)

Example:

```
:FPANel:KEYBoard:LAYout LETTers
// enables the alphanumerical additional
// and the numerical assignment of the keys.
```

Manual operation: See "Alphanumeric Keys" on page 257

:KBOard:LAYout <Layout>

Selects the language for an external keyboard and assigns the keys acccordingly.

Parameters:

<Layout> CHINese | DANish | DUTCh | ENGLish | ENGUK | FINNish | FRENch | FREBe | FRECa | GERMan | ITALian | JAPanese | KOREan | NORWegian | PORTuguese | RUSSian | SPANish | SWEDish | ENGUS

*RST: n.a. (factory preset: ENGLish)

Example:

```
:KBOard:LAYout US
// activates American keyboard
```

Manual operation: See "Layout" on page 257

13.13 OUTPut subsystem

In the `OUTPut` subsystem, you can configure the output signals.

The LF output signal is defined with the commands of the Section 13.16.6, "SOURce:LFOutput subsystem", on page 495 system.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`OUTPut<hw>`	[1]	Optional suffix

:OUTPut:ALL[:STATe] 419
:OUTPut<hw>[:STATe] 419
:OUTPut<hw>[:STATe]:PON 419
:OUTPut<hw>:AMODe 420
:OUTPut<hw>:IMPedance? 420
:OUTPut<hw>:AFIXed:RANGe:LOWer? 421
:OUTPut<hw>:AFIXed:RANGe:UPPer? 421
:OUTPut<hw>:PROTection:CLEar 421
:OUTPut<hw>:PROTection:TRIPped? 421

:OUTPut:ALL[:STATe] <State>

Enables the RF output signal of the instrument.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 0)

Example: `OUTPut:ALL:STATe 0`
Disables the RF output signal.

:OUTPut<hw>[:STATe] <State>

Activates the RF output signal.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: `:OUTPut1 ON`
Activates the RF output.

Manual operation: See "RF State/RF ON" on page 57

:OUTPut<hw>[:STATe]:PON <Pon>

Defines the state of the RF output signal when the instrument is switched on.

Parameters:

<Pon> OFF | UNCHanged

*RST: n.a. (factory preset: UNCHanged)

Example: `:OUTPut1:PON OFF`
The RF output is deactivated when the instrument is switched on.

Manual operation: See "Power-On State" on page 258

:OUTPut<hw>:AMODe <AMode>

Sets the step attenuator mode at the RF output.

Parameters:

<AMode> AUTO | FIXed | NORMal | HPOWer

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 with constant output VSWR. The resulting variation range is calculated according to the position.

*RST: AUTO

Example:
```
:SOURce1:POWer:ALC:STATe 1
:OUTPut1:AMODe FIXed
```

Manual operation: See "Mode" on page 172

:OUTPut<hw>:IMPedance?

Queries the impedance of the RF outputs.

Return values:

<Impedance> G1K | G50 | G10K

*RST: G50

Example: `:OUTPut1:IMP?`
queries the impedance of RF output.
`Response: 50`
the impedance is 50 ohms

Usage: Query only

Manual operation: See "RF output impedance" on page 57

: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 420

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 173

:OUTPut<hw>:PROTection:CLEar

Resets the protective circuit after it has been tripped.

To define the output state, use the command `:OUTPut<hw>[:STATe]`.

Example:
```
:OUTPut1:PROT:CLE
```
Resets the protective circuit of the RF output.

Usage: Event

Manual operation: See "Overload" on page 173

:OUTPut<hw>:PROTection:TRIPped?

Queries the state of the protective circuit.

Return values:

<Tripped> 1 | ON | 0 | OFF
*RST: 0

Example:
```
:OUTPut1:PROT:TRIP
```
queries the state of the protective circuit of the RF output.
```
Response: 0
```
the protective circuit has not tripped.

Usage: Query only

Manual operation: See "Overload" on page 173

13.14 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"
// Lists all automatically detected sensors.

SLISt:SCAN:STATe 1
// Searches for sensors connected in the LAN or via the USBTMC protocol.

SLISt:SCAN:LSENsor 'NRQ6',101624 // sensor name, serial number
SLISt:SCAN:LSENsor 11.123.1.123, 101624 // IP address, serial number
// Adds sensors to the list, that are connected to LAN.


SLISt:SCAN:USENsor 'NRQ6',101624 //sensor name, serial number
SLISt:SCAN:USENsor #H15b,101624  //device ID (hexadecimal), serial number
SLISt:SCAN:USENsor 347,101624    //device ID (decimal), serial number
// Adds a sensor to the list, that is connected to the USB interface.


SLISt:LIST?
// Response: "NRP33SN-V-900007-USB Legacy","NRP-Z211-900001-USB Legacy",
// "NRP33SN-V-900005-USBTMC","NRP33SN-V-900011-LAN"
// Lists all automatically detected sensors.

SLISt:ELEMent3:MAPPing SENS1
// Maps the third sensor from the list to the first sensor channel.

SLISt:SENSor:MAP "NRPS18S-100654-USB Legacy", SENS3
// Maps the sensor to channel 3.


SLISt:CLEar[ALL]
// Remove all sensors that use VISA communication protocol
// from the sensor mapping list.
SLISt:CLEar:LAN
// Remove all sensors from the list, that use VISA and are connected over LAN.
SLISt:CLEar:USB
// Remove all sensors from the list, that use VISA and are connected over USB.
```

Example: Performing a simple power measurement

Prerequisite: The sensor is connected to the instrument and mapped to the first sensor channel.

```
INITiate1:CONTinuous ON
// Switches the 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]?....425
:SLISt:SCAN[:STATe]....425
:SLISt:SCAN:LSENsor....425
:SLISt:SCAN:USENsor....426
:SLISt:CLEar:LAN....426
:SLISt:CLEar:USB....426
:SLISt:CLEar[:ALL]....427
:SLISt:ELEMent<ch>:MAPPing....427
:SLISt:SENSor:MAP....427
:INITiate<hw>[:POWer]:CONTinuous....428
:READ<ch>[:POWer]?....428
:SENSe<ch>:UNIT[:POWer]....429
:SENSe<ch>[:POWer]:APERture:DEFault:STATe....429
:SENSe<ch>[:POWer]:APERture:TIMe....429
:SENSe<ch>[:POWer]:CORRection:SPDevice:SELect....430
:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe....430
:SENSe<ch>[:POWer]:CORRection:SPDevice:LIST?....430
:SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority....430
:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe....431
:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?....431

:SENSe<ch>[:POWer]:FILTer:LENGth[:USER] 431
:SENSe<ch>[:POWer]:FILTer:NSRatio 432
:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe 432
:SENSe<ch>[:POWer]:FILTer:SONCe 432
:SENSe<ch>[:POWer]:FILTer:TYPE 433
:SENSe<ch>[:POWer]:FREQuency 433
:SENSe<ch>[:POWer]:LOGGing:STATe 434
:SENSe<ch>[:POWer]:OFFSet 434
:SENSe<ch>[:POWer]:OFFSet:STATe 434
:SENSe<ch>[:POWer]:SNUMber? 435
:SENSe<ch>[:POWer]:SOURce 435
:SENSe<ch>[:POWer]:STATus[:DEVice]? 435
:SENSe<ch>[:POWer]:SVERsion? 436
:SENSe<ch>[:POWer]:TYPE? 436
:SENSe<ch>[:POWer]:ZERO 436

: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 423.

Usage: Query only

Manual operation: See "Sensor Mapping List" on page 204

:SLISt:SCAN[:STATe] <State>

Starts the search for R&S NRP power sensors, connected in the LAN or via the USBTMC protocol.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Detecting and assigning a power sensor" on page 423.

Manual operation: See "Scan" on page 205

:SLISt:SCAN:LSENsor <IP>

Scans for R&S NRP power sensors connected in the LAN.

Setting parameters:
<IP> string
*RST: 0

Example: See Example "Detecting and assigning a power sensor" on page 423.

Usage: Setting only

Manual operation: See "Add LAN Sensor" on page 205

:SLISt:SCAN:USENsor <DeviceID>, <Serial>

Scans for R&S NRP power sensors connected over a USB interface.

Parameters:
<Serial> integer
Range: 0 to 999999

Setting parameters:
<DeviceID> String or Integer
Range: 0 to 999999
*RST: 0

Example: See Example "Detecting and assigning a power sensor" on page 423.

Usage: Setting only

Manual operation: See "Add USBTMC Sensor" on page 206

:SLISt:CLEar:LAN

Removes all entries of R&S NRP power sensors connected in the LAN from the sensor mapping list.

Example: See Example "Detecting and assigning a power sensor" on page 423.

Usage: Event

Manual operation: See "Clear" on page 205

:SLISt:CLEar:USB

Removes all entries of R&S NRP power sensors connected over USB and using the VISA communication protocol from the sensor mapping list.

Does not affect entries for sensors communicating over the USB legacy protocol.

Example: See Example "Detecting and assigning a power sensor" on page 423.

Usage: Event

Manual operation: See "Clear" on page 205

:SLISt:CLEar[:ALL]

Removes all entries of R&S NRP power sensors using the VISA communication protocol (USB or LAN) from the sensor mapping list.

Does not affect sensors communicating over USB legacy protocol.

Example: See Example "Detecting and assigning a power sensor" on page 423.

Usage: Event

Manual operation: See "Clear" on page 205

: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 423.

Manual operation: See "Sensor Mapping List" on page 204

: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 423.

Usage: Setting only

Manual operation: See "Sensor Mapping List" on page 204

:INITiate<hw>[:POWer]:CONTinuous <Continuous>

Switches the local state of the continuous power measurement by R&S NRP power sensors on and off. Switching off local state enhances the measurement performance during remote control.

The remote measurement is triggered with `:READ<ch>[:POWer]?`). This command also returns the measurement results. The local state is not affected, measurement results can be retrieved with local state on or off.

Parameters:

<Continuous> 1 | ON | 0 | OFF

*RST: 0

Example: `INIT1:CONT ON`
Switches on the local state of continuous power measurement.

Manual operation: See "State" on page 200

:READ<ch>[:POWer]?

Triggers power measurement and displays the results.

Note: This command does not affect the local state, i.e. you can get results with local state on or off. For long measurement times, we recommend that you use an SRQ for command synchronization (MAV bit).

Suffix:

<ch> 1 to 3

Return values:

<Power> float or float,float

The sensor returns the result in the unit set with command `:SENSe<ch>:UNIT[:POWer]`
Certain power sensors, such as the R&S NRP-Z81, return two values, first the value of the average level and - separated by a comma - the peak value.

Example: `:SENS1:UNIT DBM`
Selects unit dBm for presentation of measurement result.
`:READ1?`
Queries the measurement result of the sensor.
`-45.6246576745440230`
-45.6 dBm were measured at the given frequency.

Example: R&S NRP-Z81
`:READ1?`
`-55.62403263352178,-22.419472478812476`
-55.6 dBm is the measured average level, -22. 4 dBm is the measured peak level at the given frequency.

Usage: Query only

Manual operation: See "Measured Level" on page 196
See "Level (Peak) / Level (Average)" on page 200

:SENSe<ch>:UNIT[:POWer] <Power>

Selects the unit (Watt, dBm or dBµV) of measurement result display, queried with `:READ<ch>[:POWer]?`.

Parameters:
<Power> DBM | DBUV | WATT
*RST: DBM

Example: `:SENS2:UNIT DBM`
Selects dBm as unit for the measured value returned by command `READ`.
`:READ2?`
`Response: 7.34`
7.34 dBm are measured by sensor 2.

Manual operation: See "Measured Level" on page 196
See "Level (Peak) / Level (Average)" on page 200

: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 429.

Parameters:
<UseDefAp> 1 | ON | 0 | OFF
*RST: 1

Example: See Example "Performing a power measurement with a fixed filter" on page 424.

Manual operation: See "Default Aperture Time" on page 202

: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 424.

Manual operation: See "Aperture Time" on page 202

: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 203

:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe <State>

Activates the use of the S-parameter correction data.

Note: If you use power sensors with attenuator, the instrument automatically activates the use of S-parameter data.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 0

Example: `:SENSe1:POWer:CORRection:SPDevice:STATe 1`
Activates the use of the S-parameters correction data.

Manual operation: See "S-Parameter" on page 203

: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 203

:SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority <Priority>

Selects average or peak power for permanent display.

Parameters:
<Priority> AVERage | PEAK
*RST: AVERage

Example: `:SENS1:DISP:PERM:STAT ON`
Turns on the permanent view.
`:SENS1:DISP:PERM:PRI AVER`
Sets the average power for display.

Manual operation: See "Display" on page 200

:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe <State>

Activates the permanent display of the measured power level results. The instrument also indicates the sensor type, the connection, the measurement source and the offset if set.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: `:SENS1:POW:DISP:PERM:STAT ON`
Turns on the permanent view.

Manual operation: See "Display Permanent" on page 200

:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?

Queries the current filter length in filter mode `AUTO` (`:SENSe<ch>[:POWer]:FILTer:TYPE`)

Return values:

<Auto> float
Range: 1 to depends on R&S NRP power sensor type

Example: `:SENS1:FILT:TYPE AUTO`
Selects auto filter.
`:SENS1:FILT:LENG:AUTO?`
Queries the automatically set filter length.
`Response: 1024`

Usage: Query only

Manual operation: See "Filter Length" on page 202

: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 190).

The R&S NRP power sensors provide different resolutions for setting the filter length, depending on the used sensor type.

For more information, refer to the specifications document.

Parameters:

<User> float
Range: 1 to depends on R&S NRP power sensor type
*RST: 1

Example: `:SENS1:FILT:TYPE USER`
Selects user filter mode.
`:SENS1:FILT:LENG 16`
Sets a filter length of 16. E.g. using a sensor with 20 ms time window, the resulting measurement time is 640 ms (2x16x20 ms)

Manual operation: See "Filter Length" on page 202

: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 424.

Manual operation: See "Noise/Signal Ratio" on page 202

:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe <MTime>

Sets an upper limit for the settling time of the auto-averaging filter and thus limits the length of the filter.

Parameters:
<MTime> float

Range: 1 to 999.99
Increment: 0.01
*RST: 8

Example: See Example "Performing a power measurement with a fixed filter" on page 424.

Manual operation: See "Timeout" on page 202

: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 202

:SENSe<ch>[:POWer]:FILTer:TYPE <Type>

Selects the filter mode. The filter length is the multiplier for the time window and thus directly affects the measurement time.

Parameters:

<Type> AUTO | USER | NSRatio

AUTO
Automatically selects the filter length, depending on the measured value. The higher the power, the shorter the filter length, and vice versa.
Note: To avoid long settling times when the power is low, you can limit the averaging factor limited with the "timeout" parameter (`:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe`).

USER
Allows you to set the filter length manually. As the filter-length takes effect as a multiplier of the measurement time, you can achieve constant measurement times.

NSRatio
Selects the filter length (averaging factor) according to the criterion that the intrinsic noise of the sensor (2 standard deviations) does not exceed the specified noise content. You can define the noise content with command `:SENSe<ch>[:POWer]:FILTer:NSRatio`.

*RST: AUTO

Example: See Example "Performing a power measurement with a fixed filter" on page 424.

Manual operation: See "Filter" on page 201

:SENSe<ch>[:POWer]:FREQuency <Frequency>

Sets the RF frequency of the signal, if signal source `:SENSe<ch>[:POWer]:SOURce USER` is selected.

Parameters:

<Frequency> float

*RST: 1 GHz

Example: `:SENS1:SOUR USER`
Selects user-defined source.
`:SENS1:FREQ 2.44GHz`
Sets the RF frequency of the source which is 2.44 GHz.

Manual operation: See "Frequency" on page 201

:SENSe<ch>[:POWer]:LOGGing:STATe <State>

Activates the recording of the power values, measured by a connected R&S NRP power sensor.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: `:SENS:LOGG:STAT ON`
Activates recording of the power measurement of the first sensor.

Manual operation: See "Enable Logging" on page 203

: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 201

:SENSe<ch>[:POWer]:OFFSet:STATe <State>

Activates the addition of the level offset to the measured value. The level offset value is set with command `:SENSe<ch>[:POWer]:OFFSet`.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: `:SENS1:POW:OFFS 0.4dB`
Sets a level offset of 0.4 dB
`:SENS1:POW:OFFS:STAT ON`
A level offset of 0.4 dB is added to the measured value.

Manual operation: See "Level Offset State,Level Offset" on page 201

: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 200

: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 424.

Manual operation: See "Use Frequency Of" on page 201

:SENSe<ch>[:POWer]:STATus[:DEVice]?

Queries if a sensor is connected to the instrument.

Return values:
<Status> 1 | ON | 0 | OFF
*RST: 0

Example: `:SENS1:STAT?`
`Response: 1`
A sensor is connected.

Usage: Query only

Manual operation: See "State" on page 200

:SENSe<ch>[:POWer]:SVERsion?

Queries the software version of the connected R&S NRP power sensor.

Return values:
<SVersion> string

Example: `:SENS1:POW:SVER?`
Queries the software version of the power sensor.

Usage: Query only

:SENSe<ch>[:POWer]:TYPE?

Queries the sensor type. The type is automatically detected.

Return values:
<Type> string

Example: `:SENS1:TYPE?`
Queries the type of sensor.
`Response: NRP-Z21`
The R&S NRP-Z21 sensor is used.

Usage: Query only

Manual operation: See "Sensor type and serial number" on page 200

: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 200

13.15 SCONfiguration subsystem

The `SCONfiguration` subsystem contains the commands for defining the system configuration setting, like stream mapping and used baseband configuration.

Required options

R&S SMBB-K554 Multiplier Control

Common suffixes

The following common suffixes are used in the control commands:

- `RF<ch>`

This suffix defines the RF connector. Since the R&S SMB100B has only one RF connector, the value range is [1] and using the suffix is optional.

Example: Connecting and configuring external instruments

The following example lists commands to connect and configure external instruments.

```
// ******************************************************************************
// Getting information about connected external instruments.
// ******************************************************************************
// General information about the connected external device
SCONfiguration:EXTernal:RF1:REMote:INFO?
//Response: "SZM75-100001","Frontend Connection","127.0.0.1","SZM75-100001","connected"

// Connector direction
SCONfiguration:EXTernal:RF1:DIRection?
// Response: OUT

// Status of the remote connection
SCONfiguration:EXTernal:RF1:RCONnection:STATe?
// Response: 1

// Name of the connected external instrument
SCONfiguration:EXTernal:RF1:INAMe?
// Response: "SZM75-100003"


// ******************************************************************************
// Connecting a frequency multiplier.
// ******************************************************************************
//Query available external instruments
SCONfiguration:EXTernal:REMote:LIST?
//Response: SZM75-100003,SZM75-100001,SZM75-100002

// Connecting a frequency multiplier
SCONfiguration:EXTernal:RF:REMote:ICONnect "SZM75-100001"

// Query the IF of the connected frequency multiplier
SOURce1:EFRontend:FREQuency:IFRequency:VALue?
// Response: 18750000000
```

13.15.1 External instruments

The following commands configure external instruments, e.g. frequency multiplier R&S SZM.

Commands:

:SCONfiguration:EXTernal:ACONnect 438
:SCONfiguration:EXTernal:REMote:CONNect[:ALL] 438
:SCONfiguration:EXTernal:REMote:DISConnect[:ALL] 438
:SCONfiguration:EXTernal:PBEHaviour 438
:SCONfiguration:EXTernal:RF<ch>:DIRection? 439
:SCONfiguration:EXTernal:RF<ch>:RCONnection:STATe? 439
:SCONfiguration:EXTernal:RF<ch>:INAMe? 439
:SCONfiguration:EXTernal:REMote:LIST? 439
:SCONfiguration:EXTernal:REMote:REName 440
:SCONfiguration:EXTernal:RF<ch>:REMote:ISELect 440
:SCONfiguration:EXTernal:RF<ch>:REMote:ICONnect 440
:SCONfiguration:EXTernal:RF<ch>:REMote:INFO? 440
:SCONfiguration:EXTernal:REMote:CLEan 441
:SCONfiguration:EXTernal:RF<ch>:REMote:CONNect 441
:SCONfiguration:EXTernal:RF<ch>:REMote:DISConnect 441

:SCONfiguration:EXTernal:ACONnect <State>

Enables automatic detection and connection setup of connected external instruments.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Auto Connect" on page 123

:SCONfiguration:EXTernal:REMote:CONNect[:ALL]
:SCONfiguration:EXTernal:REMote:DISConnect[:ALL]

Triggers the instrument to establish the connections to all configured external instruments or to disconnect all existing connections.

Usage: Event

Manual operation: See "Connect/Disconnect" on page 122

:SCONfiguration:EXTernal:PBEHaviour <State>

If enabled, the connection to the external instruments is retained after preset (`*RST`) of the instrument.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 0)

Manual operation: See "Preset behavior: Keep connections to external instruments" on page 123

:SCONfiguration:EXTernal:RF<ch>:DIRection?

Queries the connector direction.

Return values:
<Direction> NONE | IN | OUT
*RST: IN

Example: See Example "Connecting and configuring external instruments" on page 437.

Usage: Query only

Manual operation: See "Direction" on page 123

:SCONfiguration:EXTernal:RF<ch>:RCONnection:STATe?

Queries the status of the remote connection.

Return values:
<State> 1 | ON | 0 | OFF

Example: See Example "Connecting and configuring external instruments" on page 437.

Usage: Query only

Manual operation: See "Remote Connection Status" on page 124

:SCONfiguration:EXTernal:RF<ch>:INAMe?

Queries the name of the connected external instrument.

Return values:
<InstrName> string

Example: See Example "Connecting and configuring external instruments" on page 437.

Usage: Query only

Manual operation: See "Instrument Name" on page 124

:SCONfiguration:EXTernal:REMote:LIST?

Lists all available instruments.

Return values:
<InstrNames> String
String with symbolic names and/or alias names

Example: See Example "Connecting and configuring external instruments" on page 437

Usage: Query only

Manual operation: See "External Instrument" on page 125

:SCONfiguration:EXTernal:REMote:REName

Changes the symbolic name of the instrument.

Usage: Setting only

:SCONfiguration:EXTernal:RF<ch>:REMote:ISELect <InstrName>[, <RfPath>]

Selects an external instrument for the selected connector.

Parameters:

<InstrName> String

Instrument alias name, as retrieved with the command `:SCONfiguration:EXTernal:REMote:LIST?`.

<RfPath> String

Determines the used RF output of the external instrument. For a one-path instrument, the output path is fixed.

Manual operation: See "Apply" on page 126

:SCONfiguration:EXTernal:RF<ch>:REMote:ICONnect <InstrName>, <RfPath>

Selects an external instrument for the selected connector and triggers connection.

Parameters:

<InstrName> string

Instrument alias name, as retrieved with the command `:SCONfiguration:EXTernal:REMote:LIST?`.

<RfPath> string

Determines the used RF output of the external instrument. For a one-path instrument, the output path is fixed to RF1.

Example: See Example "Connecting and configuring external instruments" on page 437.

Usage: Setting only

Manual operation: See "Apply and Connect" on page 126

:SCONfiguration:EXTernal:RF<ch>:REMote:INFO?

Queries information on the external instrument.

Example: See Example "Connecting and configuring external instruments" on page 437.

Usage: Query only

Manual operation: See "Set Symbolic Name" on page 125
See "Remote Channel" on page 125
See "Hostname or IP Address" on page 125
See "Device ID" on page 125

:SCONfiguration:EXTernal:REMote:CLEan

Removes all instruments not connected via USB cable to the R&S SMB100B from the "External Instrument" list.

Usage: Event

Manual operation: See "Clean All" on page 125

:SCONfiguration:EXTernal:RF<ch>:REMote:CONNect

Triggers the connection to the external instrument at the selected connector.

Usage: Event

:SCONfiguration:EXTernal:RF<ch>:REMote:DISConnect

Triggers the disconnection of the external instrument at the selected connector.

Usage: Event

13.16 SOURce subsystem

The `SOURce` subsystem contains the commands for configuring 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)

- Analog modulation subsystems 442
- SOURce:CORRection subsystem 476
- SOURce:EFRontend subsystem 484
- SOURce:FREQuency subsystem 487
- SOURce:INPut subsystem 493

- SOURce:LFOutput subsystem....495
- SOURce:LIST subsystem....508
- SOURce:NOISe subsystem....520
- SOURce:PGEN subsystem....522
- SOURce:PHASe subsystem....523
- SOURce:POWer subsystem....524
- SOURce:ROSCillator subsystem....537
- SOURce:SWEep subsystem....543

13.16.1 Analog modulation subsystems

Option: see Section 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 Section 13.16.6, "SOURce:LFOutput subsystem", on page 495.

For more information:

See Section 5, "Analog modulations", on page 68.

13.16.1.1 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> 1 | ON | 0 | OFF

*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

13.16.1.2 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.

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 also 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 445
[:SOURce<hw>]:AM<ch>:SOURce 446
[:SOURce<hw>]:AM<ch>[:DEPTh] 446
[:SOURce<hw>]:AM:DEPTh:SUM 447
[:SOURce<hw>]:AM:DEViation:MODE 447
[:SOURce<hw>]:AM:RATio 447
[:SOURce<hw>]:AM<ch>:SENSitivity 448

[:SOURce<hw>]:AM<ch>:STATe <State>

Activates amplitude modulation.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example "Creating an amplitude modulated RF signal" on page 443.

Manual operation: See "State" on page 74

[:SOURce<hw>]:AM<ch>:SOURce <Source>

Selects the modulation source for amplitude modulation.

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 "Creating an amplitude modulated RF signal" on page 443.

Manual operation: See "Source" on page 74

[: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

Example: See Example "Creating an amplitude modulated RF signal" on page 443.

Manual operation: See "Depth" on page 77

[: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: 0.1
*RST: 30

Example: See Example "Using combined LF signals" on page 444.

Manual operation: See "Total Depth" on page 78

[: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 444.

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: 0.1
*RST: 100

Example: See Example "Creating an amplitude modulated RF signal" on page 443.

Manual operation: See "Ratio Path2/Path1" on page 78

[: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 "Creating an amplitude modulated RF signal" on page 443.

Manual operation: See "Sensitivity" on page 77

13.16.1.3 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....450
[:SOURce<hw>]:FM<ch>[:DEViation]....450
[:SOURce<hw>]:FM<ch>:SOURce....450
[:SOURce<hw>]:FM:DEViation:MODE....451
[:SOURce<hw>]:FM:DEViation:SUM....451
[:SOURce<hw>]:FM:RATio....452
[:SOURce<hw>]:FM:MODE....452
[:SOURce<hw>]:FM:SENSitivity?....452

[:SOURce<hw>]:FM<ch>:STATe <State>

Activates frequency modulation.

Suffix:
FM<ch> 1..2
determines the modulation signal channel.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Creating a frequency modulated RF signal" on page 448.

Manual operation: See "State" on page 74

[: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 the specifiacton document).
Range: 0 to max
Increment: 0.01
*RST: 1E3

Example: See Example "Creating a frequency modulated RF signal" on page 448.

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 448.

Manual operation: See "Source" on page 74

[: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 448.

Manual operation: See "Deviation Mode" on page 75

[: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 448.

Manual operation: See "Total Deviation" on page 75

[:SOURce<hw>]:FM:RATio <Ratio>

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

Parameters:

<Ratio> float

Range: 0 to 100
Increment: 0.1
*RST: 100

Example: See Example "Creating a frequency modulated RF signal" on page 448.

Manual operation: See "Ratio Path2/Path1" on page 75

[: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 448.

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 449.

Usage: Query only

13.16.1.4 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 Section 13.16.6, "SOURce:LFOutput subsystem", on page 495.

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 a 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....454
[:SOURce<hw>]:PM<ch>:SOURce....455
[:SOURce<hw>]:PM:MODE....455
[:SOURce<hw>]:PM:DEViation:MODE....456
[:SOURce<hw>]:PM:DEViation:SUM....456
[:SOURce<hw>]:PM:RATio....456
[:SOURce<hw>]:PM:SENSitivity?....457
[:SOURce]:PM<ch>[:DEViation]....457

[: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> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Performing phase modulation" on page 453.

Manual operation: See "State" on page 74

[: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 453.

Manual operation: See "Source" on page 74

[: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 spurious characteristics close to CW mode.

*RST: HBANdwidth

Example: See Example "Performing phase modulation" on page 453.

Manual operation: See "Mode" on page 77

[: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 454

Manual operation: See "Deviation Mode" on page 76

[: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 max
Increment: 1E-6
*RST: 1

Example: See Example "Using combined LF signals" on page 454

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 453.

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 453.

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 the specifications document).

Range: 0 to max
Increment: 1
*RST: 1
Default unit: RAD

Example: See Example "Performing phase modulation" on page 453.

Manual operation: See "Deviation" on page 76

13.16.1.5 SOURce:PULM subsystem

Option: see Section 5.1, "Required options", on page 68.

The `PULM` subsystem contains the commands for setting the pulse modulation.

- Pulse modulation settings....458
- Pulse train settings....463
- Pulse train data exchange....466

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:TRIGger:IMMediate

// 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

// Route the signal to the signal valid output connector
// to use the signal for synchronizing the pulse modulation.
:SOURce:PULM:OUTPut:SYNC ON

// 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 459
[:SOURce<hw>]:PULM:TRIGger:MODE 459
[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate 460
[:SOURce<hw>]:PULM:PERiod 460
[:SOURce<hw>]:PULM:WIDTh 460
[:SOURce<hw>]:PULM:DELay 460
[:SOURce<hw>]:PULM:DOUBle:DELay 461
[:SOURce<hw>]:PULM:DOUBle:WIDTh 461
[:SOURce<hw>]:PULM:DOUBle:STATe 461
[:SOURce<hw>]:PULM:STATe 461
[:SOURce<hw>]:PULM:SOURce 461
[:SOURce<hw>]:PULM:TTYPe 462
[:SOURce<hw>]:PULM:OUTPut:SYNC[:STATe] 462
[:SOURce<hw>]:PULM:POLarity 462
[:SOURce<hw>]:PULM:IMPedance 463

[: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 458.

Options: PTRain requires R&S SMBB-K27

Manual operation: See "Pulse Mode" on page 88

[: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 458.

Manual operation: See "Trigger Mode" on page 89

[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate

If `[:SOURce<hw>]:PULM:TRIGger:MODESINGle`, triggers the pulse generator.

Example: See Example "Perform pulse modulation" on page 458.

Manual operation: See "Execute Single Trigger" on page 91

[: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 458.

Manual operation: See "Pulse Period" on page 90

[: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 458.

Manual operation: See "Pulse Width" on page 90

[:SOURce<hw>]:PULM:DELay <Delay>

Sets the pulse delay.

Parameters:

<Delay> float

*RST: 1ms

Example: See Example "Perform pulse modulation" on page 458.

Manual operation: See "Pulse Delay" on page 90

[: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 458.

Manual operation: See "Double Pulse Delay" on page 90

[: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 458.

Manual operation: See "Double Pulse Width" on page 90

[:SOURce<hw>]:PULM:DOUBle:STATe <State>

Provided for backward compatibility with former Rohde & Schwarz signal generators.

Works like the command `[:SOURce<hw>]:PULM:MODEDOUBle`.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 0

[:SOURce<hw>]:PULM:STATe <State>

Activates pulse modulation.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Perform pulse modulation" on page 458.

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 458.

Manual operation: See "Source" on page 72

[: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 458.

Manual operation: See "Transition Type" on page 72

[:SOURce<hw>]:PULM:OUTPut:SYNC[:STATe] <Sync>

Routes the pulse modulation signal to the [Signal Valid] connector.

Parameters:
<Sync> 1 | ON | 0 | OFF
*RST: OFF

Options: R&S SMBB-K23 (Pulse Generator)

Manual operation: See "Pulse Sync Out" on page 91

[: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 458.

Manual operation: See "Polarity" on page 99

[:SOURce<hw>]:PULM:IMPedance <Impedance>

Sets the impedance for the external pulse trigger and pulse modulation input.

Parameters:

<Impedance> G50 | G10K
*RST: G10K

Example: See Example "Perform pulse modulation" on page 458.

Manual operation: See "Impedance" on page 99

Pulse train settings

Option: R&S SMBB-K27

This section describes the commands for the pulse train modulation and the associated file handling.

See Section 5.4.4.2, "Pulse generator > pulse train settings", on page 91.

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?
// Reaponse: "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?
// Response: "my_pt, pt"
:SOURce1:PULM:TRAin:DEL "/var/user/my_pt"
```

The following commands are available:

[:SOURce<hw>]:PULM:TRAin:CATalog? 464
[:SOURce<hw>]:PULM:TRAin:DELete 464
[:SOURce<hw>]:PULM:TRAin:ONTime 465
[:SOURce<hw>]:PULM:TRAin:OFFTime 465
[:SOURce<hw>]:PULM:TRAin:REPetition:POINts? 465
[:SOURce<hw>]:PULM:TRAin:ONTime:POINts? 465
[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts? 465
[:SOURce<hw>]:PULM:TRAin:REPetition 465
[:SOURce<hw>]:PULM:TRAin:SELect 466

[: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 463.

Usage: Query only

Manual operation: See "Pulse Train Data" on page 93

[: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 463.

Usage: Setting only

Manual operation: See "Pulse Train Data" on page 93
See "Edit Pulse Train Data" on page 94

[: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 412 for details.
The maximum length is 2047 values.

Range: 0 ns to 10 ms

Example: See Example "Generating a pulse train signal" on page 463.

Manual operation: See "Edit Pulse Train Data" on page 94

[: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 463.

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 463.

Manual operation: See "Edit Pulse Train Data" on page 94

[: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 463.

Manual operation: See "Pulse Train Data" on page 93
See "File Name" on page 98
See "Functions for handling of data lists" on page 236

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 466
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect 468
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect 468
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute 468

[: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 466.

Manual operation: See "Mode" on page 96

[: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 466.

Manual operation: See "ASCII File Settings" on page 96

[: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 466.

Manual operation: See "ASCII File Settings" on page 96

[: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 466.

Manual operation: See "ASCII File Settings" on page 96

[: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 466.

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 97

[: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 466.

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 97

[: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 466.

Manual operation: See "Select Source/Select ASCII Destination" on page 97

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute

Usage: Event

Manual operation: See "Import / Export" on page 97

Executes the import or export of the selected list file, according to the transfer direction set with command `[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE`.

13.16.1.6 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 Section 13.22, "Direct commands for the stereo/rds coder option R&S SMBB-B5", on page 596.

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....470
[:SOURce]:STEReo:STATe....470
[:SOURce]:STEReo[:DEViation]....470
[:SOURce]:STEReo:AUDio:MODE....471
[:SOURce]:STEReo:SOURce....471
[:SOURce]:STEReo:EXTernal:IMPedance....472
[:SOURce]:STEReo:MMF....472
[:SOURce]:STEReo:AUDio:PREemphasis....472
[:SOURce]:STEReo:AUDio:PREemphasis:STATe....472
[:SOURce]:STEReo:PILot:STATe....473
[:SOURce]:STEReo:PILot[:DEViation]....473
[:SOURce]:STEReo:PILot:PHASe....473
[:SOURce]:STEReo:ARI:STATe....473
[:SOURce]:STEReo:ARI[:DEViation]....474
[:SOURce]:STEReo:ARI:TYPE:STATe....474

[:SOURce]:STEReo:ARI:TYPE....474
[:SOURce]:STEReo:ARI:BK[:CODE]....475
[:SOURce]:STEReo:RDS:STATe....475
[:SOURce]:STEReo:RDS[:DEViation]....475
[:SOURce]:STEReo:RDS:DATaset....476
[:SOURce]:STEReo:RDS:TRAFfic:PROGram[:STATe]....476
[:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe]....476

[: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 Section 13.22, "Direct commands for the stereo/rds coder option R&S SMBB-B5", on page 596.

Parameters:
<Direct> string

Example: See Example "Activating stereo modulation" on page 469.

Manual operation: See "Program Service Name" on page 86
See "Program Identification" on page 86

[:SOURce]:STEReo:STATe <State>

Activates/deactivates stereo modulation.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: See Example "Activating stereo modulation" on page 469.

Manual operation: See "State" on page 80

[: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 469.

Manual operation: See "FM Deviation" on page 80

[: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 469.

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 469.

Manual operation: See "Audio Source" on page 81

[:SOURce]:STEReo:EXTernal:IMPedance <Impedance>

For `[:SOURce]:STEReo:SOURceLREX`, 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 469.

Manual operation: See "External R/L Impedance" on page 81

[:SOURce]:STEReo:MMF <Mmf>

For `[:SOURce]:STEReo:SOURceLREX` and `[:SOURce]:STEReo:AUDio:PREemphasis:STATe1`, 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 469.

Manual operation: See "Max Modulation Frequency" on page 82

[:SOURce]:STEReo:AUDio:PREemphasis <PreEmphasis>

If `[:SOURce]:STEReo:AUDio:PREemphasis:STATe1`, 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 469.

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 469.

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 469.

Manual operation: See "Pilot State" on page 83

[: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 469.

Manual operation: See "Pilot Deviation" on page 83

[: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 469.

Manual operation: See "Pilot Phase" on page 83

[: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 469.

Manual operation: See "ARI State" on page 84

[: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 469.

Manual operation: See "ARI Deviation" on page 84

[: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 469.

Manual operation: See "ARI Identification" on page 84

[: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 475.

BKDK
The area and message identification are generated in addition. The BK code is selected in `[:SOURce]:STEReo:ARI:BK[:CODE]` on page 475.

*RST: OFF

Example: See Example "Activating stereo modulation" on page 469.

Manual operation: See "ARI Identification" on page 84

[: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 469.

Manual operation: See "ARI BK" on page 84

[: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 469.

Manual operation: See "RDS State" on page 85

[: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 Section 13.16.1.6, "SOURce:STEReo subsystem", on page 468.

Manual operation: See "RDS Deviation" on page 86

[: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 469.

Manual operation: See "RDS Data Set" on page 86

[: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 469.

Manual operation: See "Traffic Program" on page 86

[: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 469.

Manual operation: See "Traffic Announcement" on page 87

13.16.2 SOURce:CORRection subsystem

The `SOURce:CORRection` subsystem contains the commands for defining correction values for external test assemblies.

You can acquire the correction values anytime, regardless of the modulation settings of the generator. During correction, the R&S SMB100B adds the correction values to the output level of the respective RF frequency.

Determine the correction values in one of the following ways:

- Measure the RF output level at several frequency points and enter the value pairs manually in a table

- Connect an R&S NRP to the generator output signal and send the command `[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` to fill the table automatically.

Save correction values to files with file extension `*.uco`.

Refer to Section 13.5.2, "Handling files in the default or in a specified directory", on page 383 for general information on file handling in the default and in a specific directory.

Programming examples

The examples in this section assume that:

- The files are stored in the default directory.
- `*RST` does not affect data lists.

Example: To create RF level correction values

The following example shows a command sequence to create and activate a list for assigning level correction values to arbitrary RF frequencies. Further hardware settings are not considered.

```
// Reset the instrument to start from an initial state
// Query the available user correction list files in the default
// directory. Select a file or create a file.
// ****************************************************************
*RST; *CLS
:SOURce1:CORRection:CSET:CATalog?
// Response: "ucor1"
// Select the file ucor1.uco.
:SOURce1:CORRection:CSET:SELect "/var/user/ucor1"

// Enter the frequency/level value pairs in the table; existing data
// is overwritten. Query the number of frequency/power entries.
:SOURce1:CORRection:CSET:DATA:FREQuency 100MHz,110MHz,120MHz,130MHz,140MHz,150MHz
:SOURce1:CORRection:CSET:DATA:POWer -10,-7.5,-5.0,-2.5,0,2.5
:SOURce1:CORRection:CSET:DATA:FREQuency:POINts?
// 6
:SOURce1:CORRection:CSET:DATA:POWer:POINTs?
// 6

// Enable user correction mode and RF output
:SOURce1:CORRection:STATe 1
:OUTPut1:STATe ON

// Query the currently used correction value
:SOURce1:CORRection:VALue?
// -2.5

// Delete a user correction file
:SOURce1:CORRection:CSET:DELEte "/var/user/ucor1.uco"
```

Example: To fill user correction data with a sensor

The following example shows a command sequence to fill a user correction list automatically supported by a connected R&S NRP.

```
// Fill a user correction list with the level values
// measured by an R&S NRP,
// store the data in a file and enable user correction.

*RST; *CLS

:SOURce1:CORRection:CSET:SELect "/var/user/Ucor1_AutoFill.uco"
:SOURce1:CORRection:CSET:DATA:FREQuency 100MHz,110MHz,120MHz,130MHz,140MHz,150MHz
:SOURce1:CORRection:ZEROing:STATe 1
:SOURce1:CORRection:CSET:DATA:SENSor1:POWer:SONCe
// Query the number of automatically filled correction level values
:SOURce1:CORRection:CSET:DATA:POWer:POINTs?
// 6
:SOURce1:CORRection:STATe 1

// Query the correction value at a certain frequency
:FREQ 120000000
:SOURce1:CORRection:VALue?
// -52.13
```

Example: To export user correction lists

The following example shows a command sequence to export a user correction list (here the list created with the example before) into an ASCII file. Further hardware settings are not considered.

```
// Select a user correction file for exporting to file in ASCII format
// Set ASCII data parameters
// Set the ASCII file extension, the decimal separator
// and the column separator for the ASCII data
:SOURce1:CORRection:DEXChange:AFILe:CATalog?
// my_ucor
:SOURce1:CORRection:CSET:CATalog?
// ucor1,Ucor1_AutoFill
:SOURce1:CORRection:CSET:SELect "/var/user/Ucor1_AutoFill.uco"
:SOURce1:CORRection:DEXChange:AFILe:EXTension CSV
:SOURce1:CORRection:DEXChange:AFILe:SEParator:DECimal DOT
:SOURce1:CORRection:DEXChange:AFILe:SEParator:COLumn COMMa

// Select source and destination
:SOURce1:CORRection:DEXChange:AFILe:SELect "/var/user/ucor2ASCII"

// Export the user correction data into the ASCII file
:SOURce1:CORRection:DEXChange:MODE EXPort
:SOURce1:CORRection:DEXChange:EXECute
```

```
// Query the available ASCII files with extension .csv
:SOURce1:CORRection:DEXChange:AFILe:CATalog?
// ucor2ASCII,my_ucor

// Import a user correction ASCII file
:SOURce1:CORRection:DEXChange:MODE IMPort
:SOURce1:CORRection:DEXChange:AFILE:SELect "/var/user/my_ucor"
:SOURce1:CORRection:DEXChange:EXECute
```

Commands:

- Correction settings 479
- Correction data exchange 482

13.16.2.1 Correction settings

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency <Frequency>

Enters the frequency value in the table selected with `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

Parameters:

<Frequency> Frequency#1[, Frequency#2, ...]
String of values with default unit Hz.

Example: See Example "To create RF level correction values" on page 477 .

Manual operation: See "Frequency (Hz)" on page 183

[:SOURce<hw>]:CORRection:CSET:DATA:POWer <Power>

Enters the level values to the table selected with `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

Parameters:

<Power> Power#1[, Power#2, ...]
String of values with default unit dB.
*RST: 0

Example: See Example "To create RF level correction values" on page 477 .

Manual operation: See "Correction Value (dB)" on page 183

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts?
[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts?

Queries the number of frequency/level values in the selected table.

Return values:
<Points> integer
Range: 0 to 10000
*RST: 0

Example: See Example "To create RF level correction values" on page 477 .

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

Fills the selected user correction table with the level values measured by the power sensor for the given frequencies.

To select the used power sensor set the suffix in key word `SENSe`.

Example: See Example "To fill user correction data with a sensor" on page 478.

Usage: Event

Manual operation: See "Fill User Correction Data with Sensor" on page 185

[:SOURce<hw>]:CORRection:CSET[:SELect] <Filename>

Selects or creates a file for the user correction data.

If the file with the selected name does not exist, a new file is created.

Parameters:
<Filename> string
Filename or complete file path; file extension can be omitted.

Example: See Example "To create RF level correction values" on page 477 .

Manual operation: See "UCOR Data" on page 180
See "Functions for handling of data lists" on page 236

[:SOURce<hw>]:CORRection:VALue?

Queries the current value for user correction.

Return values:
<Value> float
Range: -100 to 100
Increment: 0.01
*RST: 0

Example: See Example "To create RF level correction values" on page 477 .

Usage: Query only

Manual operation: See "User Correction" on page 180

[:SOURce<hw>]:CORRection:ZERoing:STATe <State>

Activates the zeroing procedure before filling the user correction data acquired by a sensor.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 1

Example: See Example "To fill user correction data with a sensor" on page 478.

Manual operation: See "Fill User Correction Data with Sensor" on page 185

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

Fills the selected user correction list with the level values measured by the power sensor for the given frequencies.

Suffix:
SENSor<ch> Defines the used power sensor, i.e. the sensor whose values are used.

Example: See Example "To fill user correction data with a sensor" on page 478.

Usage: Event

[:SOURce<hw>]:CORRection[:STATe] <State>

Activates user correction with the currently selected table.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "To create RF level correction values" on page 477 .

Manual operation: See "State" on page 180

[:SOURce]:CORRection:CSET:CATalog?

Queries a list of available user correction tables.

Return values:
<Catalog> string
List of list filenames, separated by commas

Example: See Example "To create RF level correction values" on page 477 .

Usage: Query only

Manual operation: See "UCOR Data" on page 180
See "Directory, File List and Filename" on page 231

[:SOURce]:CORRection:CSET:DELete <Filename>

Deletes the specified user correction list file.

Setting parameters:
<Filename> string
Filename or complete file path; file extension is optional.

Example: See Example "To create RF level correction values" on page 477 .

Usage: Setting only

Manual operation: See "UCOR Data" on page 180

13.16.2.2 Correction data exchange

With the following commands, you can configure user correction lists and export or import them accordingly.

[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?

Queries the available ASCII files for export or import of user correction data in the current or specified directory.

Return values:
<Catalog> string
List of ASCII files `*.txt` or `*.csv`, separated by commas.

Example: See Example "To create RF level correction values" on page 477 .

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 97

[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension <Extension>

Determines the extension of the ASCII files for file import or export, or to query existing files.

Parameters:
<Extension> TXT | CSV
*RST: TXT

Example: See Example "To export user correction lists" on page 478 .

Manual operation: See "ASCII File Settings" on page 96

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect <Filename>

Selects the ASCII file to be imported or exported.

Parameters:
<Filename> string
Filename or complete file path; file extension can be omitted.

Example: See Example "To export user correction lists" on page 478 .

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 97

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn <Column>

Selects the separator between the frequency and level column of the ASCII table.

Parameters:
<Column> TABulator | SEMicolon | COMMa | SPACe
*RST: COMMa

Example: See Example "To export user correction lists" on page 478 .

Manual operation: See "ASCII File Settings" on page 96

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal <Decimal>

Sets the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Parameters:
<Decimal> DOT | COMMa
*RST: DOT

Example: See Example "To export user correction lists" on page 478 .

Manual operation: See "ASCII File Settings" on page 96

[:SOURce<hw>]:CORRection:DEXChange:EXECute

Executes the import or export of the selected correction list, according to the previously set transfer direction with command `[:SOURce<hw>]:CORRection:DEXChange:MODE`.

Example: See Example "To export user correction lists" on page 478 .

Usage: Event

Manual operation: See "Import / Export" on page 97

[:SOURce<hw>]:CORRection:DEXChange:MODE <Mode>

Determines import or export of a user correction list.

Specify the source or destination file with the command `[:SOURce<hw>]:CORRection:DEXChange:SELect`.

Parameters:

<Mode> IMPort | EXPort
*RST: IMPort

Example: See Example "To export user correction lists" on page 478 .

Manual operation: See "Mode" on page 96

[:SOURce<hw>]:CORRection:DEXChange:SELect <Filename>

Selects the ASCII file for import or export, containing a user correction list.

Parameters:

<Filename> string
Filename or complete file path; file extension can be omitted.

Example: See Example "To export user correction lists" on page 478 .

Manual operation: See "Select Source/Select ASCII Destination" on page 97

13.16.3 SOURce:EFRontend subsystem

The `SOURce:EFRontend` subsystem contains the commands for configuring settings of an external frontend.

Example: Configuring external frontend frequency bands

```
SOURce1:EFRontend:FREQuency:IFRequency:VALue?
// Response in Hz: "18750000000" (= 18.75 GHz)
```

Example: Configuring external frontend connection settings

```
SOURce1:EFRontend:IDN?
// Response: "Rohde&Schwarz,SZM75,1443.5004K02/100001,1.34.6,1.2.1"

//Query the installed hardware options
SOURce1:EFRontend:OPT?
// Response: "SZM-E,SZM-I"
```

Example: Configuring external frontend cable correction

```
// Query available cable correction files.
SOURce1:EFRontend:ALIGnment:FILE:CATalog?
// Select a cable correction file stored on the instrument.
SOURce1:EFRontend:ALIGnment:FILE:SELect "/var/user/ExtFrontend/CableCorrectionFiles/
if_default_cable_1347_7552_00.s2p"
// Query upper and lower frequency range of the IF correction data.
SOURce1:EFRontend:ALIGnment:FILE:FREquency:RANGe:LOWer?
// Response in Hz: "12000000000" (12 GHz)
SOURce1:EFRontend:ALIGnment:FILE:FREquency:RANGe:UPPer?
// Response in Hz: "19250000000" (19.25 GHz)
SOURce1:EFRontend:ALIGnment:STATe 1
```

Commands:

[:SOURce<hw>]:EFRontend[:FREQuency]:IFRequency[:VALue]?....485
[:SOURce<hw>]:EFRontend:IDN?....485
[:SOURce<hw>]:EFRontend:OPT?....486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:FREQuency:RANGe:LOWer?....486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:FREQuency:RANGe:UPPer?....486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:CATalog?....486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE[:SELect]....486
[:SOURce<hw>]:EFRontend:ALIGnment[:STATe]....487
[:SOURce<hw>]:EFRontend:SCRew:POSition?....487

[:SOURce<hw>]:EFRontend[:FREQuency]:IFRequency[:VALue]?

Queries the frequency of the IF signal, that is the frequency at the RF 50 Ω connector.

Return values:
<IntFrequency> float

Example: See Example "Configuring external frontend frequency bands" on page 484.

Usage: Query only

Manual operation: See "Intermediate Frequency" on page 128

[:SOURce<hw>]:EFRontend:IDN?

Identification

Returns the IDN string, i.e. the identification of the external frontend.

Return values:
<IdnString> string

Example: See Example "Configuring external frontend connection settings" on page 484.

Usage: Query only

Manual operation: See "Hardware Config" on page 129

[:SOURce<hw>]:EFRontend:OPT?

Option identification query

Queries the options included in the external frontend.

For more information, refer to the specifications document.

Return values:

<OptString> string

The query returns a list of options. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.

Example: See Example "Configuring external frontend connection settings" on page 484.

Usage: Query only

Manual operation: See "Options" on page 130

[:SOURce<hw>]:EFRontend:ALIGnment:FILE:FREQuency:RANGe:LOWer?
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:FREQuency:RANGe:UPPer?

Queries the upper/lower frequency range of IF values required at the connected external frontend.

We recommend that you cover this range in the cable correction file.

Return values:

<CableCorrFreqUp> float

Example: See Example "Configuring external frontend cable correction" on page 485.

Usage: Query only

Manual operation: See "Recommended Frequency Range" on page 132

[:SOURce<hw>]:EFRontend:ALIGnment:FILE:CATalog?

Queries the cable correction files with settings in the default directory.

Listed are cable correction files with extension `*.s2p` or `*.uco`.

Example: See Example "Configuring external frontend cable correction" on page 485.

Usage: Query only

Manual operation: See "Load Cable Correction File" on page 131

[:SOURce<hw>]:EFRontend:ALIGnment:FILE[:SELect] <CableCorrFileNa>

Selects an existing correction file to compensate for cable losses. Selectable files have file extension `*.s2p` or `*.uco`.

Parameters:
<Filename> string

Example: See Example "Configuring external frontend cable correction" on page 485.

Manual operation: See "Load Cable Correction File" on page 131

[:SOURce<hw>]:EFRontend:ALIGnment[:STATe] <CableCorrState>

Activates correction of the IF signal for different IF signal frequencies.

Parameters:
<CableCorrState> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Configuring external frontend cable correction" on page 485.

Manual operation: See "State" on page 131

[:SOURce<hw>]:EFRontend:SCRew:POSition?

Requires a connected external frequency multiplier with installed mechanically attenuator option.

Queries the value of the screw position required on the connected external frequency multiplier.

Return values:
<ScrewPosition> integer
Range: 0 to 150
*RST: 0

Usage: Query only

13.16.4 SOURce:FREQuency subsystem

The `SOURce:FREQuency` subsystem contains the commands used to define the frequency settings for the RF sources and sweeps.

Example: To configure RF frequency settings

```
:SOURce1:FREQuency:MODE CW
:SOURce1:FREQuency:CW 6000000000
:SOURce1:FREQuency:OFFSet 2000000000
:SOURce1:FREQuency:MULTiplier 1.5
:SOURce1:FREQuency:CW?
// Response in Hz: 11000000000

// Optionally, configure a user-defined frequency step mode.
:SOURce1:FREQuency:STEP:MODE USER
```

```
:SOURce1:FREQuency:STEP:INCRement 1000000
:SOURce1:FREQuency:CW UP

:SOURce1:PHASe 2
:SOURce1:PHASe:REFerence
```

[:SOURce<hw>]:FREQuency:MODE....488
[:SOURce<hw>]:FREQuency[:CW|FIXed]....489
[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL....490
[:SOURce<hw>]:FREQuency:MANual....490
[:SOURce<hw>]:FREQuency:MULTiplier....490
[:SOURce<hw>]:FREQuency:OFFSet....491
[:SOURce<hw>]:FREQuency:CENTer....491
[:SOURce<hw>]:FREQuency:SPAN....492
[:SOURce<hw>]:FREQuency:STARt....492
[:SOURce<hw>]:FREQuency:STOP....492
[:SOURce<hw>]:FREQuency:STEP:MODE....493
[:SOURce<hw>]:FREQuency:STEP[:INCRement]....493

[: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 | COMBined

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 492 and `[:SOURce<hw>]:FREQuency:STOP` on page 492,
`[:SOURce<hw>]:FREQuency:CENTer` on page 491,
`[:SOURce<hw>]:FREQuency:SPAN` on page 492,
`[:SOURce<hw>]:FREQuency:MANual` on page 490

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 Section 13.16.7, "SOURce:LIST subsystem", on page 508.

COMBined
Sets the combined RF frequency / level sweep mode.
The instrument processes frequency and level settings in defined sweep steps.
Set the range and current frequency with the commands:
`[:SOURce<hw>]:COMBined:FREQuency:STARt` on page 552 and `[:SOURce<hw>]:COMBined:FREQuency:STOP` on page 552,
`[:SOURce<hw>]:COMBined:POWer:STARt` on page 552 and `[:SOURce<hw>]:COMBined:POWer:STOP` on page 553

*RST: CW

Example: See Example "To configure RF frequency settings" on page 487,

Example: See Example "Setting up an RF frequency or power sweep" on page 544

Manual operation: See "State (RF frequency sweep)" on page 150
See "State (RF frequency / level sweep)" on page 151
See "State" on page 161

[: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.

For more information, refer to the specifications document.

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)
Increment: depends on options
*RST: depends on options

Example: See Example "To configure RF frequency settings" on page 487

Example: See Example "Setting up an RF frequency or power sweep" on page 544

Manual operation: See "Frequency" on page 60

[: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 232

[: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 "Setting up an RF frequency or power sweep" on page 544

Manual operation: See "Current Frequency" on page 151

[: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 58.

Parameters:

<Multiplier> float

Range: -10000 to 10000
Increment: 0.001
*RST: 1

Example: See Example "To configure RF frequency settings" on page 487

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 58.

Note: The offset also affects RF frequency sweep.

Parameters:

<Offset> float

Increment: 0.01
*RST: 0

Example: See Example "To configure RF frequency settings" on page 487

Manual operation: See "Offset" on page 60

[:SOURce<hw>]:FREQuency:CENTer <Center>

Sets the center frequency of the sweep.

The maximum value depends on the installed hardware options.

For more information, refer to the specifications document.

Parameters:

<Center> float

Range: 300 kHz to depends on options
Increment: 0.01 Hz
*RST: 300E6
Default unit: Hz

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Center Frequency" on page 156

[:SOURce<hw>]:FREQuency:SPAN <Span>

Sets the span of the frequency sweep range.

Parameters:

<Span> float

Full frequency range

Increment: 0.01
*RST: 400E6

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Span" on page 156

[:SOURce<hw>]:FREQuency:STARt <Start>

Sets the start frequency for the RF sweep.

The maximum value depends on the installed hardware options.

For more information, refer to the specifications document.

Parameters:

<Start> float

Range: 300 kHz to depends on options
Increment: 0.01 Hz
*RST: 100 MHz

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Start Frequency/Stop Frequency" on page 156

[:SOURce<hw>]:FREQuency:STOP <Stop>

Sets the stop frequency range for the RF sweep.

The maximum value depends on the installed hardware options.

For more information, refer to the specifications document.

Parameters:

<Stop> float

Range: 300 kHz to depends on options
Increment: 0.01 Hz
*RST: 500 MHz
Default unit: Hz

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Start Frequency/Stop Frequency" on page 156

[: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: See Example "To configure RF frequency settings" on page 487.

Manual operation: See "Variation Active" on page 61

[: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 "To configure RF frequency settings" on page 487

Manual operation: See "Variation Step" on page 61

13.16.5 SOURce:INPut subsystem

The `SOURce:INPut` subsystem contains the commands for configuring the inputs for external modulation signals. The instrument trigger setting influences all sweeps and is effective in the List mode (Instrument Trigger).

[:SOURce<hw>]:INPut:MODext:COUPling....494
[:SOURce<hw>]:INPut:MODext:IMPedance<ch>....494
[:SOURce]:INPut:TRIGger:SLOPe....494

[: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 105

[: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 494.

Manual operation: See "Impedance" on page 105

[: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 154

13.16.6 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: Setting up 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 60000 Hz
// SOURce1:LFOutput1:SWEep:FREQuency:STEP:LOGarithmic 10 PCT
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:VOLTage 1
SOURce1:LFOutput1:OFFSet 0.001
```


- LF generator settings 496
- LF sweep settings 504

13.16.6.1 LF generator settings

With the commands described in this section, you can configure the LF signal source.

[:SOURce]:LFOutput<ch>:BANDwidth?....497
[:SOURce]:LFOutput<ch>:FREQuency....497
[:SOURce<hw>]:LFOutput<ch>:PERiod?....498
[:SOURce<hw>]:LFOutput:FREQuency:MANual....498
[:SOURce<hw>]:LFOutput:FREQuency:MODE....499
[:SOURce<hw>]:LFOutput:FREQuency:STOP....499
[:SOURce<hw>]:LFOutput:FREQuency:STARt....499
[:SOURce]:LFOutput<ch>[:STATe]....499
[:SOURce]:LFOutput<ch>:INTernal:VOLTage....500
[:SOURce]:LFOutput:OFFSet....500
[:SOURce]:LFOutput<ch>:SOURce....500
[:SOURce]:LFOutput:SIMPedance....501
[:SOURce]:LFOutput<ch>:SOURce:PATH....501
[:SOURce]:LFOutput:VOLTage....501
[:SOURce<hw>]:LFOutput<ch>:SHAPe....501
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:DCYCle....502
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:PERiod....502
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:WIDTh....502
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL....502
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH....503
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:PERiod....503
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:RISE....503
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:PERiod....504
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:RISE....504

[: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 105

[: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
Increment: 0.01
*RST: 1000
Default unit: Hz

Example:

```
SOURce1:LFOutput1:FREQuency 5 kHz
// sets the LF frequency
```

Manual operation: See "LF Gen Frequency" on page 81
See "Frequency" on page 103

[: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 496.

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 "Setting up an LF sweep" on page 495.

Manual operation: See "Current Frequency" on page 151

[: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 "Setting up an LF sweep" on page 495.

Manual operation: See "State (LF frequency sweep)" on page 101

[: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

Example: See Example "Setting up an LF sweep" on page 495.

Manual operation: See "Start Frequency/Stop Frequency" on page 156

[:SOURce]:LFOutput<ch>[:STATe] <State>

Activates LF signal output.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example "Configuring the LF generator" on page 496.

Manual operation: See "State" on page 107

[: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 496.

Manual operation: See "Output Voltage" on page 108

[: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 496.

Manual operation: See "DC-Offset" on page 108

[: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 496.

Manual operation: See "Source" on page 108

[: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 108

[: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 specifications document)
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 | PULSe | TRIangle | TRAPeze

*RST: SINE

Example: See Example "Configuring the LF generator" on page 496.

Options: R&S SMBB-K24

Manual operation: See "LF Gen Shape" on page 81
See "Shape" on page 101

[: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 496.

Manual operation: See "Pulse Duty Cycle" on page 103

[: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 496.

Manual operation: See "Period" on page 103

[: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 496.

Manual operation: See "Pulse Width" on page 103

[: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 496.

Manual operation: See "Trapezoid Rise / Fall" on page 104

[: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 496.

Manual operation: See "Trapezoid High" on page 104

[: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 496.

Manual operation: See "Period" on page 103

[: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 496.

Manual operation: See "Trapezoid Rise / Fall" on page 104

[: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 496.

Manual operation: See "Period" on page 103

[: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 496.

Manual operation: See "Triangle Rise" on page 104

13.16.6.2 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 504
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute 505
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE 505
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:POINts 506
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace 506
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RUNNing? 506
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe 506
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing 507
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic 507
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] 507

[: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 "Setting up an LF sweep" on page 495.

Manual operation: See "Dwell Time" on page 154

[: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 "Setting up an LF sweep" on page 495.

Usage: Event

Manual operation: See "Execute Single Sweep" on page 155

[: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 498.

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 "Setting up an LF sweep" on page 495.

Manual operation: See "Mode" on page 151

[: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 Section 7.2.1, "Correlating parameters in sweep mode", on page 143

Parameters:

<Points> integer

Range: 2 to POINts
*RST: 50

Example: See Example "Setting up an LF sweep" on page 495.

[: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> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "Retrace" on page 152

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RUNNing?

Queries the current status of the LF frequency sweep mode.

Return values:

<State> 1 | ON | 0 | OFF

Example: See Example "Setting up an LF sweep" on page 495.

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 "Setting up an LF sweep" on page 495.

Manual operation: See "Shape" on page 152

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing <Spacing>

Selects linear or logarithmic sweep spacing.

Parameters:

<Spacing> LINear | LOGarithmic
*RST: LINear

Example: See Example "Setting up an LF sweep" on page 495.

Manual operation: See "Spacing" on page 154

[: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 Section 7.2.1, "Correlating parameters in sweep mode", on page 143

Parameters:

<Logarithmic> float
The unit is mandatory
Range: 0.01 to 100
Increment: 0.01
*RST: 1
Default unit: PCT

Example: See Example "Setting up an LF sweep" on page 495.

Manual operation: See "Step Linear/Step Logarithmic" on page 157

[: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 Section 7.2.1, "Correlating parameters in sweep mode", on page 143

Parameters:

<Linear> float
Range: 0.1 to STOP-STARt
Increment: 0.1
*RST: 1000

Example: See Example "Setting up an LF sweep" on page 495.

Manual operation: See "Step Linear/Step Logarithmic" on page 157

13.16.7 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 Section 13.5.2, "Handling files in the default or in a specified directory", on page 383 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 activate 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
:SOURce1:LIST:CAT?
// Response:- shows the name of available list files (if applicable)
:SOURce1: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
:SOURce1:LIST:FREQ 58 MHz, 61 MHz, 73 MHz, 86 MHz, 91 MHz, 92 MHz, 98 MHz
:SOURce1:LIST:POW 13 dBm, 12 dBm, 5 dBm, 3 dBm, 0 dBm, 4 dBm, 6 dBm
:SOURce1:LIST:DWEL:LIST 10000, 100000, 200000, 19000, 10000, 150000, 220000
:SOURce1:LIST:FREQ:POIN?
// 7
:SOURce1:LIST:POW:POINT?
// 7
:SOURce1:LIST:DWEL:LIST:POIN?
// 7
:SOURce1:LIST:FREE?
// 2147483647 (bytes of free memory)

// Use dwell times from list
// Configure the list mode parameters
// Enable RF output
:SOURce1:LIST:MODE AUTO
:SOURce1:LIST:TRIG:SOUR AUTO
:SOURce1:LIST:DWEL:MODE "LIST"
```

```
:OUTPut1: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
:SOURce1:LIST:IND:START 2
:SOURce1:LIST:IND:STOP 4
:SOURce1:LIST:MODE AUTO
:SOURce1:LIST:TRIG:SOUR AUTO
:SOURce1:LIST:DWEL:LIST 500 ms
:OUTPut1: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
:SOURce1:FREQ:MODE LIST
:SOURce1:LIST:TRIG:EXEC
:SOURce1:LIST:RUNN?
:SOURce1:LIST:IND?
// 3
// value changes when the value is queried again
:SOURce1:LIST:RES

// For list mode STEP use the following commands
*RST; *CLS
// Change list mode to STEP
:SOURce1:LIST:MODE STEP
// Activate RF Output1
:OUTPut1:STAT 1
// Activate the list mode
:SOURce1:FREQ:MODE LIST
// For each step: select frequency/powerlevel pair as index from the list
:SOURce1:LIST:IND 2
:SOURce1:LIST:IND 3
:SOURce1:LIST:IND 4

// Use the selected list for path B (with List Mode B default settings)
:SOURce2:LIST:SEL "/var/user/list1.lsw"
:OUTPut2:STAT ON
:SOURce2:FREQ:MODE LIST
:SOURce2:LIST:IND?
// 2
// value canges when the value is queried again

// Deactivate the list mode
:SOURce1: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
:SOURce1:LIST:DEXC:AFIL:EXT CSV
:SOURce1:LIST:DEXC:AFIL:SEP:DEC DOT
:SOURce1:LIST:DEXC:AFIL:SEP:COL COMM

// Select source and destination path/directory
// Query available listfiles in default directory "/var/user"
:SOURce1:LIST:CAT?
// list1
:SOURce1:LIST:DEXC:AFIL:SEL "/var/user/list1ASCII"
:SOURce1:LIST:DEXC:SEL "/var/user/list1"

// Export the list file data into the ASCII file
:SOURce1:LIST:DEXC:EXEC

// Query the available ASCII files with extension .csv
:SOURce1:LIST:DEXC:AFIL:CAT?
// Response: "list1ASCII"

// Deactivate the list mode
:SOURce1:FREQ:MODE CW
```


- List mode settings 510
- List mode file operation 516
- List mode data exchange 518

13.16.7.1 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 511
[:SOURce<hw>]:LIST:DWELl:MODE 511
[:SOURce<hw>]:LIST:DWELl:LIST 511
[:SOURce<hw>]:LIST:DWELl:LIST:POINts? 512
[:SOURce<hw>]:LIST:FREQuency 512
[:SOURce<hw>]:LIST:FREQuency:POINts? 513
[:SOURce<hw>]:LIST:INDex 513
[:SOURce<hw>]:LIST:INDex:STARt 513
[:SOURce<hw>]:LIST:INDex:STOP 513

[:SOURce<hw>]:LIST:MODE....513
[:SOURce<hw>]:LIST:POWer....514
[:SOURce<hw>]:LIST:POWer:POINts?....514
[:SOURce<hw>]:LIST:TRIGger:EXECute....515
[:SOURce<hw>]:LIST:TRIGger:SOURce....515
[:SOURce<hw>]:LIST:RUNNing?....516

[: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 508.

Manual operation: See "Global Dwell Time" on page 162

[: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 508.

Manual operation: See "Dwell Time Mode" on page 161

[: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 412 for more details.

Example: See Example "Create an RF list and activate the list mode" on page 508.

Manual operation: See "Dwell Time (s)" on page 167

[:SOURce<hw>]:LIST:DWELI: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 508.

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 508.

Manual operation: See "Frequency (Hz)" on page 167

[: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 508.

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 508.

Manual operation: See "Current Index" on page 161

[: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 frequency/level value pairs in the current list.

Parameters:

<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 508.

Manual operation: See "List Range from/to" on page 163

[: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` for the description of the trigger source settings.

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.

*RST: AUTO

Example: See Example "Create an RF list and activate the list mode" on page 508.

Manual operation: See "Mode" on page 161

[: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 508.

Manual operation: See "Power (dBm)" on page 167

[: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 508.

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 508.

Usage: Event

Manual operation: See "Execute Single" on page 162

[:SOURce<hw>]:LIST:TRIGger:SOURce <Source>

Selects the trigger source for processing lists.

The designation of the parameters correspond to those in sweep mode. SCPI standard uses other designations for the parameters, which are also accepted by the instrument. The SCPI designation should be used if compatibility is an important consideration. For an overview, see the following table:

Rohde & Schwarz parameter	SCPI parameter	Applies to the list mode parameters:
AUTO	IMMediate	[:SOURce<hw>]:LIST:MODE AUTO
SINGle	BUS	[:SOURce<hw>]:LIST:MODE AUTO or [:SOURce<hw>]:LIST:MODE STEP
EXTernal	EXTernal	[:SOURce<hw>]:LIST:MODE AUTO or [:SOURce<hw>]:LIST:MODE STEP

Parameters:

<Source> AUTO | IMMediate | SINGle | BUS | EXTernal

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 508.

Manual operation: See "Mode" on page 161

[:SOURce<hw>]:LIST:RUNNing?

Queries the current state of the list mode.

Return values:

<State> 1 | ON | 0 | OFF

1
Signal generation based on the list mode is active.

Example: See Example "Create an RF list and activate the list mode" on page 508.

Usage: Query only

13.16.7.2 List mode file operation

The following section covers basic commands to file handling in list mode.

[:SOURce<hw>]:LIST:CATalog? 516
[:SOURce<hw>]:LIST:DELete 516
[:SOURce<hw>]:LIST:DELete:ALL 517
[:SOURce<hw>]:LIST:FREE? 517
[:SOURce<hw>]:LIST:RESet 517
[:SOURce<hw>]:LIST:SELect 518

[: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 508.

Usage: Query only

Manual operation: See "List Mode Data" on page 163

[: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 517.

Usage: Setting only

Manual operation: See "List Mode Data" on page 163

[: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 163

[: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 508.

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 508.

Usage: Event

Manual operation: See "Reset" on page 162

[: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 508.

Manual operation: See "List Mode Data" on page 163
See "Functions for handling of data lists" on page 236

13.16.7.3 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? 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect 519
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn 519
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal 519
[:SOURce<hw>]:LIST:DEXChange:EXECute 519
[:SOURce<hw>]:LIST:DEXChange:MODE 520
[:SOURce<hw>]:LIST:DEXChange:SELect 520

[: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 510.

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 97

[: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 510.

Manual operation: See "ASCII File Settings" on page 96

[: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 510.

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 97

[: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 510.

Manual operation: See "ASCII File Settings" on page 96

[: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 510.

Manual operation: See "ASCII File Settings" on page 96

[: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 510.

Usage: Event

Manual operation: See "Import / Export" on page 97

[: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 510.

Manual operation: See "Mode" on page 96

[: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 510.

Manual operation: See "Select Source/Select ASCII Destination" on page 97

13.16.8 SOURce:NOISe subsystem

The `SOURce:NOISe` subsystem contains the commands for:

- Setting the noise modulation signal. The noise generator is optional.

Example: To configure the noise generator

```
:SOURce1:NOISe:DISTribution GAUSs
:SOURce1:NOISe:BANDwidth 10000000

:SOURce1:LFOutput1:SOURce NOIS
:SOURce1:LFOutput1:STATe 1

:SOURce1:NOISe:LEVel:RELative?
// Response in dB: -83.86
:SOURce1:NOISe:LEVel:ABSolute?
// Response in dB: -13.86
```

- Noise generator.....521

13.16.8.1 Noise generator

[:SOURce<hw>]:NOISe:BANDwidth|BWIDth....521
[:SOURce<hw>]:NOISe:DISTribution....521
[:SOURce<hw>]:NOISe:LEVel:RELative?....521
[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?....521

[: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 "To configure the noise generator" on page 520.

Manual operation: See "Bandwidth" on page 106

[:SOURce<hw>]:NOISe:DISTribution <Distribution>

Sets the distribution of the noise power density.

Parameters:

<Distribution> GAUSs | EQUal

*RST: GAUSs

Example: See Example "To configure the noise generator" on page 520.

Manual operation: See "Distribution" on page 106

[: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 "To configure the noise generator" on page 520.

Usage: Query only

Manual operation: See "Noise Density" on page 109

[: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 "To configure the noise generator" on page 520.

Usage: Query only

Manual operation: See "Noise Level" on page 109

13.16.9 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 522
[:SOURce<hw>]:PGENerator:OUTPut[:STATe] 523
[:SOURce<hw>]:PGENerator:STATe 523

[: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 during 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 modulation" on page 522.

Manual operation: See "Pulse Output Polarity" on page 91

[:SOURce<hw>]:PGENerator:OUTPut[:STATe] <State>

Activates the output of the pulse modulation signal.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Using pulse generator as source for pulse modulation" on page 522.

Manual operation: See "Pulse Output State" on page 90

[: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> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Using pulse generator as source for pulse modulation" on page 522.

13.16.10 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 524
[:SOURce<hw>]:PHASe:REFerence 524

[:SOURce<hw>]:PHASe <Phase>

Sets the phase variation relative to the current phase.

Parameters:

<Phase> float

Range: -36000 to 36000
Increment: 0.001
*RST: 0
Default unit: DEG

Example: See Example "Programming Example" on page 523.

Manual operation: See "Delta Phase" on page 66

[:SOURce<hw>]:PHASe:REFerence

Assigns the value set with command `[:SOURce<hw>]:PHASe` as the reference phase.

Example: See Example "Programming Example" on page 523.

Usage: Event

Manual operation: See "Reset Delta Phase Display" on page 66

13.16.11 SOURce:POWer subsystem

The `SOURce:POWer` subsystem contains the commands for setting the output level, level control and level correction of the RF signal.

The default units are dBm. To change the units, perform one of the following:

- Enter the unit after the numerical value
  Example: `:POW 0.5V`
- Set the unit with the command `:UNIT:POWer`.

Example: Configuring the RF output power

```
:SOURce1:POWer;CW?
// Response -30
:SOURce1:POWer:CW -25
:SOURce1:POWer:OFFSet?
// Response 0
:SOURce1:POWer:OFFSet 2

:SOURce1:POWer:STEP:MODE?
// Response: DEC
:SOURce1:POWer:STEP:MODE USER
:SOURce1:POWer:STEP:INCRement 2
:SOURce1:POWer:LEVel:IMMediate:AMPLitude UP
```

Example: Configure the settings for NRP power control

The example shows a command sequence to configure a closed loop power control setup.

It is assumed that you have set up the measurement with the amplifier, external coupler, the power sensor and the R&S SMB100B as described in Section 8.4.4, "NRP power control", on page 193.

```
// Reset the instrument to start from an initial state
*RST; *CLS

// Select the sensor used for nrp power control
// that is e.g., connected to a second USB interface

:SOURce1:POWer:SPC:SELect SENS2

// Configure the nrp power control settings
// use the measured peak power for power control
// set the unit dBm for the target level value
// set the target level, e.g. - 10 dBmM
// use the measured target level as reference level
// select single measurement mode to acquire one level value
// set the capture range for the control loop, e.g.  +/- 15 dB
// set a time delay between the sensor readings, e.g. 2 ms

:SOURce1:POWer:SPC:PEAK ON
:SENSe1:UNIT:POWer DMB
:SOURce1:POWer:SPC:TARGet -10
:SOURce1:POWer:SPC:MEASure
:SOURce1:POWer:SPC:MODE SINGle
:SOURce1:POWer:SPC:CRANge 15
:SOURce1:POWer:SPC:DELay 2 ms

// Enable NRP power control measurement
// switch on RF output
// start the single measurement manually

:Output1:STATe 1
:SOURce1:POWer:SPC:STATe ON
:SOURce1:POWer:SPC:SINGle

// Query if the power control works properly
:SOURce1:POWer:SPC:WARNing?
// Response: 1 -> power conrol doew not work as expected
```

Example: Configuring level attenuator

```
SOURce1:POWer:ATTenuation 20dB
// set the level attenuation manually

SOURce1:POWer:ATTuation:RFOF:MODE FATTenuation
// set maximum attenuation when the RF output is turned off

SOURce:POWer:ATTenuation:VSWR?
// query the level value of the VSWR output

SOURce1:POWer:AATTenuation?
// query the currently active attenuation
// Response: 100

SOURce1:POWer:ATTenuation:DIGital 7.2
```

Example: Setting a digital attenuation

```
SOURce1:POWer:ATTenuation:DIGital 7.2
// set an attenuation for the baseband signal.
```

[:SOURce<hw>]:POWer:ALC[:STATe] ... 527
[:SOURce<hw>]:POWer:ALC:DSENsitivity ... 527
[:SOURce<hw>]:POWer:ALC:SONCe ... 528
[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE ... 528
[:SOURce<hw>]:POWer:EMF:STATe ... 528
[:SOURce<hw>]:POWer:LBEHaviour ... 529
[:SOURce<hw>]:POWer:LIMit[:AMPLitude] ... 529
[:SOURce<hw>]:POWer:MANual ... 529
[:SOURce<hw>]:POWer:MODE ... 530
[:SOURce<hw>]:POWer:POWer ... 530
[:SOURce<hw>]:POWer:STARt ... 531
[:SOURce<hw>]:POWer:STOP ... 531
[:SOURce<hw>]:POWer:SPC:CRANge ... 531
[:SOURce<hw>]:POWer:SPC:DELay ... 531
[:SOURce<hw>]:POWer:SPC:MEASure ... 532
[:SOURce<hw>]:POWer:SPC:MODE ... 532
[:SOURce<hw>]:POWer:SPC:PEAK ... 532
[:SOURce<hw>]:POWer:SPC:SELect ... 532
[:SOURce<hw>]:POWer:SPC:SINGle ... 533
[:SOURce<hw>]:POWer:SPC:STATe ... 533
[:SOURce<hw>]:POWer:SPC:TARGet ... 533
[:SOURce<hw>]:POWer:SPC:WARNing? ... 533
[:SOURce<hw>]:POWer:STEP:MODE ... 534
[:SOURce<hw>]:POWer:STEP[:INCRement] ... 534
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet ... 535

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL 535
[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] 535
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:REFLevel 536
[:SOURce<hw>]:POWer:RANGe:LOWer? 536
[:SOURce<hw>]:POWer:RANGe:UPPer? 536
[:SOURce]:POWer:WIGNore 537

[: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
R&S SMB100B RF instruments only
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 175

[: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 176

[: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 65

[: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 173

[:SOURce<hw>]:POWer:EMF:STATe <State>

Displays the signal level as voltage of the EMF. The displayed value represents the voltage over a 50 Ohm load.

Parameters:
<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 0)

Example: `POW:EMF:STAT 1`
Activates voltage level display.

Manual operation: See "Display Level as Voltage of EMF" on page 258

[: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 64

[: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 63

[: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 "Setting up an RF frequency or power sweep" on page 544

Manual operation: See "Current Level" on page 151

[: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 "Setting up an RF frequency or power sweep" on page 544

Manual operation: See "State (RF level sweep)" on page 150
See "State (RF frequency / level sweep)" on page 151

[: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 58.

Parameters:

<Power> float

Level at the RF output, without level offset

Range: See specifications document.
Increment: 0.01
Default unit: dBm

Example:
```
SOURce1:POWer:POWer 15
// sets the level at the RF output.
```

Manual operation: See "Amplitude" on page 63
See "Generator Settings used for Measurement" on page 186

[: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 Example "Setting up an RF frequency or power sweep" on page 544

Manual operation: See "Start Level / Stop Level" on page 158

[:SOURce<hw>]:POWer:SPC:CRANge <PowCntrlCRange>

Defines the capture range of the power control system.

Within the range:

Target Level +/- Catch Range

the power control locks and tries to achieve the target level. Readings outside the range are not considered.

Parameters:

<PowCntrlCRange> float

Range: 0 to 50
Increment: 0.01
*RST: 30

Example: See Example "Configure the settings for NRP power control" on page 525

Manual operation: See "Catch Range +/-" on page 197

[:SOURce<hw>]:POWer:SPC:DELay <PowCntrlDelay>

Sets a waiting time for the generator to adjust the output level. After the delay time has elapsed, the power sensor measures the next value.

Parameters:

<PowCntrlDelay> integer

Range: 0 to 1000
*RST: 0

Example: See Example "Configure the settings for NRP power control" on page 525

Manual operation: See "Delay Time" on page 197

[:SOURce<hw>]:POWer:SPC:MEASure

Sets the measured power value as reference level.

Example: See Example "Configure the settings for NRP power control" on page 525

Usage: Event

Manual operation: See "Take Measurement as Target Level" on page 196

[:SOURce<hw>]:POWer:SPC:MODE <ControlMode>

Selects the measurement mode for the power sensor.

Parameters:

<ControlMode> AUTO | SINGle

AUTO
Measures the level values continuously.

SINGle
Executes one measurement, triggered by the command `[:SOURce<hw>]:POWer:SPC:SINGle` on page 533.

*RST: AUTO

Example: See Example "Configure the settings for NRP power control" on page 525

Manual operation: See "Mode" on page 196

[:SOURce<hw>]:POWer:SPC:PEAK <PowCntrlPeak>

Activates power control by means of the peak power values, provided the power sensor supports this function.

Parameters:

<PowCntrlPeak> 1 | ON | 0 | OFF

*RST: 0

Example: See Example "Configure the settings for NRP power control" on page 525

[:SOURce<hw>]:POWer:SPC:SELect <PowCntrlSelect>

Selects the power sensor used for power control.

Parameters:

<PowCntrlSelect> SENS1 | SENS2 | SENS3 | SENS4 | SENSor1 | SENSor2 | SENSor3 | SENSor4

*RST: SENS1

Example: See Example "Configure the settings for NRP power control" on page 525

Manual operation: See "Sensor" on page 196

[:SOURce<hw>]:POWer:SPC:SINGle

Triggers the power sensor to measure the power value once.

Usage: Event

Manual operation: See "Execute Single" on page 196

[:SOURce<hw>]:POWer:SPC:STATe <PowCntrlState>

Starts power control using the selected sensor. The control loop periodically adjusts the output level of the signal generator. After switching off, the running loop is completed.

Parameters:

<PowCntrlState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example "Configure the settings for NRP power control" on page 525

Manual operation: See "State" on page 195

[:SOURce<hw>]:POWer:SPC:TARGet <PowCntrlTarget>

Sets the target level required at the DUT. To define the unit of the power value, use command `:UNIT:POWer` on page 596.

Parameters:

<PowCntrlTarget> float

Range: -50 to 30
Increment: 0.01
*RST: -10

Example: See Example "Configure the settings for NRP power control" on page 525

Manual operation: See "Target Level" on page 196

[:SOURce<hw>]:POWer:SPC:WARNing?

Queries if the activated power control works properly.

If the power control does not work, the query returns warning state 1. On the screen, the R&S SMB100B indicates a warning icon.

Return values:
<WarningState> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Configure the settings for NRP power control" on page 525.

Usage: Query only

[:SOURce<hw>]:POWer:STEP:MODE <Mode>

Defines the type of step width to vary the RF output power step-by-step with the commands `POW UP or POW DOWN`.

Parameters:
<Mode> DECimal | USER

DECimal
Increases or decreases the level in steps of ten.

USER
Increases or decreases the level in increments, determined with the command `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

*RST: DECimal

Example: See Example "Configuring the RF output power" on page 524.

Manual operation: See "Variation Active" on page 61

[: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 Example "Configuring the RF output power" on page 524.

Manual operation: See "Variation Step" on page 61

[: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 58.

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
See "Generator Settings used for Measurement" on page 186

[: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 232

[: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` on page 530
- `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 534.

Manual operation: See "Amplitude" on page 63

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:REFLevel <ReferenceLevel>

Queries the reference level of the user correction.

The reference level is the sum of the amplitude and the level offset, set with the commands `[:SOURce<hw>]:POWer:POWer [:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet`.

Parameters:

<ReferenceLevel> float

Range: -245 to 120
Increment: 0.01
*RST: -30

Manual operation: See "Generator Settings used for Measurement" on page 186

[: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> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 0)

Example:

```
SOURce:POWer:WIGNore 1
```

13.16.12 SOURce:ROSCillator subsystem

The `SOURce:ROSCillator` subsystem contains the commands for setting the external and internal reference frequency.

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 through) 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

// query calibration value
CALibration:ROSCillator:DATA?
// 32767
// change the calibration value
CALibration:ROSCillator:DATA 20000
SOURce:ROSCillator:INTernal:ADJust:VALue?
// 13767
// i.e. CalValue_Def - CalValue_User = 32767 - 20000 = 13767

SOURce:ROSCillator:INTernal:ADJust:VALue 0
CALibration:ROSCillator:DATA?
// 20000
// user-defined adjustment value is 0
// i.e. user-defined adjustment is acivated
// but the calibration value is used
// and the calibration value is the user-defined value
*RST
SOURce:ROSCillator:INTernal:ADJust:VALue?
```

```
// -12767
// user-defined adjustment value is not affected by preset
// the adjustment value is calculated as
// - (CalValue_Def - CalValue_User - AdjValue_User)
CALibration:ROSCillator:DATA?
// 32767
// calibration value is preset

// to resume calibrated state
SOURce:ROSCillator:INTernal:ADJust:VALue 0
SOURce:ROSCillator:INTernal:ADJust:STATe 0
// or
// SYSTem:FPRest
```

[:SOURce]:ROSCillator:PRESet 539
[:SOURce]:ROSCillator:SOURce 539
[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] 540
[:SOURce]:ROSCillator:EXTernal:FREQuency 540
[:SOURce]:ROSCillator:EXTernal:FREQuency:VARiable 540
[:SOURce]:ROSCillator:EXTernal:SBANdwidth 540
[:SOURce]:ROSCillator:EXTernal:MLRange? 541
[:SOURce]:ROSCillator:EXTernal:NSBandwidth? 541
[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE 541
[:SOURce]:ROSCillator:OUTPut:ALTernate:FREQuency:MODE 542
[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue 542
[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] 543

[:SOURce]:ROSCillator:PRESet

Resets the reference oscillator settings.

Example: See Example "Configuring the reference oscillator" on page 538.

Usage: Event

Manual operation: See "Set to Default" on page 213

[: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 538.

Manual operation: See "Source" on page 213

[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] <State>

Determines that the RF output is turned off when the external reference signal is selected, but missing.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: n.a. (factory preset: 0)

Example: See Example "Configuring the reference oscillator" on page 538.

Manual operation: See "Deactivate RF Output (if external reference is missing)" on page 213

[: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 538.

Options: VARiable requires R&S SMBB-K704
1GHZ requires R&S SMBB-B3

Manual operation: See "External Reference Frequency" on page 213

[: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 538.

Options: R&S SMBB-K704

Manual operation: See "Variable Reference Frequency" on page 214

[:SOURce]:ROSCillator:EXTernal:SBANdwidth <SBandwidth>

Selects the synchronization bandwidth for the external reference signal.

Depending on the RF hardware version and the installed options, the synchronization bandwidth varies.

For more information, refer to the specifications document.

Parameters:

<SBandwidth> WIDE | NARRow

NARRow
The synchronization bandwidth is a few Hz.

WIDE
Uses the widest possible synchronization bandwidth.

*RST: n.a. (factory preset: WIDE)

Example: See Example "Configuring the reference oscillator" on page 538.

Manual operation: See "Synchronization Bandwidth" on page 214

[:SOURce]:ROSCillator:EXTernal:MLRange?

Queries the minimum locking range for the selected external reference frequency.

Depending on the RF hardware version, and the installed options, the minimum locking range vaies.

For more information, refer to the specifications document.

Return values:

<MinLockRange> string

Example: `SOUR:ROSC:EXT:MLR?`

Usage: Query only

Manual operation: See "Minimum Locking Range" on page 214

[: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 214

[: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 setting 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 538.

Manual operation: See "Reference Output/1 GHz Reference Output" on page 215

[: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 538.

Options: DER1G requires R&S SMBB-B3

Manual operation: See "Reference Output/1 GHz Reference Output" on page 215

[: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 543

Manual operation: See "Adjustment Value" on page 216

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] <State>

Determines whether the calibrated (off) or a user-defined (on) **adjustment value** is used for fine adjustment of the frequency.

Parameters:

<State> 1 | ON | 0 | OFF

0
Fine adjustment with the calibrated frequency value

1
User-defined adjustment value.
The instrument is no longer in the calibrated state.
The calibration value is, however, not changed. The instrument resumes the calibrated state if you send `SOURce:ROSCillator:INTernal:ADJust:STATe 0`.

*RST: n.a. (factory preset: 0)

Example: See Example "Configuring the reference oscillator" on page 538.

Manual operation: See "Adjustment Active" on page 216

13.16.13 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))
  - RF combined sweep: `SOURce:FREQuency:MODE SWEep` (`SOURce:FREQuency:MODE CW` (off)
- All sweeps, including the LF sweep, can be set independently of each other.
- All sweeps can be set independently of each other.

See Section 7.1, "Signal generation and triggering in the sweep and list modes", on page 135.

Example: Setting up 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
// Select sweep mode
SOURce:FREquency:MODe SWEep

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

// Initiate an LF frequency sweep
TRIGger1:FSWeep:SOURce SINGle
SOURce1:SWEep:FREQuency:MODE AUTO
TRIGger:LFFSweep

// 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
// Set the frequency range
SOURce1:FREQuency:STARt 50 MHz
SOURce1:FREQuency:STOP 350 MHz
SOURce1:FREQuency:MANual 30 MHz
// 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
// Set 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

// Trigger an enabled sweep immediately
TRIGger1:FSWeep:SOURce SINGle
SOURce1:SWEep:FREQuency:MODE AUTO
TRIGger<hw>[:SWEep][:IMMediate]


// Query the interruption-free level range
SOURce1:POWer:RANGe:LOWer?
// Response: -50
SOURce1:POWer:RANGe:UPPer?
// Response: -15


// Activate a combined RF frequency / level sweep
*RST; *CLS
*RST; *CLS
SYSTem:DISPlay:UPDate OFF
TRIGger1:FSWeep:SOURce SINGle
SOURce1:SWEep:COMBined:MODE AUTO
SOURce1:SWEep:COMBined:COUNt 200
SOURce1:FREQuency:STARt 1000000000 Hz
SOURce1:FREQuency:STOP 5000000000 Hz
```

```
SOURce1:POWer:STARt -30 dBm
SOURce1:POWer:STOP -10 dBm
SOURce1:SWEep:COMBined:RETRace 1
SOURce1:SWEep:COMBined:SHAPe SAWT
SOURce1:SWEep:COMBined:DWELl 0.01
// Activate combined RF frequency/level sweep
SOURce1:FREQuency:MODe COMB
// Activate RF Output1.
Output1:STATe 1
// Execute combined frequency / level sweep
SOURce1:SWEep:COMBined:EXECute
```

[:SOURce<hw>]:SWEep:POWer:DWELl....546
[:SOURce<hw>]:SWEep:POWer:MODE....547
[:SOURce<hw>]:SWEep:POWer:POINts....547
[:SOURce<hw>]:SWEep:POWer:SPACing:MODE?....548
[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic]....548
[:SOURce<hw>]:SWEep[:FREQuency]:DWELl....548
[:SOURce<hw>]:SWEep[:FREQuency]:MODE....549
[:SOURce<hw>]:SWEep[:FREQuency]:POINts....549
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing....549
[:SOURce<hw>]:SWEep:POWer:SHAPe....550
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe....550
[:SOURce<hw>]:SWEep:POWer:EXECute....550
[:SOURce<hw>]:SWEep[:FREQuency]:EXECute....550
[:SOURce<hw>]:SWEep:POWer:RETRace....550
[:SOURce<hw>]:SWEep[:FREQuency]:RETRace....550
[:SOURce<hw>]:SWEep:POWer:RUNNing?....551
[:SOURce<hw>]:SWEep[:FREQuency]:RUNNing?....551
[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic....551
[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]....551
[:SOURce<hw>]:COMBined:FREQuency:STARt....552
[:SOURce<hw>]:COMBined:FREQuency:STOP....552
[:SOURce<hw>]:COMBined:POWer:STARt....552
[:SOURce<hw>]:COMBined:POWer:STOP....553
[:SOURce<hw>]:SWEep:COMBined:COUNt....553
[:SOURce<hw>]:SWEep:COMBined:DWELl....553
[:SOURce<hw>]:SWEep:COMBined:EXECute....553
[:SOURce<hw>]:SWEep:COMBined:MODE....554
[:SOURce<hw>]:SWEep:COMBined:RETRace....554
[:SOURce<hw>]:SWEep:COMBined:SHAPe....555
[:SOURce<hw>]:SWEep:RESet[:ALL]....555

[: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 "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Dwell Time" on page 154

[: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 "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Mode" on page 151

[:SOURce<hw>]:SWEep:POWer:POINts <Points>

Sets the number of steps within the RF level sweep range.

Parameters:

<Points> integer

Range: 2 to Max

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

[: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.

Parameters:

<Logarithmic> float

The unit `dB` is mandatory.

Range: 0.01 to 139
Increment: 0.01
*RST: 1
Default unit: dB

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Step" on page 158

[: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 "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Dwell Time" on page 154

[: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 "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Mode" on page 151

[:SOURce<hw>]:SWEep[:FREQuency]:POINts <Points>

Sets the number of steps within the RF frequency sweep range.

Two separate `POINts` values are used for linear or logarithmic sweep spacing. This command always affects the currently set sweep spacing that you can set via the following command:

`:SOURce<hw>:SWEep:FREQuency:SPACing LINear|LOGarithmic`

Parameters:

<Points> integer

Range: 2 to Max

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

[: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 "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Spacing" on page 154

[: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 "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Shape" on page 152

[: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 "Setting up an RF frequency or power sweep" on page 544.

Usage: Event

Manual operation: See "Execute Single Sweep" on page 155

[: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> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Retrace" on page 152

[:SOURce<hw>]:SWEep:POWer:RUNNing?
[:SOURce<hw>]:SWEep[:FREQuency]:RUNNing?

Queries the current sweep state.

Return values:
<State> 1 | ON | 0 | OFF

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

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.

Parameters:
<Logarithmic> float
The unit is mandatory.
Range: 0.01 to 100
Increment: 1E-3
*RST: 1
Default unit: PCT

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Step Linear/Step Logarithmic" on page 157

[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step width for linear sweeps.

Parameters:
<Linear> float
Range: 0.001 Hz to (STOP - STARt)
Increment: 0.01

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Step Linear/Step Logarithmic" on page 157

[:SOURce<hw>]:COMBined:FREQuency:STARt <CombFreqStart>

Sets the start frequency of the combined RF sweep.

Parameters:

<CombFreqStart> float

Range: -59999E5 to 12E9
Increment: 0.01
*RST: 100E6

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Start Frequency/Stop Frequency" on page 156

[:SOURce<hw>]:COMBined:FREQuency:STOP <CombFreqStop>

Sets the end frequency of the combined RF frequency / level sweep.

Parameters:

<CombFreqStop> float

Range: -59999E5 to 12E9
Increment: 0.01
*RST: 500E6

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Start Frequency/Stop Frequency" on page 156

[:SOURce<hw>]:COMBined:POWer:STARt <CombPowStart>

Sets the start level value of the combined RF sweep.

Parameters:

<CombPowStart> float

Range: -245 to 120
Increment: 0.01
*RST: -30

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Start Level / Stop Level" on page 158

[:SOURce<hw>]:COMBined:POWer:STOP <CombPowStop>

Sets the stop level value of the combined RF frequency / level sweep.

Parameters:

<CombPowStop> float

Range: -245 to 120
Increment: 0.01
*RST: -10

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Start Level / Stop Level" on page 158

[:SOURce<hw>]:SWEep:COMBined:COUNt <StepCount>

Defines the number of sweeps you want to execute.

This parameter applies to `[:SOURce<hw>]:SWEep:COMBined:MODE > SINGle`. To start the sweep signal generation, use the command `[:SOURce<hw>]:SWEep:COMBined:EXECute` on page 553.

Parameters:

<StepCount> integer

Range: 1 to SeMAX_INT_STEP-1
*RST: 501

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Step Count" on page 158

[:SOURce<hw>]:SWEep:COMBined:DWELl <Dwell>

Sets the dwell time for the combined frequency / level sweep.

Parameters:

<Dwell> float

Range: 0.01 to 100
Increment: 100E-6
*RST: 0.01

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Dwell Time" on page 154

[:SOURce<hw>]:SWEep:COMBined:EXECute

Executes an RF frequency / level sweep cycle.

The command triggers one single sweep manually. Therefore, you can use it in manual sweep mode, selected with the command `[:SOURce<hw>]:SWEep:COMBined:MODE > MANual`.

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Usage: Event

Manual operation: See "Execute Single Sweep" on page 155

[:SOURce<hw>]:SWEep:COMBined:MODE <SweepCombMode>

Sets the cycle mode for the combined frequency / level sweep.

Parameters:

<SweepCombMode> 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 commands `[:SOURce<hw>]:FREQuency:MANual` and `[:SOURce<hw>]:POWer:MANual`.

STEP
Each trigger event triggers one sweep step.

*RST: AUTO

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Mode" on page 151

[:SOURce<hw>]:SWEep:COMBined:RETRace <RetraceState>

Activates that the signal changes to the start level 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:

<RetraceState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Retrace" on page 152

[:SOURce<hw>]:SWEep:COMBined:SHAPe <Shape>

Selects the waveform shape for the combined frequency / level sweep sequence.

Parameters:

<Shape> SAWTooth | TRIangle

*RST: SAWTooth

Example: See Example "Setting up an RF frequency or power sweep" on page 544.

Manual operation: See "Shape" on page 152

[:SOURce<hw>]:SWEep:RESet[:ALL]

Resets all active sweeps to the starting point.

Usage: Event

Manual operation: See "Reset Sweep" on page 155

13.17 SYSTem subsystem

The SYSTem subsystem contains a series of commands for general functions which do not directly affect signal generation.

Example: To check the instrument specifications

```
// Check information on specifications document versions.
// Query all versions saved on the instrument:
:SYSTem:SPECification:VERSion:CATalog?
"04.03,04.02,04.01,04.00,03.04,03.03,03.02,03.01,03.00,02.96,02.95,02.94,
02.02,02.01,02.00,01.03,01.02,01.01,01.00"

// Query the initial version of your delivery.
:SYSTem:SPECification:VERSion:FACTory?
// Response: "04.00"

// Select a specific version:
:SYSTem:SPECification:VERSion "04.01"

// Check information of a particular specifications document.
// Query the IDs of all parameters listed in the selected version:
:SYSTem:SPECification:VERSion "04.03"
:SYSTem:SPECification:IDENtification:CATalog?
"ID_RF_FREQ_SETTING_TIME_ALC_ON_MS,ID_RF_FREQ_SETTING_TIME_MS,..."

// Query specification information on a specific parameter by its ID.
:SYSTem:SPECification? "ID_RF_FREQ_SETTING_TIME_ALC_ON_MS"
// Returns the specified value of the parameter.
```

Example: To check network-related settings

```
:SYSTem:COMMunicate:NETWork:STATus?
// Response: "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?
// Response: "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: To restart the network

```
:SYSTem:COMMunicate:NETWork:RESTart
// terminates the network connection and sets it up again
```

Example: To find out VISA resource strings

```
:SYSTem:COMMunicate:NETWork:RESource?
// Response: "TCPIP::10.113.0.104::inst0::INSTR"

:SYSTem:COMMunicate:HISLip:RESource?
// Response: "TCPIP::10.113.0.104::hislip0::INSTR"

:SYSTem:COMMunicate:SOCKet:RESource?
// Response: "TCPIP::10.113.0.104::5025::SOCKET"

:SYSTem:COMMunicate:USB:RESource?
// "USB::0x0AAD::0x01DE::100001::INSTR"

:SYSTem:COMMunicate:GPIB:RESource?
// Response: "GPIB::28::INSTR"
:SYSTem:COMMunicate:GPIB:SELF:ADDRess?
// Response: 28
:SYSTem:COMMunicate:GPIB:LTERminator?
// Response: STAN

:SYSTem:COMMunicate:SERial:RESource?
// Response: "ASRL1::INSTR"
:SYSTem:COMMunicate:SERial:SBITs?
// Response: 1
:SYSTem:COMMunicate:SERial:BAUD?
// Response: 115200
:SYSTem:COMMunicate:SERial:PARity?
// Response: NONE
```

Disabling LAN services

► **NOTICE!** Risk of loosing access over LAN. Disabling the LAN interface or the common services "LAN", "SCPI over LAN", "VNC" and "HTTP" locks the remote access to the instrument.

Use the commands in Example "To disable the LAN interface and LAN services" on page 557 to disable or enable the LAN interface and LAN interface services individually.

a) For the first parameter of the command, enter the security password of your instrument.
The default password is 123456.
b) For the second parameter of the command, enter the state: 1 (ON), 0 (OFF)

Example: To disable the LAN interface and LAN services

```
// ******************************************************************************
// Disable the LAN interface.
// ******************************************************************************
SYSTem:SECurity:NETWork:STATe "<password>", 0

// ******************************************************************************
// Disable the LAN services individually.
// ******************************************************************************
SYSTem:SECurity:NETWork:RAW:STATe "<password>", 0
// Disables remote access over raw socket.
SYSTem:SECurity:NETWork:SOE:STATe "<password>", 0
// Disables SCPI over Ethernet/LAN communication.
SYSTem:SECurity:NETWork:VNC:STATe "<password>", 0
// Disables remote access over VNC.
SYSTem:SECurity:NETWork:HTTP:STATe "<password>", 0
// Disables remote access over HTTP.
SYSTem:SECurity:NETWork:RPC:STATe "<password>", 0
// Disables remote access over remote procedure call (RPC).
SYSTem:SECurity:NETWork:SSH:STATe "<password>", 0
// Disables SSH network protocol that is used for service purposes.
SYSTem:SECurity:NETWork:FTP:STATe "<password>", 0
//    Disables FTP for file transfer.
SYSTem:SECurity:NETWork:SMB:STATe "<password>", 0
// Disables shared access over SMB.
SYSTem:SECurity:NETWork:AVAHi:STATe "<password>", 0
// Disables Avahi service for automatic instrument configuration in the network.
SYSTem:SECurity:NETWork:SWUPdate:STATe "<password>", 0
// Disables software updates over LAN.
```

Example: To query the error queue

```
:SYSTem:ERRor:STATic?
// Response: -221,"Settings conflict", 153,"Input voltage out of range", ...
// Returns all static errors that are collected in the error queue.

:SYSTem:ERRor:HISTory:ClEar
// Deletes the history entries.
```

Example: To configure date and time

```
// Query the date and time settings of the instrument.
:SYSTem:DATE?
// Response: 2023,1,16;1
:SYSTem:TIME?
// Response: 18,15,17;1
:SYSTem:TIME:ZONE?
// Response: "";1  //default UTC setting
:SYSTem:TIME:PROTocol?
// Response: "OFF";1
// No protocol selected.
:SYSTem:NTP:STATe?
// Response: 0;1
// NTP is disabled.

// Setting the timezone and NTP time protocol
:SYSTem:TIME:ZONE:CATalog?
// Response: "UTC,leap-seconds.list,leapseconds,Africa/Abidjan,..."
:SYSTem:TIME:ZONE "Europe/Berlin"
// Set the NTP server address.
:SYSTem:NTP:HOST "timesource.net"
:SYSTem:NTP:STATe?
// Response: "1"
// The NTP time server is enabled.
```

Commands:

:SYSTem:ERRor:ALL?....560
:SYSTem:ERRor:CODE:ALL?....561
:SYSTem:ERRor:CODE[:NEXT]?....561
:SYSTem:ERRor:COUNt?....561
:SYSTem:ERRor[:NEXT]?....562
:SYSTem:ERRor:GNEXt?....562
:SYSTem:ERRor:HISTory:CLEar....563
:SYSTem:ERRor:STATic?....563
:SYSTem:DLOCk....563
:SYSTem:KLOCk....563
:SYSTem:NINFormation?....564
:SYSTem:ULOCk....564
:SYSTem:LOCK:OWNer?....565
:SYSTem:LOCK:RELease:ALL....565
:SYSTem:LOCK:REQuest[:EXCLusive]?....565

:SYSTem:SAV....565
:SYSTem:RCL....566
:SYSTem:PROTect<ch>[:STATe]....566
:SYSTem:COMMunicate:GPIB:LTERminator....567
:SYSTem:COMMunicate:GPIB:RESource?....567
:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess....567
:SYSTem:COMMunicate:HISLip:RESource?....567
:SYSTem:COMMunicate:NETWork:IPADdress....568
:SYSTem:COMMunicate:NETWork:IPADdress:MODE....568
:SYSTem:COMMunicate:NETWork:MACaddress....568
:SYSTem:COMMunicate:NETWork:RESource?....568
:SYSTem:COMMunicate:NETWork:RESTart....569
:SYSTem:COMMunicate:NETWork:STATus?....569
:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain....569
:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname....569
:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup....570
:SYSTem:COMMunicate:NETWork[:IPADdress]:DNS....570
:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway....570
:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK....570
:SYSTem:COMMunicate:SERial:BAUD....570
:SYSTem:COMMunicate:SERial:PARity....571
:SYSTem:COMMunicate:SERial:RESource?....571
:SYSTem:COMMunicate:SERial:SBITs....571
:SYSTem:COMMunicate:SOCKet:RESource?....571
:SYSTem:COMMunicate:USB:RESource?....572
:SYSTem:HELP:EXPort....572
:SYSTem:IDENtification....572
:SYSTem:IDENtification:PRESet....572
:SYSTem:IRESponse....573
:SYSTem:ORESponse....573
:SYSTem:LANGuage....573
:SYSTem:INFormation:SCPI....574
:SYSTem:SECurity:NETWork:AVAHi[:STATe]....574
:SYSTem:SECurity:NETWork:FTP[:STATe]....574
:SYSTem:SECurity:NETWork:HTTP[:STATe]....574
:SYSTem:SECurity:NETWork:RAW[:STATe]....575
:SYSTem:SECurity:NETWork:REMSupport[:STATe]....575
:SYSTem:SECurity:NETWork:RPC[:STATe]....575
:SYSTem:SECurity:NETWork:SMB[:STATe]....576
:SYSTem:SECurity:NETWork:SOE[:STATe]....576
:SYSTem:SECurity:NETWork:SSH[:STATe]....576
:SYSTem:SECurity:NETWork:SWUPdate[:STATe]....576
:SYSTem:SECurity:NETWork:VNC[:STATe]....577
:SYSTem:SECurity:NETWork[:STATe]....577
:SYSTem:SECurity:SANitize[:STATe]....577
:SYSTem:SECurity:VOLMode[:STATe]....578
:SYSTem:SPECification?....578
:SYSTem:SPECification:VERSion....578
:SYSTem:SPECification:IDENtification:CATalog?....579
:SYSTem:SPECification:PARameter?....579

:SYSTem:SPECification:VERSion:CATalog? 579
:SYSTem:SPECification:VERSion:FACTory? 580
:SYSTem:SRData? 580
:SYSTem:STARtup:COMPlete? 580
:SYSTem:DATE 581
:SYSTem:NTP:HOSTname 581
:SYSTem:NTP:STATe 581
:SYSTem:TIME 581
:SYSTem:TIME:ZONE 582
:SYSTem:TIME:ZONE:CATalog? 582
:SYSTem:TIME:PROTocol 582
:SYSTem:UPTime? 583
:SYSTem:BIOS:VERSion? 583
:SYSTem:VERSion? 583
:SYSTem:OSYStem? 583
:SYSTem:MMEMory:PATH:USER? 584
:SYSTem:DFPRint 584
:SYSTem:REBoot 584
:SYSTem:RESTart 585
:SYSTem:SHUTdown 585
:SYSTem:WAIT 585
:SYSTem:FILes:TEMPorary:DELete 585

:SYSTem:ERRor:ALL?

Queries the error/event queue for all unread items and removes them from the queue.

Return values:

<All> string

Error/event_number,"Error/event_description>[;Device-dependent info]"
A comma separated list of error number and a short description of the error in FIFO order.
If the queue is empty, the response is `0,"No error"`
Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.
Volatile errors are reported once, at the time they appear. Identical errors are reported repeatedly only if the original error has already been retrieved from (and hence not any more present in) the error queue.

Example:

```
SYSTem:ERRor:ALL?
// queries all entries in the error queue.
Response: 0, 'no error'
// no errors have occurred since the error queue was last read out.
```

Usage: Query only

Manual operation: See "Clear History" on page 622

:SYSTem:ERRor:CODE:ALL?

Queries the error numbers of all entries in the error queue and then deletes them.

Return values:

<All> string

Returns the error numbers. To retrieve the entire error text, send the command `:SYSTem:ERRor:ALL?`.

0
"No error", i.e. the error queue is empty

Positive value
Positive error numbers denote device-specific errors

Negative value
Negative error numbers denote error messages defined by SCPI.

Example:

```
SYSTem:ERRor:CODE:ALL?
// queries all entries in the error queue.
Response: 0
// no errors have occurred since the error queue was last read out.
```

Usage: Query only

:SYSTem:ERRor:CODE[:NEXT]?

Queries the error number of the oldest entry in the error queue and then deletes it.

Return values:

<Next> string

Returns the error number. To retrieve the entire error text, send the command `:SYSTem:ERRor:ALL?`.

0
"No error", i.e. the error queue is empty

Positive value
Positive error numbers denote device-specific errors

Negative value
Negative error numbers denote error messages defined by SCPI.

Example:

```
SYSTem:ERRor:CODE:NEXT?
// queries the oldest entry in the error queue.
Response: 0
// no errors have occurred since the error queue was last read out.
```

Usage: Query only

:SYSTem:ERRor:COUNt?

Queries the number of entries in the error queue.

Return values:

<Count> integer

0
The error queue is empty.

Example:
```
SYSTem:ERRor:COUNt?
// queries the number of entries in the error queue.
Response: 1
// one error has occurred since the error queue was last read out.
```

Usage: Query only

:SYSTem:ERRor[:NEXT]?

Queries the error/event queue for the oldest item and removes it from the queue.

Return values:

<Next> string

Error/event_number,"Error/event_description>[;Device-dependent info]"
Error number and a short description of the error.
If the queue is empty, the response is `0,"No error"`
Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.
Volatile errors are reported once, at the time they appear. Identical errors are reported repeatedly only if the original error has already been retrieved from (and hence not any more present in) the error queue.

Example:
```
SYSTem:ERRor:NEXT?
// queries the oldest entry in the error queue.
Response: 0, 'no error'
// no errors have occurred since the error queue was last read out.
```

Usage: Query only

Manual operation: See "Static Notifications/History" on page 621

: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: `SYSTem:ERRor:GNEXt?`
`// queries the next error message from the global error queue.`

Usage: Query only

:SYSTem:ERRor:HISTory:CLEar

Clears the error history.

Example: See Example "To query the error queue" on page 558

Usage: Event

Manual operation: See "Clear History" on page 622

: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 "To query the error queue" on page 558

Usage: Query only

Manual operation: See "Static Notifications/History" on page 621

:SYSTem:DLOCk <DispLockStat>

Disables the manual operation over the display, including the front panel keyboard of the instrument.

Parameters:
<DispLockStat> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 0)

Example: `SYST:DLOC ON`
Activates the display lock. The instrument cannot be operated via the display until it has been enabled with `SYST:DLOC OFF`.

Manual operation: See "User Interface" on page 281
See "Enabling a locked user interface for manual operation" on page 282

:SYSTem:KLOCk <State>

Disables the front panel keyboard of the instrument.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 0)

Example: `SYST:KLOC ON`
Locks the front panel and external controls.
To enable the controls, send `SYST:KLOC OFF`.

Manual operation: See "User Interface" on page 281
See "Enabling a locked user interface for manual operation" on page 282

:SYSTem:NINFormation?

Queries the oldest information message ("Error History > Level > Info") in the error/ event queue.

Return values:
<NextInfo> string

Example: `:SYSTem:NINFormation?`
Queries the oldest entry in the info message queue.
`Response: 90,"Info;=== Instrument startup... ==="`
Information message containing error number 90, that states, that the instrument startup is complete.

Usage: Query only

:SYSTem:ULOCk <SecPassWord>, <Mode>

Locks or unlocks the user interface of the instrument.

Parameters:
<Mode> ENABled | DONLy | DISabled | TOFF | VNConly

ENABled
Unlocks the display, the touchscreen and all controls for the manual operation.

DONLy
Locks the touchscreen and controls for the manual operation of the instrument. The display shows the current settings.

VNConly
Locks the touchscreen and controls for the manual operation, and enables remote operation over VNC. The display shows the current settings.

TOFF
Locks the touchscreen for the manual operation of the instrument. The display shows the current settings.

DISabled
Locks the display, the touchscreen and all controls for the manual operation.

*RST: n.a. (factory preset: ENABled)

Setting parameters:
<SecPassWord> string

Example: `:SYST:ULOC "<password>", DIS`
Activates the user interface lock, including display and controls.

Manual operation: See "User Interface" on page 281
See "Enabling a locked user interface for manual operation" on page 282

:SYSTem:LOCK:OWNer?

Queries the sessions that have locked the instrument currently.

If an exclusive lock is set, the query returns the owner of this exclusive lock, otherwise it returns `NONE`.

Return values:
<Owner> string

Example: `SYST:LOCK:OWN?`
Returns the owner of locking.
Response: `NONE`
The instrument is not locked.

Usage: Query only

:SYSTem:LOCK:RELease:ALL

Revokes the exclusive access to the instrument.

Usage: Setting only

:SYSTem:LOCK:REQuest[:EXCLusive]?

Queries whether a lock for exclusive access to the instrument via ethernet exists. If successful, the query returns a 1, otherwise 0.

Return values:
<Success> integer

Example: `SYST:LOCK:REQ?`
Queries the state of exclusive locking.
Response: `1`
The exclusive locking is active.

Usage: Query only

:SYSTem:SAV <Pathname>

Saves the current R&S SMB100B settings in a file. To deteremine the file name and storage location, enter the directory and file name with the command. According to the file type, the R&S SMB100B assigns the extension (`*.savrcltxt`) automatically.

Setting parameters:
<Pathname> string

Example:
```
SYSTem:SAV "/var/user/temp/Test"
// saves the file "Test.savrcltxt" in the directory /var/user/temp/.
```

Usage: Setting only

:SYSTem:RCL <Pathname>

Selects and uploads a `*.savrcltxt` file with previously saved R&S SMB100B settings from the default or a specified directory.

Setting parameters:
<Pathname> string

Example:
```
SYSTem:RCL "/var/user/temp/Test"
// loads the "Test.savrcltxt" file from the directory /var/user/temp/.
```

Usage: Setting only

:SYSTem:PROTect<ch>[:STATe] <State>[, <Key>]

Activates and deactivates the specified protection level.

Suffix:
<ch> Indicates the protection level.
See also "Protection" on page 277

Parameters:
<State> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 1)

Setting parameters:
<Key> integer
The respective functions are disabled when the protection level is activated. No password is required for activation of a level.
A password must be entered to deactivate the protection level.
The default password for the first level is 123456.
This protection level is required to unlock internal adjustments for example.

Example: To activate protection level:
`SYSTem:PROTect1:STATe 1`
Internal adjustments or hostname cannot be changed.
To unlock protection level 1:
`SYSTem:PROTect1:STATe 0,123456`
Internal adjustments are accessible.

Manual operation: See "Protection Level/Password" on page 283

: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 recommended 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 "To find out VISA resource strings" on page 556.

: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 "To find out VISA resource strings" on page 556.

Usage: Query only

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

Sets the GPIB address.

Parameters:

<Address> integer

Range: 0 to 30
*RST: n.a. (factory preset: 28)

Example: See Example "To find out VISA resource strings" on page 556.

Manual operation: See "GPIB Channel Address" on page 315

: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 "To find out VISA resource strings" on page 556.

Usage: Query only

Manual operation: See "HISLIP" on page 313
See "GPIB" on page 314

: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 "To check network-related settings" on page 556.

Manual operation: See "IP Address" on page 311

: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 "To check network-related settings" on page 556.

Manual operation: See "Address Mode" on page 311

: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 "To check network-related settings" on page 556.

Manual operation: See "MAC Address" on page 312

:SYSTem:COMMunicate:NETWork:RESource?

Queries the visa resource string for Ethernet instruments.

Return values:
<Resource> string

Example: See Example "To find out VISA resource strings" on page 556.

Usage: Query only

Manual operation: See "VXI11" on page 313

:SYSTem:COMMunicate:NETWork:RESTart

Restarts the network.

Example: See Example "To restart the network" on page 556.

Usage: Event

Manual operation: See "Restart Network" on page 310

:SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

Return values:
<State> 1 | ON | 0 | OFF

Example: See Example "To check network-related settings" on page 556.

Usage: Query only

Manual operation: See "Network Status" on page 310

:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain <Domain>

Determines the primary suffix of the network domain.

Parameters:
<Domain> string

Example: See Example "To check network-related settings" on page 556.

Manual operation: See "DNS Suffix" on page 312

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

Sets an individual hostname for the R&S SMB100B.

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 "To check network-related settings" on page 556.

Manual operation: See "Hostname" on page 311

:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup <Workgroup>

Sets an individual workgroup name for the instrument.

Parameters:
<Workgroup> string

Example: See Example "To check network-related settings" on page 556.

Manual operation: See "Workgroup" on page 311

:SYSTem:COMMunicate:NETWork[:IPADdress]:DNS <DNS>

Determines or queries the network DNS server to resolve the name.

Parameters:
<DNS> string

Example: See Example "To check network-related settings" on page 556.

Manual operation: See "DNS Server" on page 312

: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 "To check network-related settings" on page 556.

Manual operation: See "Default Gateway" on page 312

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK <Mask>

Sets the subnet mask.

Parameters:
<Mask> string

Example: See Example "To check network-related settings" on page 556.

Manual operation: See "Subnet Mask" on page 311

: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 "To find out VISA resource strings" on page 556.

Manual operation: See "Baud Rate" on page 315

: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 "To find out VISA resource strings" on page 556.

Manual operation: See "Parity" on page 315

: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 "To find out VISA resource strings" on page 556.

Usage: Query only

Manual operation: See "SERIAL" on page 314

: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 "To find out VISA resource strings" on page 556.

Manual operation: See "Stop Bits" on page 316

: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 "To find out VISA resource strings" on page 556.

Usage: Query only

Manual operation: See "Socket" on page 314

:SYSTem:COMMunicate:USB:RESource?

Queries the visa resource string for remote control via the USB interface.

Return values:
<Resource> string

Example: See Example "To find out VISA resource strings" on page 556.

Usage: Query only

Manual operation: See "USB" on page 314

:SYSTem:HELP:EXPort

Saves the online help as zip archive in the user directory.

Example:
```
:SYSTem:HELP:EXPort
MMEM:CDIR?
// "/var/user"
MMEM:CAT?
// ..,"Log,DIR,4096","help.tgz,BIN,69836600"
// confirms that help zip archive is saved.
```

Usage: Event

Manual operation:: "Setup > Help > Export Help to User Path"

:SYSTem:IDENtification <Identification>

Selects the mode to determine the "IDN String" and the "OPT String" for the instrument, selected with command `:SYSTem:LANGuage`.

Note: While working in an emulation mode, the R&S 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 317

: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 317

: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 317

: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 318

: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 317

:SYSTem:INFormation:SCPI <InfoString>

Inserts system information in recorded SCPI command lists, for example information on a missing command.

Parameters:
<InfoString> string

Example: `SYST:INF:SCPI "missing command"`
enters the information into a recorded SCPI command list.

:SYSTem:SECurity:NETWork:AVAHi[:STATe] <SecPassWord>, <AvahiState>

Disables the Avahi service for automatic configuration of the instrument in a network.

Parameters:
<AvahiState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork:FTP[:STATe] <SecPassWord>, <FtpState>

Disables FTP protocol for file transfer between the instrument and host.

Parameters:
<FtpState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork:HTTP[:STATe] <SecPassWord>, <HttpState>

Disables control of the instrument over HTTP, the protocol for hypermedia information systems.

Parameters:
<HttpState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork:RAW[:STATe] <SecPassWord>, <RawState>

Disables the LAN interface for remote control of the instrument over raw socket port.

Parameters:
<RawState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

:SYSTem:SECurity:NETWork:REMSupport[:STATe] <NetRemSupport>

Disables communication over SSH (SCP) for service purposes.

Parameters:
<NetRemSupport> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 1)

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork:RPC[:STATe] <SecPassWord>, <RpcState>

Enables the LAN interface for remote control of the instrument via remote procedure calls (RPC).

Parameters:
<RpcState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

:SYSTem:SECurity:NETWork:SMB[:STATe] <SecPassWord>, <SmbState>

Disables access to the file system, printers and serial ports in a network over SMB.

Parameters:
<SmbState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork:SOE[:STATe] <SecPassWord>, <SoeState>

Disables control of the instrument over LAN using SCPI commands.

Parameters:
<SoeState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork:SSH[:STATe] <SecPassWord>, <SshState>

Disables control of the instrument over LAN using the SSH network protocol.

Parameters:
<SshState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork:SWUPdate[:STATe] <SecPassWord>, <SwUpdateState>

Disables software update over LAN.

Parameters:
<SwUpdateState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork:VNC[:STATe] <SecPassWord>, <VncState>

Disables the VNC interface for remote control of the instrument.

Parameters:
<VncState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.

Example: See Example "To disable the LAN interface and LAN services" on page 557.

Manual operation: See "LAN Services" on page 285

:SYSTem:SECurity:NETWork[:STATe] <SecPassWord>, <LanStorState>

Disables the LAN interface in general, including all services.

Parameters:
<LanStorState> 1 | ON | 0 | OFF

Setting parameters:
<SecPassWord> string
Current security password.
The default password is 123456.

Example: See Example "To disable the LAN interface and LAN services" on page 557

Manual operation: See "LAN" on page 285

: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 280

: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 279

:SYSTem:SPECification? <Id>

Retrieves data sheet information for a specific parameter.

Setting parameters:
<Id> string
Identifies the name of the entry in the data sheet, as queried with the command `:SYSTem:SPECification:IDENtification:CATalog?` on page 579

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 Section 12.7.4, "Datasheet", on page 339.

Example: See Example "To check the instrument specifications" on page 555.

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 579.

Parameters:
<Version> string

Example: See :SYSTem:SPECification? on page 578.

: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 578.

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 578.

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 578.

Usage: Query only

Manual operation: See "Versions" on page 628

: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> 1 | ON | 0 | OFF
*RST: 0

Example:
```
SYSTem:STARtup:COMPlete?
Response: 1
// the instrument has started and is ready for operation.
```

Usage: Query only

:SYSTem:DATE <Year>, <Month>, <Day>

Queries or sets the date for the instrument-internal calendar.

This is a password-protected function. Unlock the protection level 1 to access it.

Parameters:

<Year> integer

<Month> integer
Range: 1 to 12

<Day> integer
Range: 1 to 31

Example: See Example "To configure date and time" on page 558.

Manual operation: See "Date" on page 638

: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 639

:SYSTem:NTP:STATe <UseNtpState>

Activates clock synchronization via NTP.

Parameters:

<UseNtpState> 1 | ON | 0 | OFF
*RST: n.a. (factory preset: 0)

Example: See Example "To configure date and time" on page 558.

Manual operation: See "NTP Address" on page 639

:SYSTem:TIME <Hour>, <Minute>, <Second>

Queries or sets the time for the instrument-internal clock.

This is a password-protected function. Unlock the protection level 1 to access it.

Parameters:

<Hour> integer
Range: 0 to 23

<Minute> integer
Range: 0 to 59

<Second> integer
Range: 0 to 59

Example: See Example "To configure date and time" on page 558.

Manual operation: See "Time" on page 638

:SYSTem:TIME:ZONE <TimeZone>

Sets the timezone. You can query the list of the available timezones with `:SYSTem:TIME:ZONE:CATalog?`.

Parameters:
<TimeZone> string

Example: See Example "To configure date and time" on page 558.

Manual operation: See "Timezone" on page 639

:SYSTem:TIME:ZONE:CATalog?

Querys the list of available timezones.

Return values:
<Catalog>

Example: See Example "To configure date and time" on page 558.

Usage: Query only

Manual operation: See "Timezone" on page 639

:SYSTem:TIME:PROTocol <TimeProtocol>

Sets the date and time of the operating system.

Parameters:
<TimeProtocol> OFF | NONE | 0 | NTP | ON | 1

NONE
Sets the date and time according to the selected timezone, see `:SYSTem:TIME:ZONE:CATalog?` on page 582 and `:SYSTem:TIME:ZONE` on page 582.

NTP
Sets the date and time derived from the network time protocol. To select the NTP time server, use the commands `:SYSTem:NTP:HOSTname` on page 581 and `:SYSTem:NTP:STATe` on page 581.

*RST: n.a. (factory preset: NONE)

Example: See Example "To configure date and time" on page 558.

Manual operation: See "Time Protocol" on page 639

:SYSTem:UPTime?

Queries the up time of the operating system.

Return values:
<UpTime> "<ddd.hh:mm:ss>"

Example: `SYSTem:UPTime?`
Response: `"0.08:11:00"`

Usage: Query only

:SYSTem:BIOS:VERSion?

Queries the BIOS version of the instrument.

Return values:
<Version> string

Example: `SYST:BIOS:VERS?`
queries the BIOS version.
`Response: 123456`

Usage: Query only

:SYSTem:VERSion?

Queries the SCPI version the instrument's command set complies with.

Return values:
<Version> string

Example:
```
SYSTem:VERSion
// queries the SCPI version.
Response: "1996"
// the instrument complies with the SCPI version from 1996.
```

Usage: Query only

:SYSTem: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:DFPRint <Directory>

Creates a file with the device footprint of the product.

The content is formatted in machine-readable form, suitable for automatic further processing.

The generic file name is composed of `DeviceFootprint_<SerialNumber>_<Date>_<Time>.xml`. R&S SMB100B saves the file in the definable directory. If the directory is not specified, it saves the footprint file in the internal default directory (`/var/lib/Rohde-Schwarz/DeviceFootprint`).

You can download the file by using the SCPI commands of the `MMEMory` subsystem.

Setting parameters:
<Directory> string

Path to the directory for saving the device footprint file.
Ensure that you have the permission to write into the directory.

Return values:
<DeviceFootprint> string

Information on the product type, identification and the installed hardware, software and further service-related information on the product's configuration.

Example:
```
SYSTem:DFPRint "/var/user/devicefootprint"

SYSTem:DFPRint?
// MMEM:DATA?
// returns the device footprint information saved with SYST:DFPRint
```

:SYSTem:REBoot

Reboots the instrument including the operating system.

Usage: Event

:SYSTem:RESTart

Restarts the instrument without restarting the operating system.

Usage: Event

:SYSTem:SHUTdown

Shuts down the instrument.

Usage: Event

Manual operation: See "Shut down" on page 646

: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 Section 11.2.2, "How to assign actions to the [★ (User)] key", on page 264.

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

13.18 STATus subsystem

This system contains the commands for the status reporting system. See also Section 12.4, "Status reporting system", on page 306 for detailed information.

*RST on page 378 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? 586
:STATus:OPERation:ENABle 586
:STATus:OPERation[:EVENt] 587
:STATus:OPERation:NTRansition 587
:STATus:OPERation:PTRansition 587
:STATus:PRESet 587
:STATus:QUEStionable:CONDition 588
:STATus:QUEStionable:ENABle 588
:STATus:QUEStionable[:EVENt] 588
:STATus:QUEStionable:NTRansition 588
:STATus:QUEStionable:PTRansition 589
:STATus:QUEue[:NEXT]? 589

: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] < >

Queries the content of the EVENt part of the STATus:OPERation register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Parameters:
< > string

Example: `:STAT:OPER:EVEN?`
queries the STATus:OPERation:EVENt register.

:STATus:OPERation:NTRansition <Ntransition>

Sets the bits of the NTRansition part of the STATus:OPERation register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register. The disappearance of an event in the hardware is thus registered, for example the end of an adjustment.

Parameters:
<Ntransition> string

Example: `:STAT:OPER:NTR 0`
a transition from 1 to 0 in the condition part of the Status:Operation register does not cause an entry to be made in the EVENt part.

:STATus:OPERation:PTRansition <Ptransition>

Sets the bits of the PTRansition part of the STATus:OPERation register. If a bit is set, a transition from 0 to 1 in the condition part causes an entry to be made in the EVENt part of the register. A new event in the hardware is thus registered, for example the start of an adjustment.

Parameters:
<Ptransition> string

Example: `:STAT:OPER:PTR 32767`
all transitions from 0 to 1 in the condition part of the Status:Operation register cause an entry to be made in the EVENt part.

:STATus:PRESet <Preset>

Resets the status registers. All PTRansition parts are set to FFFFh (32767), i.e. all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e. a transition from 1 to 0 in a CONDition bit is not detected. The ENABle parts of STATus:OPERation and STATus:QUEStionable are set to 0, i.e. all events in these registers are not passed on.

Parameters:
<Preset> string

Example: `STAT:PRES`
resets the status registers.

:STATus:QUEStionable:CONDition <Condition>

Queries the content of the CONDition part of the STATus:QUEStionable register. This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out since it indicates the current hardware status.

Parameters:
<Condition> string

Example: `:STATus:QUEStionable:CONDition?`
queries the Status:Questionable:Condition register.

:STATus:QUEStionable:ENABle <Enable>

Sets the bits of the ENABle part of the STATus:QUEStionable register. The enable part determines which events of the STATus:EVENt part are enabled for the summary bit in the status byte. These events can be used for a service request.

If a bit in the ENABle part is 1, and the correesponding 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] < >

Queries the content of the EVENt part of the `STATus:QUEStionable` register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Parameters:
< > string

Example: `STAT:QUES: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 STATus:QUEStionable register does not cause an entry to be made in the EVENt part

---

:STATus:QUEStionable:PTRansition <PTransition>

Sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register.

Parameters:
<PTransition> string

Example: `STAT:QUES:PTR 32767`
all transitions from 0 to 1 in the condition part of the STATus:QUEStionable register cause an entry to be made in the EVENt part

---

:STATus:QUEue[:NEXT]?

Queries the oldest entry in the error queue and then deletes it. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI. If the error queue is empty, 0 ("No error") is returned.

The command is identical to `:SYSTem:ERRor[:NEXT]?` on page 562.

Return values:
<Next> string

Example: `:STATus:QUEue?`
queries the oldest entry in the error queue.
`Response: 0, 'no error'`
no errors have occurred since the error queue was last read out

Usage: Query only

13.19 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.

Example: Testing the screen display

```
// show the check screen
:TEST:PIXel:WINdow 1
// selct the color for the display, e.g. blue
TEST:PIXel:COLor BLUE
// select the sequence for changing the color automatically
TEST:PIXel:COLor AUTO //(~3s per color)
// select a specific RGB color, e.g. black
TEST:PIXel:RGBA 0,0,0,255
// turn on the gradient
TEST:PIXel:GRADient 1
// switch to text mode
 :TEST:PIXel:TEXT 1
// set the point size of the text
:TEST:PIXel:POINtsize 600
// exit the check screen
:TEST:PIXel:WINdow 0
```

:TEST<hw>:ALL:STARt 590
:TEST<hw>:ALL:RESult? 590
:TEST:PIXel:COLor 590
:TEST:PIXel:GRADient 591
:TEST:PIXel:POINtsize 591
:TEST:PIXel:RGBA 591
:TEST:PIXel:TEXT 591
:TEST:PIXel:WINDow 592

:TEST<hw>:ALL:STARt

Starts the selftest. Use the command `:TEST<hw>:ALL:RESult?` to query the progress of the test.

Usage: Event

:TEST<hw>:ALL:RESult?

Queries the progress of the performed selftest. Start the selftest with `:TEST<hw>:ALL:STARt`.

Return values:

<Result> 0 | 1 | RUNning | STOPped
*RST: STOPped

Usage: Query only

:TEST:PIXel:COLor <PixTestColor>

Selects the color of the screen.

"AUTO" switches from one color to the next in tme intervals of approximately 3 s per color.

Setting parameters:

<PixTestColor> RED | BLUE | WHITe | GREen | AUTO | GR25 | GR50 | GR75 | BLACk

*RST: RED

Example: See Example "Testing the screen display" on page 590.

Usage: Setting only

Manual operation: See "Check Display Screen" on page 644

:TEST:PIXel:GRADient <PixTestGradStat>

Activates the gradient for display screen test.

Parameters:

<PixTestGradStat> 1 | ON | 0 | OFF

*RST: 0

Example: See Example "Testing the screen display" on page 590.

Manual operation: See "Check Display Screen" on page 644

:TEST:PIXel:POINtsize <PixTestGradStat>

Sets the point size of the test text.

Parameters:

<PixTestGradStat> integer

Range: 0 to 999

*RST: n.a. (no preset. default: 0)

Example: See Example "Testing the screen display" on page 590.

Manual operation: See "Check Display Screen" on page 644

:TEST:PIXel:RGBA

Sets a specific RGBA color for the screen.

Example: See Example "Testing the screen display" on page 590.

Manual operation: See "Check Display Screen" on page 644

:TEST:PIXel:TEXT <PixTestGradStat>

Activats the test text mode.

Parameters:
<PixTestGradStat> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Testing the screen display" on page 590.

Manual operation: See "Check Display Screen" on page 644

:TEST:PIXel:WINDow <PixTestWindow>

Activates the check display screen.

Setting parameters:
<PixTestWindow> 1 | ON | 0 | OFF
*RST: 0

Example: See Example "Testing the screen display" on page 590.

Usage: Setting only

Manual operation: See "Check Display Screen" on page 644

13.20 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 13-1: 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.

R&S proprietary value name	SCPI conform value name	Parameter in manual control
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....593
:TRIGger<hw>:LFFSweep:SOURce....593
:TRIGger<hw>:PSWeep:SOURce....593
:TRIGger<hw>[:SWEep]:SOURce....593
:TRIGger<hw>:FPSWeep:SOURce....594
:TRIGger<hw>:FSWeep[:IMMediate]....595
:TRIGger<hw>:LFFSweep:IMMediate....595
:TRIGger<hw>:PSWeep[:IMMediate]....595
:TRIGger<hw>[:SWEep][:IMMediate]....595
:TRIGger<hw>:LFFSweep....595

: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 379
`[: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 "Setting up an RF frequency or power sweep" on page 544

Usage: Setting only

:TRIGger<hw>:FPSWeep:SOURce <FpTrigSource>

Selects the trigger source for the combined RF frequency / level sweep.

The parameter names correspond to the manual control. If needed, see table Table 13-1 for selecting the trigger source with SCPI compliant parameter names.

Parameters:
<FpTrigSource> AUTO | IMMediate | SINGle | BUS | EXTernal | EAUTo

AUTO|IMMediate
Executes the combined RF sweep automatically. In this free-running mode, the trigger condition is met continuously. I.e. as soon as a sweep is completed, the next one starts immediately.

SINGle|BUS
Executes one complete sweep cycle triggered by the GPIB commands `[:SOURce<hw>]:SWEep:COMBined:EXECute` or `*TRG`. The mode has to be set to `[:SOURce<hw>]:SWEep:COMBined:MODE > AUTO`.

EXTernal
An external signal triggers the sweep.

EAUTo
An external signal triggers the sweep. As soon as one sweep is finished, the next sweep starts. A second trigger event stops the sweep at the current frequency and level value pairs, a third trigger event starts the trigger at the start values, and so on.

*RST: No enum range assigned!

Manual operation: See "Mode" on page 151

:TRIGger<hw>:FSWeep[:IMMediate]
:TRIGger<hw>:LFFSweep:IMMediate
:TRIGger<hw>:PSWeep[: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 155

: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

13.21 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....596
:UNIT:POWer....596

: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

13.22 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.

13.22.1 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"
```

13.22.2 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 numbers)

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 contain 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.

14 Troubleshooting and notifications

Handling R&S SMB100B start-up issues

If the product does not start, a blown fuse in the power supply can be the cause. Contact the Rohde & Schwarz customer service to confirm the fault symptoms. If the power supply has a blown fuse, you must return the product to the Rohde & Schwarz customer service to have the power supply replaced. Follow the instructions from the Rohde & Schwarz customer service.

If you need to transport or ship the instrument, see Section 15, "Transporting", on page 632.

Understanding R&S SMB100B notifications

The R&S SMB100B distinguishes between various notifications caused by events or functions. It displays a notification in the "Info" line on the screen temporarily, and saves all notifications in a history list. In addition, an event initiates an entry in the event/error queue of the status reporting system.

See:

- Section 12.4, "Status reporting system", on page 306
- Section 14.4, "Querying notifications", on page 620

14.1 Notifications

Notifications inform about operation states of the instrument, and point out deviations, deficiencies or imperfection of functions that initiate an event in the instrument. The instrument distinguishes the notifications according to the significance of the events by different icons.

Some events require that you eliminate the deviation to make sure that the instrument operates correctly.

To access the notifications and history list dialog, see Section 14.4, "Querying notifications", on page 620. In remote control mode, you can query the notifications using the command `:SYSTem:ERRor:ALL?` on page 560.

14.1.1 Volatile notifications

Volatile notifications report automatic settings in the instrument (e.g. switching off incompatible types of modulation) or on entries that are not accepted by the instrument (e.g. range violations).

Volatile notifications do not normally demand user actions and disappear automatically after a short period of time. They are saved in the history list, however.

Remote command:

`:SYSTem:ERRor:ALL?` or

`:SYSTem:ERRor:CODE[:NEXT]?`

14.1.2 Permanent notifications

Permanent notifications are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signaled by a permanent notification must be eliminated before correct instrument operation can be continued.

The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

Remote command:

`:SYSTem:ERRor:STATic?`

14.2 SCPI notifications

The SCPI notifications are similar for all SCPI instruments. Detailed information and an overview of all notifications as defined in the SCPI standard can be found in the corresponding documentation.

SCPI notifications have negative codes (numbers). The error text being entered into the error/event queue or being displayed is printed in bold face on the left together with the error code. Below the error text, there is an explanation to the respective error.

14.3 Device-specific notifications

The following table contains all error messages specific for the instrument, marked by positive error codes in numerical order and an explanation of the error situation.

The device-specific error messages set bit 3 in the ESR register.

The index provides a list of the error messages sorted according to their error codes.

Error code	Error	Description	Remedy
50	External reference out of range or disconnected	The configured reference frequency source is external but there is no physical external signal or this signal is out of range.	In the "RF Frequency" > "Reference Frequency" dialog, set the correct reference signal source.
140	This modulation forces other modulations off	The instrument disables a modulation because you enabled another modulation.	

Error code	Error	Description	Remedy
180	Adjustment failed	The instrument cannot execute an adjustment.	Generate the adjustment data and load it into the device.
182	Adjustment data missing	Adjustment data is missing.	Generate the adjustment data and load it into the device.
183	Adjustment data invalid	Adjustment data is invalid.	Generate the adjustment data and load it into the device.
200	Cannot access hardware	The data transmission to a module was unsuccessful.	The module is not installed, not properly installed or missing.
201	Hardware revision out of date	You cannot execute a specific function because of a too old hardware version. The driver does not support the installed version of a hardware module.	Consider installing a newer hardware module or downgrading the driver version
202	Cannot access the EEPROM	An error occurs when writing or reading a EEPROM.	The EEPROM is possibly defective. Replace it.
203	Invalid EEPROM data	Reading a EEPROM is possible, 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 file selected to execute the required operation.	Select a list file with the correct file extension. If no list files is available, create a list file.
242	Unknown list type specified	The list type selected is not valid for the required operation.	Check the selected list type.
460	Cannot open file	You or the application cannot open the selected file.	Check the file path and filename.
461	Cannot write file	You or the application cannot edit or write the selected file.	Check if the file is read-only.
462	Cannot read file	You or the application cannot read the selected file.	Check if the file contents are compatible with the file type.
463	Filename missing	You cannot execute a task because the filename is missing.	Enter the filename.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extension.
465	File contains invalid data	The file with its file extension contains invalid data. The file extension is wrong for the expected data.	Check the file extension.

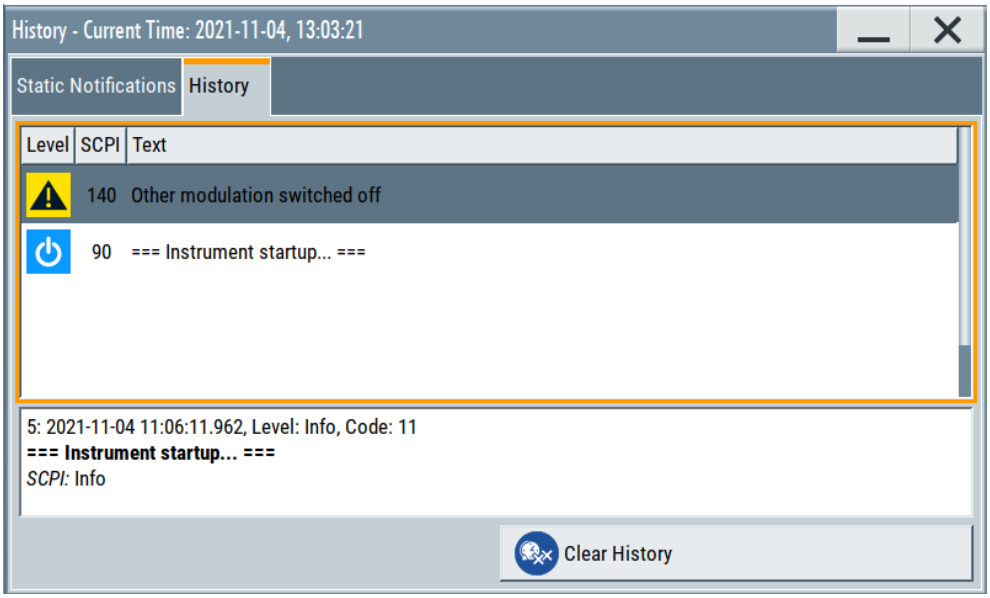
14.4 Querying notifications

The R&S SMB100B monitors the functions performed and automatically detects irregularities. The instrument displays corresponding notifications in the "Info" line and collects all notifications in a history with a detailed description.

Find details to the system notifications in Section 14, "Troubleshooting and notifications", on page 618.

To monitor static notifications and history

► In the taskbar, select the "Info" icon.



- The "Static Notifications" dialog lists the recently monitored notifications chronologically and displays additional information on the highlighted message.
- The "History" dialog lists the accumulated messages with a short description. The software reports volatile notifications once. The "Info" line displays identical errors repeatedly only if the original error disappeared. Selecting this info line also opens the "Static Notifications" dialog.

Handling permanent notifications

If any critical error occurs, the R&S SMB100B automatically shows the warning icon in the taskbar. Select the icon to obtain information on the error and the number of occurrences.

The icon is assigned to permanent notifications. The notification and icon are displayed until the error is eliminated.

Static Notifications/History

Toggles between "Static Notifications" and the "History" tab in the info dialog.

Remote command:

`:SYSTem:ERRor[:NEXT]?` on page 562

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 563

Queries the list of all errors.

Clear History
Clears all messages in the "History" tab.

Remote command:
`:SYSTem:ERRor:ALL?` on page 560
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 563
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 to network connection failures

1. **NOTICE!** Risk of network failure. Connecting to the network can cause network failure. Errors can affect the entire network.

   Consult your network administrator before performing the following tasks:
   - Connecting the instrument to the network
   - Configuring the network
   - Changing IP addresses

2. Try out the following to resolve network connection failures:
   - Exchange connecting cables, if obvious damage is visible.
     See also "Cable selection to minimize electromagnetic interference" on page 24.
   - 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 Section 11.4.4, "Configuring LAN services", on page 283.
   - If the IP address is set manually (no DHCP) or obtained with the Zeroconf (Avahi) protocol:
     – Check whether the IP address of the instrument is within the network's address range.
     – Check whether the IP address is valid.

See also "IP Address" on page 311.

14.6 Resolving errors during internal adjustments

Internal adjustments can fail for various reasons, e.g. if the adjustment data is invalid or missing, or if any error causes process to abort.

To resolve a failed adjustment process, you have the following options:

- Abort on error (default setting), see "To resolve aborted internal adjustments" on page 623
- Continue on error, see "To continue internal adjustments on error" on page 623

To resolve aborted internal adjustments

If an error occurs, the R&S SMB100B displays a notification in the "Information" field and saves the notification in the history list.

1. Select "Info".
2. Look up the error code of the notification in the overview of device-specific notifications.
   See Section 14.3, "Device-specific notifications", on page 619.

   The overview provides a brief explanation of all notifications and information on how to fix an error.
3. To resolve an adjustment failure, generate adjustment data and load it into the instrument.
4. Restart internal adjustments as described in "Running internal adjustments" on page 637

   If the error persists:
   Contact the Rohde & Schwarz customer support, see Section 14.9, "Collecting information for technical support", on page 629.

To continue internal adjustments on error

If the failed internal adjustments has no significant effect on your application, you can skip it and continue the calibration despite the error message. This function is password-protected.

1. Select "System Config > Setup > Security > Protection".
2. Unlock protection level 1, see"Protection Level/Password" on page 283.
3. Select "System Config > Setup > Internal Adjustment > Configuration > Continue Adjustment on Error > On".
4. Proceed as described in "Running internal adjustments" on page 637.

14.7 Measuring USB cable quality

To check the quality of the USB cable, see the service manual of the R&S SMB100B.

14.8 Checking the instrument configuration

The R&S SMB100B uses various hardware and software components. To get an overview, you can check the instrument assemblies, hardware options, software options and the firmware version. The "Hardware Config" and "Versions/Options" dialogs list all components according to their hardware configuration, software options and connected Rohde & Schwarz equipment, like R&S NRP power sensors.

Installing software and hardware options

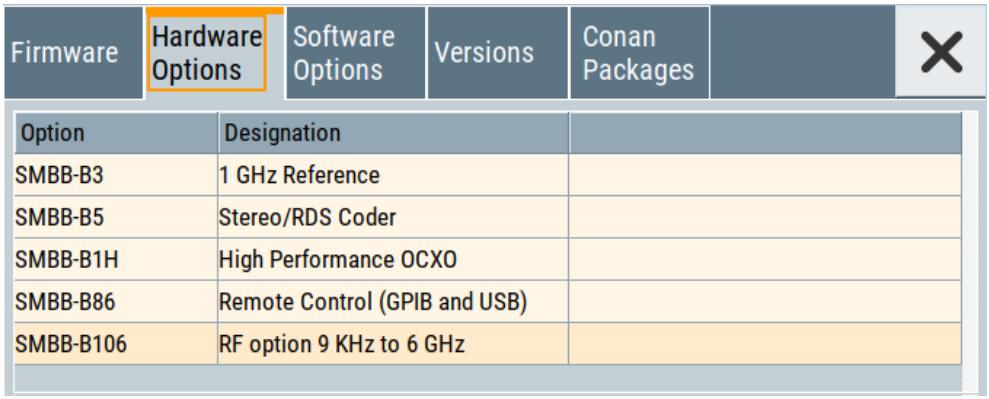
Activate newly purchased software options with a keycode. After purchase, the keycode is part of the delivery of the software option. See also Section 11.3, "Managing licenses and license keys", on page 268.

For installing newly purchased hardware options, contact Rohde & Schwarz customer support.

Checking the installed hardware options

To find out the installed options:

1. Select "System Config" > "Setup" > "Instrument Assembly" > "Versions / Options".
2. Select "Hardware Options".



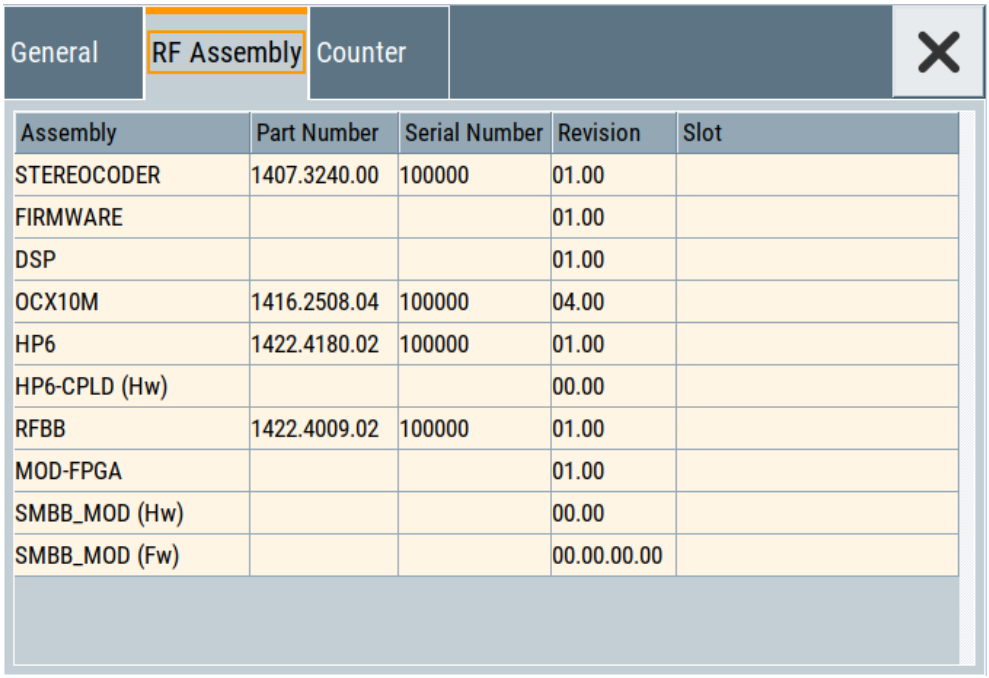
The dialog lists installed hardware options on the R&S SMB100B.

Proceed the same way to get information on the firmware or the installed software options in the corresponding tab.

Checking the RF hardware assembly

To find out the installed RF hardware:

1. Select "System Config" > "Setup" > "Instrument Assembly" > "Hardware Config".
2. Select "RF Assembly".



Assembly	Part Number	Serial Number	Revision	Slot
STEREOCODER	1407.3240.00	100000	01.00	
FIRMWARE			01.00	
DSP			01.00	
OCX10M	1416.2508.04	100000	04.00	
HP6	1422.4180.02	100000	01.00	
HP6-CPLD (Hw)			00.00	
RFBB	1422.4009.02	100000	01.00	
MOD-FPGA			01.00	
SMBB_MOD (Hw)			00.00	
SMBB_MOD (Fw)			00.00.00.00	

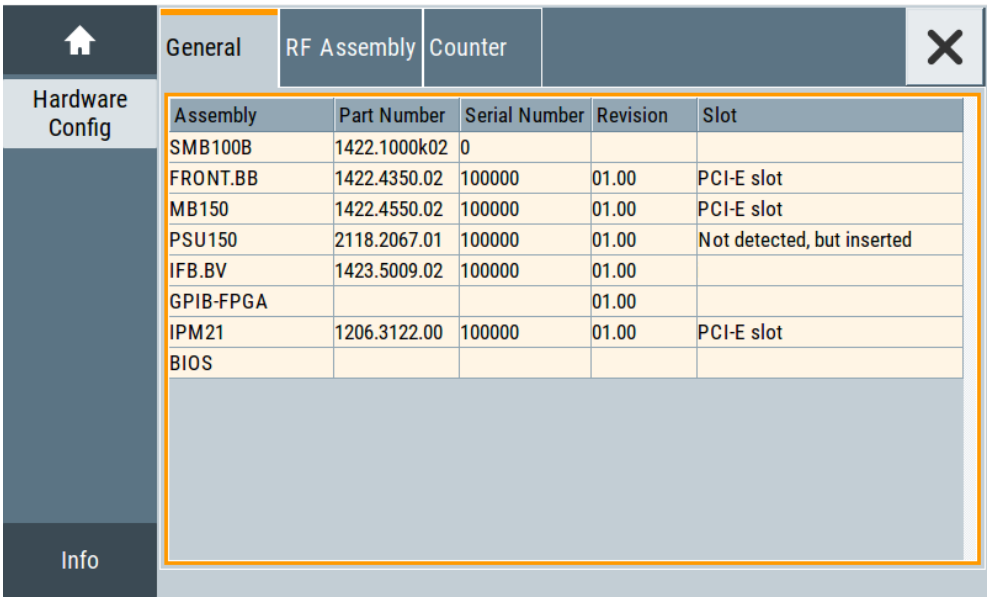
The dialog lists the installed RF hardware components installed on the R&S SMB100B.

Proceed the same way to get information on general or baseband hardware modules or on the operating times of the R&S SMB100B in the corresponding tab.

14.8.1 Hardware configuration settings

Access:

► Select "System Config" > "Setup" > "Instrument Assembly" > "Hardware Config".



The "Hardware Config" dialog lists all installed assemblies and connected external instruments with information on their part and serial numbers, and revision states. Also, it lists the BIOS version. A firmware update does not update the BIOS version. The "Counter" tab provides information on the operation time, the number of times that the instrument was powered on and the last factory calibration of the instrument.

The remote commands required to query the hardware configuration are described in Section 13.7, "DIAGnostic subsystem", on page 396.

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 397

Counter
Displays information on the operation times of the R&S SMB100B.

Operation Time / h ← Counter
Displays the operation time in hours so far.

Remote command:
`:DIAGnostic:INFO:OTIMe?` on page 397

Power On Count ← Counter
Displays the number the instrument has been turned on.

Remote command:
`:DIAGnostic:INFO:POCount?` on page 398

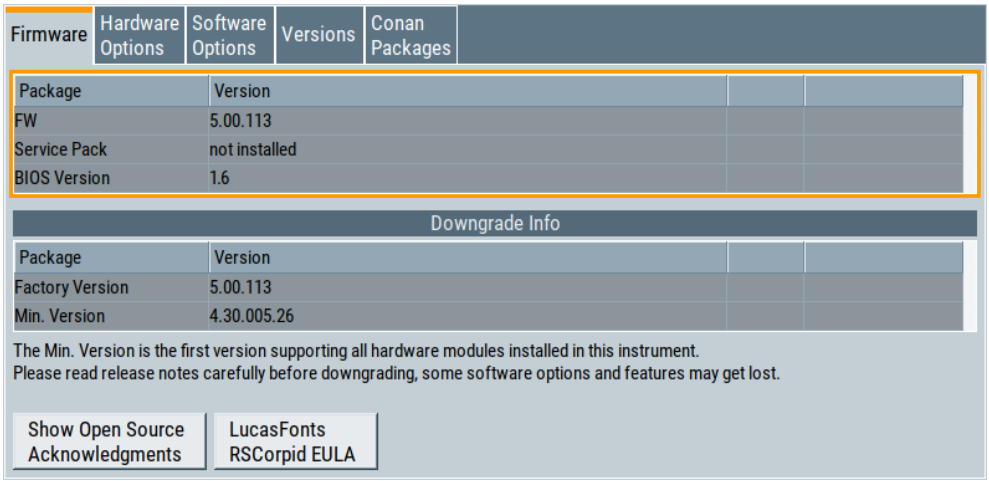
Last Full Factory Adjustment ← Counter
Displays the date of the last factory calibration.

Remote command:
`:CALibration:DATA:FACTory:DATE?` on page 394

14.8.2 Versions and options settings

Access:

► Select "System Config" > "Setup" > "Instrument Assembly" > "Versions / Options".



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 Section 13.7, "DIAGnostic subsystem", on page 396.

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.

LucasFonts RSCorpid EULA
Accesses copyright information on LucasFonts font type RSCorpid EULA.

Hardware Options/Software Options
The tables in the "Hardware" and "Software" tabs list the installed hardware and software options.

"Option" Short name of option

"Designation" Name of option

"Expiration Date"
For regular options, "Permanent" is indicated in this column.

Remote command:
`*OPT?` on page 377
`*IDN?` on page 377

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 Section 12.7.4, "Datasheet", on page 339.

Remote command:
`:SYSTem:SPECification:VERSion:FACTory?` on page 580

14.9 Collecting information for technical support

If you encounter problems that you cannot solve yourself, contact your Rohde & Schwarz support center at www.rohde-schwarz.com/support. Our support center staff is optimally trained to assist you in solving problems.

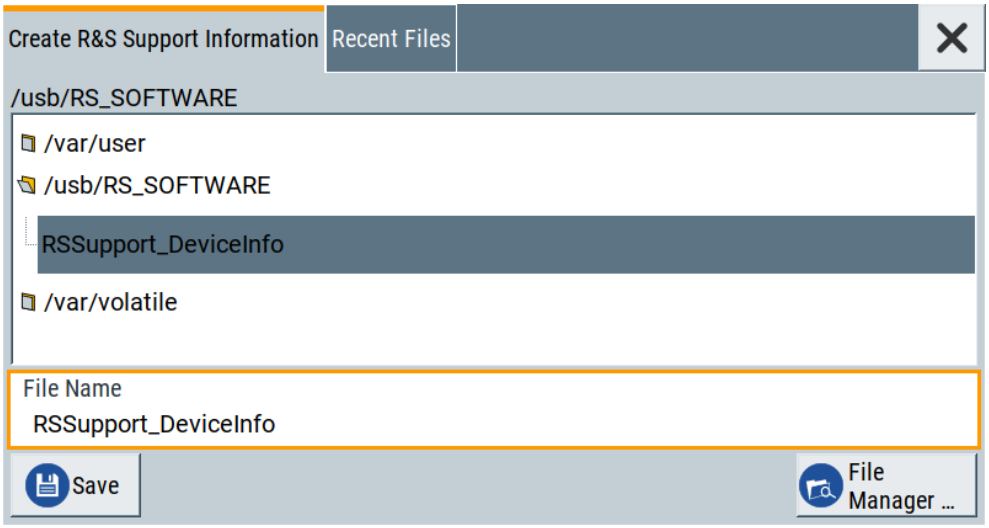
The support center finds solutions more quickly and efficiently if you provide them with information on the instrument and an error description.

- The following dialog boxes in the "Setup > Instrument Assembly" menu provide useful information:
  - **Hardware Configuration:** hardware assemblies
  - **Software and Options:** the status of all software and hardware options installed on your instrument
- **System Messages:** displayed in the "Info" line and provide information on any errors that have occurred
- **Support file:** a special file (`*.tar.gz` file) with important support information that can be created automatically.
  The support `*.tar.gz` file has a user-definable name and contains the following files and information:
  - `SgErrors.txt`: chronological record of errors
  - `SystemRestaurationSMBB.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 Section 14.1, "Notifications", on page 618.

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 are 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 as listed on the Internet (www.rohde-schwarz.com/support).

To remove sensitive data

► For information on how to handle or remove the sensitive data from your instrument, refer to the description "R&S SMB100B Instrument Security Procedures".

To pack and transport the instrument

► If you need to transport or ship the instrument, see Section 15, "Transporting", on page 632.

14.10 Contacting customer support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz product, contact our customer support center. A team of highly qualified engineers provides support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz products.

Contact information

Contact our customer support center at www.rohde-schwarz.com/support, or follow this QR code:



Figure 14-1: QR code to the Rohde & Schwarz support page

15 Transporting

Lifting and carrying

For safety information, see:

- "Lifting and carrying the product" on page 14
- Section 3.1.1, "Lifting and carrying", on page 21

Packing

Use the original packaging material. It consists of antistatic wrap for electrostatic protection and packing material designed for the product.

If you do not have the original packaging, use similar materials that provide the same level of protection. You can also contact your local Rohde & Schwarz service center for advice.

Securing

When moving the R&S SMB100B in a vehicle or using transporting equipment, make sure that the R&S SMB100B is properly secured. Only use items intended for securing objects.

Transport altitude

The maximum transport altitude without pressure compensation is specified in the specifications document.

16 Maintenance, storage and disposal

We advise to check the nominal data from time to time.

16.1 Cleaning

How to clean the product is described in "Cleaning the product" on page 15.

Do not use any liquids for cleaning. Cleaning agents, solvents, acids and bases can damage the front panel labeling, plastic parts and display.

16.2 Storage

Protect the product against dust. Ensure that the environmental conditions, e.g. temperature range and climatic load, meet the values specified in the specifications document.

16.3 Performing maintenance tasks

The R&S SMB100B is accurate due to integrated adjustment procedures and additional test functions that assure correct functioning.

Internal adjustments are integrated self-calibration routines, which you can execute directly on the instrument.

How to: See Section 16.3.1.3, "How to use the internal adjustments", on page 636.

Self-calibration routines that require additional equipment are performed at an authorized Rohde & Schwarz service center. For description, see the R&S SMB100B service manual.

16.3.1 Internal adjustments

Using the integrated adjustment procedures, you can start the calibration directly on the instrument.

Minimum power rating required for internal adjustments

Depending on the instrument configuration, it can be required that you have to replace the DUT by an external 50 Ω termination at the RF output. The following tables show the minimum required power rating of the terminating resistor regarding the output power and frequency options. The termination must be specified for the entire frequency range of the instrument.

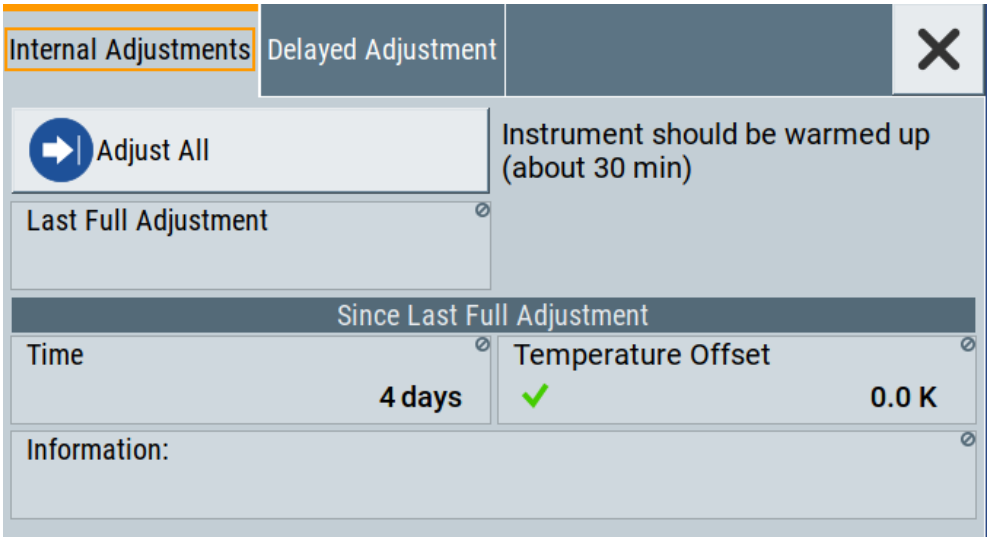
Table 16-1: Standard (no option) or high output power (R&S SMBB-K33/-K35)

Frequency option	R&S SMBB-B112/-B120	R&S SMBB-B131/-B140(N)
Min. power rating	2 W (33 dBm)	No termination required

16.3.1.1 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 "Temperature Offset" indicates the deviation of the current temperature of the instrument, compared to the temperature of the last adjustment.

The remote commands required to define these settings are described in Section 13.6, "CALibration subsystem", on page 392.

How to: See Section 16.3.1.3, "How to use the internal adjustments", on page 636.

Settings

Adjust All
Executes all available internal calibration routines of the instrument.

Note: Before you start the internal adjustment, make sure that you have connected a termination resistor, if necessary.

Remote command:
`:CALibration:ALL[:MEASure]?` on page 392

Last Full Adjustment
Displays the date of the last fully performed adjustment.

Remote command:
:CALibration<hw>:ALL:DATE? on page 393

Time
Displays the elapsed time since the last full adjustment.

Remote command:
:CALibration<hw>:ALL:TIME? on page 394

Temperature Offset
Displays the temperature difference, comparing the temperature of the last adjustment to the current instrument temperature.

A green checkmark indícates that the offset is within the permitted range. If the temperature deviates more than ±5 K, the instrument indicates a warning icon.

Remote command:
:CALibration<hw>:ALL:TEMP? on page 393

Information
Displays information to the current adjustment state.

Remote command:
:CALibration<hw>:ALL:INFormation? on page 393

Continue Adjustment on Error
Continues the calibration even though an error was detected. By default adjustments are aborted on error.

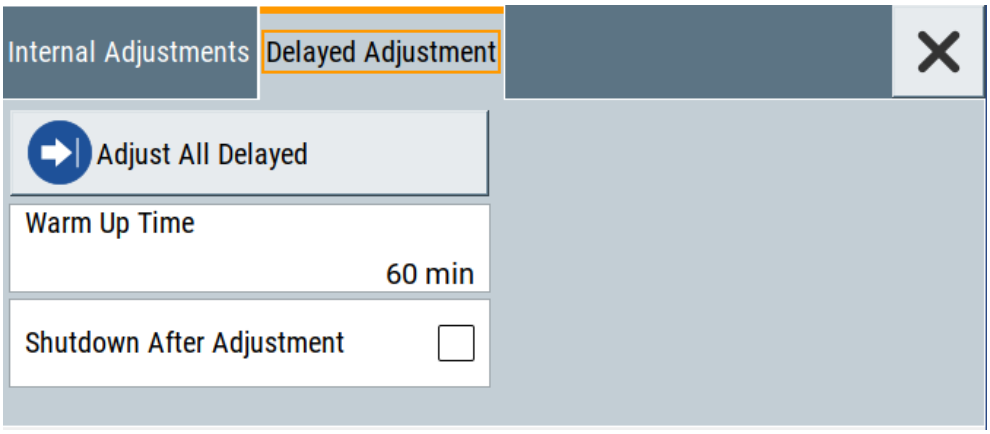
This function is password-protected. Unlock the protection level 1 to access it.

Remote command:
:CALibration<hw>:CONTinueonerror on page 394

16.3.1.2 Delayed adjustment settings

Access:

► Select "System Config > Setup > General > Delayed Adjustment".



In this dialog, you can set the internal adjustments to start automatically after the selected warm up time and to switch off the instrument after calibration.

The remote commands required to define these settings are described in Section 13.6, "CALibration subsystem", on page 392.

Settings

Adjust All Delayed....636
Warm Up Time....636
Shutdown After Adjustment....636

Adjust All Delayed
Performs all available internal calibration routines of the instrument.

How to: See Starting internal adjustments automatically.

Remote command:
`:CALibration:DELay[:MEASure]?` on page 395

Warm Up Time
Sets the time for warming up the instrument before the calibration starts automatically.

How to: See Starting internal adjustments automatically.

Remote command:
`:CALibration:DELay:MINutes` on page 395

Shutdown After Adjustment
Enables the automatic shutdown after internal adjustments.

How to: See Starting internal adjustments automatically.

Remote command:
`:CALibration:DELay:SHUTdown[:STATe]` on page 395

16.3.1.3 How to use the internal adjustments

Deciding whether to run internal adjustments

1. Select "System Config > Setup > Internal Adjustment".
2. Check the status and color indication in the section "Since Last Full Adjustment".

   Green: internal adjustments are not required.
   Red: internal adjustments are required. Observe also the indication in the "Information" field.
3. We recommend that you run internal adjustments in the following cases:
   - Before starting any application that requires a maximum of level accuracy.
   - When a long period of time has passed since the last adjustments.
   - If the ambient temperature of the instrument significantly differs from the one of the last adjustments.
4. Proceed as described in "Running internal adjustments" on page 637.

Running internal adjustments

1. After switching on, the R&S SMB100B requires up to 30 minutes to warm up.
   Wait until the instrument has reached operating temperature to achieve accurate adjustments.
2. Select "System Config > Setup > Internal Adjustment > Adjust All".
3. Confirm with "Ok".

   The adjustment process starts.

   The adjustment process takes some time depending on the equipment of the instrument.
   If any error occurs, the process aborts. To resolve adjustment issues, see Section 14.6, "Resolving errors during internal adjustments", on page 623.

Starting internal adjustments automatically

The delayed adjustment function executes the adjustments automatically. You can set the warm-up time and shut down after the adjustment process finishes. Using this function, you can execute adjustments without being on-site and start measurements directly when back.

1. If necessary, terminate the RF 50 Ω output. See "Running internal adjustments" on page 637.
2. Select "System Config > Setup > General > Internal Adjustment".
3. Select "Delayed Adjustment".
4. Set the "Warm Up Time", e.g. *40 min*.

   The R&S SMB100B requires a warm-up time of at least 30 min.
5. Enable "Shut Down After Adjustment"
6. Select "Adjust All Delayed".

   The process starts with warming up the instrument, indicating the progress in a status dialog. In this dialog, you can abort the process again, if necessary.
   After warming up, the R&S SMB100B executes the internal adjustments and shuts down when finished.

16.3.2 Date and time

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.

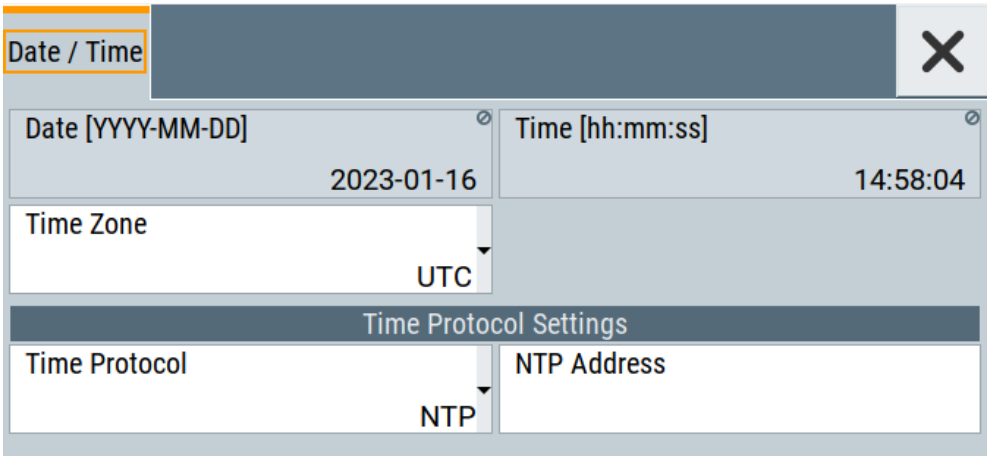
The instrument records the time whenever you create or modify files on your instrument or you use timed licenses. By default, the instrument is set to the UTC timezone, but you can select the timezone according to your location.

Moreover, the instrument supports NTP protocol for synchronizing all connected instruments and computer systems to minimize time delays in the network.

16.3.2.1 Date and time settings

Access:

► Select "System Config" > "Setup" > "Maintenance" > "Date / Time".



The "Date / Time" dialog contains the time and data settings of the operating system.
This function is password-protected. Unlock the protection level 1 to access it.
You can also set the time zone for your location, and select a time protocol controlled by a time server for synchronization.

The required remote commands are described in Section 13.17, "SYSTem subsystem", on page 555.

Settings:

Date....638
Time....638
Timezone....639
Time Protocol....639
NTP Address....639

Date
Displays the date set in the operating system in the format [yyyy.mm.dd].

Remote command:
`:SYSTem:DATE` on page 581

Time
Displays the time set in the operating system in the format [hh.mm.ss].

The time setting corresponds to the selected Timezone.

Remote command:
`:SYSTem:TIME` on page 581

Timezone
Selects the timezone in the date and time settings of the operating system.

You can select the timezone according to the major cities on the respective continents.

Tip: By typing the first letter, you can quickly navigate through the lists to find the desired destination.

Remote command:
`:SYSTem:TIME:ZONE` on page 582
`:SYSTem:TIME:ZONE:CATalog?` on page 582

Time Protocol
Enables the instrument to refer to a network time protocol.

A network time protocol synchronizes the system clocks of all participating devices in a computer network (Ethernet). A time server in the network provides the time base for the connected devices that refer to this time to synchronize events.

You can select a high-precision time protocol to achieve high clock accuracy and thus reduce the impact of varying network delays.

"None" Refers to the selected timezone, see "Timezone" on page 639.

"NTP" Uses the network time protocol (NTP).

Remote command:
`:SYSTem:TIME:PROTocol` on page 582

NTP Address
Sets the IP address or host name of the NTP server.

When the server is detected and verified, the instrument enables the connection automatically.

Remote command:
`:SYSTem:NTP:HOSTname` on page 581
`:SYSTem:NTP:STATe` on page 581

16.3.2.2 How to set date and time

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. **NOTICE!**
   This function is password-protected. Unlock the protection level 1 to access it.

   Since the date and time settings affect time-based options, changing the date and time can therefore lead to loss of access to the function of the options. We recommend that you only change the system time in urgent cases.

   If the time is not displayed correctly, the internal CMOS battery can be discharged. To change the battery, contact your Rohde & Schwarz support center at www.rohde-schwarz.com/support.

   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 sets the new date and time.

16.3.3 Check front panel

Within this dialog, you can verify the functionality of the control keys.

How To: See Section 16.3.3.2, "How to test the front panel", on page 641

16.3.3.1 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.

16.3.3.2 How to test the front panel

See:

- "Testing the key panel" on page 641
- "Testing the touchscreen" on page 642
- "Terminating the test" on page 643
- "Debugging" on page 643

Testing the key panel

To perform the key panel test, you operate the keys at the front panel, and check the response of the instrument in the "Check Front Panel" dialog. To perform this test properly, check each key of the front panel. The test is only completed, when you have verified all keys.

During the test, the actual functions of the keys are disabled.

1. 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.

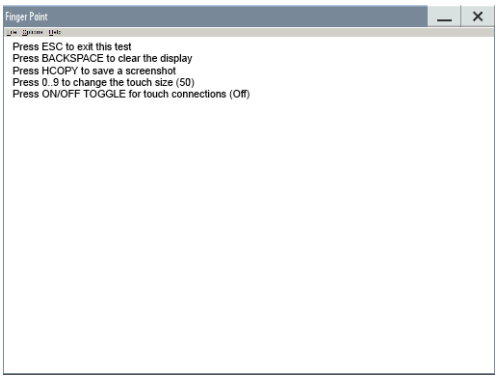
Note: Pressing the same key again has no further effect, except for the [Esc] key. Pressing this key a third time, terminates the test procedure.

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.

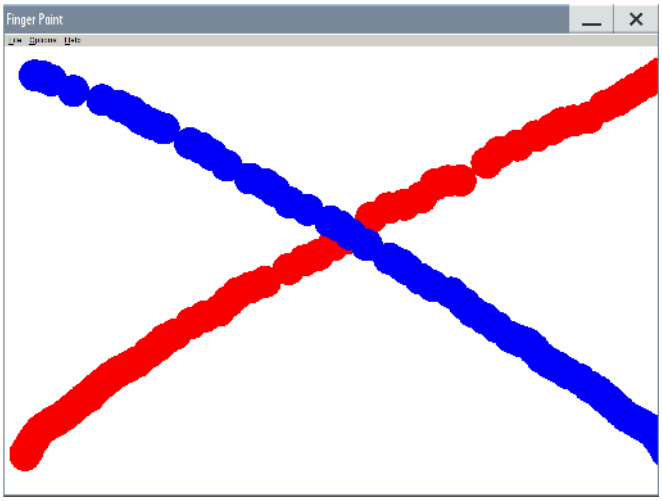
Testing the touchscreen

1. Press the [Setup] key.
2. Select "Maintenance > Check Touch Panel"
   The "Finger Paint" test window opens.

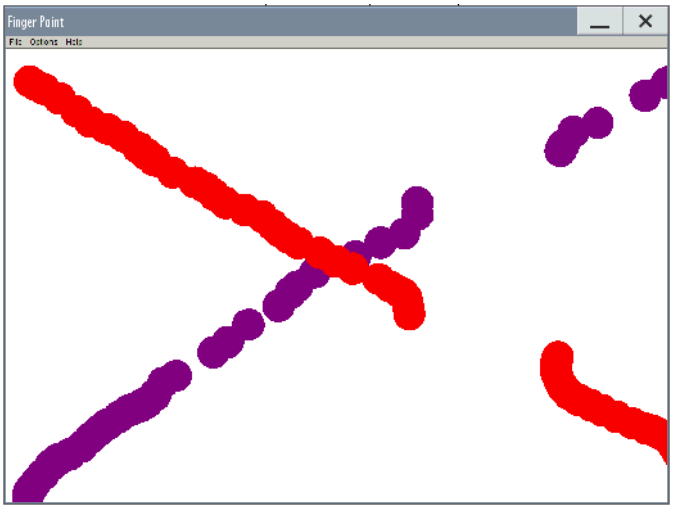


3. Drag with your finger one or more lines, for example diagonally across the screen. The test traces the movements of your finger on the screen.

   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].

Terminating the test

► Press the [Esc] key.

Exits the "Check Front Panel" dialog.

Debugging

1. If you detect a malfunction, for example, when you press the front panel key for the first time, and the color of the button in the dialog turns red (instead of green), the front panel key has probably stuck.
2. Contact the Rohde & Schwarz customer support, see Section 14.9, "Collecting information for technical support", on page 629.

16.3.4 Check display screen

Using this function, you can verify the color depth and gradient, pixels and the text display of the screen.

Access:

► Select "System Config > Setup > Maintenance > Check Display Screen".

The R&S SMB100B fades out the current display and indicates the screen in red. Short instructions on the screen explain how to execute the test.

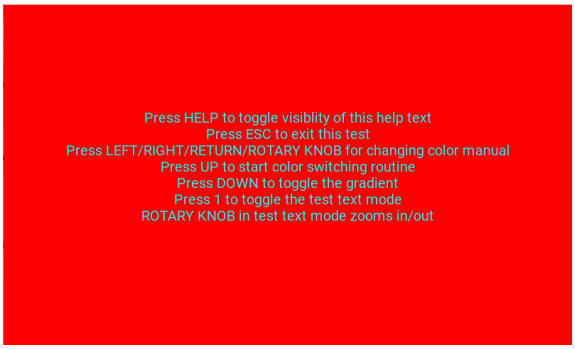
The remote commands required to define these settings are described in Section 13.19, "TEST subsystem", on page 589.

Testing the display screen

1. Press the [Setup] key.
2. Select "Maintenance > Check Display Screen"

The "Check Display Screen" window opens.

3. Test the color and gradient of the display screen:



   a) Use the [Help] key to hide the indicated text.
   b) To toggle between the provided colors manually, use the navigation controls [Left/Right] or the rotary knob.
      The R&S SMB100B provides the colors red, green, blue, white, three levels of gray shades and black.
   c) To switch between the screen colors automatically, use the [Up] key.
   d) To toggle the gradient, use the [Down] key.

4. Check if the R&S SMB100B indicates the text correctly:
   a) Press [1] on the numeric keypad.
      The R&S SMB100B displays a test text over the entire screen.
   b) To inspect the text in detail, you can use the rotary knob to zoom it out.

5. To exit the test, press the [Esc] key.

Check Display Screen.....644

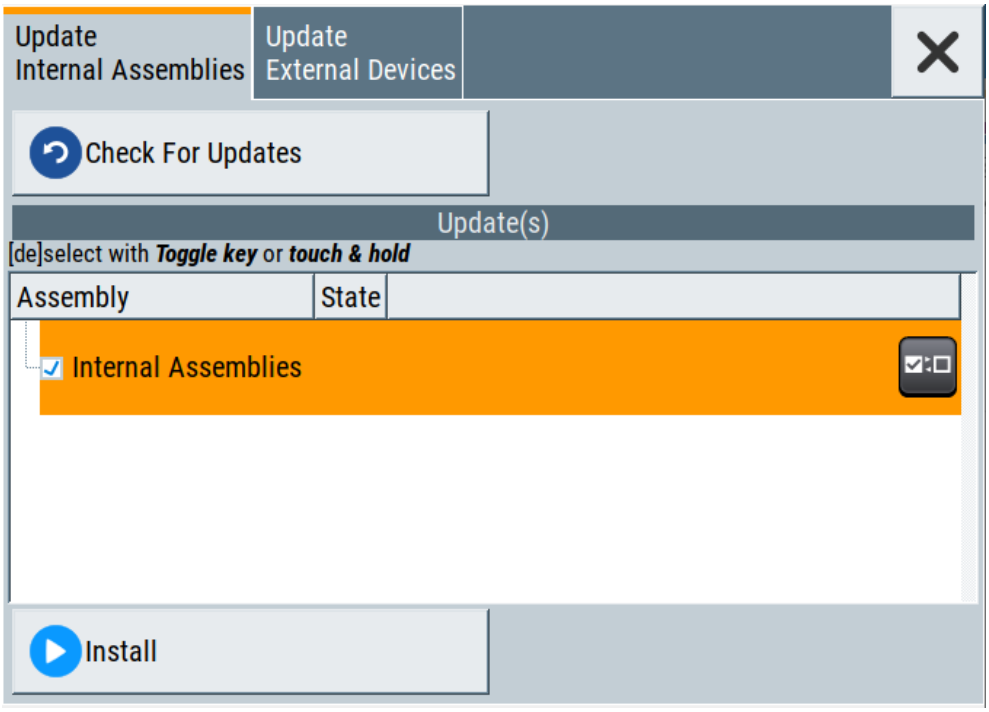
Check Display Screen
Opens the test window with instructions on how to perform the test.

Remote command:
`:TEST:PIXel:WINDow` on page 592
`:TEST:PIXel:COLor` on page 590
`:TEST:PIXel:RGBA` on page 591
`:TEST:PIXel:GRADient` on page 591
`:TEST:PIXel:TEXT` on page 591
`:TEST:PIXel:POINtsize` on page 591

16.3.5 FPGA/uC update settings

Access:

► Select "System Config > Setup > Maintenance > FPGA/µC Update".



This dialog enables you to check for internal assembly updates and perform updates.

Settings:

Check For Updates 645
Assembly 645
Install 645
Shut down 646
Update External Devices 646
└ Check For Updates 646

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 585

Update External Devices
This dialog shows the update options of external devices connected to the instrument.

Check For Updates ← Update External Devices
Check for updates of external devices.

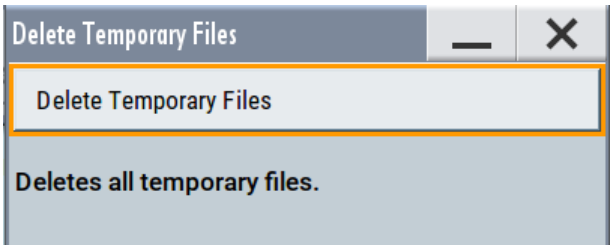
Remote command:
n.a.

16.3.6 Delete temporary files

During signal processing, the R&S SMB100B creates and saves various temporary files in a predefined directory on its non-volatile memory. This predefined directory is a protected system directory you cannot access in the "File Manager", but you can delete all temporary files saved there.

To achieve more free disc space on the internal memory

1. Select "System Config > Setup > Maintenance > Delete Temporary Files".



2. Select "Delete Temporary Files".

   Deletes the content of the predefined directory.

Another way to achieve more free disc space on the internal memory is to use the Execute Factory Preset.

This function removes all temporary files, too, but also resets several parameters to their factory preset values.

Remote command:

`:SYSTem:FILes:TEMPorary:DELete` on page 585

16.4 Disposal

Rohde & Schwarz is committed to making careful, ecologically sound use of natural resources and minimizing the environmental footprint of our products. Help us by disposing of waste in a way that causes minimum environmental impact.

Disposing of electrical and electronic equipment

A product that is labeled as follows cannot be disposed of in normal household waste after it has come to the end of its life. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.



Figure 16-1: Labeling in line with EU directive WEEE

Rohde & Schwarz has developed a disposal concept for the eco-friendly disposal or recycling of waste material. As a manufacturer, Rohde & Schwarz completely fulfills its obligation to take back and dispose of electrical and electronic waste. Contact your local service representative to dispose of the product.

Annex

A Reference information for remote control

A.1 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

```
#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;
}
```

A.2 Available user files and file extensions

The table Table A-1 lists available file extensions for user files on the instrument. Some files depend on the installed options.

For more information, refer to the specifications document.

Table A-1: User files and file extensions on the instrument

Context or function	Content type	File contents	File extension
Instrument state	Settings	Instrument settings	`*.savrcltxt`
User menu	Settings	User-defined favorite settings	`*.user_menu`
License key	License	License key	`*.xml`
User correction	List	User-defined level correction values	`*.uco`
List Mode	List	User-defined frequency/level value pairs	`*.lsw`
Pulse train	Settings	Pulse train data	`*.pulstrn`
Power sensing	Settings	R&S NRP settings	`*.nrp`, `*.rsu`
SCPI command list	List	Export file containing list of SCPIs	`*.iec`
SCPI command script	Command script	SCPI script file formats: Plain SCPI, MATLAB, NICVI, Python3	`*.txt`, `*.m`, `*.c`, `*.py`
R&S support information	Support file	Automatically collected support information	`*.tar.gz`
Tutorials	Tutorial files	Lists containing SCPIs and explanations	`*.tut`

B Unit shortcuts

When specifying units or quantities during data entry, the R&S SMB100B provides the following shortcuts for simplified input.

Shortcut	Designation	Context	Unit
a, A	ampere	Current	A
	atto-	Area, surface	am^2
c, C	centi-	Distance, length	cm
d, D	deci-	Distance, length	dm
		Level, power	dB, dBFS, dBm, dBU, dBW
	degree	Phase, polar/spherical coordinates	deg
e, E	exa-	Area, surface	em^2
f, F	femto-	Area, surface	fm^2
g, G	giga-	Area, surface	Gm^2
		Data rate, sample rate, symbol rate	Gbit/s, Gsample/s, Gsymbol/s, Gchip/s
		Frequency	GHz
		Impedance, resistance	GΩ
h, H	hertz	Frequency	Hz
k, K	kilo-	Area, surface	km^2
		Data rate, sample rate, symbol rate	kbit/s, ksample/s, ksymbol/s, kchip/s
		Distance, length	km
		Frequency	kHz
		Impedance, resistance	kΩ
		Velocity	km/h
m, M	milli-	Area, surface	mm^2
		Current	mA
		Distance, length	mm
		Electromagnetic force, level	mV
		Power	mW
		Time, period, etc.	ms
	mega-	Area, surface	Mm^2
		Data rate, sample rate, symbol rate	Mbit/s, Msample/s, Msym/s, Mchip/s
		Frequency	MHz
		Impedance, resistance	MΩ

Shortcut	Designation	Context	Unit
n, N	nano-	Area, surface	nm^2
		Current	nA
		Distance, length	nm
		Electromagnetic force, level	nV
		Power	nW
		Time, period, etc.	ns
o, O	ohm	Impedance, resistance	Ω
p, P	peta-	Area, surface	pm^2
	percent	Level, ratio	%
	pico-	Area, surface	pm^2
		Current	pA
		Electromagnetic force, level	pV
		Power	pW
		Time, period, etc.	ps
r, R	radiant	Phase, polar/spherical coordinates	rad
s, S	second	Time, period, etc.	s
t, T	terra-	Area, surface	Tm^2
		Data rate, sample rate, symbol rate	Tbit/s, Tsample/s, Tsym/s, Tchip/s
		Frequency	THz
		Impedance, resistance	TΩ
u, U	micro-	Current	µA
		Distance, length	µm
		Electromagnetic force, level	µV
		Power	µW
		Time, period, etc.	µs
v, V	volt	Level, voltage	V
w, W	watt	Level, power	W

C GPIB interface

Option: R&S SMBB-B86.

This section provides detailed information on the general-purpose interface bus (GPIB) interface "IEC 625/IEEE 488" for remote control of the instrument. It covers the following topics:

- "Pin assignment" on page 656
- "Bus lines" on page 656
- "Interface functions" on page 657

For other remote control interfaces, see Section 12, "Network operation and remote control", on page 296.

Pin assignment

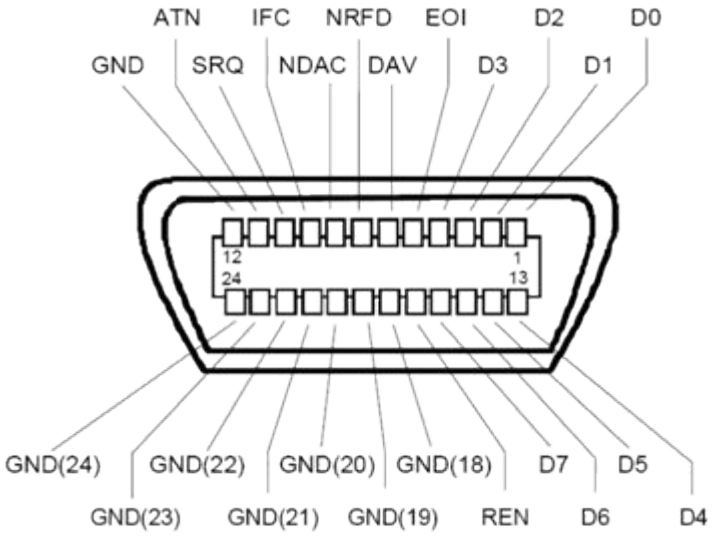


Figure C-1: Pin assignment of the GPIB interface

Bus lines

- Data bus with eight 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): 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

You can use different interface functions to control the instrument via the GPIB interface. Table C-1 lists the interface functions for the R&S SMB100B.

Table C-1: GPIB 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

For more information, refer to the specifications document.

Glossary: Terms and abbreviations

A

Avahi: A licensed Zeroconf networking feature, including DNS service. The feature enables a device to self-configure an IP address and subnet mask automatically, when a DHCP server in the LAN is not available.

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.
Synonyms to this expression are "full file path" and "absolute file path".
See also Section 13.5.2, "Handling files in the default or in a specified directory", on page 383.

Computer name: Hostname

D

daisy chain: A connection scheme in which instruments are connected together in sequence, i.e. an output of the first one is connected to an input of the second one, etc.

DHCP: Dynamic host configuration protocol

DNS: Domain name system server

E

e.g.: For example

External mass memory: External memory, connected to the instrument via USB connector (Type A female). It can hold stored files with user data.
See also System drive

F

File transfer: The transmission of files from or to the instrument by a remote client. The instrument supports the standard methods FTP and file sharing according to SAMBA/SMB.

FTP: File transfer protocol

G

Glossary: List of the often used terms and abbreviations

GUI: Graphical user interface

H

Hostname: An unambiguous indication of the instrument in a LAN that uses a DNS server.
The default hostname follows the syntax `SMBB-<serial number>`, e.g. *SMB100B-102030*.
See Serial number.
Synonym: Computer name

HUMS: Health and utilization monitoring system.

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 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

Z

Zeroconf: Zero-configuration, see Avahi.

List of commands

:CALibration:ALL[:MEASure]? 392
:CALibration:DATA:EXPort 394
:CALibration:DATA:FACTory:DATE? 394
:CALibration:DELay:MINutes 395
:CALibration:DELay:SHUTdown[:STATe] 395
:CALibration:DELay[:MEASure]? 395
:CALibration<hw>:ALL:DATE? 393
:CALibration<hw>:ALL:INFormation? 393
:CALibration<hw>:ALL:TEMP? 393
:CALibration<hw>:ALL:TIME? 394
:CALibration<hw>:CONTinueonerror 394
:DEVice:PRESet 381
:DIAGnostic:INFO:OTIMe? 397
:DIAGnostic:INFO:POCount? 398
:DIAGnostic<hw>:BGINfo:CATalog? 397
:DIAGnostic<hw>:BGINfo? 397
:DIAGnostic<hw>:POINt:CATalog? 398
:DIAGnostic<hw>[:MEASure]:POINt? 398
:DISPlay:ANNotation:AMPLitude 408
:DISPlay:ANNotation:FREQuency 409
:DISPlay:ANNotation[:ALL] 409
:DISPlay:BRIGhtness 408
:DISPlay:BUTTon:BRIGhtness 408
:DISPlay:DIALog:CLOSe 410
:DISPlay:DIALog:CLOSe:ALL 411
:DISPlay:DIALog:ID? 409
:DISPlay:DIALog:OPEN 410
:DISPlay:PSAVe:HOLDoff 407
:DISPlay:PSAVe[:STATe] 407
:DISPlay:UPDate[:STATe] 408
:FORMat:BORDer 411
:FORMat:SREGister 412
:FORMat[:DATA] 412
:FPANel:KEYBoard:LAYout 418
:HCOPy:DATA? 414
:HCOPy:DEVice:LANGuage 414
:HCOPy:FILE[:NAME] 414
:HCOPy:FILE[:NAME]:AUTO:DIRectory 415
:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar 416
:HCOPy:FILE[:NAME]:AUTO:FILE? 416
:HCOPy:FILE[:NAME]:AUTO:STATe 416
:HCOPy:FILE[:NAME]:AUTO? 415
:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer? 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix 417
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe 417

:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe 417
:HCOPy:IMAGe:FORMat 414
:HCOPy:REGion 414
:HCOPy[:EXECute] 415
:INITiate<hw>[:POWer]:CONTinuous 428
:KBOard:LAYout 418
:MEMory:HFRee? 391
:MMEMory:CATalog:LENGth? 387
:MMEMory:CATalog? 386
:MMEMory:CDIRectory 387
:MMEMory:COPY 387
:MMEMory:DATA 388
:MMEMory:DCATalog:LENGth? 389
:MMEMory:DCATalog? 389
:MMEMory:DELete 389
:MMEMory:LOAD:STATe 389
:MMEMory:MDIRectory 390
:MMEMory:MOVE 390
:MMEMory:MSIS 390
:MMEMory:RDIRectory 390
:MMEMory:RDIRectory:RECursive 391
:MMEMory:STORe:STATe 391
:OUTPut:ALL[:STATe] 419
:OUTPut<hw>:AFIXed:RANGe:LOWer? 421
:OUTPut<hw>:AFIXed:RANGe:UPPer? 421
:OUTPut<hw>:AMODe 420
:OUTPut<hw>:IMPedance? 420
:OUTPut<hw>:PROTection:CLEar 421
:OUTPut<hw>:PROTection:TRIPped? 421
:OUTPut<hw>[:STATe] 419
:OUTPut<hw>[:STATe]:PON 419
:READ<ch>[:POWer]? 428
:SCONfiguration:EXTernal:ACONnect 438
:SCONfiguration:EXTernal:PBEHaviour 438
:SCONfiguration:EXTernal:REMote:CLEan 441
:SCONfiguration:EXTernal:REMote:CONNect[:ALL] 438
:SCONfiguration:EXTernal:REMote:DISConnect[:ALL] 438
:SCONfiguration:EXTernal:REMote:LIST? 439
:SCONfiguration:EXTernal:REMote:REName 440
:SCONfiguration:EXTernal:RF<ch>:DIRection? 439
:SCONfiguration:EXTernal:RF<ch>:INAMe? 439
:SCONfiguration:EXTernal:RF<ch>:RCONnection:STATe? 439
:SCONfiguration:EXTernal:RF<ch>:REMote:CONNect 441
:SCONfiguration:EXTernal:RF<ch>:REMote:DISConnect 441
:SCONfiguration:EXTernal:RF<ch>:REMote:ICONnect 440
:SCONfiguration:EXTernal:RF<ch>:REMote:INFO? 440
:SCONfiguration:EXTernal:RF<ch>:REMote:ISELect 440
:SENSe<ch>:UNIT[:POWer] 429
:SENSe<ch>[:POWer]:APERture:DEFault:STATe 429
:SENSe<ch>[:POWer]:APERture:TIMe 429

:SENSe<ch>[:POWer]:CORRection:SPDevice:LIST? 430
:SENSe<ch>[:POWer]:CORRection:SPDevice:SELect 430
:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe 430
:SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority 430
:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe 431
:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO? 431
:SENSe<ch>[:POWer]:FILTer:LENGth[:USER] 431
:SENSe<ch>[:POWer]:FILTer:NSRatio 432
:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe 432
:SENSe<ch>[:POWer]:FILTer:SONCe 432
:SENSe<ch>[:POWer]:FILTer:TYPE 433
:SENSe<ch>[:POWer]:FREQuency 433
:SENSe<ch>[:POWer]:LOGGing:STATe 434
:SENSe<ch>[:POWer]:OFFSet 434
:SENSe<ch>[:POWer]:OFFSet:STATe 434
:SENSe<ch>[:POWer]:SNUMber? 435
:SENSe<ch>[:POWer]:SOURce 435
:SENSe<ch>[:POWer]:STATus[:DEVice]? 435
:SENSe<ch>[:POWer]:SVERsion? 436
:SENSe<ch>[:POWer]:TYPE? 436
:SENSe<ch>[:POWer]:ZERO 436
:SLISt:CLEar:LAN 426
:SLISt:CLEar:USB 426
:SLISt:CLEar[:ALL] 427
:SLISt:ELEMent<ch>:MAPPing 427
:SLISt:SCAN:LSENsor 425
:SLISt:SCAN:USENsor 426
:SLISt:SCAN[:STATe] 425
:SLISt:SENSor:MAP 427
:SLISt[:LIST]? 425
:SOURce<hw>:PRESet 381
:STATus:OPERation:CONDition? 586
:STATus:OPERation:ENABle 586
:STATus:OPERation:NTRansition 587
:STATus:OPERation:PTRansition 587
:STATus:OPERation[:EVENt] 587
:STATus:PRESet 587
:STATus:QUEStionable:CONDition 588
:STATus:QUEStionable:ENABle 588
:STATus:QUEStionable:NTRansition 588
:STATus:QUEStionable:PTRansition 589
:STATus:QUEStionable[:EVENt] 588
:STATus:QUEue[:NEXT]? 589
:SYSTem:BIOS:VERSion? 583
:SYSTem:COMMunicate:GPIB:LTERminator 567
:SYSTem:COMMunicate:GPIB:RESource? 567
:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 567
:SYSTem:COMMunicate:HISLip:RESource? 567
:SYSTem:COMMunicate:NETWork:IPADdress 568
:SYSTem:COMMunicate:NETWork:IPADdress:MODE 568

:SYSTem:COMMunicate:NETWork:MACaddress....568
:SYSTem:COMMunicate:NETWork:RESource?....568
:SYSTem:COMMunicate:NETWork:RESTart....569
:SYSTem:COMMunicate:NETWork:STATus?....569
:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain....569
:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname....569
:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup....570
:SYSTem:COMMunicate:NETWork[:IPADdress]:DNS....570
:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway....570
:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK....570
:SYSTem:COMMunicate:SERial:BAUD....570
:SYSTem:COMMunicate:SERial:PARity....571
:SYSTem:COMMunicate:SERial:RESource?....571
:SYSTem:COMMunicate:SERial:SBITs....571
:SYSTem:COMMunicate:SOCKet:RESource?....571
:SYSTem:COMMunicate:USB:RESource?....572
:SYSTem:DATE....581
:SYSTem:DFPRint....584
:SYSTem:DLOCk....563
:SYSTem:ERRor:ALL?....560
:SYSTem:ERRor:CODE:ALL?....561
:SYSTem:ERRor:CODE[:NEXT]?....561
:SYSTem:ERRor:COUNt?....561
:SYSTem:ERRor:GNEXt?....562
:SYSTem:ERRor:HISTory:CLEar....563
:SYSTem:ERRor:STATic?....563
:SYSTem:ERRor[:NEXT]?....562
:SYSTem:FILes:TEMPorary:DELete....585
:SYSTem:FPReset....381
:SYSTem:HELP:EXPort....572
:SYSTem:IDENtification....572
:SYSTem:IDENtification:PRESet....572
:SYSTem:INFormation:SCPI....574
:SYSTem:IRESponse....573
:SYSTem:KLOCk....563
:SYSTem:LANGuage....573
:SYSTem:LOCK:OWNer?....565
:SYSTem:LOCK:RELease:ALL....565
:SYSTem:LOCK:REQuest[:EXCLusive]?....565
:SYSTem:MMEMory:PATH:USER?....584
:SYSTem:NINFormation?....564
:SYSTem:NTP:HOSTname....581
:SYSTem:NTP:STATe....581
:SYSTem:ORESponse....573
:SYSTem:OSYStem?....583
:SYSTem:PRESet....381
:SYSTem:PROTect<ch>[:STATe]....566
:SYSTem:RCL....566
:SYSTem:REBoot....584
:SYSTem:RESTart....585

:SYSTem:SAV ... 565
:SYSTem:SECurity:NETWork:AVAHi[:STATe] ... 574
:SYSTem:SECurity:NETWork:FTP[:STATe] ... 574
:SYSTem:SECurity:NETWork:HTTP[:STATe] ... 574
:SYSTem:SECurity:NETWork:RAW[:STATe] ... 575
:SYSTem:SECurity:NETWork:REMSupport[:STATe] ... 575
:SYSTem:SECurity:NETWork:RPC[:STATe] ... 575
:SYSTem:SECurity:NETWork:SMB[:STATe] ... 576
:SYSTem:SECurity:NETWork:SOE[:STATe] ... 576
:SYSTem:SECurity:NETWork:SSH[:STATe] ... 576
:SYSTem:SECurity:NETWork:SWUPdate[:STATe] ... 576
:SYSTem:SECurity:NETWork:VNC[:STATe] ... 577
:SYSTem:SECurity:NETWork[:STATe] ... 577
:SYSTem:SECurity:SANitize[:STATe] ... 577
:SYSTem:SECurity:VOLMode[:STATe] ... 578
:SYSTem:SHUTdown ... 585
:SYSTem:SPECification:IDENtification:CATalog? ... 579
:SYSTem:SPECification:PARameter? ... 579
:SYSTem:SPECification:VERSion ... 578
:SYSTem:SPECification:VERSion:CATalog? ... 579
:SYSTem:SPECification:VERSion:FACTory? ... 580
:SYSTem:SPECification? ... 578
:SYSTem:SRData? ... 580
:SYSTem:STARtup:COMPlete? ... 580
:SYSTem:TIME ... 581
:SYSTem:TIME:PROTocol ... 582
:SYSTem:TIME:ZONE ... 582
:SYSTem:TIME:ZONE:CATalog? ... 582
:SYSTem:ULOCk ... 564
:SYSTem:UPTime? ... 583
:SYSTem:VERSion? ... 583
:SYSTem:WAIT ... 585
:TEST:PIXel:COLor ... 590
:TEST:PIXel:GRADient ... 591
:TEST:PIXel:POINtsize ... 591
:TEST:PIXel:RGBA ... 591
:TEST:PIXel:TEXT ... 591
:TEST:PIXel:WINDow ... 592
:TEST<hw>:ALL:RESult? ... 590
:TEST<hw>:ALL:STARt ... 590
:TRIGger<hw>:FPSWeep:SOURce ... 594
:TRIGger<hw>:FSWeep:SOURce ... 593
:TRIGger<hw>:FSWeep[:IMMediate] ... 595
:TRIGger<hw>:LFFSweep ... 595
:TRIGger<hw>:LFFSweep:IMMediate ... 595
:TRIGger<hw>:LFFSweep:SOURce ... 593
:TRIGger<hw>:PSWeep:SOURce ... 593
:TRIGger<hw>:PSWeep[:IMMediate] ... 595
:TRIGger<hw>[:SWEep]:SOURce ... 593
:TRIGger<hw>[:SWEep][:IMMediate] ... 595

:UNIT:ANGLe ... 596
:UNIT:POWer ... 596
[:SOURce]:CORRection:CSET:CATalog? ... 481
[:SOURce]:CORRection:CSET:DELete ... 482
[:SOURce]:INPut:TRIGger:SLOPe ... 494
[:SOURce]:LFOutput:OFFSet ... 500
[:SOURce]:LFOutput:SIMPedance ... 501
[:SOURce]:LFOutput:VOLTage ... 501
[:SOURce]:LFOutput<ch>:BANDwidth? ... 497
[:SOURce]:LFOutput<ch>:FREQuency ... 497
[:SOURce]:LFOutput<ch>:INTernal:VOLTage ... 500
[:SOURce]:LFOutput<ch>:SOURce ... 500
[:SOURce]:LFOutput<ch>:SOURce:PATH ... 501
[:SOURce]:LFOutput<ch>[:STATe] ... 499
[:SOURce]:PM<ch>[:DEViation] ... 457
[:SOURce]:POWer:WIGNore ... 537
[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate ... 460
[:SOURce]:ROSCillator:EXTernal:FREQuency ... 540
[:SOURce]:ROSCillator:EXTernal:FREQuency:VARiable ... 540
[:SOURce]:ROSCillator:EXTernal:MLRange? ... 541
[:SOURce]:ROSCillator:EXTernal:NSBandwidth? ... 541
[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] ... 540
[:SOURce]:ROSCillator:EXTernal:SBANdwidth ... 540
[:SOURce]:ROSCillator:OUTPut:ALTernate:FREQuency:MODE ... 542
[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE ... 541
[:SOURce]:ROSCillator:PRESet ... 539
[:SOURce]:ROSCillator:SOURce ... 539
[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue ... 542
[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] ... 543
[:SOURce]:STEReo:ARI:BK[:CODE] ... 475
[:SOURce]:STEReo:ARI:STATe ... 473
[:SOURce]:STEReo:ARI:TYPE ... 474
[:SOURce]:STEReo:ARI:TYPE:STATe ... 474
[:SOURce]:STEReo:ARI[:DEViation] ... 474
[:SOURce]:STEReo:AUDio:MODE ... 471
[:SOURce]:STEReo:AUDio:PREemphasis ... 472
[:SOURce]:STEReo:AUDio:PREemphasis:STATe ... 472
[:SOURce]:STEReo:DIRect ... 470
[:SOURce]:STEReo:EXTernal:IMPedance ... 472
[:SOURce]:STEReo:MMF ... 472
[:SOURce]:STEReo:PILot:PHASe ... 473
[:SOURce]:STEReo:PILot:STATe ... 473
[:SOURce]:STEReo:PILot[:DEViation] ... 473
[:SOURce]:STEReo:RDS:DATaset ... 476
[:SOURce]:STEReo:RDS:STATe ... 475
[:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe] ... 476
[:SOURce]:STEReo:RDS:TRAFfic:PROGram[:STATe] ... 476
[:SOURce]:STEReo:RDS[:DEViation] ... 475
[:SOURce]:STEReo:SOURce ... 471
[:SOURce]:STEReo:STATe ... 470

[:SOURce]:STEReo[:DEViation] 470
[:SOURce<hw>]:AM:DEPTh:SUM 447
[:SOURce<hw>]:AM:DEViation:MODE 447
[:SOURce<hw>]:AM:RATio 447
[:SOURce<hw>]:AM<ch>:SENSitivity 448
[:SOURce<hw>]:AM<ch>:SOURce 446
[:SOURce<hw>]:AM<ch>:STATe 445
[:SOURce<hw>]:AM<ch>[:DEPTh] 446
[:SOURce<hw>]:COMBined:FREQuency:STARt 552
[:SOURce<hw>]:COMBined:FREQuency:STOP 552
[:SOURce<hw>]:COMBined:POWer:STARt 552
[:SOURce<hw>]:COMBined:POWer:STOP 553
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency 479
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts? 479
[:SOURce<hw>]:CORRection:CSET:DATA:POWer 479
[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts? 479
[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe 480
[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe 481
[:SOURce<hw>]:CORRection:CSET[:SELect] 480
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? 482
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension 482
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect 483
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn 483
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal 483
[:SOURce<hw>]:CORRection:DEXChange:EXECute 483
[:SOURce<hw>]:CORRection:DEXChange:MODE 483
[:SOURce<hw>]:CORRection:DEXChange:SELect 484
[:SOURce<hw>]:CORRection:VALue? 480
[:SOURce<hw>]:CORRection:ZERoing:STATe 481
[:SOURce<hw>]:CORRection[:STATe] 481
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:CATalog? 486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:FREQuency:RANGe:LOWer? 486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE:FREQuency:RANGe:UPPer? 486
[:SOURce<hw>]:EFRontend:ALIGnment:FILE[:SELect] 486
[:SOURce<hw>]:EFRontend:ALIGnment[:STATe] 487
[:SOURce<hw>]:EFRontend:IDN? 485
[:SOURce<hw>]:EFRontend:OPT? 486
[:SOURce<hw>]:EFRontend:SCRew:POSition? 487
[:SOURce<hw>]:EFRontend[:FREQuency]:IFRequency[:VALue]? 485
[:SOURce<hw>]:FM:DEViation:MODE 451
[:SOURce<hw>]:FM:DEViation:SUM 451
[:SOURce<hw>]:FM:MODE 452
[:SOURce<hw>]:FM:RATio 452
[:SOURce<hw>]:FM:SENSitivity? 452
[:SOURce<hw>]:FM<ch>:SOURce 450
[:SOURce<hw>]:FM<ch>:STATe 450
[:SOURce<hw>]:FM<ch>[:DEViation] 450
[:SOURce<hw>]:FREQuency:CENTer 491
[:SOURce<hw>]:FREQuency:MANual 490
[:SOURce<hw>]:FREQuency:MODE 488

[:SOURce<hw>]:FREQuency:MULTiplier 490
[:SOURce<hw>]:FREQuency:OFFSet 491
[:SOURce<hw>]:FREQuency:SPAN 492
[:SOURce<hw>]:FREQuency:STARt 492
[:SOURce<hw>]:FREQuency:STEP:MODE 493
[:SOURce<hw>]:FREQuency:STEP[:INCRement] 493
[:SOURce<hw>]:FREQuency:STOP 492
[:SOURce<hw>]:FREQuency[:CW|FIXed] 489
[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL 490
[:SOURce<hw>]:INPut:MODext:COUPling 494
[:SOURce<hw>]:INPut:MODext:IMPedance<ch> 494
[:SOURce<hw>]:LFOutput:FREQuency:MANual 498
[:SOURce<hw>]:LFOutput:FREQuency:MODE 499
[:SOURce<hw>]:LFOutput:FREQuency:STARt 499
[:SOURce<hw>]:LFOutput:FREQuency:STOP 499
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl 504
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute 505
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE 505
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:POINts 506
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace 506
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RUNNing? 506
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe 506
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing 507
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic 507
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] 507
[:SOURce<hw>]:LFOutput<ch>:PERiod? 498
[:SOURce<hw>]:LFOutput<ch>:SHAPe 501
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:DCYCle 502
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:PERiod 502
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:WIDTh 502
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL 502
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH 503
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:PERiod 503
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:RISE 503
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:PERiod 504
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:RISE 504
[:SOURce<hw>]:LIST:CATalog? 516
[:SOURce<hw>]:LIST:DELete 516
[:SOURce<hw>]:LIST:DELete:ALL 517
[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog? 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension 518
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect 519
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn 519
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal 519
[:SOURce<hw>]:LIST:DEXChange:EXECute 519
[:SOURce<hw>]:LIST:DEXChange:MODE 520
[:SOURce<hw>]:LIST:DEXChange:SELect 520
[:SOURce<hw>]:LIST:DWELl 511
[:SOURce<hw>]:LIST:DWELl:LIST 511
[:SOURce<hw>]:LIST:DWELl:LIST:POINts? 512

[:SOURce<hw>]:LIST:DWELl:MODE 511
[:SOURce<hw>]:LIST:FREE? 517
[:SOURce<hw>]:LIST:FREQuency 512
[:SOURce<hw>]:LIST:FREQuency:POINts? 513
[:SOURce<hw>]:LIST:INDex 513
[:SOURce<hw>]:LIST:INDex:STARt 513
[:SOURce<hw>]:LIST:INDex:STOP 513
[:SOURce<hw>]:LIST:MODE 513
[:SOURce<hw>]:LIST:POWer 514
[:SOURce<hw>]:LIST:POWer:POINts? 514
[:SOURce<hw>]:LIST:RESet 517
[:SOURce<hw>]:LIST:RUNNing? 516
[:SOURce<hw>]:LIST:SELect 518
[:SOURce<hw>]:LIST:TRIGger:EXECute 515
[:SOURce<hw>]:LIST:TRIGger:SOURce 515
[:SOURce<hw>]:MODulation[:ALL][:STATe] 442
[:SOURce<hw>]:NOISe:BANDwidth|BWIDth 521
[:SOURce<hw>]:NOISe:DISTribution 521
[:SOURce<hw>]:NOISe:LEVel:RELative? 521
[:SOURce<hw>]:NOISe:LEVel[:ABSolute]? 521
[:SOURce<hw>]:PGENerator:OUTPut:POLarity 522
[:SOURce<hw>]:PGENerator:OUTPut[:STATe] 523
[:SOURce<hw>]:PGENerator:STATe 523
[:SOURce<hw>]:PHASe 524
[:SOURce<hw>]:PHASe:REFerence 524
[:SOURce<hw>]:PM:DEViation:MODE 456
[:SOURce<hw>]:PM:DEViation:SUM 456
[:SOURce<hw>]:PM:MODE 455
[:SOURce<hw>]:PM:RATio 456
[:SOURce<hw>]:PM:SENSitivity? 457
[:SOURce<hw>]:PM<ch>:SOURce 455
[:SOURce<hw>]:PM<ch>:STATe 454
[:SOURce<hw>]:POWer:ALC:DSENsitivity 527
[:SOURce<hw>]:POWer:ALC:SONCe 528
[:SOURce<hw>]:POWer:ALC[:STATe] 527
[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE 528
[:SOURce<hw>]:POWer:EMF:STATe 528
[:SOURce<hw>]:POWer:LBEHaviour 529
[:SOURce<hw>]:POWer:LIMit[:AMPLitude] 529
[:SOURce<hw>]:POWer:MANual 529
[:SOURce<hw>]:POWer:MODE 530
[:SOURce<hw>]:POWer:POWer 530
[:SOURce<hw>]:POWer:RANGe:LOWer? 536
[:SOURce<hw>]:POWer:RANGe:UPPer? 536
[:SOURce<hw>]:POWer:SPC:CRANge 531
[:SOURce<hw>]:POWer:SPC:DELay 531
[:SOURce<hw>]:POWer:SPC:MEASure 532
[:SOURce<hw>]:POWer:SPC:MODE 532
[:SOURce<hw>]:POWer:SPC:PEAK 532
[:SOURce<hw>]:POWer:SPC:SELect 532

[:SOURce<hw>]:POWer:SPC:SINGle ... 533
[:SOURce<hw>]:POWer:SPC:STATe ... 533
[:SOURce<hw>]:POWer:SPC:TARGet ... 533
[:SOURce<hw>]:POWer:SPC:WARNing? ... 533
[:SOURce<hw>]:POWer:STARt ... 531
[:SOURce<hw>]:POWer:STEP:MODE ... 534
[:SOURce<hw>]:POWer:STEP[:INCRement] ... 534
[:SOURce<hw>]:POWer:STOP ... 531
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet ... 535
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL ... 535
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:REFLevel ... 536
[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] ... 535
[:SOURce<hw>]:PULM:DELay ... 460
[:SOURce<hw>]:PULM:DOUBle:DELay ... 461
[:SOURce<hw>]:PULM:DOUBle:STATe ... 461
[:SOURce<hw>]:PULM:DOUBle:WIDTh ... 461
[:SOURce<hw>]:PULM:IMPedance ... 463
[:SOURce<hw>]:PULM:MODE ... 459
[:SOURce<hw>]:PULM:OUTPut:SYNC[:STATe] ... 462
[:SOURce<hw>]:PULM:PERiod ... 460
[:SOURce<hw>]:PULM:POLarity ... 462
[:SOURce<hw>]:PULM:SOURce ... 461
[:SOURce<hw>]:PULM:STATe ... 461
[:SOURce<hw>]:PULM:TRAin:CATalog? ... 464
[:SOURce<hw>]:PULM:TRAin:DELete ... 464
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? ... 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension ... 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect ... 468
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn ... 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal ... 467
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute ... 468
[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE ... 466
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect ... 468
[:SOURce<hw>]:PULM:TRAin:OFFTime ... 465
[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts? ... 465
[:SOURce<hw>]:PULM:TRAin:ONTime ... 465
[:SOURce<hw>]:PULM:TRAin:ONTime:POINts? ... 465
[:SOURce<hw>]:PULM:TRAin:REPetition ... 465
[:SOURce<hw>]:PULM:TRAin:REPetition:POINts? ... 465
[:SOURce<hw>]:PULM:TRAin:SELect ... 466
[:SOURce<hw>]:PULM:TRIGger:MODE ... 459
[:SOURce<hw>]:PULM:TTYPe ... 462
[:SOURce<hw>]:PULM:WIDTh ... 460
[:SOURce<hw>]:SWEep:COMBined:COUNt ... 553
[:SOURce<hw>]:SWEep:COMBined:DWELl ... 553
[:SOURce<hw>]:SWEep:COMBined:EXECute ... 553
[:SOURce<hw>]:SWEep:COMBined:MODE ... 554
[:SOURce<hw>]:SWEep:COMBined:RETRace ... 554
[:SOURce<hw>]:SWEep:COMBined:SHAPe ... 555
[:SOURce<hw>]:SWEep:POWer:DWELl ... 546

[:SOURce<hw>]:SWEep:POWer:EXECute 550
[:SOURce<hw>]:SWEep:POWer:MODE 547
[:SOURce<hw>]:SWEep:POWer:POINts 547
[:SOURce<hw>]:SWEep:POWer:RETRace 550
[:SOURce<hw>]:SWEep:POWer:RUNNing? 551
[:SOURce<hw>]:SWEep:POWer:SHAPe 550
[:SOURce<hw>]:SWEep:POWer:SPACing:MODE? 548
[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic] 548
[:SOURce<hw>]:SWEep:RESet[:ALL] 555
[:SOURce<hw>]:SWEep[:FREQuency]:DWELl 548
[:SOURce<hw>]:SWEep[:FREQuency]:EXECute 550
[:SOURce<hw>]:SWEep[:FREQuency]:MODE 549
[:SOURce<hw>]:SWEep[:FREQuency]:POINts 549
[:SOURce<hw>]:SWEep[:FREQuency]:RETRace 550
[:SOURce<hw>]:SWEep[:FREQuency]:RUNNing? 551
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe 550
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing 549
[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic 551
[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] 551
*CLS 376
*ESE 376
*ESR? 376
*IDN? 377
*IST? 377
*OPC 377
*OPT? 377
*PRE 378
*PSC 378
*RCL 378
*RST 378
*SAV 379
*SRE 379
*STB? 379
*TRG 379
*TST? 380
*WAI 380
DIAGnostic:HUMS:DELete:ALL 399
DIAGnostic:HUMS:DEVice:HISTory:DELete:ALL 400
DIAGnostic:HUMS:DEVice:HISTory? 399
DIAGnostic:HUMS:FORMat 400
DIAGnostic:HUMS:SAVE 401
DIAGnostic:HUMS:STATe 401
DIAGnostic:HUMS:TAGS:ALL? 401
DIAGnostic:HUMS:TAGS:DELete 402
DIAGnostic:HUMS:TAGS:DELete:ALL 402
DIAGnostic:HUMS:TAGS[:VALue] 402
STEReo:DIRect 599
STEReo:DIRect 600
STEReo:DIRect 600
STEReo:DIRect 601

STEReo:DIRect ... 601
STEReo:DIRect ... 602
STEReo:DIRect ... 602
STEReo:DIRect ... 602
STEReo:DIRect ... 603
STEReo:DIRect ... 603
STEReo:DIRect ... 603
STEReo:DIRect ... 604
STEReo:DIRect ... 604
STEReo:DIRect ... 605
STEReo:DIRect ... 605
STEReo:DIRect ... 606
STEReo:DIRect ... 606
STEReo:DIRect ... 606
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STEReo:DIRect ... 614
STEReo:DIRect ... 614
STEReo:DIRect ... 614
STEReo:DIRect ... 615
STEReo:DIRect ... 615
STEReo:DIRect ... 616
STEReo:DIRect ... 616
STEReo:DIRect ... 617
STEReo:DIRect ... 617
STEReo:DIRect? ... 616
SYSTem:COMMunicate:REST:ENABle ... 403
SYSTem:COMMunicate:SNMP:COMMunity:RO ... 403
SYSTem:COMMunicate:SNMP:COMMunity:RW ... 403
SYSTem:COMMunicate:SNMP:CONTact ... 404
SYSTem:COMMunicate:SNMP:LOCation ... 404
SYSTem:COMMunicate:SNMP:USM:USER ... 404

SYSTem:COMMunicate:SNMP:USM:USER:ALL? 405
SYSTem:COMMunicate:SNMP:USM:USER:DELete 405
SYSTem:COMMunicate:SNMP:USM:USER:DELete:ALL 405
SYSTem:COMMunicate:SNMP:VERSion 405

Index

Symbols

/var/user directory ... 382
/var/volatile directory ... 382
&GTL ... 352
&LLO ... 352
&NREN ... 352
50 - Extern reference out of range or disconnected ... 619
140 - This modulation forces other modulations off ... 619
180 - Adjustment failed ... 620
182 - Adjustment data missing ... 620
183 - Adjustment data invalid ... 620
200 - Cannot access hardware ... 620
201 - Hardware revision out of date ... 620
202 - Cannot access the EEPROM ... 620
203 - Invalid EEPROM data ... 620
204 - river initialization failed ... 620
241 - No current list ... 620
242 - Unknown list type specified ... 620
460 - Cannot open the file ... 620
461 - Cannot write file ... 620
462 - Cannot read file ... 620
463 - Filename missing ... 620
464 - Invalid filename extension ... 620
465 - File contains invalid data ... 620

A

About
  ALC states and their effects ... 174
  Attenuator ... 171
  Internal adjustments ... 633
  Power-On/EMF ... 258
  Reference oscillator ... 211
  Selftests ... 633
  UCOR ... 176, 177
Accept
  Security settings ... 287
Access modes
  Overview ... 297
Active connections
  Remote access settings ... 318
Active elements ... 50
Add LAN sensor
  NRP sensor mapping ... 205
Add sensor
  NRP sensor mapping ... 205
Add USBTMC sensor
  NRP sensor mapping ... 206
Add, change, delete
  User key action ... 267
Address
  GPIB interface ... 315
Adjust
  Display and keyboard ... 255
  Display settings ... 254
  Keyboard settings ... 254
Adjustment frequency
  Reference oscillator ... 216
Adjustments
  All ... 634
  All delayed ... 636
  Continue ... 635
  Delay settings ... 635
  Information ... 635
  Last full adjustment ... 634
  Settings ... 634
  Shutdown ... 636
  Warm up time ... 636
Advanced configuration
  LXI ... 336
ALC
  Detector sensitivity ... 176
  Settings ... 175
  State ... 175
ALC states and their effects ... 174
Alphanumeric keys
  Front panel keyboard ... 257
Alphanumeric values
  Entering ... 53
AM ... 68
  Deviation mode ... 77
  Overview ... 111
  Ratio ... 78
  Subsystem ... 443
  Total deviation ... 78
Amplitude modulation ... 77
  Depth ... 77
  Deviation mode ... 77
  Ratio ... 78
  Sensitivity ... 77
  Subsystem ... 443
Analog modulation
  Options ... 68
  Overview ... 109
  Signal source ... 68
Annotation
  Disable amplitude display ... 281
  Disable frequency display ... 280
  Disable level ... 281
Aperture time
  Power sensors ... 202
Application cards ... 20
Application notes ... 20
Apply
  Settings of external instrument ... 126
Apply and connect
  Settings of external instrument ... 126
ARI
  BK code ... 84
  Deviation ... 84
  Enabling ... 84
  Identification of ARI signal ... 84
ATN ... 656
Attention ... 656
Attenuator
  About ... 171
  RF signal ... 171
  Settings ... 172
Attenuator settings
  Level range ... 173
  Mode ... 172
  RF OFF mode ... 173
Auto once
  Power sensors ... 202
  Power viewer ... 202

Automatic level control
Detector sensitivity ... 176
Readjust internal switch position ... 65, 173
Settings ... 175
State ... 175
Automation ... 296
Autonegotiation
Failed ... 622
Avahi
LAN services ... 285
Average level
Power viewer ... 200

B

Bandwidth
Modulation input ... 105
Noise generator ... 106
Basics
Editor ... 94, 167, 183
Export list files ... 95, 186
Fill with sensor list files ... 184
Import list files ... 95, 186
Baud rate
RS232 interface ... 315
Bench top, placing ... 22
Brochures ... 19
Browser settings
LXI ... 333
Bytes order
Definition ... 411

C

Calibrate RF output level with power sensor ... 206
Calibration certificate ... 20
CALibration subsystem ... 392
Carrying the instrument ... 21
Catch range
NRP power control ... 197
Central storage
Accessing ... 248
Change
GPIB address ... 344, 351
Change password
Setup (security) ... 290
Change user password
Setup (security) ... 289
Check display screen
Display screen test ... 643
Check front panel
Key panel test ... 641
Performing ... 641
Settings ... 640
Check touch panel
Touchscreen test ... 642
Checking the instrument ... 21
Clean
List of external instrument ... 125
Cleaning ... 633
Clear
NRP sensor mapping ... 205
RF output protection ... 173
User menu ... 265
Clear history
Undo/Redo ... 295
Clear status
Remote ... 376
Close
Show SCPI command ... 355
Closed connections
Remote access settings ... 319
Combined RF frequency / level sweep
Step count ... 158
Combined sweep
Spacing ... 154, 156
Command sequence
Remote ... 380
Commands of all settings
SCPI list ... 232
Configuration
Restoring ... 233
Restoring instrument settings ... 230
Configure remote access ... 341
Configuring LAN services ... 283
Confirm user password
Setup (security) ... 289
Connect ... 122
External instrument ... 126
Connect remote instruments
Keep connection on preset ... 123
On start-up ... 123
Connecting
Keyboard ... 25
LAN ... 25
Memory stick ... 25
Mouse ... 25
Power ... 24
To Ref In/Ref Out ... 28
To RF ... 28
To RF coaxial connectors ... 26
USB devices ... 25
Connecting to RF coaxial connectors
To connect to pluggable connectors ... 27
To connect to screwable connectors ... 27
To prepare for connecting ... 26
Connection fault
169.254.*.* ... 622
Connector
AC power supply ... 37
GPIB ... 37
IEC/IEEE ... 37
Inst Trig ... 38
LAN ... 37
LF ... 38
Mod. Ext. ... 38
Pulse Ext. ... 38
Pulse Video ... 38
Ref In ... 38
Ref Out ... 38
RF 50 Ω ... 35
S/P Dif ... 37
Signal Valid ... 38
Stereo L/R ... 37
USB ... 34, 37
USB In ... 37
Connector direction
Settings ... 123
Context-sensitive menu ... 50
Continue
Internal adjustments ... 635
Continue on error
Failed internal adjustments ... 623

Control bus 656
Convert
Remote command list 362
Copy
Instrument settings 239
Several files 237, 245, 246
Show SCPI command 355
Counter 627
Coupling mode
AM, FM, PhiM 105
External modulation input 105
Create
New directory 239
Current frequency
Sweep 151
Current index
List mode 161
Current level
Sweep 151
Customer support 630
Cut
Instrument settings 239
CW
Frequency 60
CW mode
Output level 63
CW signal
Settings 57

D

Data
Accessing 220
Handling 220
Retrieving 220
Data editor
UCOR 181
Data entry 52
Data format
Definition 412
Data list
Access 234
How to open 383
Select, edit, new 236
Data sheets 19
Data valid 656
Datasheet
LXI 339
Date 638
DAV 656
Deactivate RF output 213
Deactivated licenses 270
Declassification 280
Default directory
Mass memory 382
User data 222, 382
Default values
Remote 378
Define
User key action 267
Delay
Double pulse (PULM) 90
PULM 90
Delay time
NRP power control 197
Delete
Instrument settings 239
List mode file 163
Delete instrument settings 389
Delete temporary files 646
Delta phase
RF frequency 66
Detector sensitivity
Automatic level control 176
Deviation
Fixed total deviation 75, 76
PhiM 76
Deviation mode
AM 77
Amplitude modulation 77
FM 75
Frequency modulation 75
Phase modulation 76
PhiM 76
Device ID 269
NRP sensor mapping 206
Device reset 381
Device-specific notifications 619
Dialog boxes 51
Direction
Connector 123
Directory
Temporary data 382
User data 382
Disable
Frequency display 280
Level display 281
Disconnect 122
Disk & memory
Security settings 278
Display
Active elements 50
Brightness 256, 257
Context-sensitive menu 50
Info line 50
Information 48
Lock 281
On-screen keypad 50
Overview 31
Power sensors 200
Screen saver 256
Settings 255
Setup 255
Status bar 49
Tab labels 50
Taskbar 49
Tile diagram 49
USB keyboard 257
Wait time (screen saver) 256
Display correction file data
UCOR 181
Display correction value
UCOR 180
Display permanent
Power sensors 200
Display screen
Checking 643
Display screen test
Perform 643
DISPlay subsystem 406
Disposal 633

Distribution
Noise generator ... 106
DNS server ... 312
DNS suffix ... 312
Documentation overview ... 18
Double pulse delay
PULM ... 90
Double pulse width
PULM ... 90
Downgrade information ... 628
Factory version ... 628
Min. version ... 628
Dwell time
Sweep ... 154
Dwell time mode
List mode ... 161

E

Edit
Editor ... 94, 167, 183
List mode data ... 163
UCOR data ... 181
Editor
Basics ... 94, 167, 183
Edit ... 94, 167, 183
Fill with sensor ... 183
Goto ... 94
Save ... 94, 167, 183
Save as ... 94, 167, 183
Select row ... 167, 183
EMF display
RF level ... 258
Emulation
IDN string ... 317
Language ... 317
Mode ... 317
Set IDN and OPT to default ... 317
Enable
LAN interface ... 285
Enable registers
Remote ... 378
Enter license key ... 269
Enter password
Setup (security) ... 287
EOI ... 656
Error log ... 629
Error messages ... 620
Adjustment data invalid (183) ... 620
Adjustment data missing (182) ... 620
Adjustment failed (180) ... 620
Cannot access hardware (200) ... 620
Cannot access the EEPROM (202) ... 620
Cannot open file (460) ... 620
Cannot read file (462) ... 620
Cannot write file (461) ... 620
Driver initialization failed (204) ... 620
Extern reference out of range or disconnected (50) ... 619
File contains invalid data (465) ... 620
Filename missing (463) ... 620
Hardware revision out of date (201) ... 620
Invalid EEPROM data (203) ... 620
Invalid filename extension (464) ... 620
No current list (241) ... 620
SCPI ... 619
See notifications ... 618
This modulation forces other modulations off (140) ... 619
Unknown list type specified (242) ... 620
Event status enable register (ESE)
Remote ... 376
Event status register (ESR)
Remote ... 376
Exclude frequency ... 232
Exclude level ... 232
Execute
Single sweep ... 155
Trigger (list mode) ... 162
Execute single
NRP power control ... 196
Expiration date of option ... 628
Export
Execute ... 97, 165, 188
SCPI ... 236
SCPI export ... 358
SCPI list ... 356
SCPI settings ... 356
Export deactivation response ... 270
Export license key ... 270
Export list files
Basics ... 95, 186
Express level in
Volts ... 524
External frequency
Reference oscillator ... 213
External instrument
Settings ... 124
External RF
Configuration and settings ... 122

F

Factory
Preset ... 227
Factory preset
Change GPIB address ... 344
GPIB address ... 351
Factory version
Firmware ... 628
File
SCPI export ... 357
File catalog
List mode ... 163
File content
SCPI export ... 358
File handling ... 223
File list ... 386
File manager ... 237
File name ... 250
File select
Dialog ... 234
File server
Data exchange ... 248
File sharing ... 243
File storage location ... 382
File system ... 221
Accessing ... 243
File transfer ... 223
From file server ... 248
FTP/SAMBA ... 296
How to ... 243
File type selection ... 238
Filename
Pulse graph ... 98

Files
User data ... 220
Fill
User correction data ... 94, 167, 183
Fill table
Automatically ... 94, 167, 183
UCOR ... 181
Fill with sensor
Basics ... 184
Editor ... 183
Filter
Power sensors ... 201
Filter length
Auto ... 202
User-defiend ... 202
Finding out the default directory ... 222, 382
Firmware
Factory version ... 628
Min. version ... 628
Version ... 628
Fixed
Frequency ... 60
Floating licenses ... 628
FM ... 68
Deviation ... 74
Deviation mode ... 75
Ratio ... 75
Subsystem ... 448
Total deviation ... 75
FM deviation
Stereo modulation ... 80
Format
SCPI Export ... 357
FORMat subsystem ... 411
FPGA/µC
Check for updates ... 645
Check for updates of external ... 646
Shut down after update internal ... 646
Update installation internal assembly ... 645
Update table ... 645
Free space
internal memory ... 646
Frequency
Annotation disable ... 280
CW, fixed ... 60
LF gen frequency ... 81
LF generator ... 103
LF sweep ... 103
Multiplier ... 61
Offset ... 60
Power sensors ... 201
RF signal ... 59
UCOR ... 181
Frequency modulation ... 74
Deviation mode ... 75
Ratio ... 75
Subsystem ... 448
Frequency multiplier
Test setup ... 115
Frequency, internal
AM ... 103
FM ... 103
Front panel
Checking ... 640
Front panel test
Performing ... 641
Front panel tour ... 30
FTP
How to access the instrument ... 243
LAN services ... 285
Function keys
Overview ... 32

G

Gateway ... 312
General configuration of instrument ... 254
General instrument functions
User key ... 260
User menu ... 260
General instrument settings ... 254
Generating an unmodulated signal ... 57
Getting started ... 19
Global dwell time
List mode ... 162
Goto
Editor ... 94
GPIB
Address ... 315
Change address ... 344, 351
Channel address ... 314
Characteristics ... 302
Interface ... 302
Set up remote control ... 351
Visa resource string ... 314
GPIB address
Factory preset ... 351
GUI
Setting ... 259
GUI update
Setup ... 254

H

Hard copy
Create, how to ... 252
File format ... 250, 251
Print, how to ... 252
Hard disk
Deleting temp files ... 646
Hardcopy ... 249
Options ... 250
Hardware channel
Remote Instrument ... 125
Health and utilization
LXI ... 339
Help ... 19, 54
HiSlip
Visa resource string ... 313
HiSLIP
Resource string ... 299
History
Undo/Redo ... 295
Host name
NRP sensor mapping ... 205
Hostname ... 311
LXI ... 332
Remote Instrument ... 125
How to
Calibrate RF output level with power sensor ... 206
Change the default directory ... 383
Checking hardware options ... 624
Checking RF assembly ... 625
Configure the R&S SMB100B for frontend control ... 117

Connect an R&S SZM ... 116
Internal adjustments ... 636
Multiplying RF output frequencies ... 121
Output the external frontend RF signal ... 121
Resolve adjustments errors ... 623
Run delayed adjustments ... 637
Use an complete file path ... 383
User key ... 264
User menu ... 262
Using power sensors ... 189
How to:
Enable VNC ... 364
Remote control with LXI browser ... 344
Return to manual operation ... 353
HTTP
LAN services ... 285
HUMS ... 320
About ... 320
Add device tags ... 331
Delete device tag entry ... 331
Delete device tags ... 331
Delete history ... 322
Device ID ... 330
Device tag key ... 330
Device tag value ... 330
Device tags ... 329
Enhanced settings ... 322
Export history ... 322
LXI ... 339
Protocol settings ... 323
REST ... 324
SNMP protocol ... 324
SNMPv2 access ... 325
SNMPv2 community ... 324
SNMPv2 configuration ... 324
SNMPv3 user ... 325
State ... 322

I

Identification
Emulation mode ... 317
Remote ... 377
IDN string
Emulation mode ... 317
IEC/IEEE bus interface
Channel address ... 314
IFC ... 656
Impedance
External modulation source ... 105
Impedance audio signal ... 81
Import
Execute ... 97, 165, 188
SCPI ... 236
Import license key ... 270
Import list files
Basics ... 95, 186
Import/Export
Lists ... 163
Select file ... 97, 165, 188
Inactive licenses ... 270
Index
List mode ... 161
Info line ... 50, 620
Information
Internal adjustments ... 635
Input
Impedance external modulations ... 105
Pulse polarity ... 99
Stereo modulation ... 78
Trigger impedance ... 99
Input connector ... 38
Input connectors
S/P Dif ... 37
Stereo L/R ... 37
Installed assembly ... 626
Instrument
Carrying ... 21
Checking ... 21
Lifting ... 21
Operating site ... 21, 22
Unpacking ... 21
Instrument emulations ... 316
Instrument help ... 19
Instrument name
External instrument ... 124
Instrument security procedures ... 19
Instrument settings
Recall ... 378, 389
Save ... 379, 391
Instrument tour ... 30
Interface
Functions (GPIB) ... 657
GPIB ... 302
Interface clear ... 656
Interfaces
GPIB ... 302
RS232 ... 301
USB ... 301
Internal adjustements
How to ... 636
Internal adjustment
Continue on error ... 623
Internal adjustments
Abort on error ... 623
About ... 633
Troubleshooting ... 623
internal memory
Deleting temp files ... 646
IP address ... 299
Dynamic ... 311
LXI ... 332
Not recognized ... 622
NRP sensor mapping ... 205
Remote Instrument ... 125
Zeroconf ... 311
IP address mode ... 311
IP configuration
LXI ... 335
IST flag
Remote ... 377

K

Key
★ (User) ... 34
Arrow ... 33
Backspace ... 33
Down ... 33
Enter ... 33
Esc ... 33
Freq ... 32
Help ... 31

Home ... 34
Left ... 33
Level ... 32
Local ... 31
Mod on/off ... 32, 70
Next window ... 34
On/Off ... 34
On/Standby ... 35
Preset ... 31
Resize window ... 34
RF on/off ... 32
Right ... 33
Setup ... 31
Up ... 33
Key panel test
Check front panel ... 641
Keyboard
On-screen ... 52
Setting ... 259
Settings ... 255
Setup ... 255
Subsystem ... 418
Usage ... 47
Keypad
On-screen ... 52
Overview ... 35

L

LAN
Connecting ... 25
Environment ... 25
Interface ... 299
IP address ... 299
Main services ... 285
Reset ... 333
Samba services ... 286
Services ... 283
LAN configuration
LXI ... 335
LAN interface
Avahi ... 285
Enable ... 285
FTP ... 285
HTTP ... 285
LAN over SCPI ... 285
SMB (Samba) ... 285
SSH ... 285
VNC ... 285
LAN status
LXI ... 332
Language
Emulation ... 317
Last factory calibration ... 627
Last full adjustment
Internal adjustments ... 634
Layout
USB keyboard ... 257
Level
Annotation disable ... 281
Behavior (RF) ... 64, 158, 197
Noise generator ... 109
Level default unit
Change ... 524
Level in SCPI in V ... 524
Level limit ... 63, 197
Level offset
Power sensors ... 201
RF level ... 64
State (power sensors) ... 201
Level range
Attenuator settings ... 173
Level settings
On start-up ... 258
LF frequency sweep
State ... 101, 151
LF generator
Shape ... 101
LF Out
Overview ... 110
LF output ... 107
Load impedance ... 108
Offset ... 108
Period ... 103
Pulse duty cycle ... 103
Pulse width ... 103
Shape ... 101
Source ... 108, 111
Source impedance ... 108
Sweep reset ... 155
Trapezoid high ... 104
Trapezoid rise, fall ... 104
Triangle rise ... 104
Voltage ... 108
LF sweep
Frequency ... 103
License
Keys ... 268
License for software option ... 628
Infos ... 628
Licenses ... 268
Server ... 271
Settings ... 268
Lifting the instrument ... 21
Limit
RF level ... 63, 197
List
Define ... 163
Range ... 163
State ... 161
List file
Catalog ... 163
List mode
Create list automatically ... 94, 167, 183
Current index ... 161
Dwell time mode ... 161
Edit ... 163
Execute trigger ... 162
Export user data ... 97, 165, 188
File settings, import/export ... 96, 164, 187
Global dwell time ... 162
Import/export ... 96, 163, 164, 187
Load from file ... 97, 165, 188
Load user data ... 163
Reset ... 162
Select file ... 163
Settings ... 159
State ... 161
Trigger execute ... 162
Trigger source ... 161
Load
Impedance ... 108
See recall ... 230

Load instrument settings 378, 389
Loading
Trying out 44
Lock
Display 281
LSB/MSB order
Definition 411
LucasFonts
RSCorpid EULA 628
LXI
Advanced configuration 336
Browser settings 333
Configuration 370
Datasheet 339
Health and utilization 339
Hostname 332
IP address 332
IP configuration 335
LAN configuration 335
LAN status 332
MAC address 332
Ping 337
Remote trace (SCPI) 337
Reset (LXI) 333
Status settings 332
Tracing 345
LXI broswer
Starting remote control 344

M

Mac address 312
MAC address
LXI 332
Maintenance 633
Managing license keys 268
Managing licenses 268
Manual interaction 47
Manual operation
Security settings 280
Map network share
Settings 238, 239
Mapping network folders 241
Mass storage location 382
Maximal deviation
Frequency modulation 74
PhiM 76
Maximal modulation frequency 82
Measured level
NRP level control 196
Min. version
Firmware 628
Minimum locking range 214
Mode
Attenuator settings 172
Emulation 317
Frequency modulation 75
IP address 311
List 161
NRP power control 196
PhiM 77
PULM 88
Pulse modulation 88
Sweep 151
User variation 61, 65
Modulation
AM 71
Analog 68
Bandwidth, external input 105
External coupling 105
FM 71
Input impedance 105
Overview 109
Phase 71
PhiM 71
PM 71
Pulse 71
Source 74
State 74
Stereo modulation 71, 78
Modulation depth
AM 77
Modulation sensitivity
AM 77
Modulations state
Toggle 70
More free disc space
Deleting temp files 646
Mounting, in a rack 23
Mouse
Usage 47
Multiple files
Copy 237, 245, 246
Multiplier
Frequency 61

N

Naming conventions
Allowed file names 221
Navigation
Keys 33
Navigation controls
Overview 32
NDAC 656
Network
Connection fails 622
Environment 25
Settings 310
Network share
Mapping 239, 241
Network status 310
New password
Setup (security) 289
New user password
Setup (security) 289
Noise
Distribution 106
Noise bandwidth limitation
System bandwidth 106
Noise generator
Bandwidth 106
Noise level
Absolute system bandwidth 109
Relative system bandwidth 109
Noise ratio
Power sensors 202
Non-operational data 220
Notifications 618, 620
Device-specific 619
NRFD 656

NRP level control
Measured level ... 196
NRP power control ... 193
Catch range ... 197
Delay time ... 197
Execute single ... 196
Mode ... 196
Reference level ... 196
Remote command sequence ... 525
Select sensor ... 196
Settings ... 194
State ... 195
Take measured level as reference ... 196
Target level ... 196
NRP power viewer ... 192
Settings ... 193
Use S-Parameter ... 203
NRP sensor configuration ... 198
NRP sensor mapping ... 203
Add LAN sensor ... 205
Add sensor ... 205
Add USBTMC sensor ... 206
Clear ... 205
Connector ... 204
Device ID ... 206
Host name ... 205
IP address ... 205
Protocol ... 204
Scan ... 205
Sensor name ... 204, 206
Serial number ... 206
Settings ... 204
NTP
Address ... 639
Number of licenses ... 628
Numeric data entry ... 52
Numeric values
Entering ... 52

O

Offset
Frequency ... 60
Old password
Setup (security) ... 289
Old user password
Setup ... 288
On-screen keypad ... 50
Open source acknowledgment (OSA) ... 20
Open-source acknowledgments ... 628
Operating site
Choosing ... 21
Setting up the instrument ... 22
Operation
Concepts ... 46
Manual ... 47
Operation complete
Remote ... 377
Operation hours ... 627
Operation mode ... 230
Operation status register ... 308
Operational data ... 220
Option
Expiration date ... 628
Option: expiration date ... 628
Options
Analog modulation ... 68
Identification (remote) ... 377
Oscillator
Reference ... 211
Output
LF ... 108
SCPI list (select file) ... 357
Source (LF output) ... 111
OUTPut
Subsystem ... 419
Output connector ... 38
Output connectors
RF 50 Ω ... 35
Output, LF
Offset ... 108
Voltage ... 108
Overview
AM ... 111
LF Out ... 110

P

Parallel poll register enable
Remote ... 378
Parity
RS232 interface ... 315
Password
Change (security password) ... 290
Change (user password (security)) ... 289
Confirm (security password) ... 289
Confirm (user password (security)) ... 289
Enter (security password) ... 287
New (security password) ... 289
New (user password (security) ... 289
Old (security password) ... 289
Old user password ... 288
Protection level ... 283
Password management
Security ... 287
Paste
Instrument settings ... 239
PCI bus ... 626
Phase
Subsystem ... 523
Phase modulation ... 76
Deviation ... 76
Deviation mode ... 76
Mode ... 77
Ratio ... 76
Subsystem ... 453
Phase reference ... 66
Phase settings
RF signal ... 66
PhiM
Deviation mode ... 76
Mode ... 77
Ratio ... 76
Settings ... 76
Total deviation ... 76
Pilot tone
Enabling ... 83
Pilot deviation ... 83
Pilot phase ... 83
Ping
LXI ... 337
Placing, on a bench top ... 22

PM 68
Subsystem 453
Polarity
Pulse generator output 91
Pulse modulation 99
Power
Connecting the instrument 24
UCOR 181
Power On 35
Power sensors
Activation 200
Aperture time 202
Auto once 202
Filter 201
Filter length 202
Frequency 201
Level (average) 200
Level (peak) 200
Level offset 201
Noise ratio 202
NRP power control 193
Serial number 200
Source 201
State 200
State (level offset) 201
Timeout 202
Unit 200
Update 191
Use default aperture time 202
Zero 200
Power Sensors
Display 200
Display permanent 200
Power supply
Connector 37
Power viewer
Auto once 202
Power-On
Settings 258
Power-On count 627
Power-On state
RF level 258
Power-On/EMF
About 258
RF signal 258
Preemphasis 81
Prefix, year, month, Day 252
Preparing for use 21
Preset
Factory preset 227
Print
Hard copy 252
Protection
Settings 282
Setup 277
Protection level
1 277
2 277
3, 4, 5 277
Adjustments 277
Calibration 277
Factory only 277
Protection level 283
Service department 277
PULM
Delay 90
Double pulse delay 90
Double pulse width 90
Impedance (trigger input) 99
Mode 88
Period 90
Pulse polarity (input) 99
see PM 71
Source 72
State 71
Subsystem 457
Transition type 72
Width 90
Pulse
Duty cycle 103
Length (PULM) 90
Period 103
Width 103
Width (PULM) 90
Pulse generator
Delay 90
Output polarity 91
Output state 90
Pulse sync signal output 91
Single Trigger 91
Subsystem 522
Width 90
Pulse graph
Filename 98
Zoom In/Out 98
Zoom position 98
Zooming 98
Pulse modulation 71
Double pulse delay 90
Double pulse width 90
Mode 88
Period 90
Pulse polarity (input) 99
Repetition frequency 90
see PM 71
Select pulse train file 93
Source 72
State 71, 72
Subsystem 457
Trigger input impedance 99
Trigger mode 89
Pulse sync out
Pulse generator 91
Pulse train
File catalog 93
Import/export 96, 164, 187
On/off time 94
Repetition 94
Select 93

Q

QR code 331
Questionable status register 308
Quick recall 233
Quick save 232

R

Rack, mounting 23
Ratio
AM 78
Amplitude modulation 78
FM 75

Frequency modulation 75
Phase modulation 76
PhiM 76
RDS
Data set 86
Deviation 86
Enable identification of program 86
Enable traffic announcement function 87
Enable traffic program function 86
Enabling 85
Show program service name 86
Readjust
Automatic level control 65, 173
Recall
Instrument settings 233
User menu 265
Recall instrument settings 378, 389
Recall intermediate 378
Recorded SCPI commands
SCPI list 356
Recording list
SCPI settings 355
Redo 294
Clear history 295
History 295
Settings 294
State 295
Reference frequency output
1 GHz 215
10 MHz, 100 MHz 215
Loop through 215
Reference oscillator 211
Adjustment 216
Adjustment frequency 216
External frequency 213
Output frequency 215
Preset 213
Reference frequency, variable 214
RF off state 213
Source 213
Synchronization bandwidth 214
Release notes 20
Reload
SCPI list 358
Remote access 296
Active connection settings 318
Closed connection settings 319
Configuring 341
DNS server 312
DNS suffix 312
GPIB address 314
GPIB resource (VISA resource string) 314
HISLIP resource (VISA resource string) 313
HUMS 320
Identification 317
IDN string 317
IEC/ IEEE bus address 314
Instrument emulations 316
IP address mode 311
Language 317
Network gateway 312
Network hostname 311
Network IP address 311
Network Mac address 312
Network resource (Ethernet resource string) 313
Network settings 310
Network status 310
OPT string 318
QR code 331
RS232 315
Serial resource (VISA resource string) 314
Set IDN and OPT to default 317
Settings 309
Socket resource (VISA resource string) 314
Subnet mask 311
USB resource (VISA resource string) 314
Visa resource strings settings 313
VXI11 resource (VISA resource string) 313
Workgroup name 311
Remote command list
Convert 362
Remote connection
Status 124
Remote control 46
Access modes 297
Configure access 341
GPIB 351
GPIB interface 302
Interfaces and protocols 298
Programming examples 375
Programs and libraries 303
return to manual operation 353
SCPI 296
Setting up 340
Source subsystem 441
Remote Desktop 46
Remote interfaces and protocols 298
Remote operation 46
Stop acess 370
VNC 296
Remote to local switch over 352
Remote trace
LXI 337
Removing sensitive data 629
REN 656
Rename
File 390
Instrument settings 239
Reset
List mode 162
RF frequency (delta phase) 66
Sweep 155
Reset device parameters 381
Reset values
Remote 378
Resolving internal adjustment failures 623
Resource string
RS232 302
USB 301
VISA 299
Restoring configuration 226
Resulting file name 252
Retrace
Sweep 152
RF 50 Ω connector 35
RF combined sweep
State 151
RF frequency
Configuring 57
RF frequency sweep
State 150
RF frontend
Cable correction settings 130
Configuration and settings 126

General settings 127
Versions and options 128
RF level
Configuring 57
EMF display 258
Offset 64
Power-On state 258
Setting characteristics 64, 158, 197
Settings 61
RF level sweep
State 150
RF OFF mode
Attenuator settings 173
RF off state
Reference oscillator 213
RF ON, RF OFF, RF ON/OFF 57
RF output
Amplitude 63
Impedance 57
Protection 173
State 57
RF Output
Level range 65, 159
RF output signal
Phase 66
Phase reference 66
RF phase
Configuring 57
RF signal
Analog modulation 68
Attenuator 171
Frequency 59
Phase settings 66
Power-On/EMF 258
User correction 176
Rotary knob 33
User variation 61, 65
RS232
Baud rate 315
Interfaces 301
Parity 315
Remote access 315
Resource string 302
Serial (VISA resource string) 314
Stop bits 316

S

S-Parameter
Activate corrections 203
S/P Dif connector 37
Safety instructions 13, 19
Samba services
SMB client 286
SMB server 287
SAMBA/SMB
How to access the instrument 243
Sanitize 280
save
Save 230
Save
Editor 94, 167, 183
Instrument settings 232
User menu 265
Save and load 230
Save as
Editor 94, 167, 183
Save hard copy as
bmp, jpg, png 250, 251
Save instrument settings 379, 391
Save intermediate 379
Save/Recall 230
Dialog 230
How to 233
SCPI-Export 360
Saving 43
Saving files 383
Scan
NRP sensor mapping 205
SCONfiguration subsystem 436
SCPI
Error messages 619
Export 236
Export settings 356
Import 236
LAN services 285
Output file 357
Recording list settings 355
SCPI export 358
File content 358
Select file 357
SCPI Export
Format 357
SCPI list
Commands of all settings 232
Export 356
Recorded SCPI commands 356
Show all commands 232
SCPI recording
Settings 354
SCPI remote trace
LXI 337
SCPI script
Select 267
SCPI-Export
Save/Recall 360
Screen saver
Activate 259
State 256
Wait time 256
SD card slot 34
Security
Accept settings 287
Change password (setup) 290
Change user password (setup) 289
Confirm password (setup) 289
Confirm user password (setup) 289
Disk & memory settings 278
Display lock 281
Enter password (setup) 287
Manual operation settings 280
New password (setup) 289
New user password (setup) 289
Old password (setup) 289
Old user password 288
Password management 287
Sanitize 280
Security password 289
Setup 277
USB storage (setup) 279
User name (setup) 288
User password 288
Volatile memory 279

Security password
Security ... 289
Setup ... 289
Security procedures ... 19
Security settings ... 277
Select
List mode data file ... 163
Setup file ... 267
User correction data file ... 180
Select file ... 236
Select instrument
Remote Instrument ... 125
Select row
Editor ... 167, 183
Self-test
Remote ... 380
Selftests
About ... 633
Sensitive information
Protecting ... 222, 229
Sensor
NRP power control ... 196
Sensor name
NRP sensor mapping ... 206
Serial
Visa resource string ... 314
Serial bus ... 626
Serial number ... 343
NRP sensor mapping ... 206
Power sensors ... 200
Service manual ... 19
Service request enable register (SRE)
Remote ... 379
Services
LAN ... 283
Set IDN and OPT to default
Emulation mode ... 317
Set up remote control
GPIB ... 351
Setting up
remote control ... 340
Settings
Active connections ... 318
ALC ... 175
AM ... 77
Attenuator ... 172
Automatic level control ... 175
Check front panel ... 640
Closed remote connections ... 319
Delayed adjustment ... 635
Display ... 255
Instrument emulations ... 316
Internal adjustments ... 634
Keyboard ... 255
Licenses ... 268
List mode ... 159
Managing ... 220
NRP power control ... 194
NRP power viewer ... 193
NRP sensor mapping ... 204
On power-on ... 258
Phase ... 66
Protection ... 282
Remote access ... 309
RF level ... 61
SCPI export ... 356
SCPI recording ... 354
SCPI recording list ... 355
Security ... 278, 280
Show SCPI command ... 355
UCOR ... 179
Undo/Redo ... 294
User key ... 266
Setup
Accept security settings ... 287
Adjusting display ... 254
Adjusting keyboard ... 254
Annotation frequency ... 280
Annotation level ... 281
Change password ... 289
Change password (security) ... 290
Confirm password ... 289
Confirm password (security) ... 289
Display lock ... 281
Enter password (security) ... 287
GUI update ... 254
Keyboard settings ... 255
Layout (front panel keyboard) ... 257
Layout (USB keyboard) ... 257
New password ... 289
New password (security) ... 289
Old password (security) ... 289
Password (protection) ... 283
Performing the front panel test ... 641
Protection level ... 283
Screen saver ... 256
Security password ... 289
USB storage (security) ... 279
User name (security) ... 288
User password ... 288
Wait time ... 256
Setup files
Data exchange ... 248
Setup key ... 254
Shape
LF gen shape ... 81
LF generator ... 101
LF output ... 101
Period ... 103
Pulse duty cycle ... 103
Pulse width ... 103
Sweep ... 152
Trapeze high ... 104
Trapezoid rise, fall ... 104
Triangle rise ... 104
Show
SCPI list ... 232
Show SCPI command
Close ... 355
Copy ... 355
Settings ... 355
Signal output
LF ... 107
Signal source
Analog modulation ... 68
Single
Execute (list mode) ... 162
SMB (Samba)
LAN services ... 285
Socket
Visa resource string ... 314
Softkey bar
See Taskbar ... 49

Source
AM, FM, ΦM ... 74
Analog modulation ... 68
Impedance ... 108
LF output ... 108, 111
Power sensors ... 201
Pulse modulation ... 72
Reference oscillator ... 213
Sweep trigger ... 151
Source subsystem
Remote control commands ... 441
Spacing
Frequency sweep ... 154, 156
RF frequency / level sweep ... 154, 156
RF level sweep ... 158
Span
Frequency sweep ... 156
Specifications ... 19
SRQ ... 656
SSH
LAN services ... 285
Standby ... 35
Start
Frequency sweep ... 156
RF level sweep ... 158
State
Adjustment (reference oscillator) ... 216
AM, FM, PhiM ... 74
Automatic level control ... 175
LF frequency sweep ... 101, 151
List mode ... 161
NRP power control ... 195
Power sensors ... 200
Pulse generator output ... 90
Pulse modulation ... 71
RF frequency / level sweep ... 151
RF frequency sweep ... 150
RF level sweep ... 150
RF output ... 57
RF output protection ... 173
Screen saver ... 256
Stereo modulation ... 80
UCOR ... 180
Undo/Redo ... 295
Status
Remote connection ... 124
Status bar
Display ... 49
Status byte
Remote ... 376, 379
Status information ... 270
Status register
Response format deinition ... 412
Status reporting system ... 306
Common commands ... 376
Overview of status registers ... 306
Status settings
LXI ... 332
Step
Frequency sweep ... 157
Linear (frequency sweep) ... 157
Logarithmic (frequency sweep) ... 157
RF level sweep ... 158
Step count
Combined RF frequency / level sweep ... 158
Step width
User variation ... 61, 65
Stereo L/R connector ... 37
Stereo modulation ... 68, 78
Change modes ... 80
Enabling ... 80
Frequency of LF generator signal ... 81
Impedance of external analog audio signal ... 81
Maximal modulation frequency ... 82
MPX deviation ... 80
Preemphasis ... 81
Shape of LF generator signal ... 81
Source of audio signal ... 81
Stop
Frequency sweep ... 156
RF level sweep ... 158
Stop bits
RS232 interface ... 316
Stopping remote operation ... 370
Storage ... 633
Storage location
/usb/ ... 221
/var/user ... 221
/var/volatile ... 221
Mass memory ... 382
Subnet mask ... 311
Subsystem
AM ... 443
FM ... 448
Keyboard ... 418
Phase ... 523
PM ... 453
Power ... 524
PULM ... 457
Pulse generator ... 522
Stereo modulation ... 468
Support ... 629
Sweep
Center frequency ... 156
Current frequency ... 151
Current level ... 151
Dwell time ... 154
Execute single ... 155
Frequency span ... 156
Mode ... 151
Reset ... 155
Retrace ... 152
Shape ... 152
Spacing ... 154, 156, 158
Start/stop frequency ... 156
Start/stop level ... 158
State (LF frequency) ... 101, 151
State (RF combined) ... 151
State (RF frequency) ... 150
State (RF level) ... 150
Step ... 157, 158
Trigger manually ... 155
Switching
On or off ... 28
Symbolic name
Remote Instrument ... 125
Synchronization bandwidth
Reference oscillator ... 214
System
Factory preset ... 227
System bandwidth
Noise level (absolute) ... 109
Noise level (relative) ... 109

T

Tab labels 50
Take measured level as reference
  NRP power control 196
Target level
  NRP power control 196
Temperature offset
  Internal adjustments 635
Temporary files 222, 229
Test
  Check front panel 641
Text entry 52
Tile diagram
  Display 49
Time
  UTC 638
Time protocol
  Settings 639
Timeout
  Filter (power sensors) 202
Tooltips
  Show 54
Touchscreen 31
  Compared with mouse 47
  Usage 47
Touchscreen test
  Perform 642
Tracing
  Messages 345
  SCPI commands 345
Transition
  PULM 72
  Pulse modulation 72
Transporting 632
Trapezoid
  High (LF generator) 104
  Rise, fall 104
Triangle
  Rise 104
Trigger
  Event (remote) 379
  Execute (list mode) 162
  Sweep, manually 155
Trigger source
  List mode 161
  Sweep 151
Tripped
  RF output protection 173

U

UCOR
  About 177
  Calibrate RF output level with power sensor 206
  Data 180
  Data editor 181
  Display correction file data 181
  Display correction value 180
  Edit data 181
  Export user data 97, 165, 188
  File catalog 180
  File settings, import/export 96, 164, 187
  Fill with sensor 185
  Import/export 96, 163, 164, 187
  Load from file 97, 165, 188
  RF signal 176
  Select file 180
  Settings 179
  State 180
Undo 294
  Clear history 295
  History 295
  Settings 294
  State 295
Unpacking the instrument 21
USB
  Interfaces 301
  Resource string 301
  Storage (security) 279
  Visa resource string 314
Use default aperture time
  Power sensors 202
User correction
  see UCOR 176
User correctioon
  Data editor 181
User data
  Access 234
  Load from a specific directory 384
User files 221
User interface
  Front panel keyboard 257
  Lock 281
User key 260
  Action name 266
  Add, change, delete action 267
  Assign actions 264
  Define action 266, 267
  SCPI command 267
  Select dialog ID 267
  Settings 266
  Toggle between define and execute mode 267
User manual 19
User menu 260
  Access 262
  Clear 265
  Create 262
  Recall 265
  Save 265
  Settings 265
User name
  Setup (security) 288
User password
  Security 288
  Setup 288
User preset 226
User variation
  Activating 61, 65
  Level 61, 65
  RF 61, 65
User-definable preset
  Recall 261
Utility keys
  Overview 31

V

Variable reference frequency 214
Varying
  RF frequency and level 61, 65
Version
  Firmware 628
Videos 20

VISA 299
Resource string 299
Visa resource string
Ethernet 313
GPIB 314
HISLIP 313
Serial 314
Socket 314
USB 314
VXI11 313
Visa resource strings 313
VNC 46
How to enable 364
LAN services 285
Volatile memory 222, 229
Volatile mode
Activate 279
VXI11
Visa resource string 313

W

Wait
Remote 380
Wait time
Screen saver 256
Warnings 618, 620
Web interface 46
What's new 18
White papers 20
Wi-Fi
WLAN 367
Width
Double pulse (PULM) 90
PULM 90
Pulse modulation 90
Workgroup name 311

Z

Zero
Power Sensors 200
Zeroconf
IP address 622
Zoom In/Out
Pulse graph 98
Zoom position
Pulse graph 98
Zooming
Pulse graph 98