R&S®SMA100B
RF Signal Generator
User Manual

1178383402

User Manual

Version 05

ROHDE&SCHWARZ

This document describes the R&S®SMA100B, stock no. 1419.8888.02 and its options:

- R&S®SMAB-B1H
- R&S®SMAB-B28
- R&S®SMAB-B29
- R&S®SMAB-B32/-B34
- R&S®SMAB-B80/-B85
- R&S®SMAB-B81
- R&S®SMAB-B86
- R&S®SMAB-B92/-B93
- R&S®SMAB-B103/-B106/-B112/-B120
- R&S®SMAB-B709/-B710(N)/-B711(N)
- R&S®SMAB-K22/-K23/-K24/-K27
- R&S®SMAB-K25
- R&S®SMAB-K31/-K33
- R&S®SMAB-K703
- R&S®SMAB-K704
- R&S®SMAB-K720/-K721
- R&S®SMAB-K722
- R&S®SMAB-K723
- R&S®SMAB-K724

This manual describes firmware version FW 4.50.090.xx and later of the R&S®SMA100B.

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1178.3834.02 | Version 05 | R&S®SMA100B

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®SMA100B is indicated as R&S SMAB. Linux® is abbreviated as Linux.

Safety Instructions
Instrucciones de seguridad
Sicherheitshinweise
Consignes de sécurité

⚠ WARNING

Risk of injury and instrument damage

The instrument must be used in an appropriate manner to prevent electric shock, fire, personal injury or instrument damage.

- Do not open the instrument casing.
- Read and observe the "Basic Safety Instructions" delivered as printed brochure with the instrument.
- Read and observe the safety instructions in the following sections. Note that the data sheet may specify additional operating conditions.
- Keep the "Basic Safety Instructions" and the product documentation in a safe place and pass them on to the subsequent users.

⚠ ADVERTENCIA

Riesgo de lesiones y daños en el instrumento

El instrumento se debe usar de manera adecuada para prevenir descargas eléctricas, incendios, lesiones o daños materiales.

- No abrir la carcasa del instrumento.
- Lea y cumpla las "Instrucciones de seguridad elementales" suministradas con el instrumento como folleto impreso.
- Lea y cumpla las instrucciones de seguridad incluidas en las siguientes secciones. Se debe tener en cuenta que las especificaciones técnicas pueden contener condiciones adicionales para su uso.
- Guarde bien las instrucciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

⚠ WARNUNG

Gefahr von Verletzungen und Schäden am Gerät

Betreiben Sie das Gerät immer ordnungsgemäß, um elektrischen Schlag, Brand, Verletzungen von Personen oder Geräteschäden zu verhindern.

- Öffnen Sie das Gerätegehäuse nicht.
- Lesen und beachten Sie die "Grundlegenden Sicherheitshinweise", die als gedruckte Broschüre dem Gerät beiliegen.
- Lesen und beachten Sie die Sicherheitshinweise in den folgenden Abschnitten; möglicherweise enthält das Datenblatt weitere Hinweise zu speziellen Betriebsbedingungen.
- Bewahren Sie die "Grundlegenden Sicherheitshinweise" und die Produktdokumentation gut auf und geben Sie diese an weitere Benutzer des Produkts weiter.

⚠ AVERTISSEMENT

Risque de blessures et d'endommagement de l'appareil

L'appareil doit être utilisé conformément aux prescriptions afin d'éviter les électrocutions, incendies, dommages corporels et matériels.

- N'ouvrez pas le boîtier de l'appareil.
- Lisez et respectez les "consignes de sécurité fondamentales" fournies avec l’appareil sous forme de brochure imprimée.
- Lisez et respectez les instructions de sécurité dans les sections suivantes. Il ne faut pas oublier que la fiche technique peut indiquer des conditions d’exploitation supplémentaires.
- Gardez les consignes de sécurité fondamentales et la documentation produit dans un lieu sûr et transmettez ces documents aux autres utilisateurs.

Contents

1 Preface

The R&S SMA100B is a new high-performance signal generator developed to meet demanding customer requirements. Offering excellent signal characteristic and straightforward and intuitive operation, the signal generator makes signal generation fast and easy.

1.1 Key Features

Outstanding key features of the R&S SMA100B are:

- Frequency range from 8 kHz to up to 20 GHz
- Excellent signal quality
- Excellent single sideband (SSB) phase noise
- Nearly no wideband noise
- Very high output power
- Low harmonics
- Unique pulse train generation
- High-stability reference oscillator
- Intuitive operation via touchscreen with the tile diagram as key element

For more information, see data sheet.

1.2 For Your Safety

The R&S SMA100B is designated for the development, production and verification of electronic components and devices in industrial and laboratory environments. Use the R&S SMA100B only for its designated purpose. Observe the operating conditions and performance limits stated in the data sheet.

The product documentation helps you to use the R&S SMA100B safely and efficiently. Keep the product documentation in a safe place and pass it on to the subsequent users.

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

- In the "Basic Safety Instructions", safety issues are grouped according to subjects. For example, one subject is electrical safety. The "Basic Safety Instructions" are delivered with the R&S SMA100B in different languages in print.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation. Always read the safety instructions carefully. Make sure to comply fully with them. Do not take risks and do not underestimate the potential danger of small details such as a damaged power cable.

1.3 About this Manual

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

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

- **Welcome to the R&S SMA100B**
  Introduction to and getting familiar with the instrument, including introduction to the signal generation principles.
- **Getting Started**
  Information that you have received as a printed book together with your instrument
- **Configuration of the RF Signal**
  Descriptions of the individual operation modes, including configuration settings and task descriptions
- **File and Data Management**
  Description of general functions to handle data files and work with the file system of the instrument
- **System and General Instrument Configuration**
  Description of the general instrument settings and functions
- **Network and Remote Control Operation**
  Information on setting up the instrument in a network and operating it remotely.
- **Remote Commands**
  Remote commands required to configure and perform measurements in a remote environment, sorted by tasks.
  Remote commands required to set up the environment and to perform common tasks on the instrument, sorted by tasks.
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes.
- **Maintenance**
  Information on tasks required to maintain the operability of the instrument
- **Troubleshooting and Error Messages**
  Hints and tips on how to handle errors
- **Appendix**
  Extensive reference information on remote control, hardware interfaces, etc.
- **Glossary**
  List of often used terms and abbreviations
- **List of Commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

Contents and scope

This help system describes the full functionality of an R&S SMA100B. Depending on your model and the installed options, some of the functions may not be available on your instrument.

Notes on screenshots

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

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

1.4 Documentation Overview

This section provides an overview of the R&S SMA100B user documentation. Unless specified otherwise, you find the documents on the R&S SMA100B product page at:

www.rohde-schwarz.com/manual/sma100b

1.4.1 Getting Started Manual

Introduces the R&S SMA100B and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.4.2 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 SMA100B. The help offers quick, context-sensitive access to the complete information.

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

1.4.3 Service Manual

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

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

1.4.4 Instrument Security Procedures

Deals with security issues when working with the R&S SMA100B in secure areas. It is available for download on the Internet.

1.4.5 Basic Safety Instructions

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

1.4.6 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S SMA100B. It also lists the options and their order numbers and optional accessories.

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

See www.rohde-schwarz.com/brochure-datasheet/sma100b

1.4.7 Release Notes and Open Source Acknowledgment (OSA)

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

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

See www.rohde-schwarz.com/firmware/sma100b

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

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

See www.rohde-schwarz.com/application/sma100b

2 Getting Started

2.1 Preparing for Use

2.1.1 Putting into Operation

This section describes the basic steps to be taken when setting up the R&S SMA100B for the first time.

⚠ WARNING

Risk of injury due to disregarding safety information

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

- Do not open the instrument casing.

NOTICE

Risk of instrument damage due to inappropriate operating conditions

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

NOTICE

Instrument damage caused by electrostatic discharge

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

NOTICE

Risk of instrument damage due to inappropriate operating conditions

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

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

2.1.1.1 EMI Suppression

Electromagnetic interference (EMI) may affect the measurement results.

To suppress generated Electromagnetic Interference (EMI),

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

Note the EMC classification in the data sheet.

2.1.1.2 Unpacking and Checking the Instrument

Unpack the R&S SMA100B carefully and check the contents of the package.

- Check if all items listed on the delivery note, including this getting started manual, are included in the delivery.
- Check the R&S SMA100B for any damage.
  If the contents are damaged, immediately contact the carrier who delivered the package.

Packing material

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

WARNING

Risk of injury during transportation

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

2.1.1.3 Accessory List

The instrument comes with the following accessories:

- Power cable
- Getting Started printed manual

2.1.1.4 Placing or Mounting the Instrument

The R&S SMA100B is designed for use under laboratory conditions, either on a bench top or in a rack using the standard rackmount kit.

Bench top operation

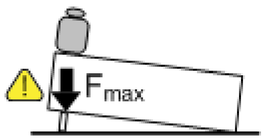
If the R&S SMA100B is operated on a bench top, the surface must be flat. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

WARNING

Risk of injury if feet are folded out

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

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



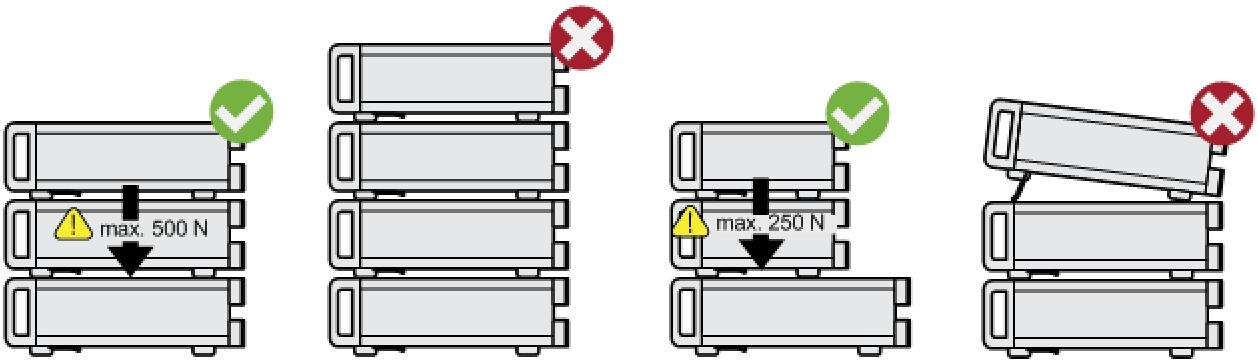
WARNING

Risk of injury when stacking instruments

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

Observe the following instructions when stacking instruments:

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



Correct | Too many instruments | Different dimensions | Feet folded out

Mounting in a rack

The R&S SMA100B can be installed in a rack using a rack adapter kit (Order No. see data sheet). The installation instructions are part of the adapter kit.

NOTICE

Risk of instrument damage due to insufficient airflow in a rack

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

2.1.1.5 Connecting AC Power

The R&S SMA100B is equipped with an AC power supply connector, that can be operated with different AC power voltages. Once it is connected, the instrument automatically adjusts to the given voltage. Refer to the data sheet for the requirements of voltage and frequency. There is no need to set the voltage manually or change fuses.

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

To connect the AC supply

► Connect the R&S SMA100B to the AC power source using the supplied power cable.

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

Characteristics of the AC power supply:
- 100 V to 240 V AC
- 50 Hz to 60 Hz; 400 Hz
- 3.5 to 1.6 A, 2HU height unit (R&S SMAB-B92)
- 7.3 to 4.6 A, 3HU height unit (R&S SMAB-B92)

2.1.1.6 Turning the Instrument On and Off

To turn on the R&S SMA100B

1. Connect the instrument to the AC supply.
2. Turn on the main AC power switch at the rear panel of the R&S SMA100B (position "I" (on)).

   The instrument is supplied with AC power.

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

To start the R&S SMA100B

Starting the R&S SMA100B requires that it is connected and turned on.

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

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

  After booting, the instrument is in the state before the last power off (standby or ready), indicated by the color of the [On/Standby] key's LEDs:
  - Green: the R&S SMA100B is running and ready for operation.
    All modules are power-supplied.
  - Orange: the R&S SMA100B is in standby mode (main AC power switch is in position "I").
    The standby power mode keeps the power switch circuits and the oven-controlled crystal oscillator OCXO active. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply.

  To switch between standby and ready state, briefly press the [On/Standby] key.

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

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

To shut down and turn off the R&S SMA100B

NOTICE

Risk of losing data

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

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

1. Press the [On/Standby] key.

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

2. Turn off the main AC power switch at the rear panel of the R&S SMA100B (position "0" (off)).

   The instrument is no longer supplied with AC power.

Turning off the AC power

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

2.1.1.7 Functional Check

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

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

Apart from the automatic monitoring, the R&S SMA100B provides internal adjustments to check correct functioning. See the corresponding sections under "Maintenance" in the user manual.

2.1.1.8 Checking the Supplied Options and Licenses

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

1. Press the [Setup] key.
2. Select "Instrument Assembly > Hardware Config" and "Software / Options".
   A list with hardware and firmware information is displayed.
3. Check the availability of the hardware options as indicated in the delivery note.
   For an overview of the available options, refer to the data sheet.

See also Chapter 14.3.5, "Requesting Instrument Configuration and Specifications", on page 698.

2.1.2 Connecting USB Devices

The USB interfaces of the R&S SMA100B allow you to connect USB devices, including USB hubs directly to the instrument. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the R&S SMA100B.

The following list shows various USB devices that can be useful:

- Memory stick for easy transfer of data to/from a computer (for example firmware updates)
- Keyboard or mouse to simplify the entry of data, comments, filenames, etc.
- Power sensors of the R&S NRP families

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

Connecting a USB storage device

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

Connecting a keyboard

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

Use the "Setup > User Interface > USB Keyboard Settings" dialog to configure the keyboard properties (see Chapter 11.1.4.1, "Setting the Keyboard Language", on page 321).

Connecting a mouse

A mouse is detected automatically when it is connected.

2.1.3 Setting Up a Network (LAN) Connection

The R&S SMA100B is equipped with a network interface and can be connected to an Ethernet LAN (local area network). Provided the appropriate rights have been assigned by the network administrator, the interface can be used, for example:

- To transfer data between a controller and the instrument, for example to run a remote control program.
  See Chapter 12, "Network Operation and Remote Control", on page 346.
- To access or operate the instrument from a remote computer using the Ultr@VNC program (or a similar tool, like another VNC client or any Web browser supporting Java).
- To transfer data from a remote computer and back, for example using network folders.
- To use power sensors with netwok capability, e.g. the R&S NRP LAN power sensors.

This section describes how to configure the LAN interface.

Accessing operating system

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

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

2.1.3.1 Connecting the Instrument to the Network

There are two methods to establish a LAN connection to the instrument:

- A non-dedicated network (Ethernet) connection from the instrument to an existing network
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer

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

If the IP address is not assigned automatically, see Chapter 2.1.3.3, "Assigning the IP Address", on page 30 for information on how to assign the address manually.

To set up a network (LAN) connection

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

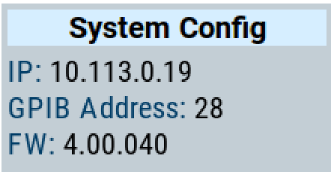
- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses

Errors can affect the entire network.

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

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

When connected, the R&S SMA100B displays the address information on the screen.



Risk of network connection failure

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

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

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

2.1.3.2 Using Computer Names (Hostnames)

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

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

The default computer name follows the syntax <INST>-<Serial Number> (previous syntax: rs<inst><Serial Number>), where:

- <INST> is the short name of your instrument, as stated on the front panel.
- <Serial Number> is the individual serial number of the instrument.
  You can find the serial number at the rear panel of instrument. It is the third part of the device ID printed on the barcode sticker .

Example:

The default hostname of an R&S SMA100B with a serial number 102030 is SMA100B-102030.

To query and change a computer name

1. Press the [Setup] key.
2. Select "Remote Access > Network".

   The computer name is displayed under "Hostname".
3. Press the [Setup] key.
4. Select "Security > Protection".
5. Enable the "Protection Level 1".
   The default password is *123456*.

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

2.1.3.3 Assigning the IP Address

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

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

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

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

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

Errors can affect the entire network.

To assign the IP address manually on the instrument

Use computer names to identify the instrument

In networks using a DHCP server, we recommend that you address the instrument by its unambiguous computer name, see Chapter 2.1.3.2, "Using Computer Names (Hostnames)", on page 29.

1. Press the [Setup] key.
2. Select "Remote Access > Network".
3. Select "Address Mode > Static".
4. Select the "IP Address".
5. Enter the IP address, for example *192.168.0.1*.

   The IP address consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.
6. Select the "Subnet Mask" and enter the subnet mask, for example *255.255.255.0*.

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

To assign the IP address manually on the computer

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

2.2 Instrument Tour

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

- Chapter 2.2.1, "Front Panel Tour", on page 32

- Chapter 2.2.2, "Rear Panel Tour", on page 39

This section explains the control elements and the connectors of the R&S SMA100B with the aid of the front and rear views. For specifications of the interfaces, refer to the data sheet.

2.2.1 Front Panel Tour

This section provides an overview of the control elements at the front panel of the R&S SMA100B. Most of the connectors are at the rear panel and are described in Chapter 2.2.2, "Rear Panel Tour", on page 39.

Figure 2-1: Front panel view of the R&S SMA100B RF Signal Generator with height unit 2HU (option R&S SMAB-B92)

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

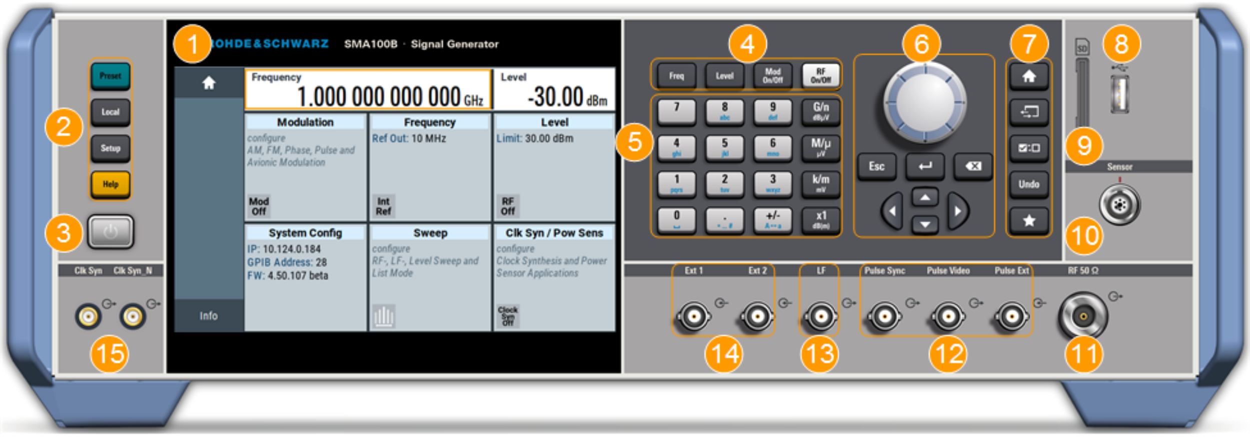


Figure 2-2: Front panel view of the R&S SMA100B RF Signal Generator with height unit 3HU (option R&S SMAB-B93)

1 = Touchscreen
2 = Utility keys
3 = [On/Standby]
4 = Function keys
5 = Keypad
6 = Navigation controls
7 = Display keys
8 = USB connector
9 = SD card slot
10 = Sensor connector
11 = RF output connector
12 = Pulse signal input and output connectors
13 = LF output connector
14 = Ext1/2 input connectors
15 = Clk Syn and Clk Syn N output connectors (SMA)

2.2.1.1 Touchscreen

The screen at the front panel is the graphical user interface. It shows the settings dialogs and parameters, and the current configuration at a glance, see Chapter 2.4.3, "Understanding the Display Information", on page 52.

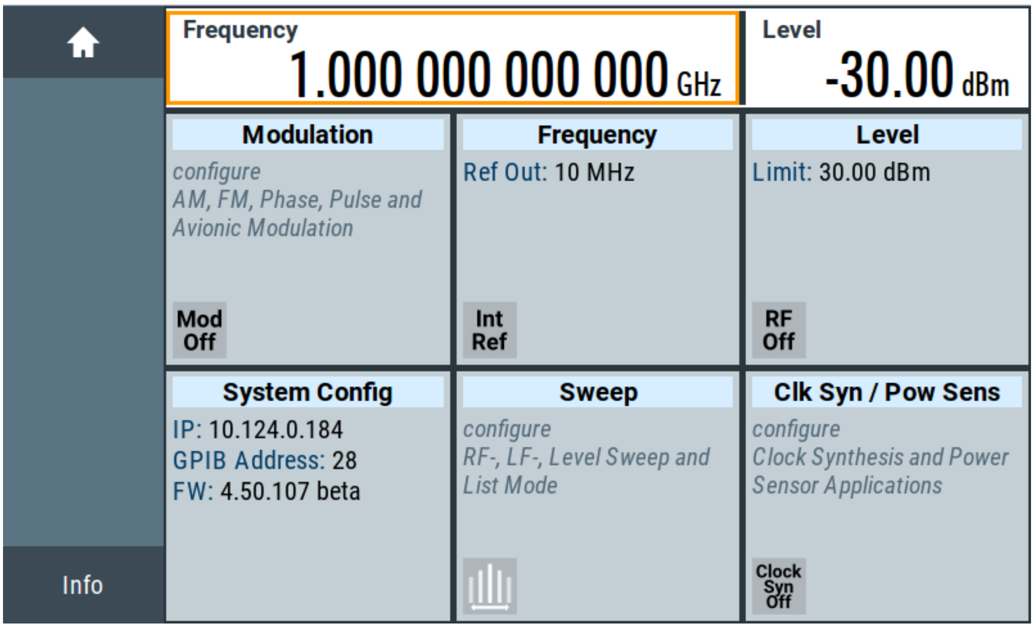


Figure 2-3: Touchscreen

The touch-sensitive panel provides an alternative means of user interaction for quick and easy handling of the instrument, see Chapter 2.4.2, "Means of Manual Interaction", on page 51.

NOTICE

Risk of touchscreen damage

Inappropriate tools or excessive force can damage the touchscreen.

Observe the following instructions when operating the touchscreen:

- Never touch the screen with ball point pens or other sharp objects, use your fingers instead.
  As an alternative, you can use a stylus pen with a smooth soft tip.
- Never apply excessive force to the screen. Touch it gently.
- Never scratch the screen surface, for example with a finger nail.
- Never rub the screen surface strongly, for example with a dust cloth.
  For instructions on cleaning the screen, see Chapter 14.1, "Cleaning", on page 686.

2.2.1.2 Utility Keys

The utility keys set the R&S SMA100B to a defined state, and provide access to basic settings and information on assistance.

Table 2-1: Utility keys

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

2.2.1.3 On/Standby

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

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

2.2.1.4 Function Keys

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

Table 2-2: Function keys

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

2.2.1.5 Keypad

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

Table 2-3: Keys on the keypad

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

2.2.1.6 Navigation Controls

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

Rotary Knob

The rotary knob has several functions:

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

Editing Keys

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

Table 2-4: Editing keys

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

Navigation Keys

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

Table 2-5: Navigation keys

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

2.2.1.7 Display Keys

The display keys arrange different windows on the display.

Table 2-6: Display keys

Display key	Assigned functions
[Home]	Returns to the initial feature screen.
[Next window]	Toggles between the entry fields in the taskbar.
[On/Off]	● Switches highlighted elements or a function block on and off. ● Switches between two or more settings, e.g. items of selection lists. At the end of a list, the cursor is set on the first entry again.

Display key	Assigned functions
[Undo]	Reverts the last operation.
[★ (User)]	Adds a parameter to the user menu for quick access.

2.2.1.8 USB Connector

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

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

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

2.2.1.9 SD card slot

Slot for removable mass storage (option R&S SMAB-B85).

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.

2.2.1.10 Sensor

Connector for R&S NRP sensors.

The R&S SMA100B supports the use of R&S NRP power sensors in various ways including the use as a power viewer.

A power sensor is connected to the R&S SMA100B by inserting the male connector. To disconnect, pull the connector by its sleeve. You cannot disconnect the sensor simply by pulling at the cable or the rear part of the connector.

The female connector allows the mechanical connection of 6-pole and 8-pole male connectors.

It mates with the interface cables R&S NRP-ZK8 and R&S NRP-ZK6, used for connecting R&S NRPxx power sensors, and also with the six-pole push-pull plugs of the R&S NRP-Zxx series.

However, the signal pair of the common time base clock assigned to the two pins in the center of the male connectors is not available. These pins are used by Rohde & Schwarz power meters to synchronize several power sensors.

Further information on connecting and using power sensors, see Chapter 7.4.1, "Connecting R&S NRP Power Sensors to the R&S SMA100B", on page 211, Chapter 7.4.3, "NRP Power Viewer", on page 214, Chapter 7.4.2, "NRP Sensor Mapping", on page 212, Chapter 7.4.4, "NRP Power Analysis", on page 222 and Chapter 7.3, "User Correction", on page 199.

2.2.1.11 RF 50 Ω

Output of the RF signal.

NOTICE

Maximum input levels

Do not overload the RF output.

The instrument is equipped with a reverse power protection that prevents the RF output against back feed, see Chapter 7.1.2, "Reverse Power Protection", on page 196. Nevertheless, the maximum permissible reverse power is specified in the data sheet.

The connector type depends on the installed frequency option.

Table 2-7: Overview of RF connector types depending on the frequency range

Required option	Connector type
RF: R&S SMAB-B103	N female
RF: R&S SMAB-B106	N female
RF: R&S SMAB-B112	Test port adapter, PC 3.5 mm female
RF: R&S SMAB-B120	Test port adapter, PC 3.5 mm female

NOTICE

Risk of RF connector and cable damage

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

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

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

Rohde & Schwarz offers appropriate torque wrenches for various connectors. For ordering information, see the R&S SMA100B data sheet or product brochure.

2.2.1.12 Pulse Signal Connectors

Pulse Sync

Output signal for synchronizing the pulse generator signal. The synchronization signal is generated at the beginning of each pulse. For double-pulse generation, the synchronization signal is generated at the beginning of the first pulse.

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

See Chapter 4.4.1, "Pulse Modulation", on page 76.

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

2.2.1.13 LF Modulation Connectors

LF
Output for internal LF generator signal.

See also data sheet and user manual, section "Analog Modulation".

Ext
Input for external analog modulation signals.

See Chapter 4, "Analog Modulations", on page 73.

2.2.1.14 Clock Synthesizer Connectors

Clk Syn/Clk Syn N
Connectors for output of the clock synthesizer signal, or the inverted signal.

2.2.2 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.

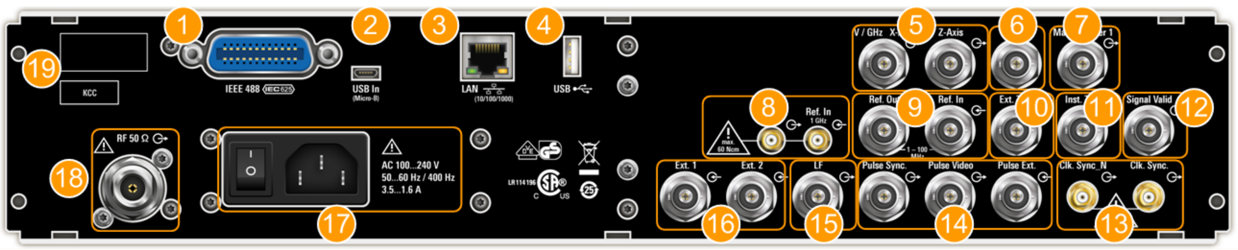


Figure 2-4: Rear panel view of the R&S SMA100B RF Signal Generator with height unit 2HU (option R&S SMAB-B92)

1 = IEC 625/IEEE 488 connector
2 = USB In connector (type micro-B)
3 = LAN connector
4 = USB connector (type A)
5 = V/GHz X-Axis and Z-Axis output connectors (BNC)
6 = Stop input and output connector (BNC)
7 = Marker User1 output connector (BNC)

8 = Ref In 1GHz and Ref Out 1GHz connectors (SMA)
9 = Ref In and Ref Out connectors (BNC)
10 = EFC input connector (BNC)
11 = Inst Trig input connector (BNC)
12 = Signal Valid output connector (BNC)
13 = Clk Syn and Clk Syn N output connectors (SMA)
14 = Pulse Sync, Pulse Video and Pulse Ext connectors (BNC)
15 = LF output connector (BNC)
16 = Ext 1/2 input connectors (BNC)
17 = AC power supply connection and main power switch
18 = RF output connector
19 = Serial number (six digits in the string 1419.8888.02-<serial number>-<checksum>)

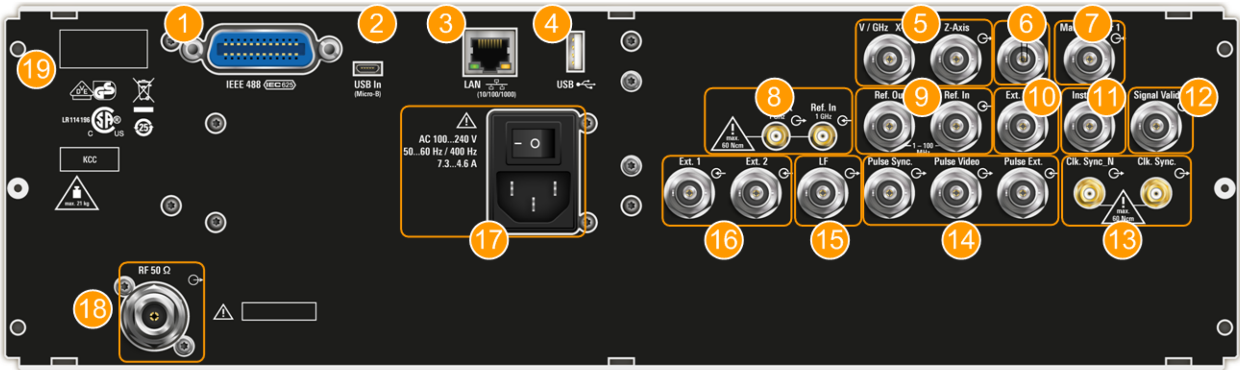


Figure 2-5: Rear panel view of the R&S SMA100B RF Signal Generator with height unit 3HU (option R&S SMAB-B93)

1 = IEC 625/IEEE 488 connector
2 = USB In connector (type micro-B)
3 = LAN connector
4 = USB connector (type A)
5 = V/GHz X-Axis and Z-Axis output connectors (BNC)
6 = Stop input and output connector (BNC)
7 = Marker User1 output connector (BNC)
8 = Ref In 1GHz and Ref Out 1GHz connectors (SMA)
9 = Ref In and Ref Out connectors (BNC)
10 = EFC input connector (BNC)
11 = Inst Trig input connector (BNC)
12 = Signal Valid output connector (BNC)
13 = Clk Syn and Clk Syn N output connectors (SMA)
14 = Pulse Sync, Pulse Video and Pulse Ext connectors (BNC)
15 = LF output connector (BNC)
16 = Ext 1/2 input connectors (BNC)
17 = AC power supply connection and main power switch
18 = RF output connector
19 = Serial number (six digits in the string 1419.8888.02-<serial number>-<checksum>)

2.2.2.1 Connectors

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

GPIB-bus interface for remote control of the instrument.

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

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

See also Chapter B.1, "GPIB-Bus Interface", on page 737 and Chapter 12, "Network Operation and Remote Control", on page 346.

USB/USB In

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

See also Chapter 2.1.2, "Connecting USB Devices", on page 27.

LAN

The LAN interface can be used to connect the R&S SMA100B to a local network for remote control, remote operation, and data transfer.

For details, see Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 28.

V/GHz X-Axis

Output of a voltage ramp:

- "V / GHz": the voltage is proportional to the frequency.
- "X-Axis": output of a voltage ramp for the X deflection of an oscilloscope or an XY recorder.

Z-Axis

Output of a voltage pulse, e.g. for the combined blanking and marker generation of network analyzers.

Stop

Input and output for stopping the sweep in all modes.

This connector is bidirectional. Used as:

- "Input": enables you to stop a sweep triggered by an external network analyzer.
- "Output": enables the R&S SMA100B to stop the sweep of an external network analyzer.

Marker User1

Output signal for marker or trigger signal.

Signal Valid

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

Alternatively, you can use this connector to synchronize pulse signals by activating the "Pulse Sync" in the dialog Chapter 4.4.3, "Pulse Generator", on page 84.

Inst Trig

Input for external trigger of sweeps and list mode.

For detailed information on the sweep modes and the triggering, see Chapter 6.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 156.

EFC
Input connector for an EFC (external frequency control) signal for electronic tuning of the internal reference frequency.

See Chapter 8, "Reference Oscillator", on page 268.

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

Incl. dedicated connectors for the 1GHz reference signal.

See Chapter 8, "Reference Oscillator", on page 268.

Clk Syn/Clk Syn N
Connectors for output of the clock synthesizer signal, or the inverted signal.

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

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

See Chapter 4.4.1, "Pulse Modulation", on page 76.

Pulse Sync
Output signal for synchronizing the pulse generator signal. The synchronization signal is generated at the beginning of each pulse. For double-pulse generation, the synchronization signal is generated at the beginning of the first pulse.

LF
Output for internal LF generator signal.

See also data sheet and user manual, section "Analog Modulation".

Ext 1/2
Inputs for external analog modulation signal, and an external detector voltage.

See Chapter 4, "Analog Modulations", on page 73.

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

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

For details, refer to Chapter 2.1.1.6, "Turning the Instrument On and Off", on page 25.

RF
Rear panel connector for the RF signal. This connector is for use of the instrument in a 19" rack.

2.3 Trying Out the Instrument

This chapter introduces the first steps with the R&S SMA100B. 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 SMA100B user manual. Basic instrument operation is described in Chapter 2.4, "Instrument Control", on page 50.

Prerequisites

The instrument is set up, connected to the power supply, and started up as described in Chapter 2.1, "Preparing for Use", on page 21.

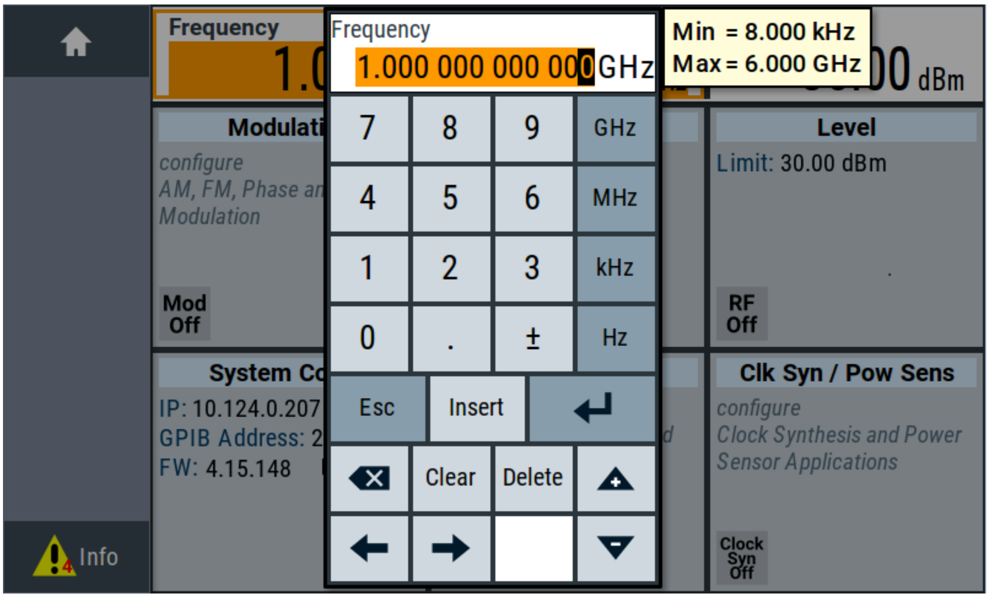
The first signal generation tasks explain how to generate an unmodulated signal, to configure the RF signal output, and how you can vary the RF frequency and level in sweep mode.

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

2.3.1 Generating an Unmodulated Carrier

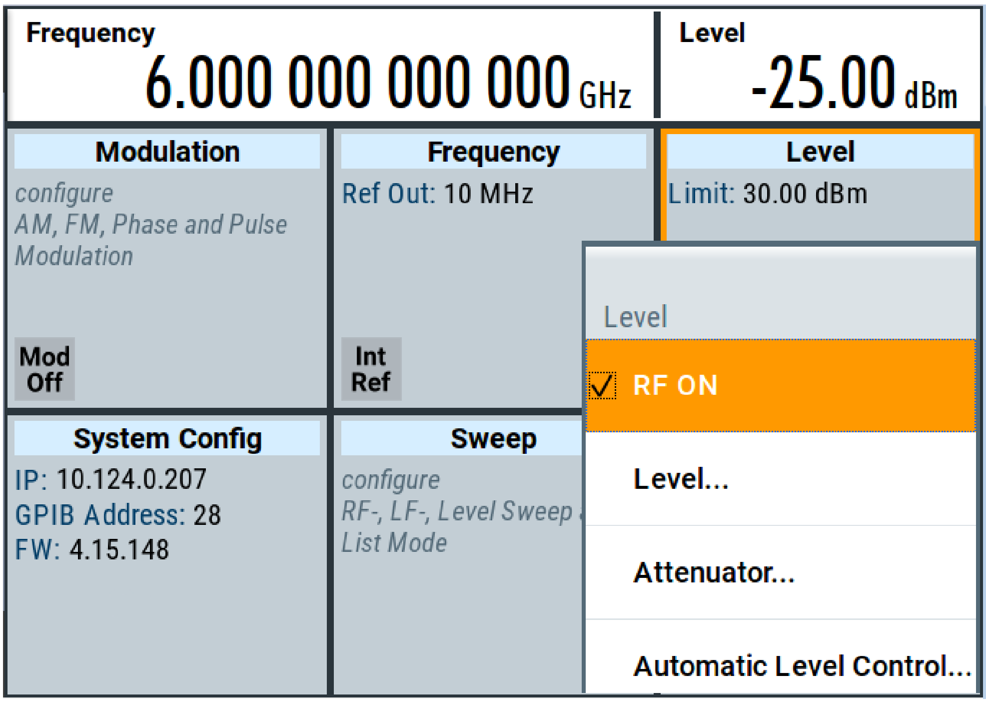
We start to generate a simple unmodulated signal. In this example, the R&S SMA100B can be in its minimal configuration.

1. On the R&S SMA100B 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 SMA100B provides the 6 GHz signal at the RF A connector at the front panel.

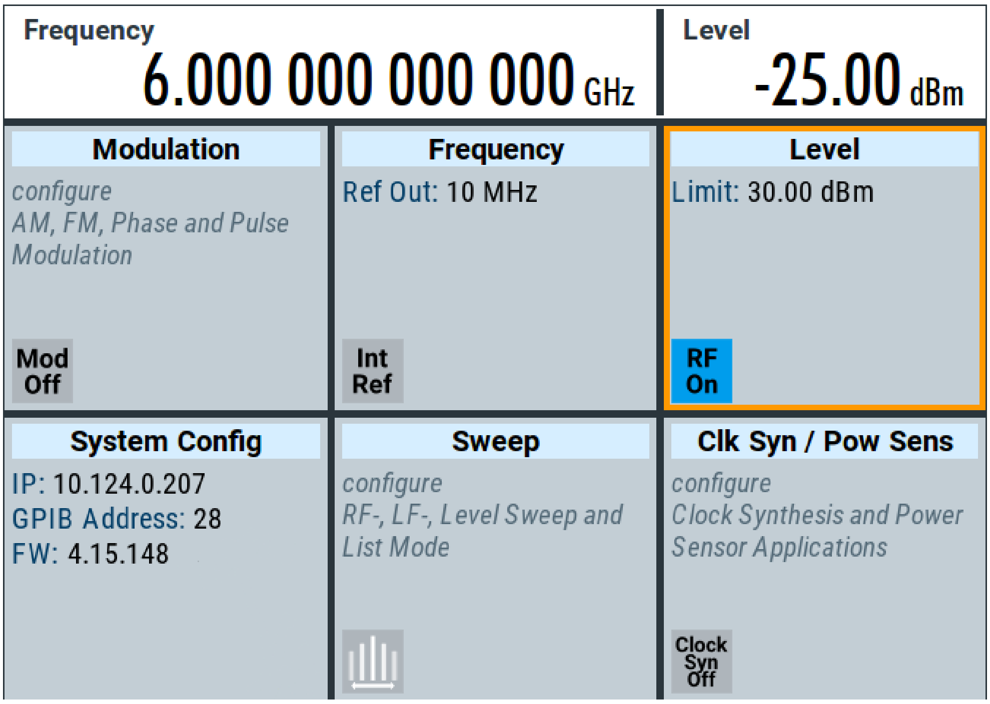


Figure 2-6: Generating an unmodulated signal

Alternative ways to access the instrument functions

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

Try out the settings dialogs

1. In the "Frequency" tile, select "Frequency...".
   a) In the "RF Frequency" tab, tap the "Frequency" field.
   b) Set the frequency via the on-screen keypad.
2. Access the "RF Level" dialog via the "Level" tile.
   a) In the "RF Level" tab, select "Amplitude".
   b) Set the amplitude (level) via the on-screen keypad.
3. Select "RF State > On" to activate the RF signal generation.

See Chapter 3, "RF Signal Configuration", on page 61.

Try out the front panel keys

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

Connect RF of the R&S SMA100B 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.

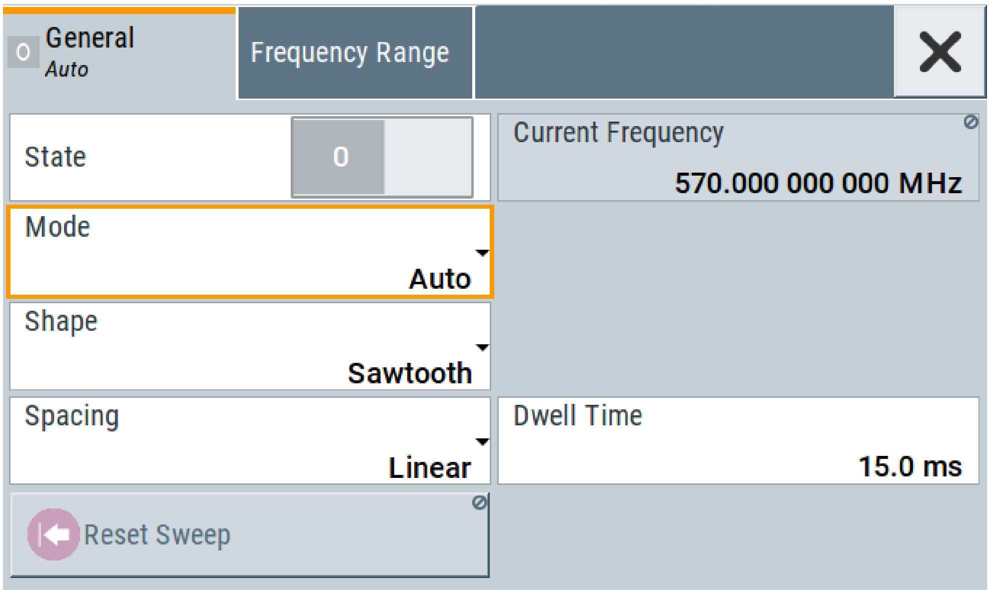
2.3.2 Generating an RF Frequency Sweep Signal

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

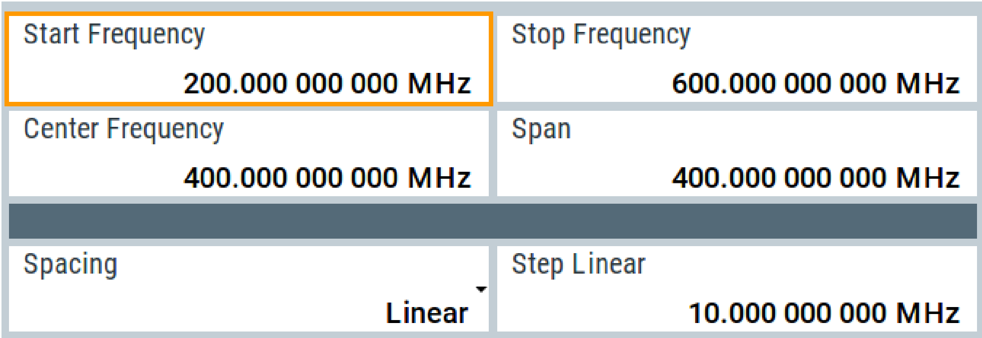
This example deals with an RF signal with varying frequency and constant level. To configure the sweep, you need to determine a defined start and end frequency with constant time intervals between the frequency steps.

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 SMA100B indicates the "Sweep" dialog as active dialog in the task bar.)
8. To activate the RF signal output, select "Level" > "RF On".

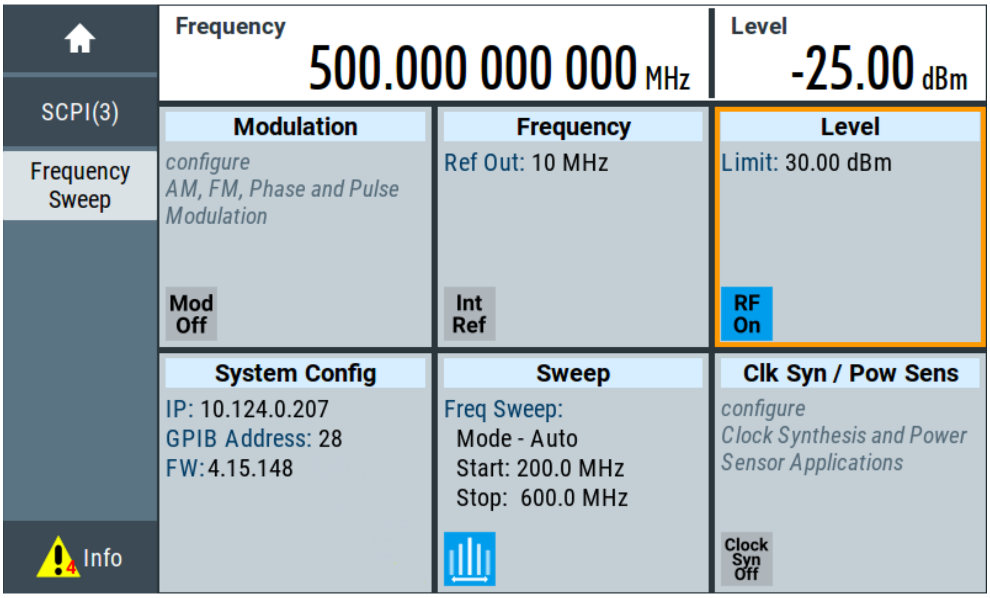


Figure 2-7: Generating a frequency sweep signal

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

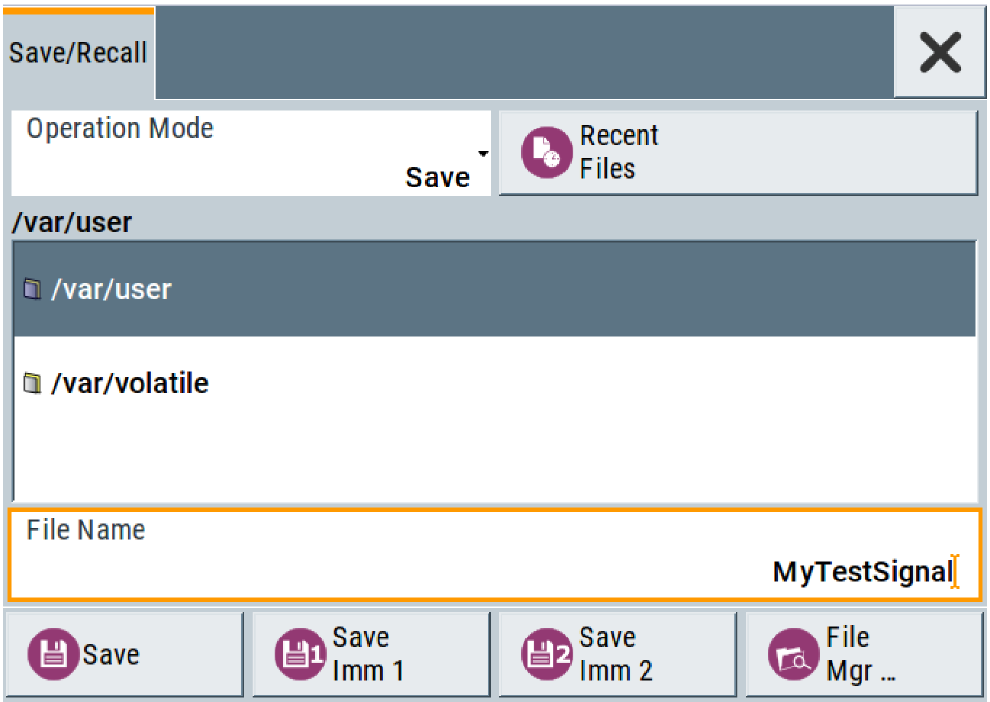
2.3.3 Saving and Recalling Settings

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

To save the instrument settings in a file

We assume, a test configuration as described in Chapter 2.3.2, "Generating an RF Frequency Sweep Signal", on page 46.

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.

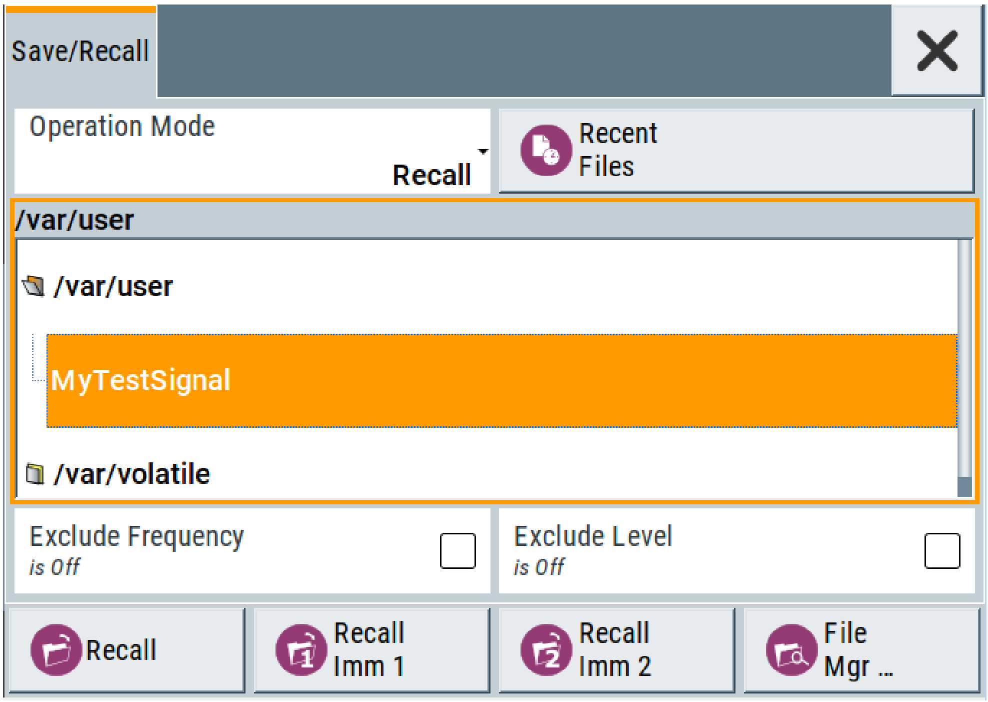
   The file `MyTestSignal.savrcltxt` is stored in the default directory `/var/user/`.

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.

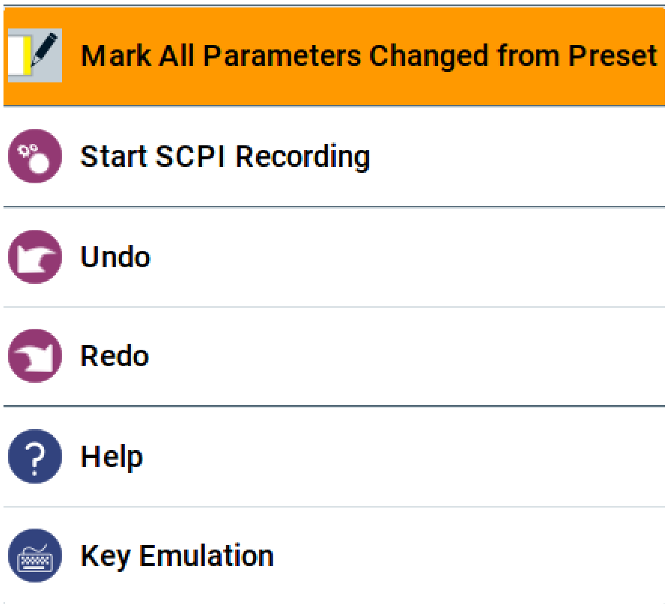
   All instrument settings are restored and the display resembles Chapter 2.3.2, "Generating an RF Frequency Sweep Signal", on page 46, which shows the instrument display right before the settings were saved.

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

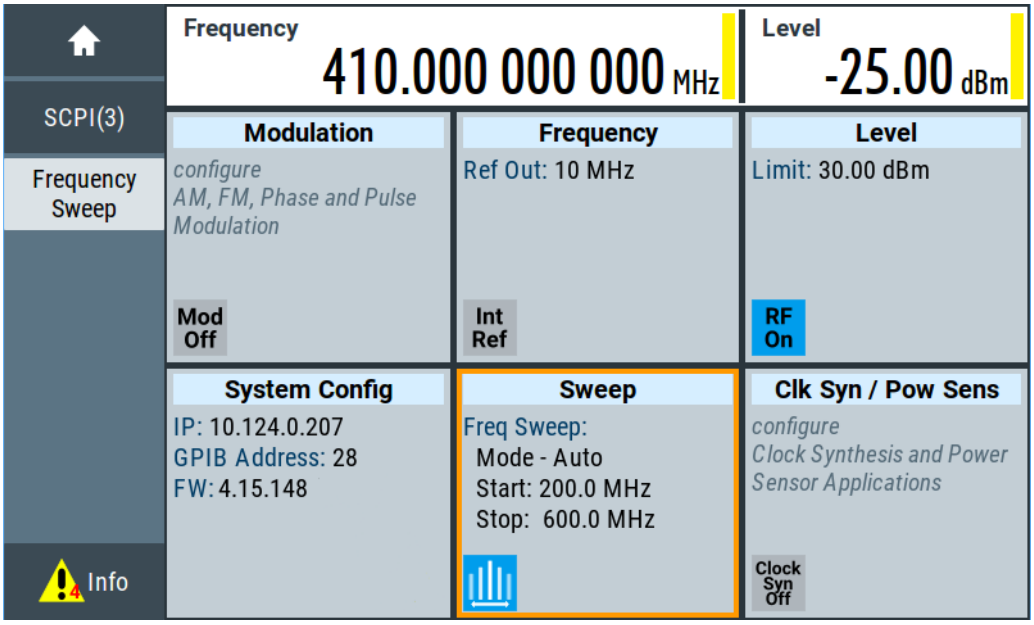
When you load a file to your instrument, you do not have enough information on the changed settings. In such case, it is useful to visualize all parameters that have been changed from their default state.

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 Chapter 10, "File and Data Management", on page 282.

2.4 Instrument Control

This chapter provides an overview on how to work with the R&S SMA100B.

It covers the following topics:

2.4.1 Possible Ways to Operate the Instrument

There are three ways to operate the R&S SMA100B:

- Manual operation:
  Use the touchscreen, hard keys and rotary knob, or an optional mouse and/or keyboard.
  The description under Chapter 2.4, "Instrument Control", on page 50 shows how to operate the instrument manually.
- Remote control:
  Create programs to automatize repeating settings, tests and measurements. The instrument is connected to a computer running the program.
  This way of operation is described in Chapter 12, "Network Operation and Remote Control", on page 346.
- Remote operation from a computer:
  Remote monitoring and control of the instrument from a connected computer is based on the common cross-platform technology VNC (Virtual Network Computing). On the remote computer, any standard web browser (supporting Java) or a dedicated VNC client (like Ultr@VNC) can be used. See also Chapter 2.4.8, "Remote Operation over VNC", on page 60.

2.4.2 Means of Manual Interaction

For the manual interaction with the R&S SMA100B, you have several methods that you can use as an alternative to perform a task:

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

  Tapping the screen works like clicking mouse buttons:
  - Touch quickly = click: Selects a parameter or provokes an action.
  - Touch and hold = right-click: Opens a context-sensitive menu.
  - Touch and swipe = drag: Scrolls through the contents of a display element larger than the screen, e.g. a list or a table.
- Function keys and rotary knob:
  The front panel provides nearly all functions and controls to operate the instrument in the classic way, without touchscreen.

- Optional mouse and/or keyboard:
  These devices work like known from PCs. The navigation keys on the front panel correspond to the keys on the keyboard.

This manual describes the manual interaction with the instrument via the touchscreen. It mentions the alternative methods using the keys on the instrument or the on-screen keypads if it deviates from the standard operating procedures. The usage of the touchscreen and navigation keys is described in Chapter 2.4.4, "Accessing the Functionality", on page 55.

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

2.4.3 Understanding the Display Information

The home screen of the R&S SMA100B displays all main settings and generator states, divided into three main operation areas.

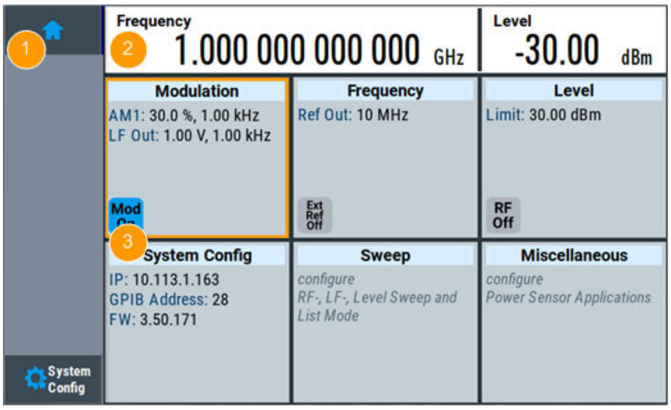


Figure 2-8: Home screen

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

2.4.3.1 Status Bar

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

2.4.3.2 Tile Diagram

The tile diagram is the main entry to the settings of the R&S SMA100B.

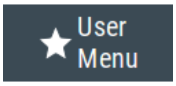
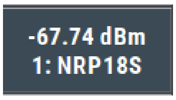
Tile	Access to:
"Modulation"	• Analog and stereo[1)], and pulse[1)] modulation settings • Built in LF generator
"System Config"	• "Save/Recall": settings for saving and loading instrument configurations • "Remote access": Network and emulation settings. • "Setup": general system configuration
"Sweep"	• Frequency and level sweeps • List mode
"Frequency"	• RF frequency and phase • Reference frequency
"Level"	• RF level • Attenuator • Automatic level control • User correction
"Clk Syn / Pow Sens"	• Clock synthesis[1)] • Power sensors
[1)] requires additional options	

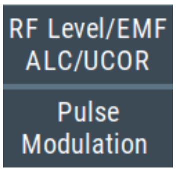
2.4.3.3 Taskbar

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

The buttons shown in the following example represent the variants.

Table 2-8: Example of buttons in the taskbar

	"Home" button Returns to the home screen.
	"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

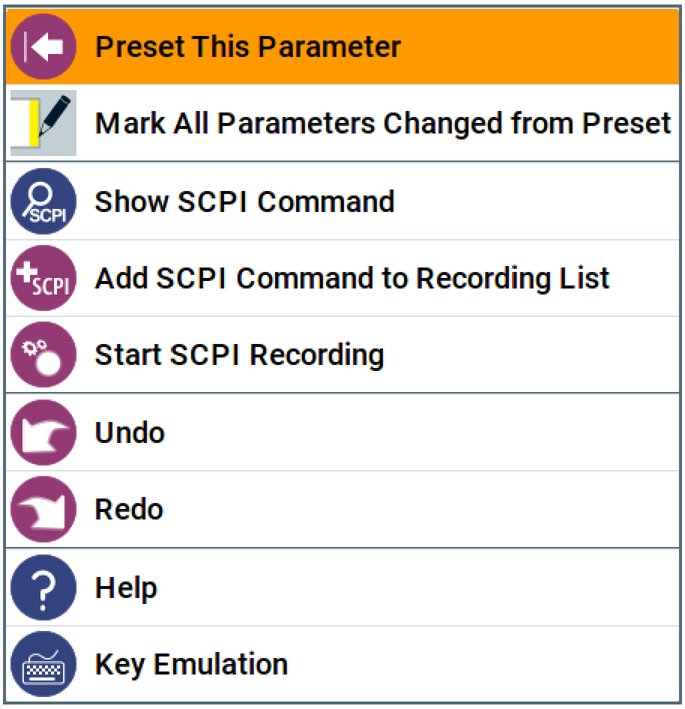
Provides access to status and error messages.

Note: The warning symbol signifies a permanent error message.

2.4.3.4 Additional Display Characteristics

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

- **Appearance of active elements**
  - *Active* elements like On/Off switches, state buttons have a **blue** background.
  - *Selected* elements are framed or highlighted **orange**.
  - *Inactive* elements are **gray**.
- **On-Screen keypads**
  As additional means of interacting with the instrument without having to connect an external keyboard, either a numerical or alphanumerical on-screen keypad appears when you activate an entry field (see Chapter 2.4.5, "Entering Data", on page 56).
- **Info line**
  The "Info line" shows brief status information and error messages. It appears when an event generates a message.
- **Key parameters indicated in tab labels**
  Most dialogs are divided into tabs with logically grouped parameters. The tab label expresses the content and can also contain status indicators or the set value of a key parameter.
- **Scroll bar handle**
  An arrow icon that appears when you touch a scroll bar helps you to scroll in a dialog or list.
  If no scrollbar handle appears, you can touch and swipe an element to scroll up and down.
- **Context-sensitive menus**
  Within the entire screen display, including single parameters, you can access context-sensitive menus that provide some additional functions.



2.4.4 Accessing the Functionality

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

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

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

To open a dialog box

► Perform one of the following actions:
  - Tap the required tile, and then the menu entry.
  - Tap the minimized view (button) on the taskbar.

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

To minimize a dialog box

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

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

To close a dialog box

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

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

To select an option in a dialog box

► Tap the required option.

2.4.5 Entering Data

Some parameters have their own key on the front panel.

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

Correcting an entry

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

Completing the entry

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

Aborting the entry

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

2.4.5.1 Entering Numeric Parameters

To enter values with the on-screen keypad

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

1. Enter the numeric value.
2. Tap the unit button to complete the entry.
   The unit is added to the entry.
3. If the parameter does not require a unit, confirm the entered value by pressing "Enter".

To enter values by using the front panel controls

1. Change the currently used parameter value by using the rotary knob or the [Up/ Down] keys.
2. If the parameter does not require a unit, confirm the entered value by pressing the [Enter] key or any of the unit keys.
   The instrument highlights the editing line to confirm the entry.

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

2.4.5.2 Entering Alphanumeric Parameters

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

2.4.5.3 Undo and Redo Actions

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

"Redo" restores a previously undone action.

2.4.6 Getting Information and Help

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

For further information, you can use the following sources:

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

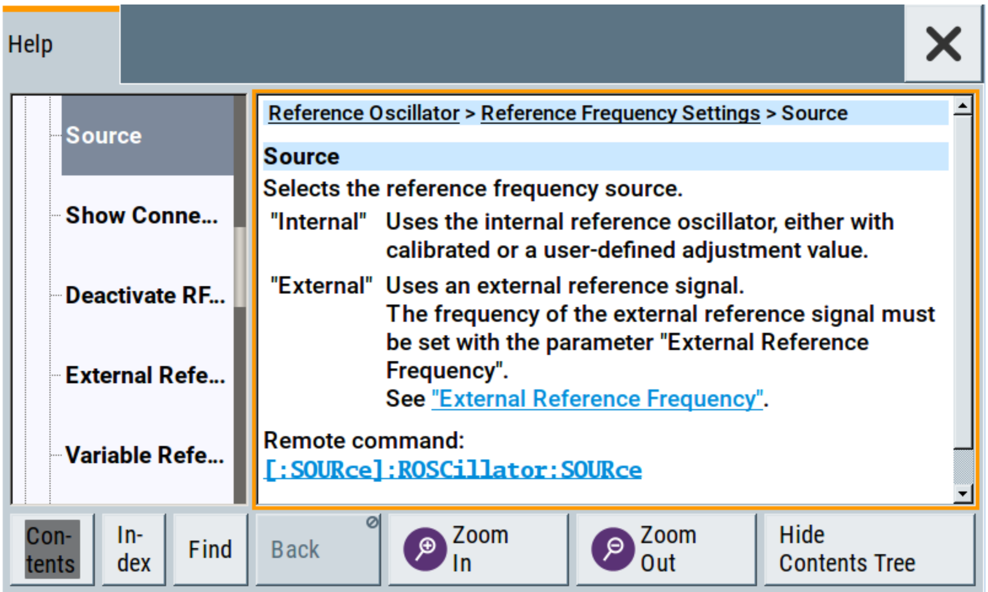
To display context help

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

a) Tap and hold the parameter for which you need information and tap "Help" in the context menu.

b) Tap the parameter and press the [Help] key.

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



Contents of the help dialog box

The help dialog box covers two main areas:

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

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

To open general help

► Press the yellow [Help] key on the front panel.

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

Navigating in the table of contents and in the help topics

1. To move through the displayed contents entries, tap on an entry and scroll or use a connected mouse or the [Up/Down] keys.
   Entries with a plus sign contain further entries.
2. To display a help topic, tap on the topic name or double click on the topic name or press the [Enter] key.
3. To follow a cross-reference, tap on the link text.
4. To return to the previous page, select "Back".
   This function scrolls back all steps you have performed before.
5. Use the "scroll bars" to shift the visible section of content shown.
6. To maximize the "Topics" area, tap the "Hide Contents Tree" button to hide the contents tree.

Using the index

1. Select the "Index" button.
2. Enter the first characters of the topic you are interested in.

   The entries starting with these characters are displayed.
3. Tap on the index entry.

   The corresponding help topic is displayed.

2.4.7 Remote Control

In addition to working with the R&S SMA100B interactively, located directly at the instrument, it is also possible to operate and control it from a remote PC.

The R&S SMA100B supports various methods for remote control:

- Connecting the instrument to a (LAN) network (see Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 28)
- Using the LXI browser interface in a LAN network
- Connecting a PC via the IEC-bus (IEEE 488) interface
- Remote control via the USB interface

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

How to configure the remote control interfaces is described in Chapter 12, "Network Operation and Remote Control", on page 346.

2.4.8 Remote Operation over VNC

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

Instrument control from a remote computer

To access the basic utility functions of the R&S SMA100B, perform a right mouse click on the block diagram and select "Key Emulation".

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

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

For more information, refer to Chapter 12.16, "How to Set Up Remote Operation via VNC", on page 395.

3 RF Signal Configuration

The R&S SMA100B signal generator generates RF signals with outstanding spectral purity within the frequency range from 8 kHz up to 20 GHz and with adjustable signal level over a wide range.

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

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

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

The R&S SMA100B 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 SMA100B generates unmodulated or analog modulated RF signals. You can output the signal in fixed mode or as a signal having periodically varying frequencies or amplitudes.

Signal modes for RF signal generation:

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

  For information on the signal frequency and level settings and an example on how to configure a simple CW signal, see:
  - Chapter 3.3, "RF Frequency Settings", on page 64
  - Chapter 3.4, "RF Level Settings", on page 66
  - Chapter 2.3.1, "Generating an Unmodulated Carrier", on page 43
- Analog modulated signal
  Modulates the signal with an analog signal and generates amplitude, phase, frequency and pulse modulation.
  See Chapter 4, "Analog Modulations", on page 73.

The R&S SMA100B allows you to provide the RF signal with constant or varying frequencies and/or amplitudes at the output:

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

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

See Chapter 6, "List and Sweep Mode", on page 154.

3.1 Activating RF Signal Output

Per default, the RF output signal is deactivated.

To activate the RF output

1. Configure the RF signal as required.
   Set, for example, the frequency and level values.
2. Activate the RF output in one of the following ways:
   a) Select "Level > RF ON > On"
   b) Press the [RF on/off] key at the front panel.
3. In the "Level" tile, observe the color of the "RF On" icon.

   The blue color indicates that the RF output is activated.

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

Acts as the [RF on/off] key.

Remote command:
`:OUTPut<hw>[:STATe]` on page 445

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

Remote command:
`:OUTPut<hw>:IMPedance?` on page 446

3.2 How to Set the Frequency and Level

The simplest form of the RF signal is a continuous wave (CW) of constant frequency and amplitude. The RF signal is defined by its frequency, level and phase.

► Use one of the following:
- "Status Bar > Frequency and Level"
- "Frequency panel > Frequency"
- "Level panel > Level"
- "Frequency panel > Frequency > Phase"

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

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

See "RF frequency and level display with a downstream instrument" on page 63.

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 SMA100B. Examples of downstream instruments are mixers, frequency multipliers, amplifiers or attenuators and of their corresponding major parameters offset, multiplier, amplitude. The R&S SMA100B 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 3-1 illustrates the calculation of the "Frequency" and "Level" values, displayed in the status bar.

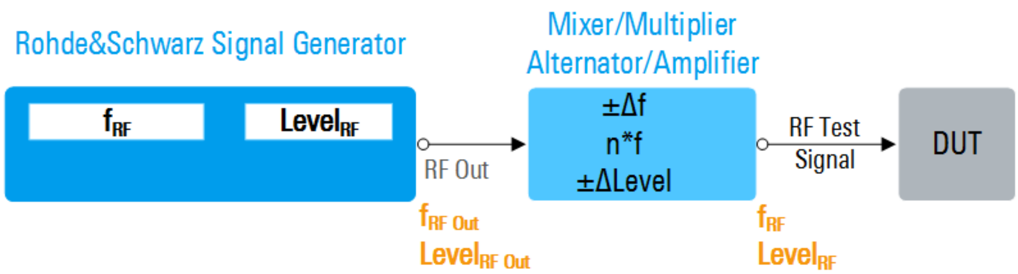


Figure 3-1: Frequency and Level display vs frequency and level at the RF output

f_{RF}, $Level_{RF}$	= Frequency and level ("Status bar > Frequency and Level") at the output of the downstream instrument, see also Calculation of f_{RF} and $Level_{RF}$)
$f_{RF\ Out}$, $Level_{RF\ Out}$	= Frequency and level at the output connector [RF] ("RF > RF Frequency > Frequency" and "RF > RF Level > Amplitude")
n*f	= Multiplication factor ("RF > RF Frequency > Multiplier")
Δf	= Frequency offset ("RF > RF Frequency > Offset")
ΔLevel	= Power offset ("RF > RF Level > Offset")

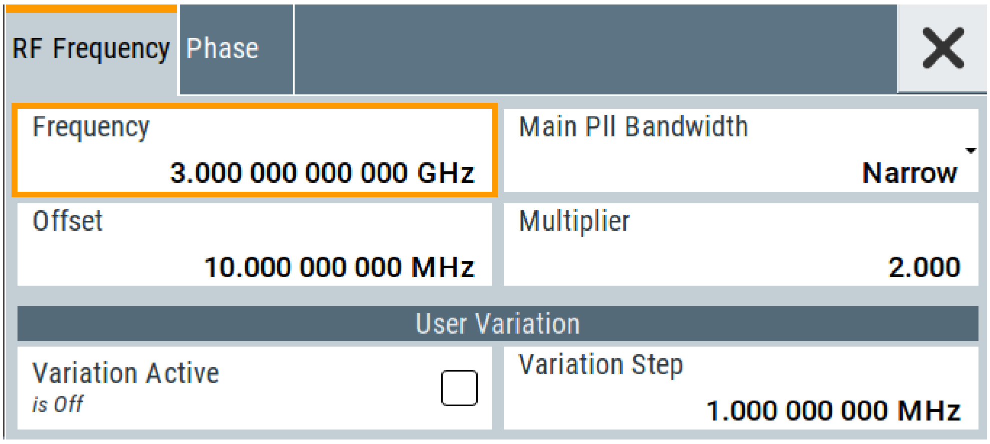
Calculation of f_{RF} and $Level_{RF}$

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

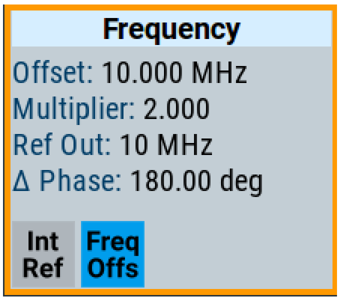
3.3 RF Frequency Settings

Access:

1. Select "Frequency" > "RF Frequency".



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



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

In the "RF Frequency" dialog, you can configure:

- RF frequency, incl. an offset or multiplication factor of a downstream instrument
- The step size for varying the frequency with the rotary knob.

The remote commands required to define the settings are described in Chapter 13.16.4, "SOURce:FREQuency Subsystem", on page 590.

Settings

Frequency
Sets the RF frequency.

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

See "RF frequency and level display with a downstream instrument" on page 63.

Note: Suppressed values in the status bar

For security concerns or certain operating modes, you can hide the frequency and level display in the status bar.

- ******

  The display has been disabled for security reasons.
  See:
  – Annotation Frequency
  – Annotation Amplitude
- 

  The display is disabled when list mode is running, see Chapter 6, "List and Sweep Mode", on page 154.

Remote command:
`[:SOURce<hw>]:FREQuency[:CW|FIXed]` on page 592

Main PLL Bandwidth
Selects the PLL (Phase Locked Loop) bandwidth of the **main synthesizer**.

"Normal" Default main PLL bandwidth.
The instrument provides the maximum modulation bandwidth and FM/PhiM deviation.

"Narrow"
Sets the narrow PLL bandwidth.

Remote command:
`[:SOURce<hw>]:FREQuency:PLL:MODE` on page 597

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 SMA100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 63.

Remote command:
`[:SOURce<hw>]:FREQuency:OFFSet` on page 594

Multiplier
Sets the multiplication factor for the RF frequency.

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

The "Frequency" value displayed in the status bar is the resulting frequency, as it is at the output of the downstream instrument. The frequency at the R&S SMA100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 63.

Remote command:
`[:SOURce<hw>]:FREQuency:MULTiplier` on page 594

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 596
`[:SOURce<hw>]:POWer:STEP:MODE` on page 634

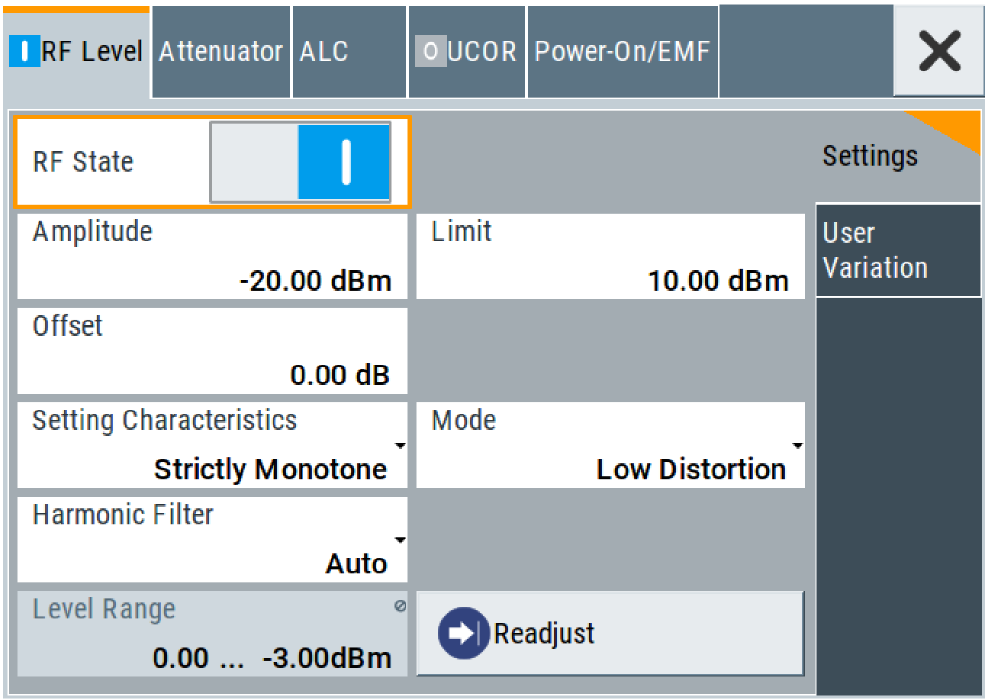
Variation Step ← User Variation
Sets the user-defined step width.

Remote command:
`[:SOURce<hw>]:FREQuency:STEP[:INCRement]` on page 596
`[:SOURce<hw>]:POWer:STEP[:INCRement]` on page 634

3.4 RF Level Settings

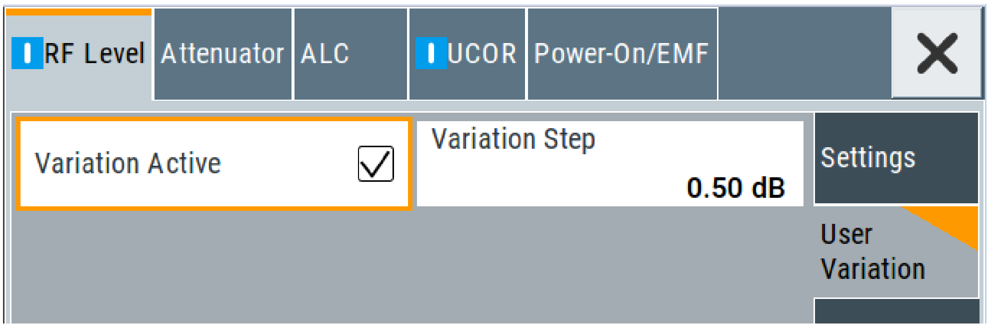
Access:

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

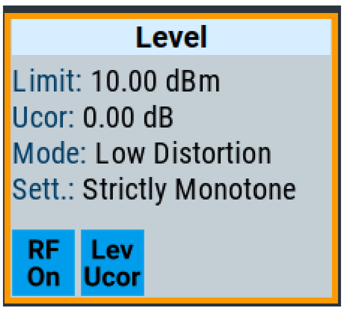


In the "RF Level" dialog, you can configure the offset-free level, the level limit, and the step width for varying the level with the rotary knob.

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 Chapter 13.16.11, "SOURce:POWer Subsystem", on page 629.

Settings

RF State/RF ON

Activates or deactivates the RF output.

Acts as the [RF on/off] key.

Remote command:
`:OUTPut<hw>[:STATe]` on page 445

Amplitude

Sets the level of the RF signal.

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

See "RF frequency and level display with a downstream instrument" on page 63.

Note: Suppressed values in the status bar

For security concerns or certain operating modes, you can hide the frequency and level display in the status bar.

- ******

  The display has been disabled for security reasons.
  See:
  – Annotation Frequency
  – Annotation Amplitude
- ---.--

  The display is disabled when list mode is running, see Chapter 6, "List and Sweep Mode", on page 154.

Remote command:
[:SOURce<hw>]:POWer:POWer on page 633
Note: The SCPI command [:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] sets the level of the "Level" display.
This means, the level containing offset.

Limit
Sets an upper limit for the RF output power.

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

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

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

Remote command:
[:SOURce<hw>]:POWer:LIMit[:AMPLitude] on page 631

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 SMA100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 63.

Remote command:
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet on page 635

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

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

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

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

"Constant-VSWR"
Suppresses output impedance variations at the RF output connector, due to changed level settings.

"High Dyn. Uninterrupted"
R&S SMAB-K724
Provides a linear output power that is uninterrupted over a wide dynamic range.

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

Remote command:
`[:SOURce<hw>]:POWer:LBEHaviour` on page 631

Mode

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

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

"Low Noise" Optimizes the signal to noise ratio.

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

Remote command:
`[:SOURce<hw>]:POWer:LMODe` on page 632

Harmonic Filter

Activates low harmonic filter or enables its automatic switching.

"On" Ensures best low harmonics performance but decreases the level range.

"Auto" Applies an automatically selected harmonic filter that fits to the current level setting.

Remote command:
`:OUTPut<hw>:FILTer:MODE` on page 446

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 636
[:SOURce<hw>]:POWer:RANGe:UPPer? on page 636

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

Remote command:
[:SOURce<hw>]:POWer:ALC:SONCe on page 630

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 596
[:SOURce<hw>]:POWer:STEP:MODE on page 634

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

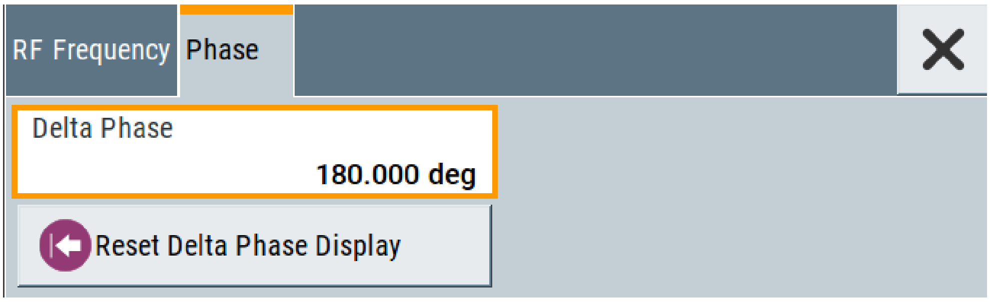
Remote command:
[:SOURce<hw>]:FREQuency:STEP[:INCRement] on page 596
[:SOURce<hw>]:POWer:STEP[:INCRement] on page 634

3.5 RF Phase Settings

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

Access:

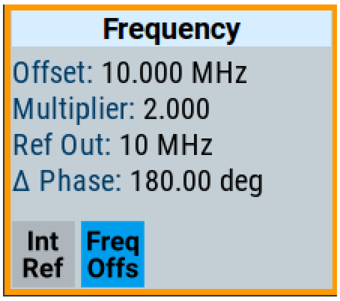
1. Select "Frequency" > "Phase".



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

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

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

   The remote commands required to define the settings are described in Chapter 13.16.10, "SOURce:PHASe Subsystem", on page 628.

Settings

Delta Phase

Sets the phase of the RF signal.

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

Remote command:
[:SOURce<hw>]:PHASe on page 628

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 628

4 Analog Modulations

The R&S SMA100B 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.

4.1 Required Options

R&S SMA100B base unit equipped with the following options:

- Option frequency (R&S SMAB-B10x)
- Option pulse modulator (R&S SMAB-K22)
- Option pulse generator (R&S SMAB-K23)
  (supports generation of single and double pulse signals)
- Option multi-function generator (R&S SMAB-K24)
- Option pulse train generator (R&S SMAB-K27)
  (requires R&S SMAB-K23)
- Option AM/FM/PhiM, up to 6 GHz (R&S SMAB-K720)
- Option Scan AM (R&S SMAB-K720 and R&S SMAB-K721)

For more information, see data sheet.

4.2 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 SMA100B 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 Ext connector.
  - Pulse modulation signals, at the Pulse Ext 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 SMAB-K22/-K23
	All analog modulations Marks the valid level and frequency	Signal Valid	
	Pulse generator	Pulse Sync	
	LF generator	LF	
Input	AM, FM, PhiM	Ext **)	R&S SMAB-K720
	Pulse modulation from external source*) Or External trigger or gate signal*)	Pulse Ext**)	R&S SMAB-K22

- *) External trigger signal and external signal for the pulse modulation cannot be used simultaneously, because these signals are expected at the same connector Pulse Ext. Signal polarity and impedance are the same for both signals.
- **) The external modulation signal must have a voltage of US = 1 V (UEFF = 0.707 V) to achieve the displayed modulation depth and range.
  Note that the input voltage does not exceed 1 V, otherwise modulation distortions can occur.

For more information, see data sheet.

Interactions and characteristics

- FM and PhiM modulations exclude each other and cannot be performed simultaneously.
- In sweep mode, LF frequency sweep is possible.

- The settings of the modulation signal affect all analog modulations that use an internal modulation source.
- You can feed an external LF signal in each of the two paths.
- Using exponential amplitude modulation with an external source, sets the coupling of the corresponding input automatically to DC.
  See also Chapter 4.4.6.2, "Source > External Settings", on page 102.
- If you use Scan AM with an external modulation input signal, the voltage range is adjusted to +/- 6 V (usually +/-1 V). Therefore, we recommend that you do not use the external modulation signal for FM or PhiM in parallel, since the voltage will affect the modulations.
- The amplitude modulation types linear and exponential derive the carrier signal either linear in percent / volt, or as complex exponential in dB / volt.
- Scan AM provides the scan mode, i.e. an amplitude modulation depth with an extended dynamic range that automatically uses the exponential amplitude modulation type.

For more information, see data sheet.

4.3 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 512

4.4 Modulation Settings

Access:

► Select "Modulation" > "Modulation Sources".

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

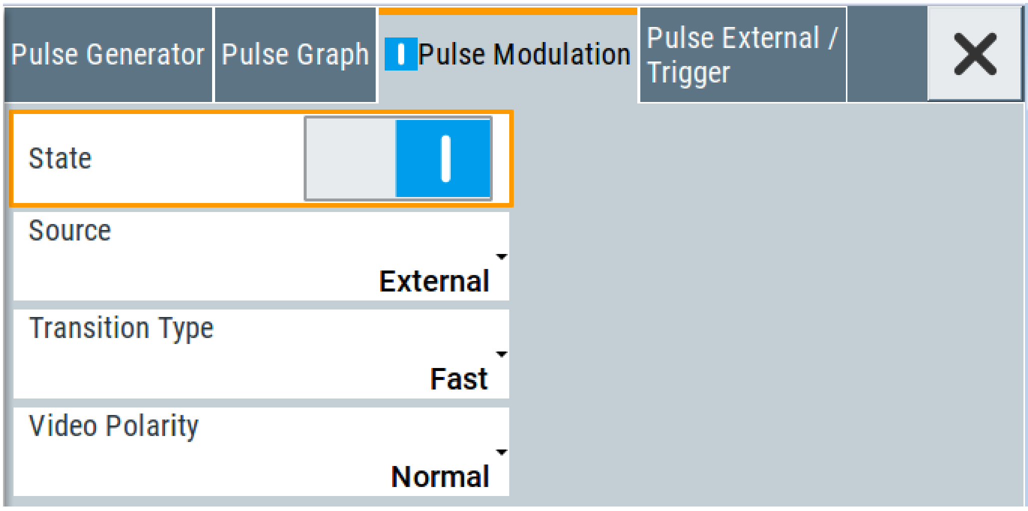
The remote commands required to define these settings are described in:
- Chapter 13.16.1.2, "SOURce:AM Subsystem", on page 513
- Chapter 13.16.1.3, "SOURce:FM Subsystem", on page 519
- Chapter 13.16.1.4, "SOURce:PM Subsystem", on page 524
- Chapter 13.16.1.5, "SOURce:PULM Subsystem", on page 528
- Chapter 13.16.6, "SOURce:LFOutput Subsystem", on page 599

4.4.1 Pulse Modulation

Option: see Chapter 4.1, "Required Options", on page 73.

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 Chapter 4.2, "Modulation Types and Signal Sources", on page 73.

The remote commands required to define these settings are described in Chapter 13.16.1.5, "SOURce:PULM Subsystem", on page 528.

Settings:

State
Activates pulse modulation and triggers the following automatic settings:

- Pulse generator is activated.

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

Remote command:
`[:SOURce<hw>]:PULM:STATe` on page 532

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 73.

Remote command:
`[:SOURce<hw>]:PULM:SOURce` on page 533

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

"Fast" Enables fast transitions with shortest rise and fall times.

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

Remote command:
`[:SOURce<hw>]:PULM:TTYPe` on page 533

Video Polarity
Sets the polarity of the internally generated pulse video (modulating) signal, related to the RF (modulated) signal.

This signal synchronizes the pulse generator signal and the RF signal.

"Normal" The video signal level follows the RF signal, that means it is high and low simultaneously with the RF signal.

"Inverse" Inverts the polarity between the video and the RF signal, that means it is high, when RF is low, and vice versa.

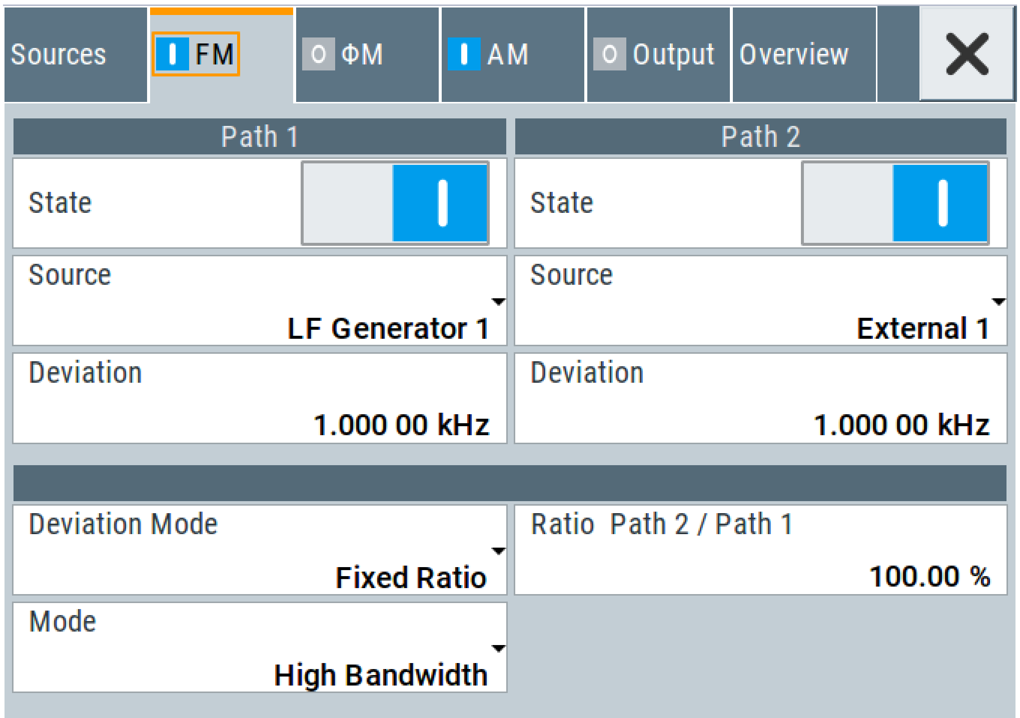
Remote command:
`[:SOURce<hw>]:PULM:OUTPut:VIDeo:POLarity` on page 533

4.4.2 FM, PhiM and AM Modulation Settings

Option: R&S SMAB-K720

Access:

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



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

Source

State

Activates a modulation.

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

Remote command:
`[:SOURce<hw>]:AM<ch>:STATe` on page 515
`[:SOURce<hw>]:FM<ch>:STATe` on page 521
`[:SOURce<hw>]:PM<ch>:STATe` on page 526

Source

Selects the LF signal source.

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

"LF Generator 1/2"
Selects one or both of the internally generated LF signals.
See Chapter 4.4.6.1, "Source > LF Generator Settings", on page 98.

"External 1/2" Selects an externally supplied LF signal.

"Noise Generator"
Selects the internally generated noise signal.
See Chapter 4.4.6.3, "Source > Noise Generator Settings", on page 103.

Remote command:
`[:SOURce<hw>]:AM<ch>:SOURce` on page 515
`[:SOURce<hw>]:FM<ch>:SOURce` on page 522
`[:SOURce<hw>]:PM<ch>:SOURce` on page 526

FM settings

The following settings are dedicated to FM.

Deviation ← FM settings

Sets the frequency modulation deviation in Hz.

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

Maximal possible deviation is selected automatically, if one of the following applies:

- The selected deviation is too high for the particular frequency
- The selected frequency is outside of the range where deviation is possible.

A warning message indicates this situation, too.

Remote command:
`[:SOURce<hw>]:FM<ch>[:DEViation]` on page 521

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 SMA100B 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 SMA100B 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 SMA100B adjusts the value of the other path.

Remote command:
`[:SOURce<hw>]:FM:DEViation:MODE` on page 522

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 523

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 523

Mode ← FM settings
Selects the mode of the frequency modulation.

"High Bandwidth"
The maximum range for modulation bandwidth is available.

"Low Noise" Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).
To reduce the phase noise further, set the Main PLL Bandwidth = "Narrow"

Remote command:
`[:SOURce<hw>]:FM:MODE` on page 523

PhiM settings

The following settings are dedicated to PhiM.

Deviation ← PhiM settings

Sets the phase modulation deviation in radians or degrees.

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

Maximal possible deviation is selected automatically, if one of the following applies:

- The selected deviation is too high for the particular frequency
- The selected frequency is outside of the range where deviation is possible.

A warning message indicates this situation, too.

Remote command:

`[:SOURce]:PM<ch>[:DEViation]` on page 528

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 SMA100B 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 SMA100B 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 SMA100B adjusts the value of the other path.

Remote command:

`[:SOURce<hw>]:PM:DEViation:MODE` on page 527

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 527

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 528

Mode ← PhiM settings

Selects the mode of the phase modulation.

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

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

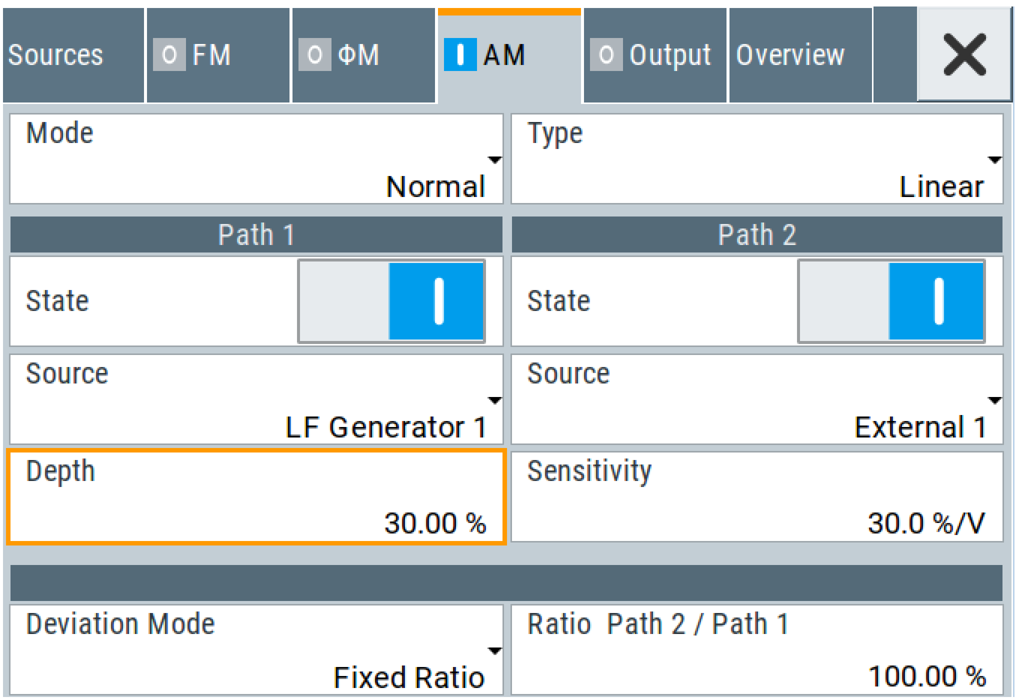
"Low Noise"
: Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

Remote command:

[:SOURce<hw>]:PM:MODE on page 527

AM settings

The following settings are dedicated to AM.



Mode ← AM settings

Selects the mode to derive the carrier signal for amplitude modulation.

"Normal" Performs the standard amplitude modulation with a single sinusoidal carrier signal.

"Scan" (Option: R&S SMAB-K721)
Performs amplitude modulation with a higher dynamic range.
The R&S SMA100B provides a special exponential amplitude modulation system optimized for highest dynamic range. You can use the scan mode to emulate level behaviors of transmitter/receiver systems with rotating antennas. Selecting "Mode > Scan" sets the modulation type to "Exponential".
Note: Using exponential AM with an external source affects other operating modes as described in "Interactions and characteristics" on page 74.

Remote command:
[:SOURce<hw>]:AM:MODE on page 517

Type ← AM settings
Selects the type of the amplitude modulation for both paths.

Using exponential AM with an external source affects the coupling mode and the external modulation input, see "Interactions and characteristics" on page 74.

"Linear" Sets linear amplitude modulation with depths specified in percent / volt.

"Exponential" Sets ethe exponential AM type with depths in dB / volt.

Remote command:
[:SOURce<hw>]:AM:TYPE on page 519

Depth ← AM settings
Determines the depth of the modulation signal in percent.

For "Type = Exponential", the unit of "AM Depth" changes to dB.

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

Remote command:
[:SOURce<hw>]:AM<ch>:DEPTh:LINear on page 516
[:SOURce<hw>]:AM<ch>:DEPTh:EXPonential on page 517

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

Remote command:
[:SOURce<hw>]:AM<ch>:SENSitivity[:LINear] on page 519
[:SOURce<hw>]:AM<ch>:SENSitivity:EXPonential on page 518

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 SMA100B 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 SMA100B 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 SMA100B adjusts the value of the other path.

Remote command:
`[:SOURce<hw>]:AM:DEViation:MODE` on page 518

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 SMA100B 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 517

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 SMA100B indicates the Sensitivity per Volts for the input signal.

In conjunction with the deviation mode, you can set the depth of both paths independently or coupled.
- Deviation Mode > Uncoupled
  Enables you to set the Depth or Sensitivity of both paths independently.
- Deviation Mode > Fixed Ratio
  Couples the ratio of the two paths as follows.
  – Changing the ratio path2/path1 adjusts the depth of both path2. The depth of path1 remains the same
  – Changing the depth of one path adjusts the depth of the other accordingly. The ratio path2/path1 remains the same.

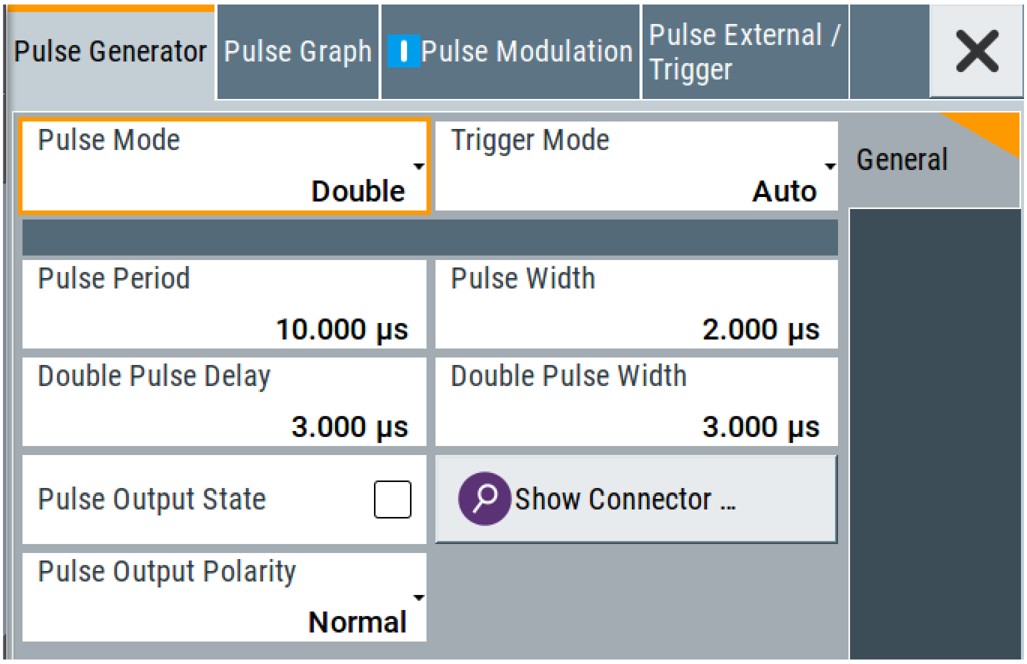
Remote command:
`[:SOURce<hw>]:AM:RATio` on page 518

4.4.3 Pulse Generator

Option: see Chapter 4.1, "Required Options", on page 73.

Access:

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



The "Pulse Generator" tab contains the settings for creating the pulse modulation signal internally.

4.4.3.1 Pulse Generator > General Settings

Access:

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

Settings

Pulse Mode

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

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

"Double" Generates two pulses in one pulse period.

"Train" Option: R&S SMAB-K27
Generates a user-defined pulse train.
See Chapter 4.4.3.2, "Pulse Generator > Pulse Train Settings", on page 89.

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

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 74.

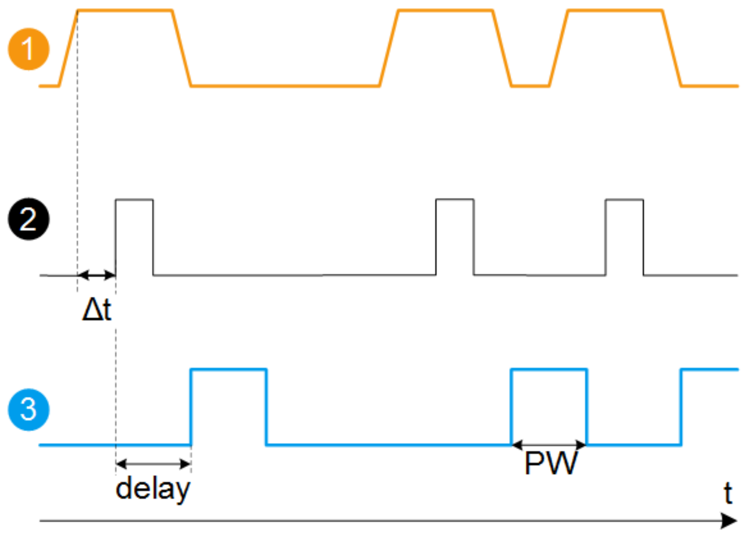
"Auto" Generates the internal modulation signal continuously.

"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.

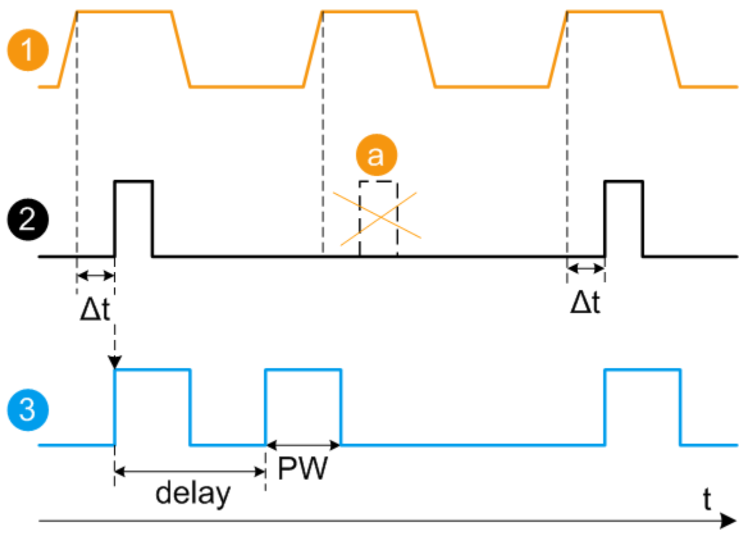
"Ext Triggered" Generates the pulse signal each time an external trigger event occurs.

Example: Generation of single pulse signal ("Pulse Mode = Single") using "Trigger Mode = Ext Triggered"



1 = External trigger signal input with "Trigger Input Polarity = Normal" (the positive slope is active)
2 = Sync signal
3 = Pulse signal
Δt = Trigger delay between the trigger and the sync signal start; see data sheet
delay = "Pulse Delay = 100 ns"
PW = "Pulse Width = 100 ns"

Example: Generation of double pulse signal ("Pulse Mode = Double") using "Trigger Mode = Ext Triggered"

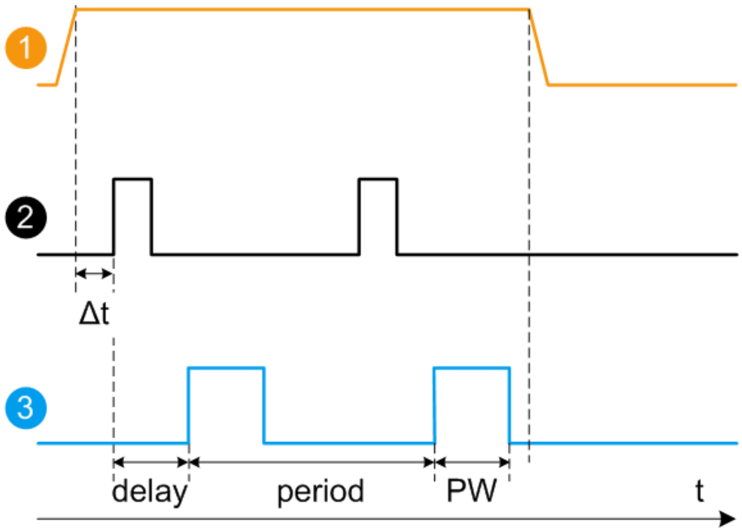


1 = External trigger signal input with "Trigger Input Polarity = Normal" (the positive slope is active)
2 = Sync signal

3 = Pulse signal
a = Trigger signal during double pulse generation is without effect
Δt = Trigger delay between the trigger and the sync signal start; see data sheet
delay = "Double Pulse Delay = 200 ns"; the first pulse starts without a delay
PW = "Double Pulse Width = 100 ns"

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

Example: Generation of single pulse signal ("Pulse Mode = Single") using "Trigger Mode = Ext Gated"



1 = External trigger signal input with "Trigger Input Polarity = Normal" (the positive slope is active)
2 = Sync signal
3 = Pulse signal
Δt = Trigger delay between the trigger and the sync signal start; see data sheet
delay = "Pulse Delay = 100 ns"
PW = "Pulse Width = 100 ns"
period = "Pulse Period = 300 ns" (time between the pulse start of two consecutive pulses)
a = Gate active duration (pulses are generated during the gate active part)

Remote command:
[:SOURce<hw>]:PULM:TRIGger:MODE on page 530

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

Remote command:
[:SOURce<hw>]:PULM:PERiod on page 531

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 531

Double Pulse Width

Sets the width of the second pulse.

Remote command:
`[:SOURce<hw>]:PULM:DOUBle:WIDTh` on page 532

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 531

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 532

Pulse Output State

Activates the output of the pulse modulation signal.

Remote command:
`[:SOURce<hw>]:PGENerator:OUTPut[:STATe]` on page 627

Show Connector

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

Pulse Output Polarity

Sets the polarity of the pulse output signal.

Remote command:
`[:SOURce<hw>]:PGENerator:OUTPut:POLarity` on page 627

Execute Single Trigger

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

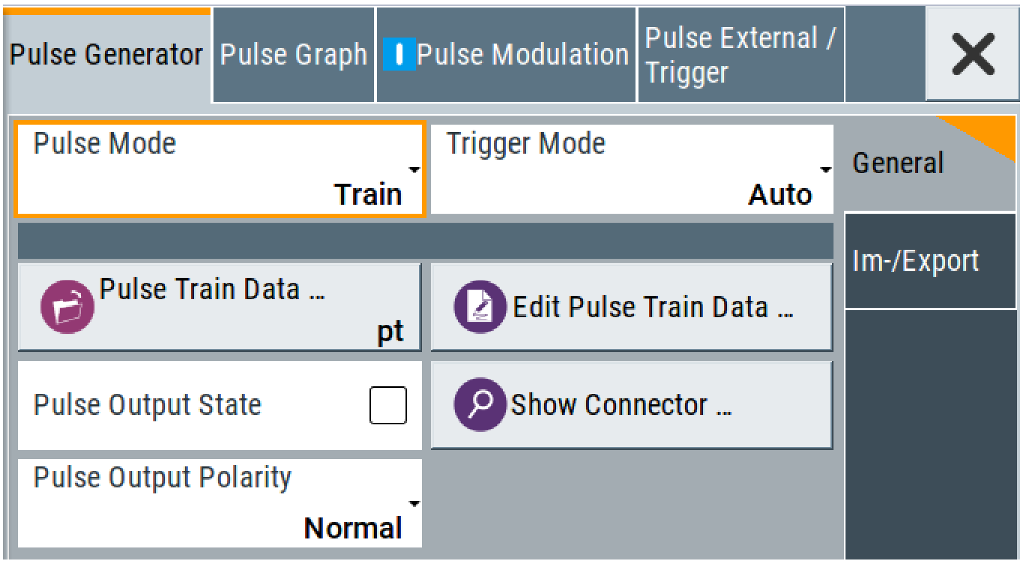
Remote command:
`[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate` on page 531

4.4.3.2 Pulse Generator > Pulse Train Settings

Option: see Chapter 4.1, "Required Options", on page 73.

Access:

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



2. Select "Pulse Train Data".
3. Select an existing file or select "New" to create one.
4. Define the filename.
   Select "Edit Pulse Train Data", if the file is empty or to control and change the values.
5. In the "Edit Pulse Train Data" dialog, enter the pulse on/off times and pulse repetition values.
6. Select "Save".

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

Possible ways to configure a pulse train

You can configure a pulse train in the following ways:

- **Internally**
  – Use the built-in editor table editor, see in the "Pulse Generator > Pulse Train" dialog.
    Once defined, pulse train settings can be saved in a file. For example, to exchange configuration between instruments or to modify the file content with an external program and reload them again.
    The filename is user-definable; the file extension is `*.pulstrn`.
  – Using the corresponding remote-control commands.
    Note that you have to create a pulse train file first.
- **Externally**
  Create a pulse train sequence as a CSV file with Microsoft Excel, with a Notepad or a similar tool, save it with the predefined extension. Transfer the file to and load it into the instrument.

Pulse train ASCII file format

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

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

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

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

For file handling, use the standard functions in the "File Manager", see Chapter 10.8, "Using the File Manager", on page 298.

Settings

Pulse Train Data

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

Pulse train files are files with predefined file extension `*.pulstrn`. When a file is selected, the dialog indicates the filename.

You can create the file internally in the table editor or externally.
- To select an existing file, select "Select List > navigate to the file *.pulstrn > Select"
- Use the general editor function to create internally new file or to edit an existing one.
- Use the standard file manager function to load externally created files to the instrument.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:CATalog?` on page 536
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 537
`[:SOURce<hw>]:PULM:TRAin:DELete` on page 536

Edit Pulse Train Data

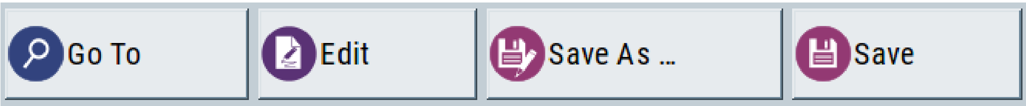
Accesses the build-in table editor to define a new pulse train file or edit an existing one.

"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 536
`[:SOURce<hw>]:PULM:TRAin:OFFTime` on page 536
`[:SOURce<hw>]:PULM:TRAin:REPetition` on page 537
`[:SOURce<hw>]:PULM:TRAin:DELete` on page 536

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.

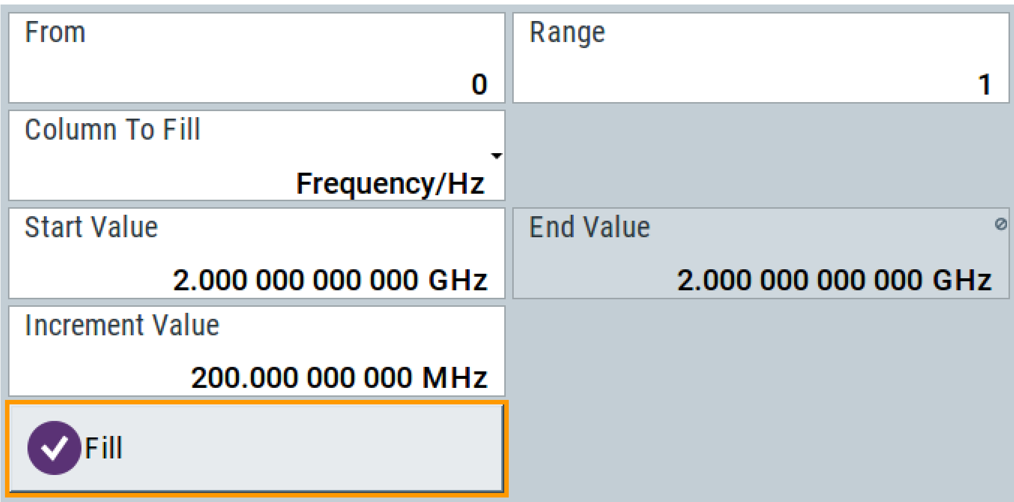
Go To ← Data handling keys
Selects a row for editing.

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 92.

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".

4.4.3.3 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".

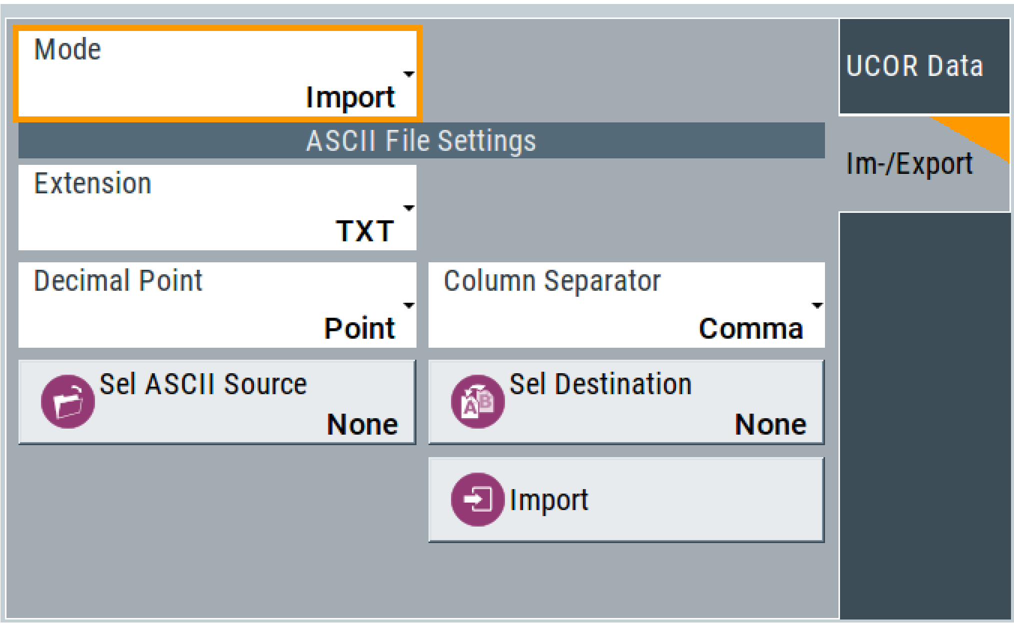


Figure 4-1: Im-/Export dialog (example with UCOR settings)

The "Import/Export" dialog contains all functions and settings to import externally created list data or to export it accordingly. You can process and store a list in the formats `*.txt` (ASCII), or `*.csv` (plain text with identical sequence of fields). The table separators and the decimal floating point numbers are customizable.

Settings

Mode

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

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:MODE` on page 624
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 590
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 538

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 623
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal` on page 624
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn` on page 624
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension` on page 588
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal` on page 589
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn` on page 589
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension` on page 538
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal` on page 539
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn` on page 539

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 623
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 623
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 588
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 589
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 539
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 539

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 624
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 590
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 540

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

Remote command:
[:SOURce<hw>]:LIST:DEXChange:EXECute on page 623
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 589
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 540

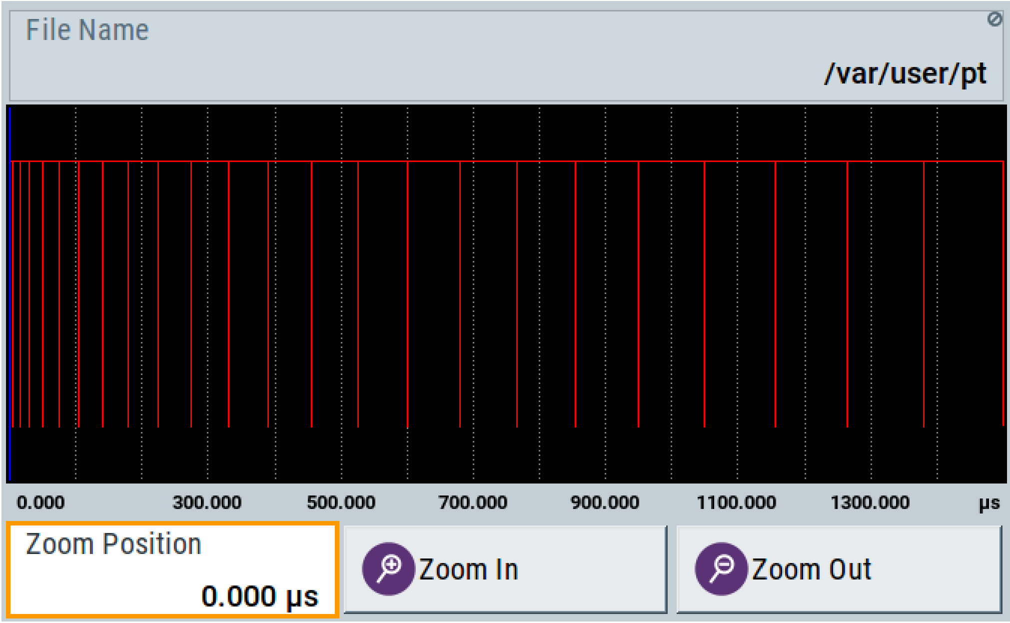
4.4.4 Pulse Graph

Option: see Chapter 4.1, "Required Options", on page 73.

Access:

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

The pulse graph is the graphical representation of the current pulse signal.



The height of the bars corresponds to the selected amplitude of the pulse signal.

File Name

Indicates the name of the pulse train data file.

To create or select a file, see "Pulse Train Data" on page 91.

Remote command:

`[:SOURce<hw>]:PULM:TRAin:SELect` on page 537

Zooming

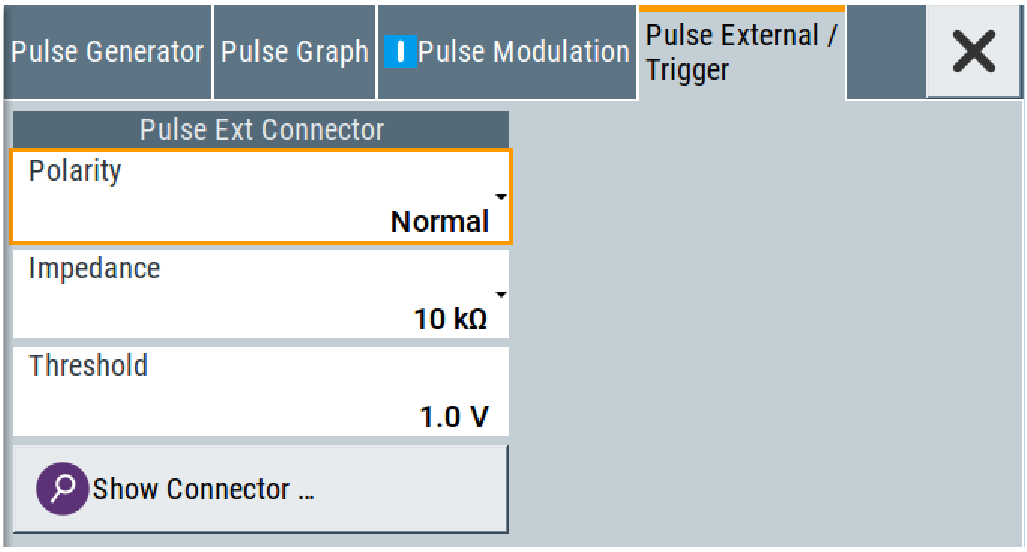
You can zoom into the diagram to visualize the graph in more detail:

- "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.

4.4.5 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 74.

Settings

Polarity

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

Remote command:
`[:SOURce<hw>]:PULM:POLarity` on page 534

Impedance

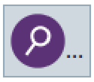
Sets the input impedance.

Remote command:
`[:SOURce<hw>]:PULM:IMPedance` on page 534

Threshold

Sets the high/low threshold in volts for the signal at the [Pulse Ext] connector.

Remote command:
`[:SOURce<hw>]:PULM:THReshold` on page 534



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

4.4.6 FM, PhiM and AM Modulation Sources

Access:

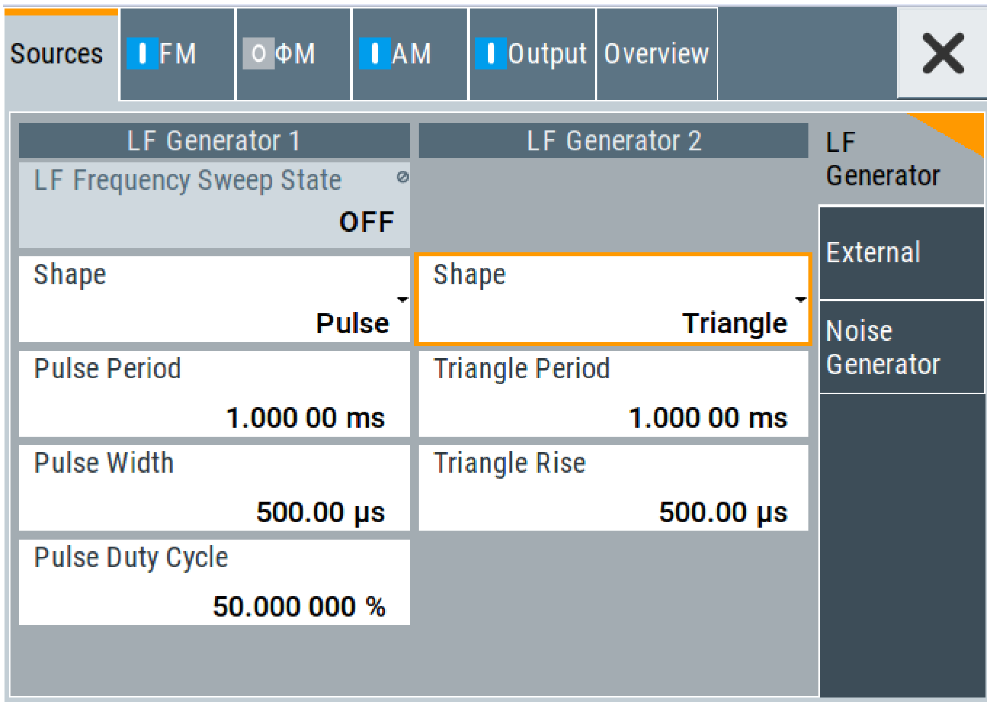
▶ Select "Modulation > Modulation Sources".

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.

4.4.6.1 Source > LF Generator Settings

Access:

▶ Select "Modulation" > "Modulation Sources > LF Generator".



The internal LF signal can the modulation signal source for any of the analog modulations. The LF signal applies to all modulations which use the internal modulation signal. Therefore, any modification of the LF signal immediately affects all currently active modulations.

Settings

State (LF frequency sweep)

Status of the LF frequency sweep signal.

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

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

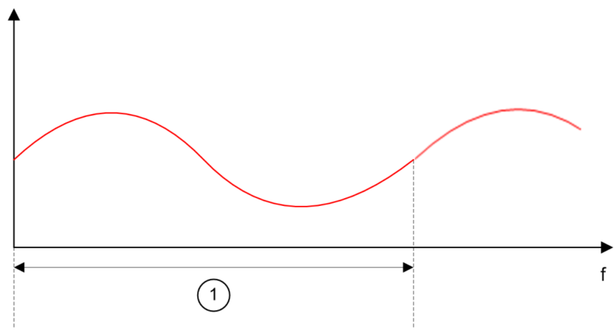
Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:MODE` on page 603

Shape

Selects the waveform shape of the LF signal.

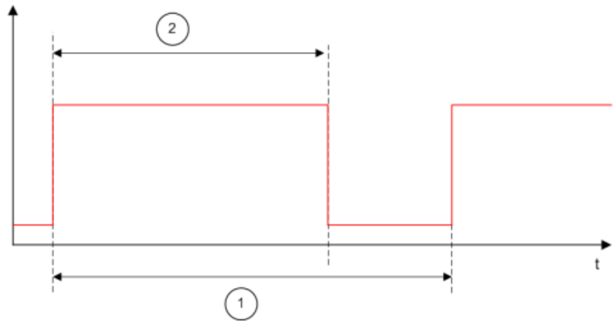
The "Triangle" and "Trapezoid" waveforms require option R&S SMAB-K24.

"Sine"



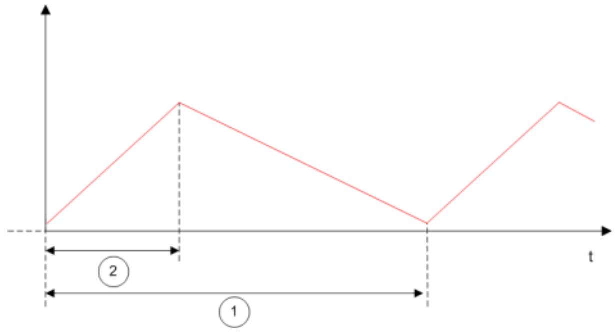
1 = Period

"Pulse"



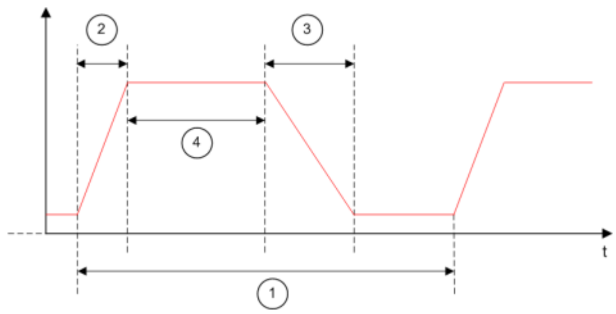
1 = Pulse period
2 = Pulse width

"Triangle"



1 = Triangle period
2 = Triangle rise

"Trapezoid"



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

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe on page 606

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 602

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 607
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:PERiod` on page 608
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:PERiod` on page 606

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

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:WIDTh` on page 607

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 606

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 608

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 608
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL` on page 607

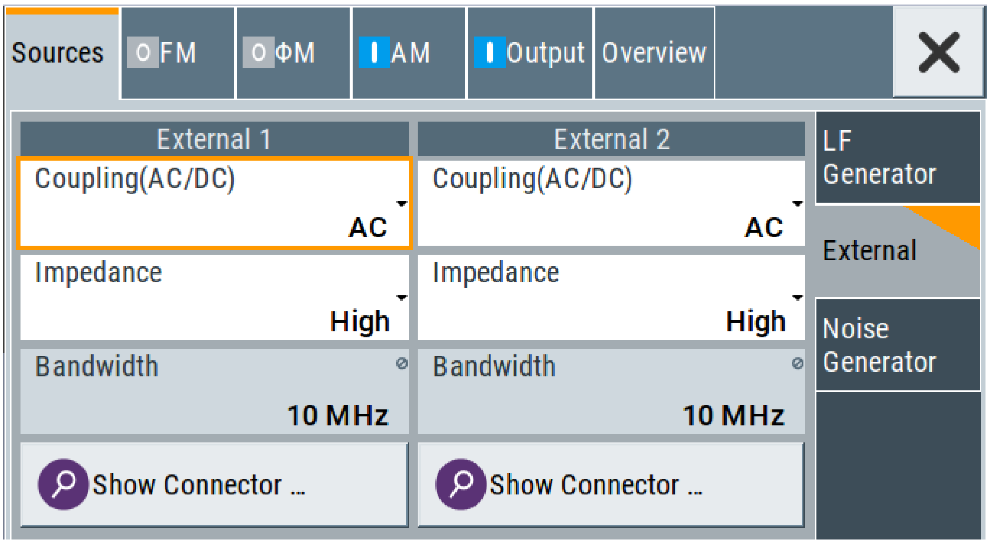
Trapezoid High
Sets how long the trapezoid signal is at high level.

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH` on page 607

4.4.6.2 Source > External Settings

Access:

► Select "Modulation" > "Modulation Sources > External".



The "External" settings section contains all parameters required to configure the signal of an externally supplied LF signal.

Settings

Coupling (AC/DC)

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

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

"DC" Uses the modulation signal with both components, AC and DC.
For active external exponential AM, sets the coupling of the corresponding input automatically to DC.

Remote command:
`[:SOURce<hw>]:INPut:MODext:COUPling<ch>` on page 598

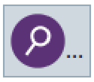
Impedance

Sets the impedance for the externally supplied signal.

Remote command:
`[:SOURce<hw>]:INPut:MODext:IMPedance<ch>` on page 599

Bandwidth
Displays the maximum bandwidth of the external LF signal.

Remote command:
`[:SOURce]:LFOutput<ch>:BANDwidth?` on page 602

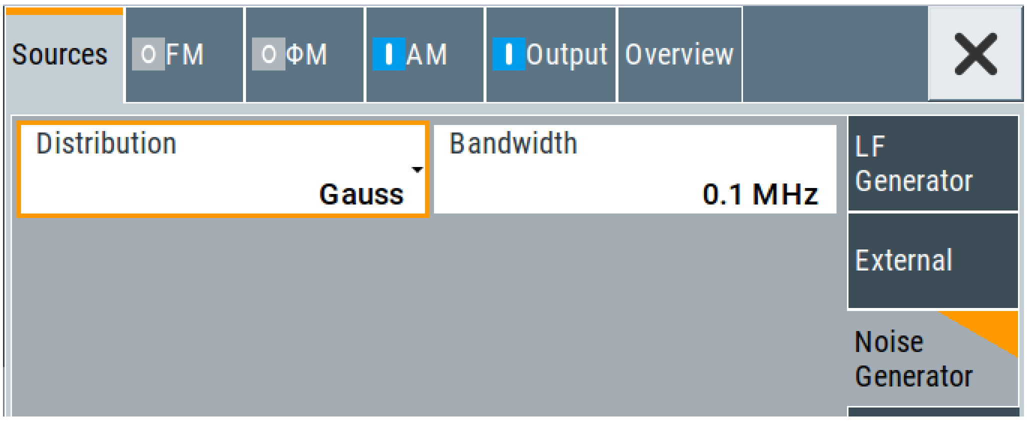


Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

4.4.6.3 Source > Noise Generator Settings

Access:

► Select "Modulation" > "Modulation Sources > Noise Generator".



The "Noise Generator" settings contain all parameters to configure the signal of the internal noise generator.

Settings

Distribution
Selects the distribution of the noise power density.

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

"Equal" Generates an evenly distributed noise.

Remote command:
`[:SOURce<hw>]:NOISe:DISTribution` on page 626

Bandwidth
Sets the noise bandwidth as distinct value.

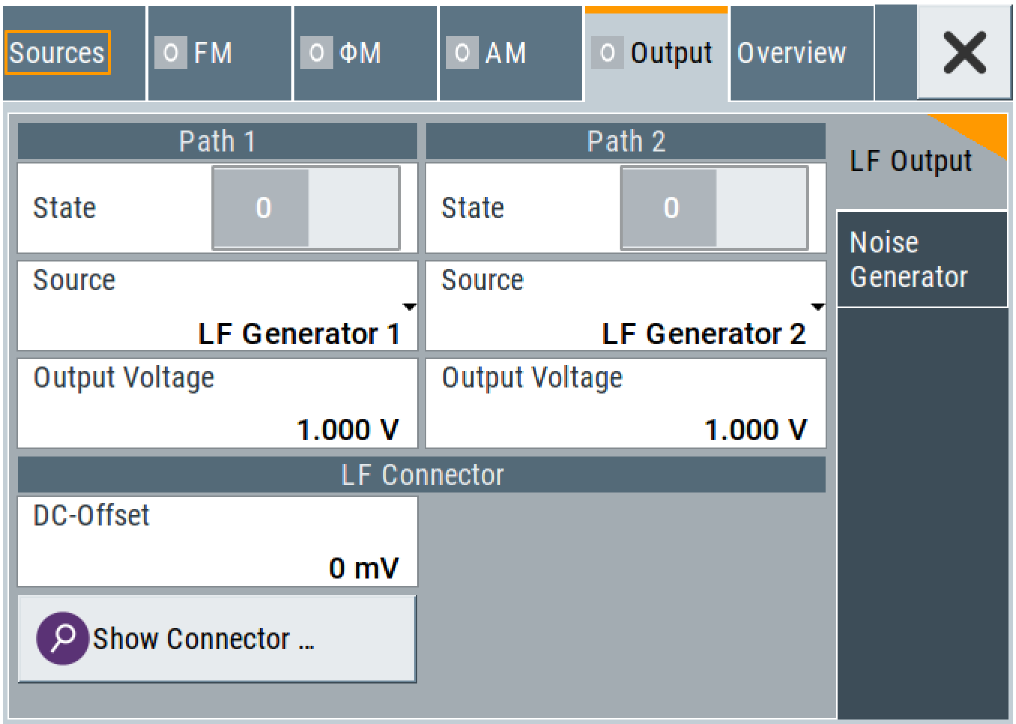
You can set the bandwidth between 100 kHz and 10 MHz in 100 KHz steps.

Remote command:
[:SOURce<hw>]:NOISe:BANDwidth|BWIDth on page 625
[:SOURce<hw>]:NOISe:BWIDth:STATe on page 625

4.4.7 LF Signal Output Settings

Access:

► Select "Modulation" > "LF Output".



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

Settings:

State
Activates the output of the LF signal.

Remote command:
[:SOURce]:LFOutput<ch>[:STATe] on page 604

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.

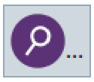
"AM"
Option: R&S SMAB-K720
Selects the AM signal.

"FM/PhiM"
Option: R&S SMAB-K720
Selects the signal also used by the frequency or phase modulations.

"Noise Generator"
Selects the internally generated noise signal.

"External 1/2"
Selects one of the externally supplied LF signals.

Remote command:
[:SOURce]:LFOutput<ch>:SOURce on page 605



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

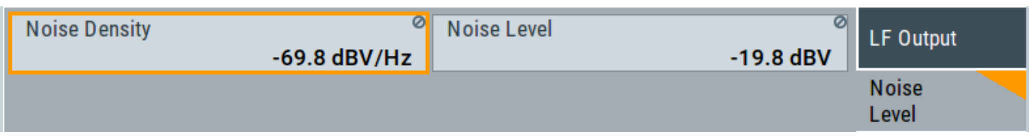
Output Voltage
Sets the voltage (peak) of the selected LF output source.

Remote command:
[:SOURce]:LFOutput<ch>:INTernal:VOLTage on page 604

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

Remote command:
[:SOURce]:LFOutput:OFFSet on page 605

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 626

Noise Level ← Noise Level

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

Remote command:

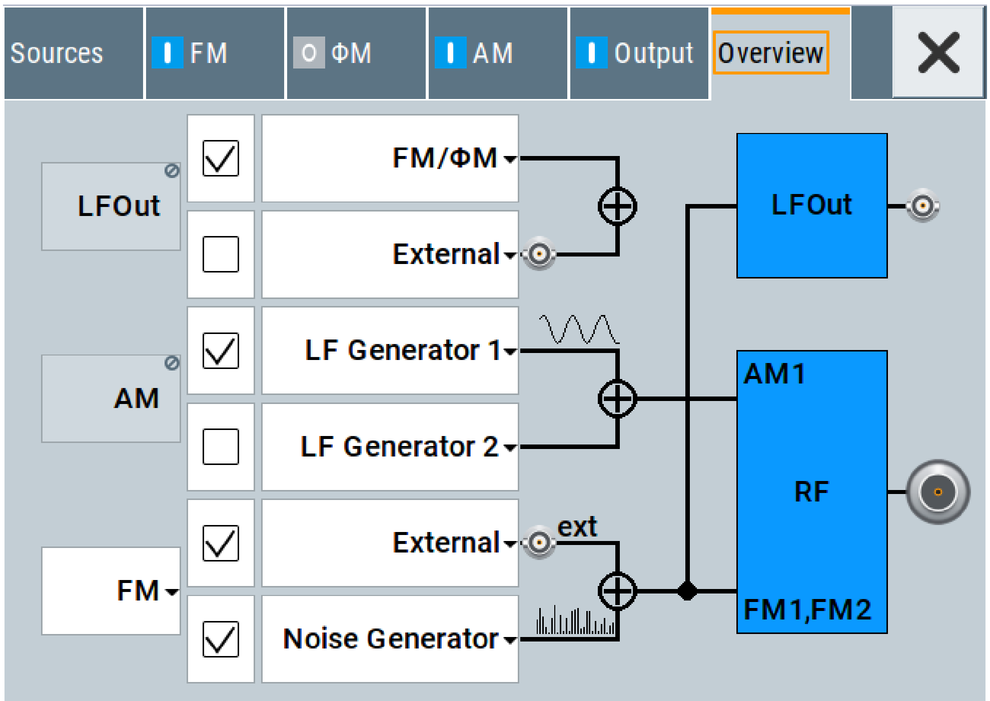
[:SOURce<hw>]:NOISe:LEVel[:ABSolute]? on page 626

4.4.8 Overview

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

Access:

► Select "Modulation" > "Modulation Sources > Overview".



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

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

Here you can:

- Select the output signal ("LF Out") in one or two paths; the setting acts as the parameter "LF Output Source"
- Select the source for each modulation and modulation path; the setting acts as the parameter "Source"
- Activate modulation in one or two paths; the setting acts as the parameter "State"

To generate a two-tone signal composed form the two paths of the same modulation type, activate both paths.
- The "FM" box allows switching to "PhiM", but those modulations are mutually exclusive.

LFOut
Label for the LF output settings in the overview.

Remote command:
n.a.

AM
Label for the amplitude modulation settings in the overview.

Remote command:
n.a.

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

Remote command:
n.a.

4.5 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.

4.6 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.

4.7 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.

5 Avionic Standards

The R&S SMA100B supports avionic standards VOR, ILS and ADF.

Contents

5.1 Required Options

The R&S SMA100B base unit equipped with the following options:

- Option frequency (R&S SMAB-B10x)
- Option signal generation for VOR, ILS and ADF (R&S SMAB-K25)

5.2 About the Avionics Options

The following topics summarize some background information on the related avionics standards. The provided overview information is intended as explanation of the used terms and does not aim to be comprehensive.

Brief overview of the avionics standards

- **Landing systems:** ILS (Instrument Landing System), MLS (Microwave Landing System)
  Landing systems are ground-based approach systems that provide precision guidance to an aircraft approaching and (blind) landing on a runway.
- **Radio/Flight navigation systems:** VOR (VHF Omnidirectional Radio), DME (Distance measuring equipment), TACAN (Tactical Air Navigation), ADF (Automatic Direction Finder)
  The radio navigation systems are aircraft systems that support the pilots to determine the aircraft positions and stay on course. These systems are more and more obsolete. However, due to security reasons, these flight navigation systems are still in use.
- **Radar systems:** RSR (En Route Surveillance Radar), ASR (Airport Surveillance Radar), PAR (Precision Approach Radar), ASDE (Airport Surface Detection Equipment), SSR (Secondary Surveillance Radar)
  Radar systems are divided into two groups, primary (RSR, ASR, PAR and ASDE) and secondary (SSR). The radar systems are used in air traffic control to mainly detects and measures the position of aircraft, i.e. its range and bearing.

5.2.1 VHF Omni Directional Radio Range (VOR)

Very high frequency (VHF) omnidirectional radio range (VOR) is used for radio navigation and helps aircraft to determine their position and stay on course.

A VOR system consists of a ground transmission station and a VOR receiver on the board of the aircraft.

The transmitter stations operate at VHF frequencies of 108 MHz to 118 MHz (see Table 5-1), with the code identification (COM/ID) transmitting on a modulation tone of 1.020 kHz. It emits two types of signals:

- An omnidirectional reference signal (REF) that can consist of two parts:
  - 30 Hz frequency modulated (FM) sine wave on subcarrier 9.96 kHz from amplitude modulation (AM) carrier
  - 1020 Hz AM modulated sine wave morse code
- A directional positioning signal, variable (VAR): 30 Hz AM modulated sine waves with variable phase shift

The position of the aircraft is determined by measuring azimuth as the difference in phase of those two signals. The magnetic north is defined as the reference point, for which both signals are exactly in phase.

VOR ICAO Frequencies

The individual values in Table 5-1 cells are:

- **Chan.** = ICAO channel number
- **VOR Freq.** = VOR Interrogation frequency (MHz)

Table 5-1: VOR ICAO standard frequencies (MHz) and channels

Chan.	VOR Freq.	Chan.	VOR Freq.	Chan.	VOR Freq.	Chan.	VOR Freq.	Chan.	VOR Freq.	Chan.	VOR Freq.
17X 17Y	108.00 108.05	45X 45Y	110.80 110.85	75X 75Y	112.80 112.85	89X 89Y	114.20 114.25	103X 103Y	115.60 115.65	117X 117Y	117.00 117.05
19X 19Y	108.20 108.25	47X 47Y	111.00 111.05	76X 76Y	112.90 112.95	90X 90Y	114.30 114.35	104X 104Y	115.70 115.75	118X 118Y	117.10 117.15
21X 21Y	108.40 108.45	49X 49Y	111.20 111.25	77X 77Y	113.00 113.05	91X 91Y	114.40 114.45	105X 105Y	115.80 115.85	119X 119Y	117.20 117.25
23X 23Y	108.60 108.65	51X 51Y	111.40 111.45	78X 78Y	113.10 113.15	92X 92Y	114.50 114.55	106X 106Y	115.90 115.95	120X 120Y	117.30 117.35
25X 25Y	108.80 108.85	53X 53Y	111.60 111.65	79X 79Y	113.20 113.25	93X 93Y	114.60 114.65	107X 107Y	116.00 116.05	121X 121Y	117.40 117.45
27X 27Y	109.00 109.05	55X 55Y	111.80 111.85	80X 80Y	113.30 113.35	94X 94Y	114.70 114.75	108X 108Y	116.10 116.15	122X 122Y	117.50 117.55
29X 29Y	109.20 109.25	57X 57Y	112.00 112.05	81X 81Y	113.40 113.45	95X 95Y	114.80 114.85	109X 109Y	116.20 116.25	123X 123Y	117.60 117.65
31X 31Y	109.40 109.45	58X 58Y	112.10 112.15	82X 82Y	113.50 113.55	96X 96Y	114.90 114.95	110X 110Y	116.30 116.35	124X 124Y	117.70 117.75

Chan.	VOR Freq.	Chan.	VOR Freq.	Chan.	VOR Freq.	Chan.	VOR Freq.	Chan.	VOR Freq.	Chan.	VOR Freq.
33X 33Y	109.60 109.65	59X 59Y	112.20 112.25	83X 83Y	113.60 113.65	97X 97Y	115.00 115.05	111X 111Y	116.40 116.45	125X 125Y	117.80 117.85
35X 35Y	109.80 109.85	70X 70Y	112.30 112.35	84X 84Y	113.70 113.75	98X 98Y	115.10 115.15	112X 112Y	116.50 116.55	126X 126Y	117.90 117.95
37X 37Y	110.00 110.05	71X 71Y	112.40 112.45	85X 85Y	113.80 113.85	99X 99Y	115.20 115.25	113X 113Y	116.60 116.65		
39X 39Y	110.20 110.25	72X 72Y	112.50 112.55	86X 86Y	113.90 113.95	100X 100Y	115.30 115.35	114X 114Y	116.75 116.75		
41X 41Y	110.40 110.45	73X 73Y	112.60 112.65	87Y 87Y	114.00 114.05	101X 101Y	115.40 115.45	115X 115Y	116.80 116.85		
43X 43Y	110.60 110.65	74X 74Y	112.70 112.75	88X 88Y	114.10 114.15	102X 102Y	115.50 115.55	116X 116Y	116.90 116.95		

Related Settings

For VOR settings at the R&S SMA100B, see Chapter 5.3, "VOR Configuration and Settings", on page 116.

5.2.2 Instrument Landing System (ILS)

The instrument landing system is used during the landing approach and monitors the correct approach path to the runway.

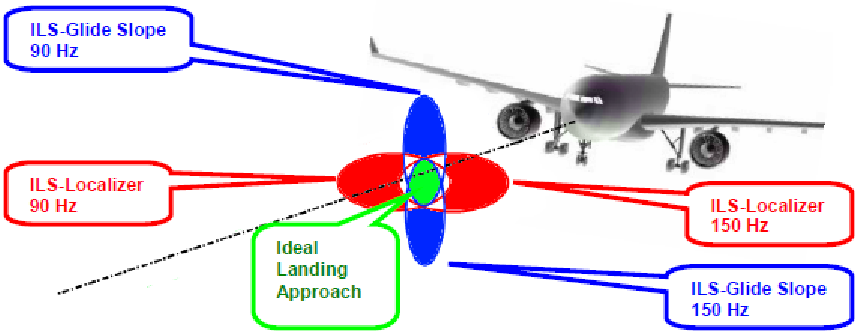


Figure 5-1: Approach navigation using instrument landing system (ILS) [1MA193]

An ILS system consists of three independent subsystems:

- A glide slope for vertical guidance.
- A localizer for horizontal guidance.
- (optional) marker beacons

Glide Slope

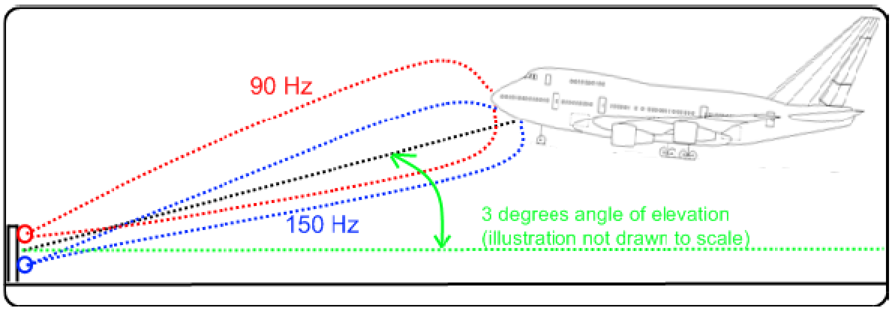
The glide slope transmitter is located near the end of the runway (nearest to the start of the aircraft approach).

Typically, vertically aligned antennas transmit two intersecting main beams on top of one another at carrier frequencies between 329 MHz and 335 MHz (see Table 5-2). The top beam is usually modulated at 90 Hz and the beam below at 150 Hz [1MA193].

The information on position is provided after demodulation of the beam signals by evaluating the difference in depth of modulation (DDM). The following scenarios are possible:

- Predominance of the 90 Hz beam: the aircraft is too high and must descend
- Predominance of the 150 Hz beam: the aircraft is too low and needs to climb
- The signal strength from both beams is equal: the aircraft is in the center, on the right course.

If there is a predominance of the 90 Hz beam, then the aircraft is too high and must descend. A predominant 150 Hz means that the aircraft is too low and needs to climb.

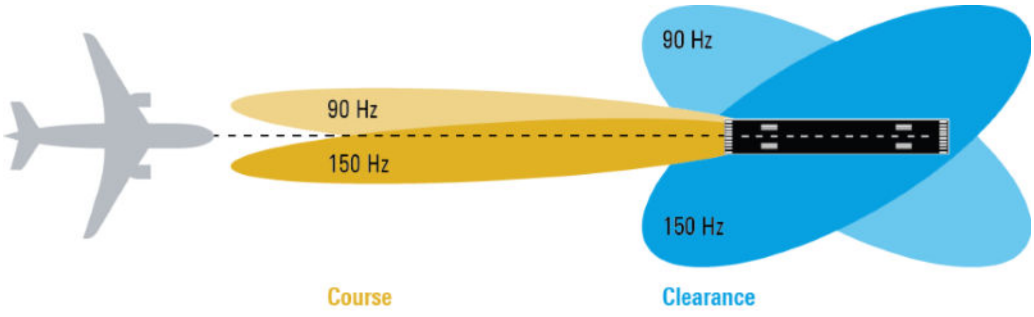


Localizer

The localizer transmitter is located near the end of the runway (nearest to the start of the aircraft approach). Typically, horizontally aligned antennas transmit two intersecting main beams beside one another at carrier frequencies between 108 MHz and 112 MHz (see Table 5-2). As seen from the approaching aircraft coming in for a landing, the left beam is usually modulated at 90 Hz and the right beam at 150 Hz [1MA193].

The information on position is provided after demodulation of the beam signals by evaluating the difference in depth of modulation (DDM). The following scenarios are possible:

- Predominance of the 90 Hz beam: the aircraft is too far to the left and must turn to the right
- Predominance of the 150 Hz beam: the aircraft is too far to the right and must turn to the left
- The signal strength from both beams is equal: the aircraft is in the center, on the right course.



ILS ICAO Frequencies

The individual values in Table 5-2 are:

- **Chan.** = ICAO channel number
- **LOC Freq.** = ILS localizer frequency (MHz)
- **GS Freq.** = ILS glide slope frequency (MHz)

Table 5-2: ILS glide slope and localizer ICAO standard frequencies (MHz) and channels

Chan.	LOC Freq.	GS Freq.	Chan.	LOC Freq.	GS Freq.	Chan.	LOC Freq.	GS Freq.
18X 18Y	108.10 108.15	334.70 334.55	32X 32Y	109.50 109.55	332.60 332.45	46X 46Y	110.90 110.95	330.80 330.65
20X 20Y	108.30 108.35	334.10 333.95	34X 34Y	109.70 109.75	333.20 333.05	48X 48Y	111.10 111.15	331.70 331.55
22X 22Y	108.50 108.55	329.90 329.75	36X 36Y	109.90 109.95	333.80 333.65	50X 50Y	111.30 111.35	332.30 332.15
24X 24Y	108.70 108.75	330.50 330.35	38X 38Y	110.10 110.15	334.40 334.25	52X 52Y	111.50 111.55	332.90 332.75
26X 26Y	108.90 108.95	329.30 329.15	40X 40Y	110.30 110.35	335.00 334.85	54X 54Y	111.70 111.75	333.50 333.35
28X 28Y	109.10 109.15	331.40 331.25	42X 42Y	110.50 110.55	329.60 329.45	56X 56Y	111.90 111.95	331.10 330.95
30X 30Y	109.30 109.35	332.00 331.85	44X 44Y	110.70 110.75	330.20 330.05			

Marker Beacons

Marker beacon receivers are used for a rough distance measurement. They are available only for some ILS installations [1MA193].

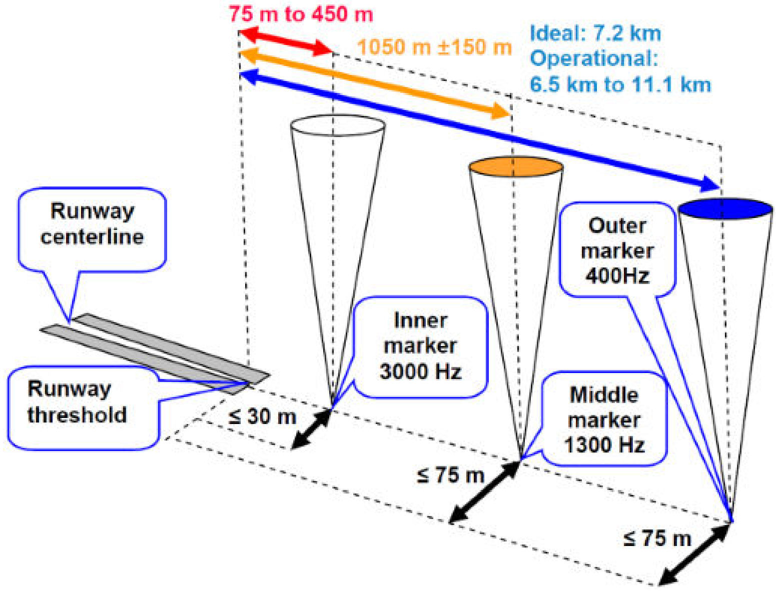


Figure 5-2: Marker beacon placement and distance to runway

Marker beacon receivers decode audio and provide signaling output to identify one of three marker beacons installed near the runway. They transmit a narrow beam width at 75 MHz carrier frequency in a vertical direction. Each of them has a different distinct modulation code to allow the receiver to identify which one it is flying over [1MA193].

Both visual (color of the marker beacon) and audio tone identification is supported for determining which marker has been flown over. The audio/visual pairing of marker beacons is as follows:

- Outer marker flashes BLUE in the cockpit at 400 Hz ("relaxed" tone).
- Middle marker flashes AMBER in the cockpit at 1300 Hz ("hurried" tone).
- Inner marker flashes WHITE in the cockpit at 3000 Hz ("urgent" tone).

Related Settings

For ILS settings at the R&S SMA100B, see the following sections:

- Chapter 5.4.2, "ILS Glide Slope Settings", on page 127
- Chapter 5.4.3, "ILS Localizer Settings", on page 134
- Chapter 5.4.4, "ILS Marker Beacons Settings", on page 143

5.2.3 Automatic Direction Finder (ADF)

ADF receivers provide the relative bearing of a basic ground-based Non-Directional Beacon (NDB) to the fore/aft axis of the aircraft. The beacon signal is generated by a directional antenna assembly in the aircraft.

The ADF determines the direction to the NDB station relative to the aircraft and is used for instrument approaches (autopilot). It provides additional information to other navigation equipment, e.g. VOR.

Related Settings

For ADF settings at the R&S SMA100B, see Chapter 5.5, "ADF Configuration and Settings", on page 148.

5.3 VOR Configuration and Settings

Option: R&S SMAB-K25

Access:

► Select "Modulation > Avionic Standards > VOR".

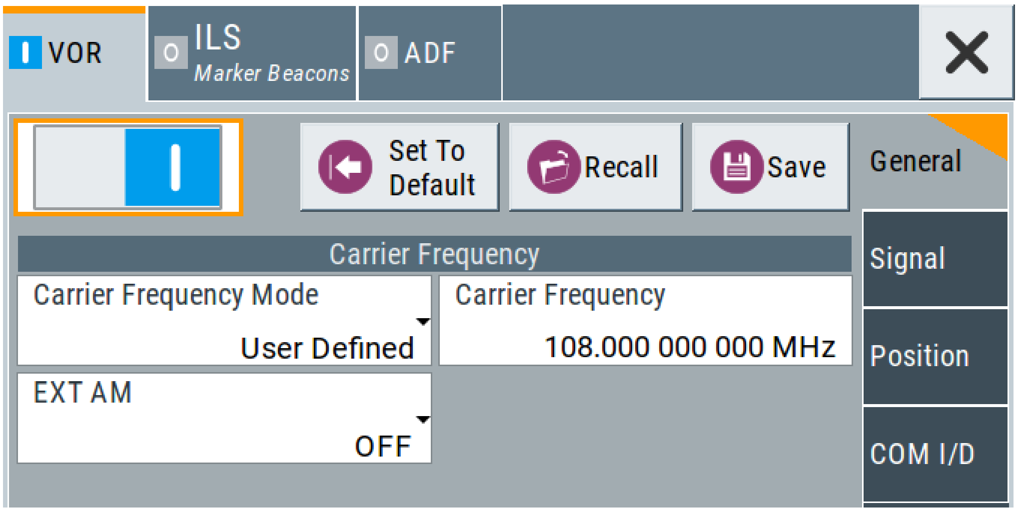
The remote commands required to define VOR settings are described in Chapter 13.16.2.5, "SOURce:VOR Subsystem", on page 574.

Settings

5.3.1 General Settings

Access:

► Select "VOR > General"



This dialog comprises general settings of the VOR standard, the default and the "Save/Recall" settings.

By default, a VOR modulation signal is set on an RF carrier with a frequency of 108 MHz or ICAO channel 17X. The 9.96 kHz subcarrier signal is frequency modulated with a 30.00 Hz reference signal. The COM/ID signal has 1.02 kHz frequency, the variable phase signal 30.00 Hz frequency.

If enabled, the avionic standard modulation is displayed in the "Modulation" tile as follows:
- "Avionic: VOR" for enabled VOR modulation
- "Avionic ILS: Glide Slope/Localizer/Marker Bcn" for enabled ILS glide slope/ localizer/marker beacons modulation
- "Avionic: ADF" for enabled ADF modulation

Changing a parameter in the avionic standards causes an instant signal change in the R&S SMA100B. There is no extra measurement cycle to calculate the RMS value of the baseband signal to set the correct RF level.

If the avionics standard is activated for the first time, or after every subsequent on/off sequence, the measurement cycle will take place to determine the correct RF level. Every subsequent parameter change in the avionic standard is performed without another measurement cycle to provide a continuous signal output.

Settings

State

Activates the avionic standard.

Activation of the standard deactivates a previously active avionic standard. The "VOR/ILS > Carrier Frequency" setting is applied automatically to the "RF > "Frequency" on page 65"/"Frequency" in the status bar.

Remote command:
`<subsystem>:SETTing:STATe` on page 547

Set To Default

Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Value
State	Not affected by "Set to default"
Carrier Frequency Mode	User Defined
Carrier Frequency	334.700000 MHz

Remote command:
<subsystem>:PRESet on page 546

Save/Recall
Accesses the "Save/Recall" dialog, that is the standard instrument function for saving and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The filename and the directory, in which the settings are stored, are user-definable; the file extension is however predefined.

Remote command:
<subsystem>:SETTing:CATalog on page 546
<subsystem>:SETTing:DELete on page 546
<subsystem>:SETTing:LOAD on page 546
<subsystem>:SETTing:STORe on page 547

Carrier Frequency Mode
Sets the mode for the carrier frequency of the signal.

"User Defined" Activates user-defined variation of the carrier frequency.

"ICAO" Activates variation in predefined steps according to standard VOR transmitting frequencies (see Table 5-1). The start value can be selected in the field "ICAO Channel".

Remote command:
[:SOURce<hw>]:VOR:FREQuency:MODE on page 579

Carrier Frequency
Requires "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:
[:SOURce<hw>]:VOR:FREQuency on page 579

ICAO Channel
Requires "Carrier Frequency Mode > ICAO".

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

For an overview of the VOR ICAO channel frequencies, see Table 5-1.

Remote command:
[:SOURce<hw>]:VOR:ICAO:CHANnel on page 579

EXT AM
Enables/disables additional modulation from an external source. The external signal is input via the Ext connector.

"OFF" Selects the internal modulation source for VOR modulation.

"EXT (MOD AM)"
Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the Ext connector. The sensitivity is 10 mV per percent modulation depth.

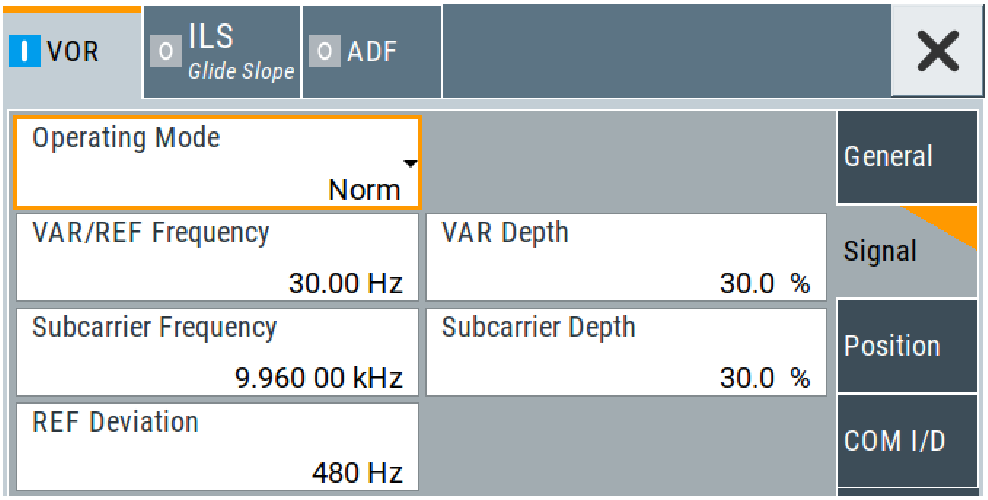
Note: There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated. To avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining VOR signal components.

Remote command:
<subsystem>:SETTing:SOURce on page 547

5.3.2 Signal Settings

Access:

► Select "VOR > Signal".



This dialog provides access to signal settings of the VOR modulation signal.

Settings

Mode

Selects the operating mode for the VOR modulation signal.

"Norm" VOR modulation is active.

"Var" Amplitude modulation of the output signal with the VAR signal component (30Hz signal content) of the VOR signal. The modulation depth corresponds to the value set under VAR Depth.

"Subcarrier" Amplitude modulation of the output signal with the unmodulated FM carrier (9960Hz) of the VOR signal. The modulation depth corresponds to the value set under Subcarrier Depth .

"Subcarrier + FM" Amplitude modulation of the output signal with the frequency-modulated FM carrier (9960Hz) of the VOR signal. The frequency deviation corresponds to the value set under REF Deviation, the modulation depth corresponds to the value set under "Subcarrier Depth".

Remote command:
[:SOURce<hw>]:VOR:MODE on page 580

VAR/REF Frequency

Sets the frequency of the VAR signal and the REF signal. As the two signals must have the same frequency, the setting is valid for both signals.

Remote command:
[:SOURce<hw>]:VOR:VAR:FREQuency on page 582

VAR Depth

Sets the AM modulation depth of the 30Hz VAR signal.

Note: The sum of "Subcarrier depth", "VAR depth" and "COM/ID > Depth" must be smaller than 100 %.

Remote command:
[:SOURce<hw>]:VOR:VAR[:DEPTh] on page 582

Subcarrier Frequency

Sets the frequency of the FM carrier.

Remote command:
[:SOURce<hw>]:VOR:SUBCarrier[:FREQuency] on page 581

Subcarrier Depth

Sets the AM modulation depth of the FM carrier.

Note: The sum of "Subcarrier depth", "VAR depth" and "COM/ID > Depth" must be smaller than 100 %.

Remote command:
[:SOURce<hw>]:VOR:SUBCarrier:DEPTh on page 581

REF Deviation

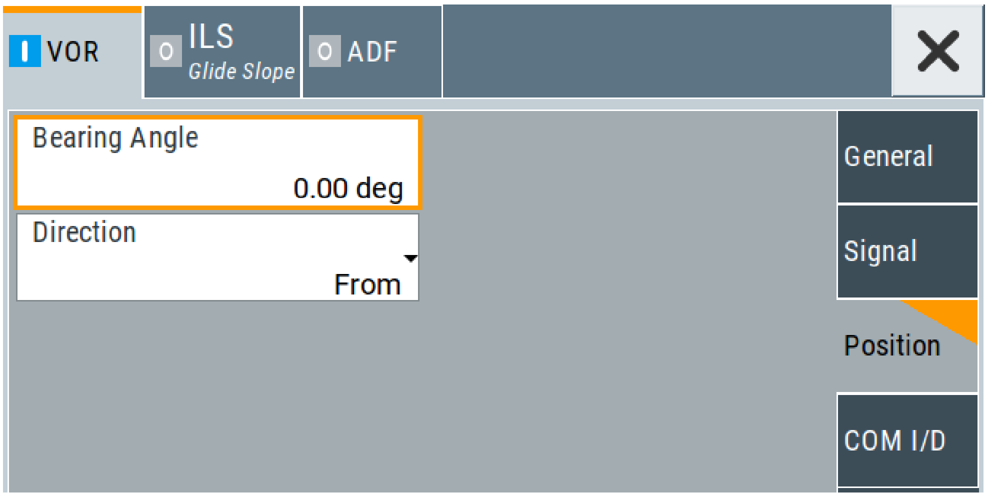
Sets the frequency deviation of the reference signal on the FM carrier.

Remote command:
[:SOURce<hw>]:VOR:REFerence[:DEViation] on page 581

5.3.3 Position Settings

Access:

► Select "VOR > Position".



This dialog provides access to position settings related to the VOR modulation signal.

Settings

Bearing Angle

Sets the phase angle between the 30 Hz VAR signal and the 30 Hz reference signal. The orientation of the angle depends on the set Direction.

Remote command:

`[:SOURce<hw>]:VOR[:BANGle]` on page 575

Direction

Sets the reference position of the phase information.

The angle set under "Bearing Angle" corresponds to the angle between the geographic north and the connection line from beacon to airplane.

"From"	Selection of the beacon as a reference position.
"To"	Selection of the airplane position as a reference position.

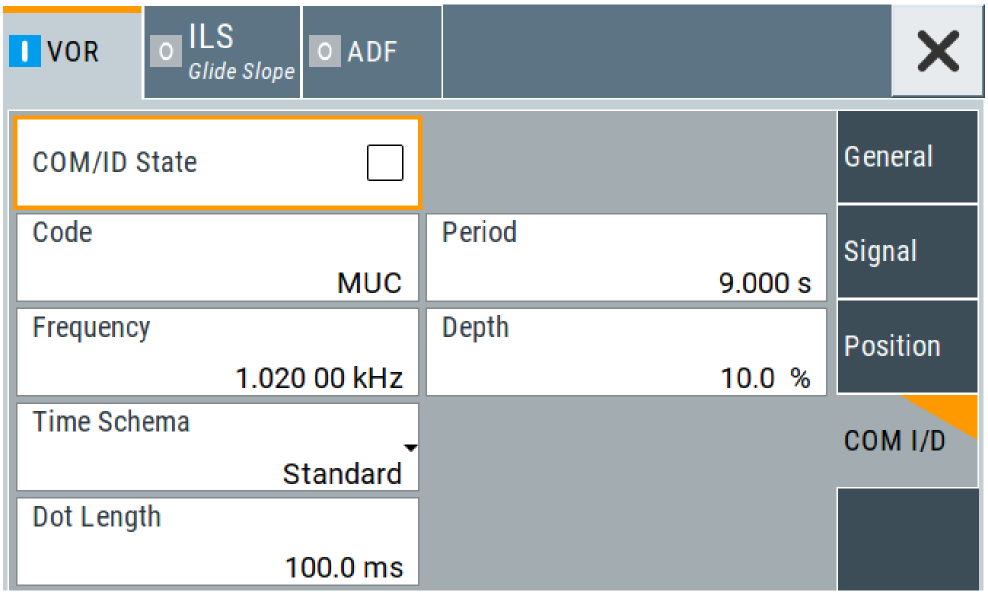
Remote command:

`[:SOURce<hw>]:VOR[:BANGle]:DIRection` on page 575

5.3.4 COM/ID Settings

Access:

► Select "VOR > COM/ID"



This dialog comprises COM/ID signal settings related to the VOR signal.

Settings

COM/ID State

Enables/disables the COM/ID signal.

See also Chapter D, "Morse Code Settings", on page 740.

Remote command:

`[:SOURce<hw>]:VOR:COMid[:STATe]` on page 578

Code

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter D, "Morse Code Settings", on page 740.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Remote command:
`[:SOURce<hw>]:VOR:COMid:CODE` on page 575

Period
Sets the period of the COM/ID signal.

Remote command:
`[:SOURce<hw>]:VOR:COMid:PERiod` on page 577

Frequency
Sets the frequency of the COM/ID signal.

Remote command:
`[:SOURce<hw>]:VOR:COMid:FREQuency` on page 577

Depth
Sets the AM modulation depth of the COM/ID signal.

Note: The sum of Subcarrier Depth , VAR Depth and COM/ID > Depth must be smaller than 100 %.

Remote command:
`[:SOURce<hw>]:VOR:COMid:DEPTh` on page 576

Time Schema
Sets the time schema of the Morse code for the COM/ID signal.

- "Standard"
  The set dot length determines the length of the dash, the symbol space and letter space of the Morse code.
- "User"
  You can set each length value separately.

Remote command:
`[:SOURce<hw>]:VOR:COMid:TSCHema` on page 578

Dot Length
Sets the length of a Morse code dot.

If "Time Schema > Standard", the dot length value determines also the length of the dash (= 3 times the dot length), symbol space (= dot length) and letter space (= 3 times the dot length).

Remote command:
`[:SOURce<hw>]:VOR:COMid:DOT` on page 576

Dash Length
Requires "Time Schema > User".

Sets the length of a Morse code dash.

Remote command:
`[:SOURce<hw>]:VOR:COMid:DASH` on page 576

Symbol Space

Requires "Time Schema > User".

Sets the length of the Morse code symbol space.

Remote command:

`[:SOURce<hw>]:VOR:COMid:SYMBol` on page 578

Letter Space

Requires "Time Schema > User".

Sets the length of a Morse code letter space.

Remote command:

`[:SOURce<hw>]:VOR:COMid:LETTer` on page 577

5.4 ILS Configuration and Settings

Option: R&S SMAB-K25

Access:

► Select "Modulation > Avionic Standards > ILS".

The remote commands required to define ILS settings are described in Chapter 13.16.2.4, "SOURce:ILS Subsystem", on page 551.

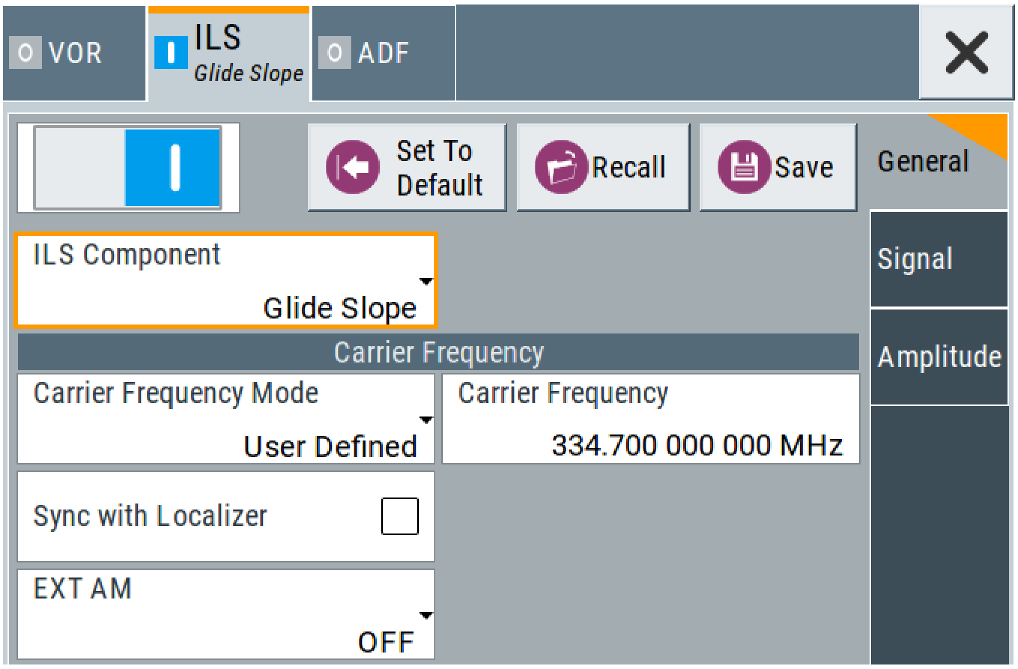
Settings

5.4.1 General Settings

This chapter comprises general settings, which are common for all ILS components.

Access:

► Select "ILS > General".



This dialog comprises general settings of the ILS standard, the default and the "Save/Recall" settings.
By default, an ILS glide slope modulation signal on an RF carrier with a frequency of 344.7 MHz or ICAO channel 18X. The dual-tone LF signal with frequencies 90 Hz and 150 Hz and a balanced modulation at SDM of 80 %.

If enabled, the avionic standard modulation is displayed in the "Modulation" tile as follows:

- "Avionic: VOR" for enabled VOR modulation
- "Avionic ILS: Glide Slope/Localizer/Marker Bcn" for enabled ILS glide slope/ localizer/marker beacons modulation
- "Avionic: ADF" for enabled ADF modulation

Changing a parameter in the avionic standards causes an instant signal change in the R&S SMA100B. There is no extra measurement cycle to calculate the RMS value of the baseband signal to set the correct RF level.

If the avionics standard is activated for the first time, or after every subsequent on/off sequence, the measurement cycle will take place to determine the correct RF level. Every subsequent parameter change in the avionic standard is performed without another measurement cycle to provide a continuous signal output.

Settings

State
Activates the avionic standard.

Activation of the standard deactivates a previously active avionic standard. The "VOR/ILS > Carrier Frequency" setting is applied automatically to the "RF > "Frequency" on page 65"/"Frequency" in the status bar.

Remote command:
`<subsystem>:SETTing:STATe` on page 547

Set To Default
Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Value
State	Not affected by "Set to default"
Carrier Frequency Mode	User Defined
Carrier Frequency	334.700000 MHz

Remote command:
`<subsystem>:PRESet` on page 546

Save/Recall
Accesses the "Save/Recall" dialog, that is the standard instrument function for saving and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The filename and the directory, in which the settings are stored, are user-definable; the file extension is however predefined.

Remote command:
`<subsystem>:SETTing:CATalog` on page 546
`<subsystem>:SETTing:DELete` on page 546
`<subsystem>:SETTing:LOAD` on page 546
`<subsystem>:SETTing:STORe` on page 547

ILS Component
Sets the ILS component.

"Glide slope" Enables the glide slope.

"Localizer" Enables the localizer.

"Marker Beacons"
Enables the marker beacons.

Remote command:
`[:SOURce<hw>]:ILS:TYPE` on page 553

EXT AM

Enables/disables additional modulation from an external source. The external signal is input via the Ext connector.

"OFF" Selects the internal modulation source for VOR/ILS glide slope/ILS localizer modulation.

"EXT (MOD AM)"
Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the Ext connector. The sensitivity is 10 mV per percent modulation depth.

Note: There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated. To avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining VOR signal components.

Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:SOURce` on page 547
`[:SOURce<hw>]:ILS:LOCalizer:SOURce` on page 547

5.4.2 ILS Glide Slope Settings

Access:

1. Select "ILS > General".
2. Select "ILS Component > Glide Slope".

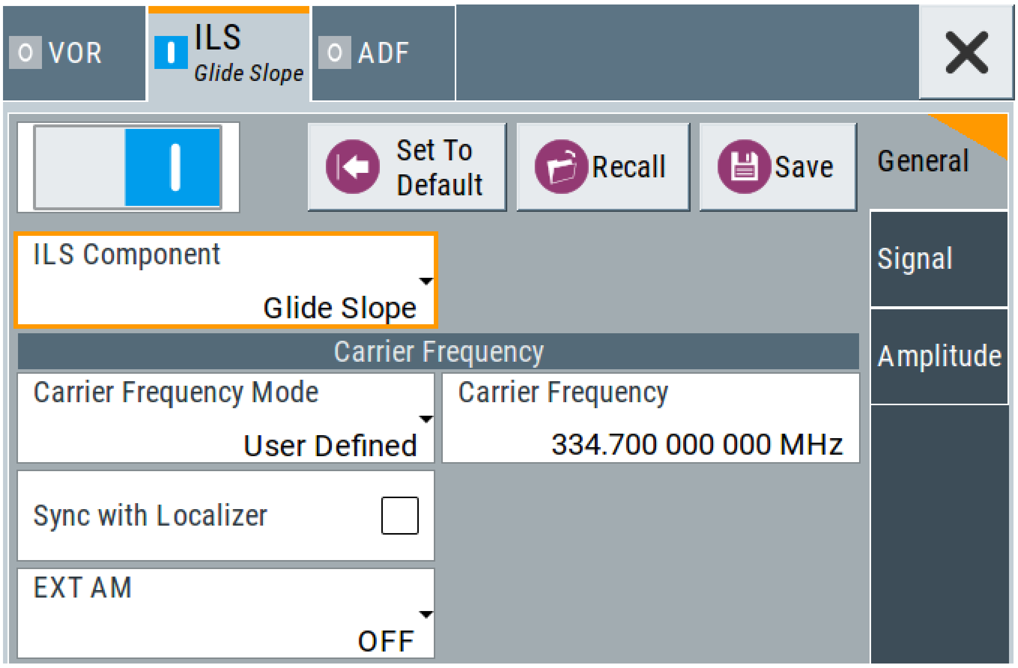
Settings

5.4.2.1 General Settings

Access:

1. Select "ILS Component > Glide Slope", see Chapter 5.4.2, "ILS Glide Slope Settings", on page 127.

2. Select "ILS > General".



This dialog comprises carrier frequency settings related to the ILS glide slope component of the ILS signal.

Settings

Carrier Frequency Mode

Sets the mode for the carrier frequency of the signal.

"User Defined" Activates user-defined variation of the carrier frequency.

"ICAO" Activates variation in predefined steps according to standard ILS transmitting frequencies (see Table 5-2).
Select the Carrier Frequency Mode to set a standard ILS frequency channel. If you want to couple carrier frequencies of ILS glide slope and localizer components, enable Sync with Glide Slope/ Sync with Localizer.

Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:FREQuency:MODE` on page 556

Carrier Frequency

Requires "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:
[:SOURce<hw>]:ILS[:GS|GSLope]:FREQuency on page 556

ICAO Channel
Requires "Carrier Frequency Mode > ICAO".

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

For an overview of the ILS ICAO channel frequencies, see Table 5-2.

Remote command:
[:SOURce<hw>]:ILS[:GS|GSLope]:ICAO:CHANnel on page 557

Sync with Glide Slope/ Sync with Localizer
Activates synchronization of the ILS glide slope with the ILS localizer carrier frequency or vice versa.

E.g. if Carrier Frequency Mode > User, the ILS glide slope carrier frequency is applied to the ILS localizer carrier frequency or vice versa.

If "Carrier Frequency Mode > ICAO", the ILS glide slope ICAO channel is applied to the ILS localizer ICAO channel or vice versa. The ILS glide slope/localizer frequency of the ICAO channel (Table 5-2) is set automatically.

Remote command:
<subsystem>:SETTing:FREQuency:SYNChronize:STATe on page 548

EXT AM
Enables/disables additional modulation from an external source. The external signal is input via the Ext connector.

"OFF" Selects the internal modulation source for VOR modulation.

"EXT (MOD AM)"
Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the Ext connector. The sensitivity is 10 mV per percent modulation depth.

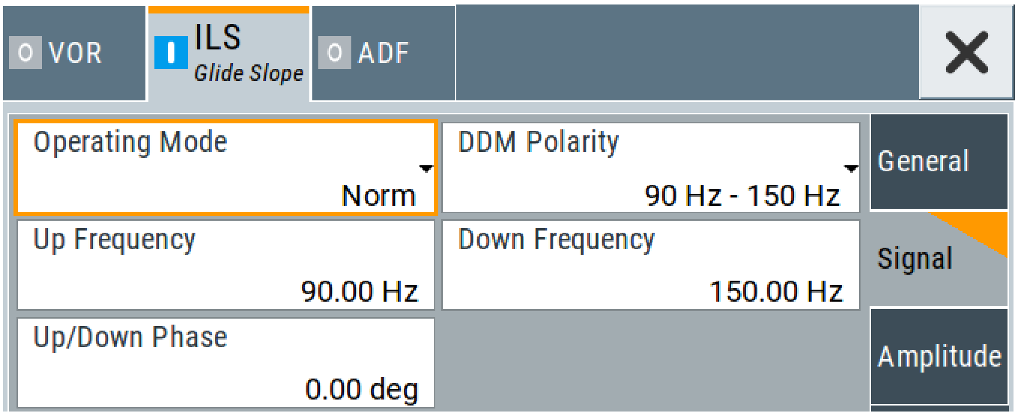
Note: There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated. To avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining VOR signal components.

Remote command:
<subsystem>:SETTing:SOURce on page 547

5.4.2.2 Signal Settings

Access:

1. Select "ILS Component > Glide Slope", see Chapter 5.4.2, "ILS Glide Slope Settings", on page 127.
2. Select "ILS > Signal".



This dialog comprises modulation signal settings related to the ILS glide slope component of the ILS signal.

Settings

Operating Mode

Selects the operating mode for the ILS glide slope modulation signal.

"Norm" ILS glide slope modulation is active.

"90 Hz" Amplitude modulation of the output signal with the upper lobe signal component (90 Hz signal content) of the ILS glide slope signal.

The modulation depth of the 90 Hz signal results from the settings of the parameters Sum of Depth and DDM Depth according to:

- "Fly > Down"
  AM (90 Hz) = 0.5 × (SDM + DDM × 100 %)
- "Fly > Up"
  AM (90 Hz) = 0.5 × (SDM - DDM × 100 %)

"150 Hz" Amplitude modulation of the output signal with the lower lobe signal component (150 Hz signal content) of the ILS glide slope signal.

The modulation depth of the 150 Hz signal results from the settings of parameters Sum of Depth and DDM Depth according to:

- "Fly > Down"
  AM (150 Hz) = 0.5 × (SDM + DDM × 100 %)
- "Fly > Up"
  AM (150 Hz) = 0.5 × (SDM - DDM × 100 %)

Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:MODE` on page 558

DDM Polarity
Defines the polarity for DDM calculation (see "DDM Depth" on page 133).

Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:POLarity` on page 555

Up Frequency
Sets the modulation frequency of the upper antenna lobe.

Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:ULOBe[:FREQuency]` on page 559

Down Frequency
Sets the modulation frequency of the lower antenna lobe.

Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:LLOBe[:FREQuency]` on page 557

Up/Down Phase
Sets the phase between the modulation signals of the upper and lower antenna lobe.

The zero crossing of the lower lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the lower antenna lobe.

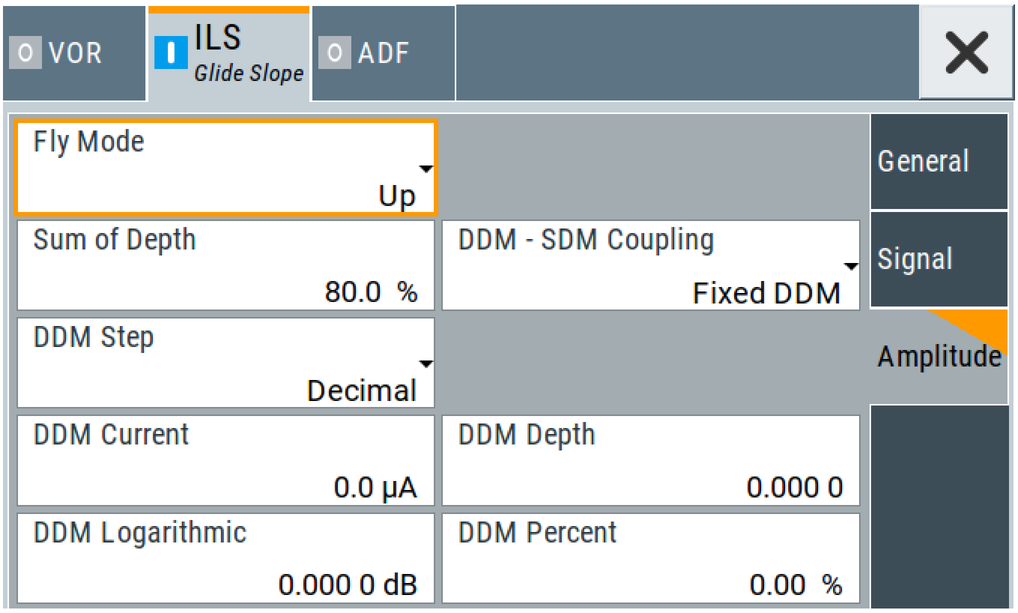
Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:PHASe` on page 558

5.4.2.3 Amplitude Settings

Access:

1. Select "ILS Component > Glide Slope", see Chapter 5.4.2, "ILS Glide Slope Settings", on page 127.

2. Select "ILS > Amplitude".



This dialog comprises amplitude settings related to the ILS glide slope component of the ILS signal.

Settings

Sum of Depth

Sets the arithmetic sum of the modulation depths of the upper lobe (90 Hz) and lower lobe (150 Hz) ILS glide slope signal contents.

The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

Remote command:

`[:SOURce<hw>]:ILS[:GS|GSLope]:SDM` on page 559

FlyMode

Selects the simulation mode for the ILS glide slope modulation signal. A change of the setting automatically changes the sign of the DDM value.

This setting simulates the direction in which the pilot has to correct the course.

"Up" The 150 Hz modulation signal is predominant, the DDM value is negative (the airplane is too low, it must climb).

"Down" The 90 Hz modulation signal is predominant, the DDM value is positive (the airplane is too high, it must descend).

Remote command:
[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:DIRection on page 554

DDM Step

Selects the variation of the DDM values.

"Decimal" Decimal variation according to the current cursor position.

"Predifined" Variation in predefined steps according to the standardized DDM values.

Remote command:
[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:STEP on page 555

DDM Current

Sets the current of the ILS indicating the instrument corresponding to the DDM value. The instrument current is calculated according to:

DDM Current μA = DDM Depth [%] × 857,125 μA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Remote command:
[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:CURRent on page 553

DDM Depth

Sets the difference in depth of modulation between the upper lobe (90 Hz) and the lower lobe (150 Hz) tone of the ILS glide slope modulation signal.

The DDM value is calculated with the formula:

- "DDM Polarity > 90 Hz - 150 Hz":
  DDM = [AM (90 Hz) - AM (150 Hz)] / 100%
- "DDM Polarity > 150 Hz - 90 Hz":
  DDM = [AM (150 Hz) - AM (90 Hz)] / 100%

A variation of the DDM value automatically leads to a variation of the value of the instrument current and the DDM value in dB.

Remote command:
[:SOURce<hw>]:ILS[:GS|GSLope]:DDM[:DEPTh] on page 556

DDM Logarithmic

Sets the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM+DDM×100%) / (SDM-DDM×100%)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

Remote command:
[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:LOGarithmic on page 554

DDM Percent

Sets the difference in depth of modulation between the upper lobe (90 Hz) and the lower lobe (150 Hz) tone of the ILS glide slope modulation signal.

The DDM value in percent is calculated as follows:

- "DDM Polarity > 90 Hz - 150 Hz":
  DDM = [AM (90 Hz) - AM (150 Hz)]
- "DDM Polarity > 150 Hz - 90 Hz":
  DDM = [AM (150 Hz) - AM (90 Hz)]

A variation of the DDM value automatically leads to a variation of the value of the instrument current and the DDM value in dB.

Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:PCT` on page 555

DDM - SDM Coupling
Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see below).

"Fixed DDM" The absolute DDM value stays constant, if the SDM is changed.

"Coupled to SDM"
The absolute DDM value changes, if the SDM is changed. The DDM value expressed in dB stays constant.

Remote command:
`[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:COUPling` on page 553

5.4.3 ILS Localizer Settings

Access:

1. Select "ILS > General".
2. Select "ILS Component > Localizer".

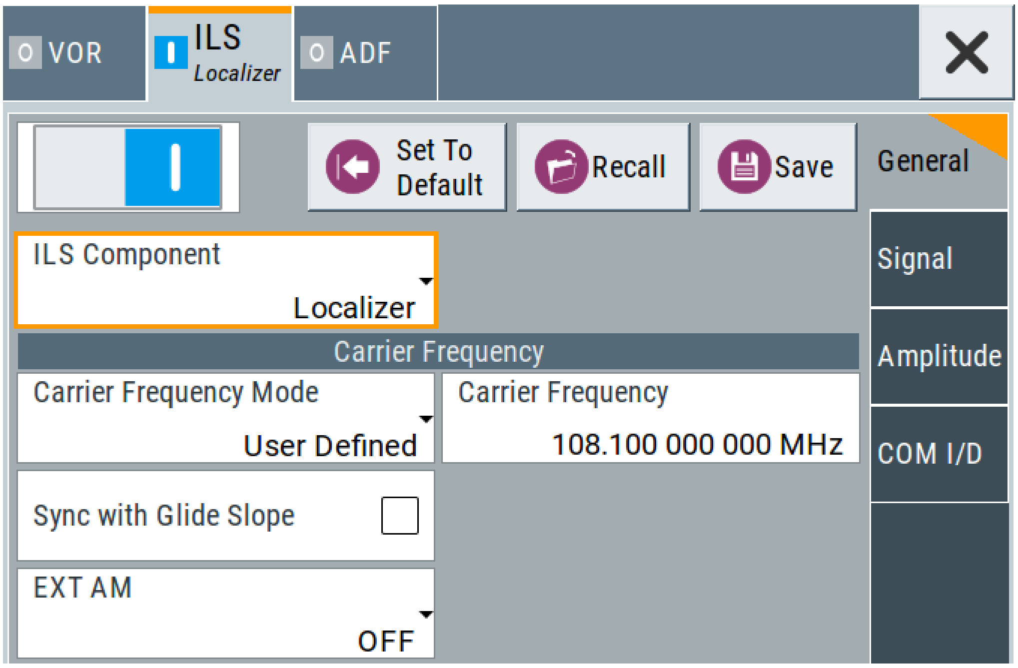
Settings

5.4.3.1 General Settings

Access:

1. Select "ILS Component > Localizer", see Chapter 5.4.3, "ILS Localizer Settings", on page 134.

2. Select "ILS > General".



This dialog comprises carrier frequency settings related to the ILS localizer component of the ILS signal.

Settings

Carrier Frequency Mode

Sets the mode for the carrier frequency of the signal.

"User Defined" Activates user-defined variation of the carrier frequency.

"ICAO" Activates variation in predefined steps according to standard ILS transmitting frequencies (see Table 5-2).
Select the ICAO Channel to set a standard ILS frequency channel. If you want to couple carrier frequencies of ILS glide slope and localizer components, enable General Settings .

Remote command:
[:SOURce<hw>]:ILS:LOCalizer:FREQuency:MODE on page 566

Carrier Frequency

Requires "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:
[:SOURce<hw>]:ILS:LOCalizer:FREQuency on page 565

ICAO Channel
Requires "Carrier Frequency Mode > ICAO".

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

For an overview of the ILS ICAO channel frequencies, see Table 5-2.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:ICAO:CHANnel` on page 566

Sync with Glide Slope/ Sync with Localizer
Activates synchronization of the ILS glide slope with the ILS localizer carrier frequency or vice versa.

E.g. if Carrier Frequency Mode > User, the ILS glide slope carrier frequency is applied to the ILS localizer carrier frequency or vice versa.

If "Carrier Frequency Mode > ICAO", the ILS glide slope ICAO channel is applied to the ILS localizer ICAO channel or vice versa. The ILS glide slope/localizer frequency of the ICAO channel (Table 5-2) is set automatically.

Remote command:
`<subsystem>:SETTing:FREQuency:SYNChronize:STATe` on page 548

EXT AM
Enables/disables additional modulation from an external source. The external signal is input via the Ext connector.

"OFF" Selects the internal modulation source for VOR modulation.

"EXT (MOD AM)"
Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the Ext connector. The sensitivity is 10 mV per percent modulation depth.

Note: There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated. To avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining VOR signal components.

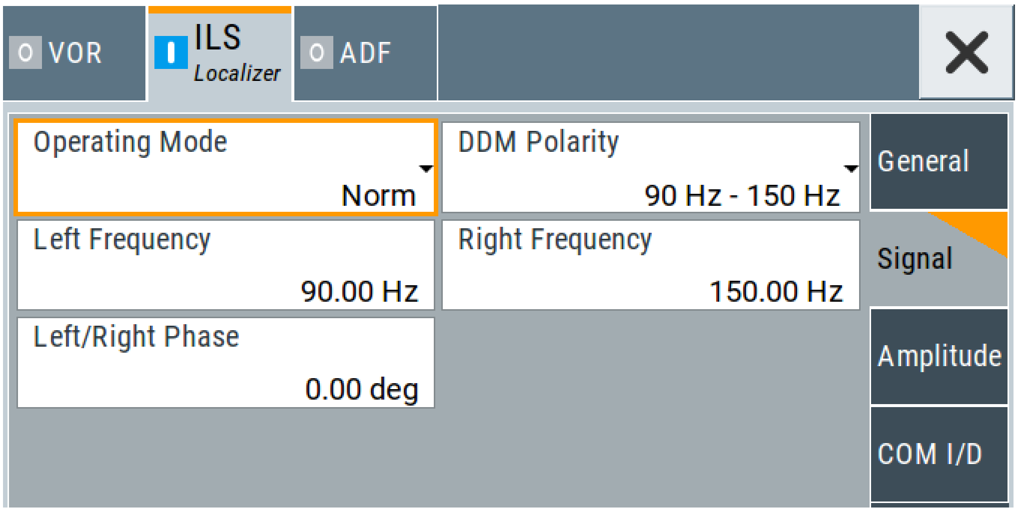
Remote command:
`<subsystem>:SETTing:SOURce` on page 547

5.4.3.2 Signal Settings

Access:

1. Select "ILS Component > Localizer", see Chapter 5.4.3, "ILS Localizer Settings", on page 134.

2. Select "ILS > Signal".



This dialog comprises audio signal and modulation settings related to the ILS localizer component of the ILS signal.

Settings

Operating Mode

Selects the operating mode for the ILS localizer modulation signal.

"Norm" ILS localizer modulation is active.

"90 Hz" Amplitude modulation of the output signal with the left lobe (90 Hz) signal component of the ILS localizer signal.

The modulation depth of the 90 Hz signal results from the settings of parameters Sum of Depth and DDM Depth according to:

- "Fly > Right"
  AM (90 Hz) = 0.5 × (SDM + DDM × 100 %)
- "Fly > Left"
  AM (90 Hz) = 0.5 × (SDM - DDM × 100 %)

"150 Hz" Amplitude modulation of the output signal with the right lobe (150 Hz) signal component of the ILS localizer signal.

The modulation depth of the 150 Hz signal results from the settings of parameters Sum of Depth and DDM Depth according to:

- "Fly" = "Right"
  AM (150 Hz) = 0.5 × (SDM + DDM × 100 %)
- "Fly" = "Left"
  AM (150 Hz) = 0.5 × (SDM - DDM × 100 %)

Remote command:
[:SOURce<hw>]:ILS:LOCalizer:MODE on page 567

DDM polarity
Defines the polarity for DDM calculation (see "DDM Depth" on page 140).

Remote command:
[:SOURce<hw>]:ILS:LOCalizer:DDM:POLarity on page 564

Left Frequency
Sets the modulation frequency of the antenna lobe arranged at the left viewed from the air plane.

Remote command:
[:SOURce<hw>]:ILS:LOCalizer:LLOBe[:FREQuency] on page 567

Right Frequency
Sets the modulation frequency of the antenna lobe arranged at the right viewed from the air plane.

Remote command:
[:SOURce<hw>]:ILS:LOCalizer:RLOBe[:FREQuency] on page 568

Left/Right Phase
Sets the phase between the modulation signals of the left and right antenna lobe. The zero crossing of the right lobe (150 Hz) signal serves as a reference. The angle refers to the period of the signal of the right antenna lobe.

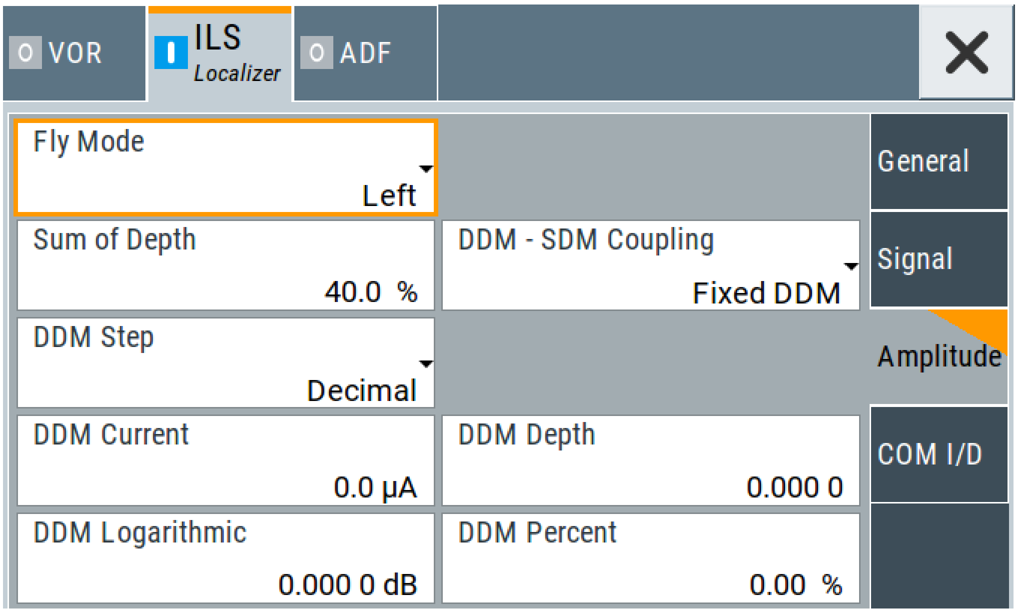
Remote command:
[:SOURce<hw>]:ILS:LOCalizer:PHASe on page 568

5.4.3.3 Amplitude Settings

Access:

1. Select "ILS Component > Localizer", see Chapter 5.4.3, "ILS Localizer Settings", on page 134.

2. Select "ILS > Amplitude".



This dialog comprises amplitude settings related to the ILS localizer component of the ILS signal.

Settings

FlyMode

Selects the simulation mode for the ILS localizer modulation signal. A change of the setting automatically changes the sign of the DDM value.

This setting simulates the direction in which the pilot has to correct the course.

"Left" The 150 Hz modulation signal is predominant, the DDM value is negative (the airplane is too far to the right, it must turn to the left).

"Right" The 90 Hz modulation signal is predominant, the DDM value is positive (the airplane is too far to the left, it must turn to the right).

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:DDM:DIRection` on page 563

Sum of Depth

Sets the arithmetic sum of the modulation depths of the left lobe (90 Hz) and right lobe (150 Hz) ILS localizer signal contents.

The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

The "Sum of Depth" and "COM/ID > Depth" must be smaller than 100 %.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:SDM` on page 568

DDM - SDM Coupling
Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see below).

"Fixed DDM"	The absolute DDM value stays constant, if the SDM is changed.
"Coupled to SDM"	The absolute DDM value changes, if the SDM is changed. The DDM value expressed in dB stays constant.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:DDM:COUPling` on page 563

DDM Step
Selects the variation step of the DDM values.

"Decimal"	Decimal variation according to the current cursor position.
"Predifined"	Variation in predefined steps according to the standardized DDM values.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:DDM:STEP` on page 565

DDM Current
Sets the current of the ILS indicating instrument corresponding to the DDM value. The instrument current is calculated according to:

DDM µA = DDM × 967.75 µA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:DDM:CURRent` on page 563

DDM Depth
Sets the difference in depth of modulation (DDM) between the signal of the left lobe (90 Hz) and the right lobe (150 Hz) of the ILS localizer modulation signal.

The DDM value in percent is calculated as follows:
- "DDM Polarity > 90 Hz - 150 Hz" (default setting):
  DDM = [AM (90 Hz) - AM (150 Hz)] / 100 %
- "DDM Polarity > 150 Hz - 90 Hz":
  DDM = [AM (150 Hz) - AM (90 Hz)] / 100 %

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:DDM[:DEPTh]` on page 565

DDM Logarithmic

Sets the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM + DDM × 100 %) / (SDM - DDM × 100 %)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:DDM:LOGarithmic` on page 564

DDM Percent

Sets the difference in depth of modulation between the signal of the left lobe (90 Hz) and the right lobe (150 Hz).

The DDM value in percent is calculated by the following formulas:

- "DDM Polarity > 90 Hz - 150 Hz" (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)]
- "DDM Polarity > 150 Hz - 90 Hz":
  DDM = [AM(150 Hz) - AM (90 Hz)]

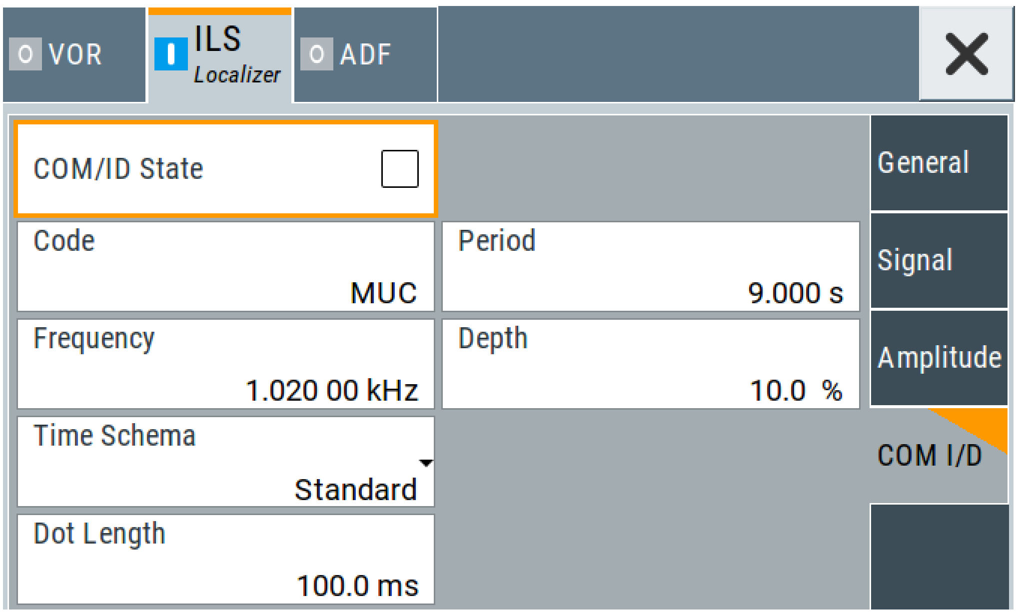
A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:DDM:PCT` on page 564

5.4.3.4 COM/ID Settings

Access:

1. Select "ILS Component > Localizer", see Chapter 5.4.3, "ILS Localizer Settings", on page 134.
2. Select "ILS > COM/ID".



This dialog comprises COM/ID settings related to the ILS localizer component of the ILS signal.

Settings

COM/ID State

Enables/disables the COM/ID signal.

See also Chapter D, "Morse Code Settings", on page 740.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid[:STATe]` on page 562

Code

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter D, "Morse Code Settings", on page 740.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:CODE` on page 560

Frequency

Sets the frequency of the COM/ID signal.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:FREQuency` on page 561

Period

Sets the period of the COM/ID signal.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:PERiod` on page 561

Depth

Sets the AM modulation depth of the COM/ID signal.

Note: The sum of Sum of Depth and COM/ID > Depth must be smaller than 100 %.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:DEPTh` on page 560

Time Schema
Sets the time schema of the Morse code for the COM/ID signal.

- "Standard"
  The set dot length determines the length of the dash, the symbol space and letter space of the Morse code.
- "User"
  You can set each length value separately.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:TSCHema` on page 562

Dot Length
Sets the length of a Morse code dot.

If "Time Schema > Standard", the dot length value determines also the length of the dash (= 3 times the dot length), symbol space (= dot length) and letter space (= 3 times the dot length).

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:DOT` on page 560

Dash Length
Requires "Time Schema > User".

Sets the length of a Morse code dash.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:DASH` on page 560

Symbol Space
Requires "Time Schema > User".

Sets the length of the Morse code symbol space.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:SYMBol` on page 562

Letter Space
Requires "Time Schema > User".

Sets the length of a Morse code letter space.

Remote command:
`[:SOURce<hw>]:ILS:LOCalizer:COMid:LETTer` on page 561

5.4.4 ILS Marker Beacons Settings

Access:

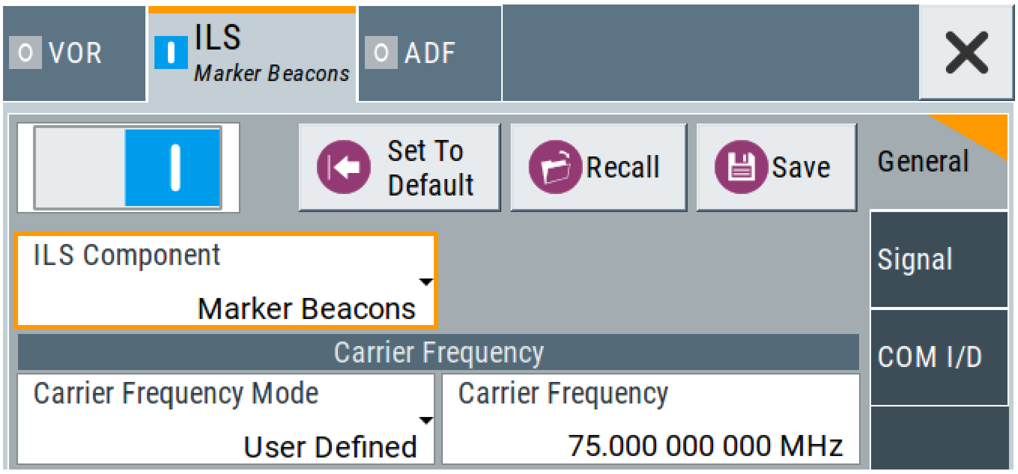
1. Select "ILS > General".
2. Select "ILS Component > Marker Beacons".

Settings

5.4.4.1 General Settings

Access:

1. Select "ILS Component > Marker Beacons", see Chapter 5.4.4, "ILS Marker Beacons Settings", on page 143.
2. Select "ILS > General".



This dialog comprises carrier frequency and signal settings related to the ILS marker beacons component of the ILS signal.

Settings

Carrier Frequency Mode

Sets the mode for the carrier frequency of the signal.

"User Defined" Activates user-defined variation of the carrier frequency.

"Predefined" Activates variation of the carrier frequency by integer 25 kHz steps.

Remote command:

`[:SOURce<hw>][:ILS]:MBEacon:FREQuency:MODE` on page 572

Carrier Frequency

Requires "Carrier Frequency Mode > User Defined".

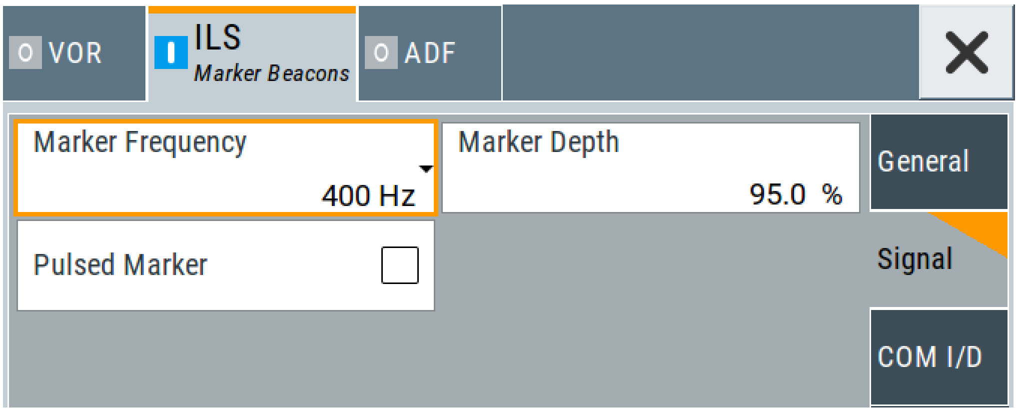
Sets the carrier frequency of the signal.

Remote command:
[:SOURce<hw>][:ILS]:MBEacon:FREQuency on page 572

5.4.4.2 Signal Settings

Access:

1. Select "ILS Component > Marker Beacons", see Chapter 5.4.4, "ILS Marker Beacons Settings", on page 143.
2. Select "ILS > Signal".



This dialog comprises signal settings related to the ILS marker beacons component of the ILS signal.

Settings

Marker Frequency
Sets the modulation frequency of the marker signal.

Remote command:
[:SOURce<hw>][:ILS]:MBEacon:MARKer:FREQuency on page 573

Marker Depth
Sets the modulation depth of the marker signal.

Remote command:
[:SOURce<hw>][:ILS]:MBEacon[:MARKer]:DEPTh on page 573

Pulsed Marker
Activates the modulation of a pulsed marker signal (morse coding).

"ON" Modulation of pulsed marker signals (morse coding). The duty cycle, i.e. the marker on- and off-times, depend on the marker signal frequency (Table 5-3).

Table 5-3: Morse coding for ILS marker beacons marker signals

Marker signal	On	Off	Rate	Duty cycle
Outer Marker (400 Hz)	375 ms	125 ms	2 dots/s	75 %
Middle Marker (1300 Hz)	First: 375 ms Second: 83 ms	First: 125 ms Second: 83 ms	1.5 dots/s	68.8 %
Inner Marker (3000 Hz)	83 ms	83 ms	6 dots/s	50 %

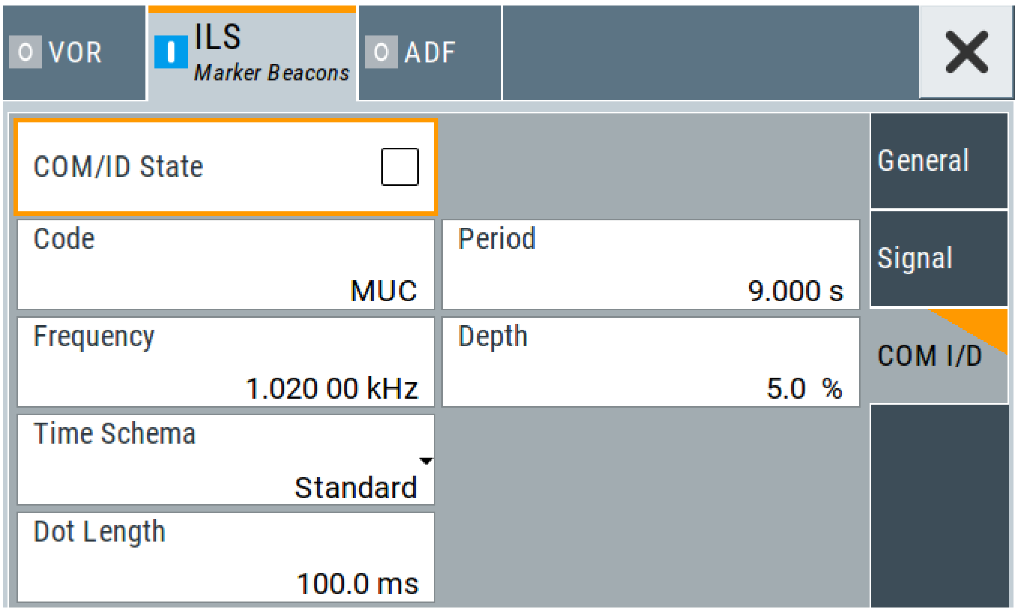
"OFF" Modulation of a continuous non-coded marker signal.

Remote command:
[:SOURce<hw>][:ILS]:MBEacon[:MARKer]:PULSed on page 573

5.4.4.3 COM/ID Settings

Access:

1. Select "ILS Component > Marker Beacons", see Chapter 5.4.4, "ILS Marker Beacons Settings", on page 143.
2. Select "ILS > COM/ID".



This dialog provides access to general, signal and COM/ID settings of the marker beacons component of the ILS signal.

Settings

COM/ID State

Enables/disables the COM/ID signal.

See also Chapter D, "Morse Code Settings", on page 740.

Remote command:

`[:SOURce<hw>][:ILS]:MBEacon:COMid[:STATe]` on page 572

Code

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter D, "Morse Code Settings", on page 740.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Remote command:

`[:SOURce<hw>][:ILS]:MBEacon:COMid:CODE` on page 569

Period

Sets the period of the COM/ID signal.

Remote command:

`[:SOURce<hw>][:ILS]:MBEacon:COMid:PERiod` on page 571

Frequency

Sets the frequency of the COM/ID signal.

Remote command:

`[:SOURce<hw>][:ILS]:MBEacon:COMid:FREQuency` on page 570

Depth

Sets the AM modulation depth of the COM/ID signal.

Remote command:

`[:SOURce<hw>][:ILS]:MBEacon:COMid:DEPTh` on page 570

Time Schema

Sets the time schema of the Morse code for the COM/ID signal.

- "Standard"

The set dot length determines the length of the dash, the symbol space and letter space of the Morse code.
- "User"
  You can set each length value separately.

Remote command:
`[:SOURce<hw>][:ILS]:MBEacon:COMid:TSCHema` on page 572

Dot Length
Sets the length of a Morse code dot.

If "Time Schema > Standard", the dot length value determines also the length of the dash (= 3 times the dot length), symbol space (= dot length) and letter space (= 3 times the dot length).

Remote command:
`[:SOURce<hw>][:ILS]:MBEacon:COMid:DOT` on page 570

Dash Length
Requires "Time Schema > User".

Sets the length of a Morse code dash.

Remote command:
`[:SOURce<hw>][:ILS]:MBEacon:COMid:DASH` on page 569

Symbol Space
Requires "Time Schema > User".

Sets the length of the Morse code symbol space.

Remote command:
`[:SOURce<hw>][:ILS]:MBEacon:COMid:SYMBol` on page 571

Letter Space
Requires "Time Schema > User".

Sets the length of a Morse code letter space.

Remote command:
`[:SOURce<hw>][:ILS]:MBEacon:COMid:LETTer` on page 571

5.5 ADF Configuration and Settings

Option: R&S SMAB-K25

Access:

► Select "Modulation > Avionic Standards > ADF".

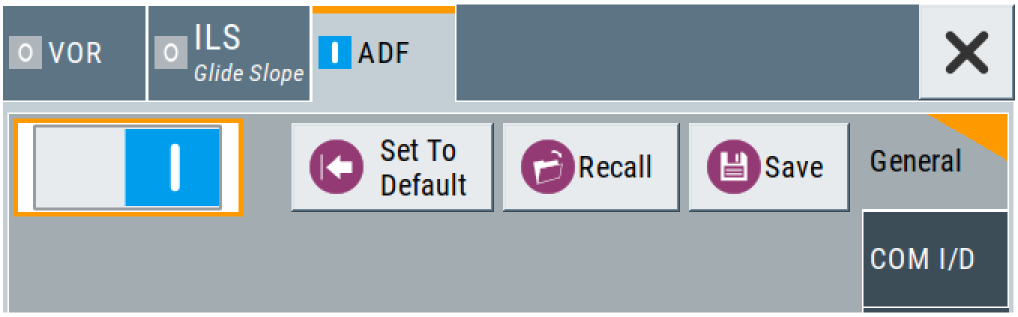
The remote commands required to define ADF settings are described in Chapter 13.16.2.3, "SOURce:ADF Subsystem", on page 548.

Settings

5.5.1 General Settings

Access:

► Select "ADF > General".



This dialog comprises general settings of the ADF standard, the default and the "Save/Recall" settings.
By default, an ADF signal modulation is set on an RF carrier with a frequency of 190 kHz. The COM/ID signal has 1.02 kHz frequency.

If enabled, the avionic standard modulation is displayed in the "Modulation" tile as follows:

- "Avionic: VOR" for enabled VOR modulation
- "Avionic ILS: Glide Slope/Localizer/Marker Bcn" for enabled ILS glide slope/ localizer/marker beacons modulation
- "Avionic: ADF" for enabled ADF modulation

ADF state and carrier frequency range

If the R&S SMA100B carrier frequency is outside the specified ADF frequency range from 190 to 1750 kHz, a settings conflict is displayed. Activating the ADF is not possible. Change the carrier frequency to a value within the specified frequency range.

Changing a parameter in the avionic standards causes an instant signal change in the R&S SMA100B. There is no extra measurement cycle to calculate the RMS value of the baseband signal to set the correct RF level.

If the avionics standard is activated for the first time, or after every subsequent on/off sequence, the measurement cycle will take place to determine the correct RF level. Every subsequent parameter change in the avionic standard is performed without another measurement cycle to provide a continuous signal output.

Settings

State

Activates the avionic standard.

Activation of the standard deactivates a previously active avionic standard. The "VOR/ILS > Carrier Frequency" setting is applied automatically to the "RF > "Frequency" on page 65"/"Frequency" in the status bar.

Remote command:

`<subsystem>:SETTing:STATe` on page 547

Set To Default

Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Value
State	Not affected by "Set to default"
Carrier Frequency Mode	User Defined
Carrier Frequency	334.700000 MHz

Remote command:

`<subsystem>:PRESet` on page 546

Save/Recall

Accesses the "Save/Recall" dialog, that is the standard instrument function for saving and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The filename and the directory, in which the settings are stored, are user-definable; the file extension is however predefined.

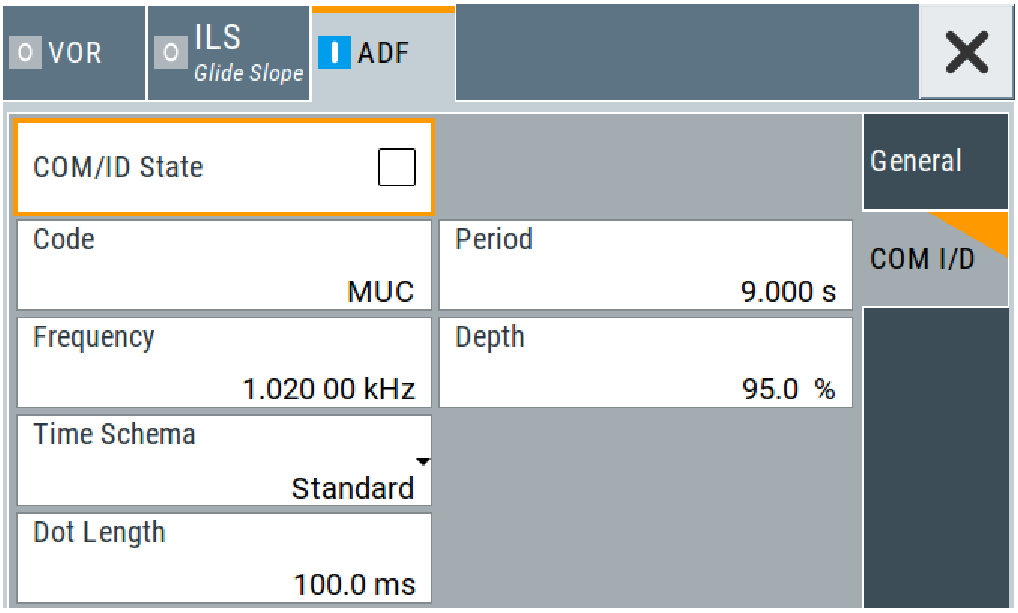
Remote command:

`<subsystem>:SETTing:CATalog` on page 546
`<subsystem>:SETTing:DELete` on page 546
`<subsystem>:SETTing:LOAD` on page 546
`<subsystem>:SETTing:STORe` on page 547

5.5.2 COM/ID Settings

Access:

► Select "ADF > COM/ID".



This dialog comprises COM/ID signal settings related to the ADF signal.

Settings

COM/ID State

Enables/disables the COM/ID signal.

Remote command:

[:SOURce<hw>]:ADF:COMid[:STATe] on page 551

Code

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter D, "Morse Code Settings", on page 740.

If no coding is set, the COM/ID tone is sent uncoded (key down).

If no coding is set, the COM/ID tone is sent uncoded (key down).

Remote command:
[:SOURce<hw>]:ADF:COMid:CODE on page 548

Period
Sets the period of the COM/ID signal.

Remote command:
[:SOURce<hw>]:ADF:COMid:PERiod on page 550

Frequency
Sets the frequency of the COM/ID signal.

Remote command:
[:SOURce<hw>]:ADF:COMid:FREQuency on page 550

Depth
Sets the AM modulation depth of the COM/ID signal.

Remote command:
[:SOURce<hw>]:ADF:COMid:DEPTh on page 549

Time Schema
Sets the time schema of the Morse code for the COM/ID signal.

- "Standard"
  The set dot length determines the length of the dash, the symbol space and letter space of the Morse code.
- "User"
  You can set each length value separately.

Remote command:
[:SOURce<hw>]:ADF:COMid:TSCHema on page 551

Dot Length
Sets the length of a Morse code dot.

If "Time Schema > Standard", the dot length value determines also the length of the dash (= 3 times the dot length), symbol space (= dot length) and letter space (= 3 times the dot length).

Remote command:
[:SOURce<hw>]:ADF:COMid:DOT on page 549

Dash Length
Requires "Time Schema > User".

Sets the length of a Morse code dash.

Remote command:
[:SOURce<hw>]:ADF:COMid:DASH on page 549

Symbol Space
Requires "Time Schema > User".

Sets the length of the Morse code symbol space.

Remote command:
`[:SOURce<hw>]:ADF:COMid:SYMBol` on page 551

Letter Space
Requires "Time Schema > User".

Sets the length of a Morse code letter space.

Remote command:
`[:SOURce<hw>]:ADF:COMid:LETTer` on page 550

6 List and Sweep Mode

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

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

The R&S SMA100B supports two basic methods:

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

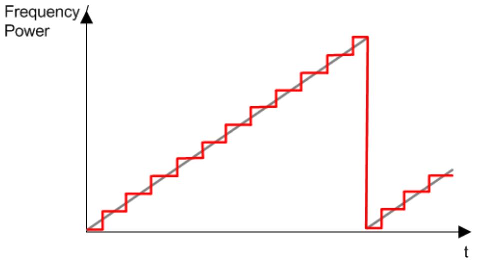
  

  Figure 6-1: Schematic representation of a signal generated in sweep mode

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

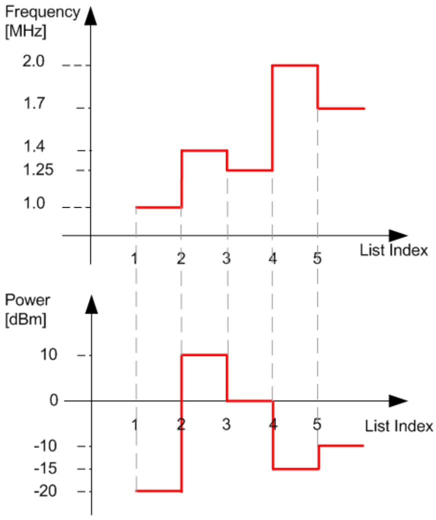


Figure 6-2: Schematic representation of a signal generated in list mode (global dwell time)

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

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

Interactions and characteristics of list and sweep mode

- Activating the list mode automatically deactivates all RF and LF sweeps and vice versa.
- In list processing mode, the frequency and level display in the status bar is disabled.

- The sweep modes only work with a *global* dwell time, that means the time intervals are constant during signal generation.
- If you want to hold a running sweep at a specific frequency or level value, enter the value in the status bar. The sweep stops immediately.
- We recommend that you switch off the display update for optimum sweep performance, especially with short dwell times
  See Chapter 11.1.2, "Display Update Settings", on page 319.

6.1 Signal Generation and Triggering in the Sweep and List Modes

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

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

If the dwell time in sweep or list mode is too short or external trigger signals come too fast, the signal generation delays. As the delay increases, the R&S SMA100B signals an overrun, or even stops sweep or list mode signal generation, if the delay gets too long.

The instrument diplays corresponding error messages.

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

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

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

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

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

- Example "Setup an RF frequency or power sweep" on page 643
- Example "Setup an LF sweep" on page 599
- Example "Create an RF list and activate the list mode" on page 612

Auto mode (Sweep/List)

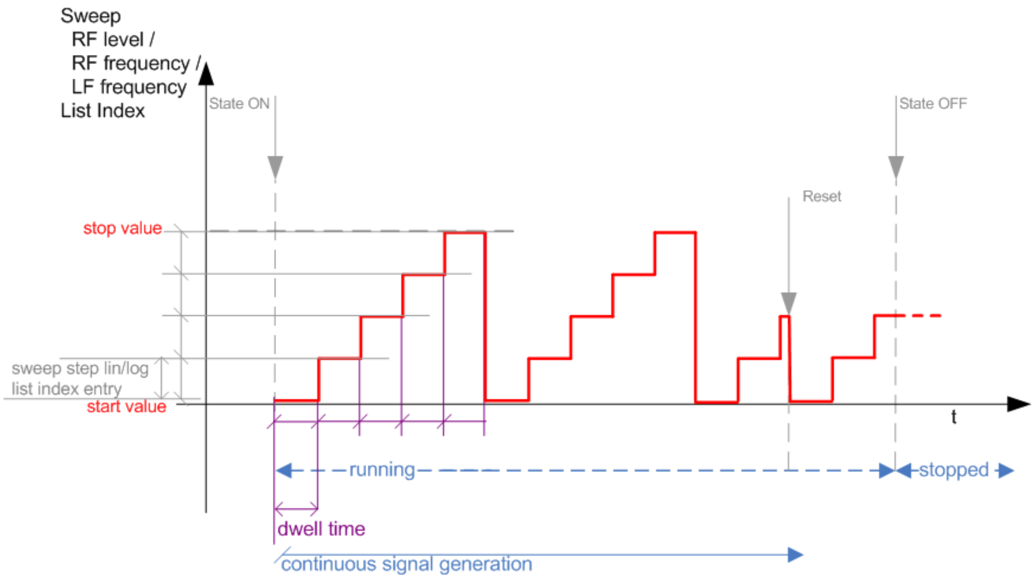


Figure 6-3: Auto mode (Sweep/List)

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

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

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

Single / Extern Single mode (Sweep/List)

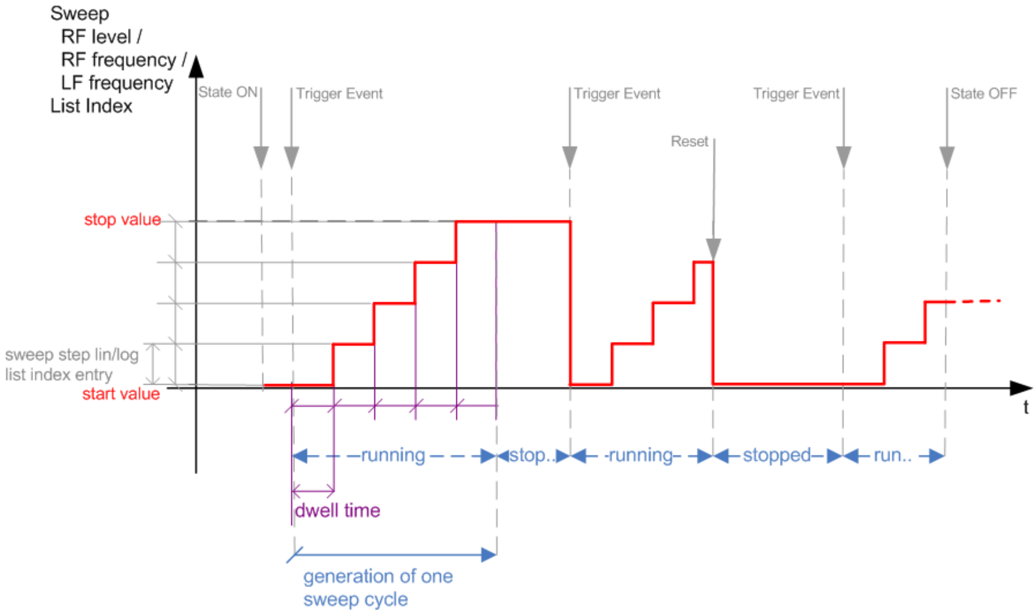


Figure 6-4: Single / Extern Single mode (sweep / list)

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

See "The Retrace function" on page 163 for details.

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

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

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

Step / Extern Step mode (Sweep/List)

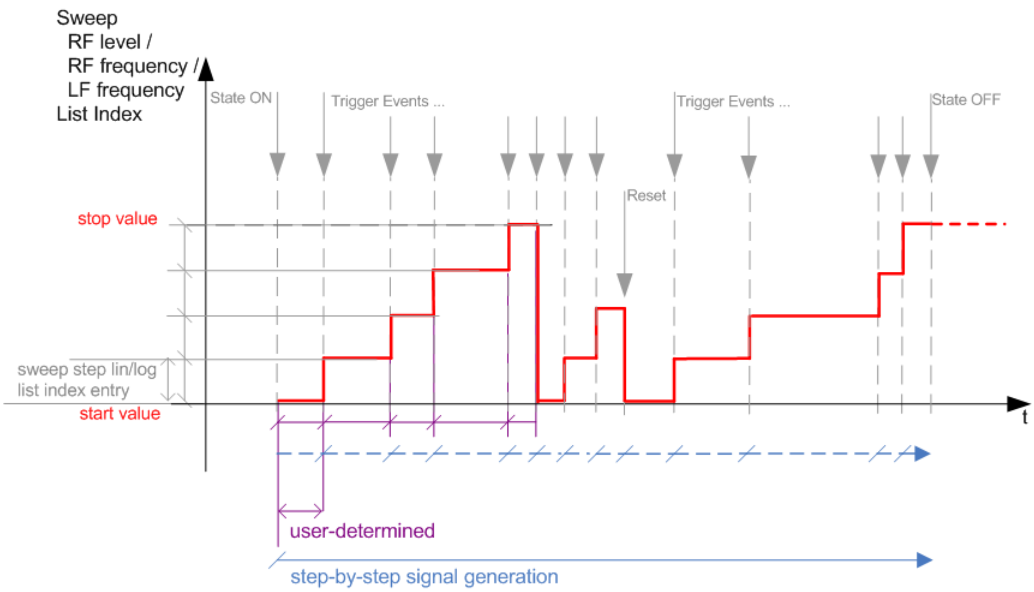


Figure 6-5: Step / Extern Step mode (sweep / list)

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

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

To step through the sweep frequencies or levels:

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

Steps that would exceed the sweep range are ignored.

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

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

Extern Start/Stop mode (sweep)

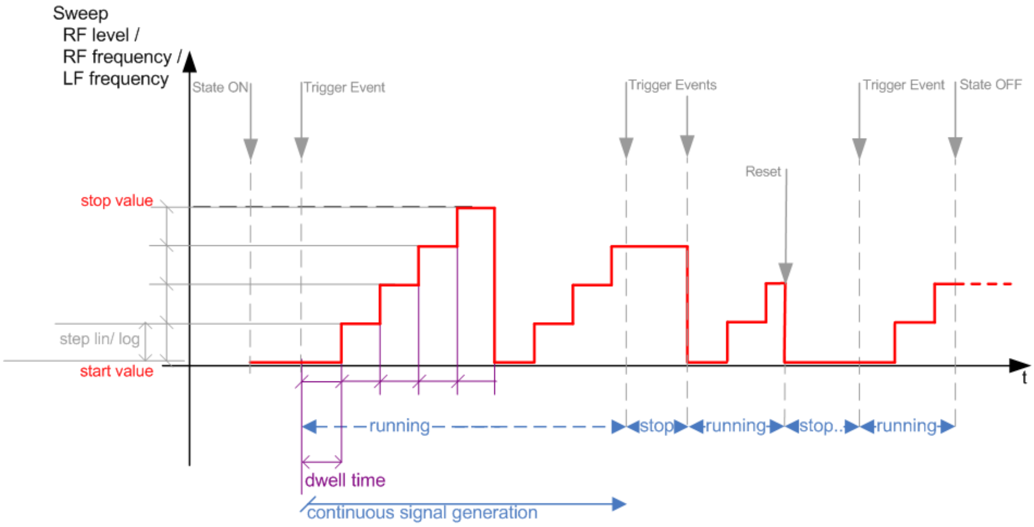


Figure 6-6: Extern Start/Stop mode (sweep)

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

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

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

Manual mode (Sweep/List)

The **manual** mode only applies to remote control. It is not visible in the graphical user interface of the instrument and is described here for completeness.

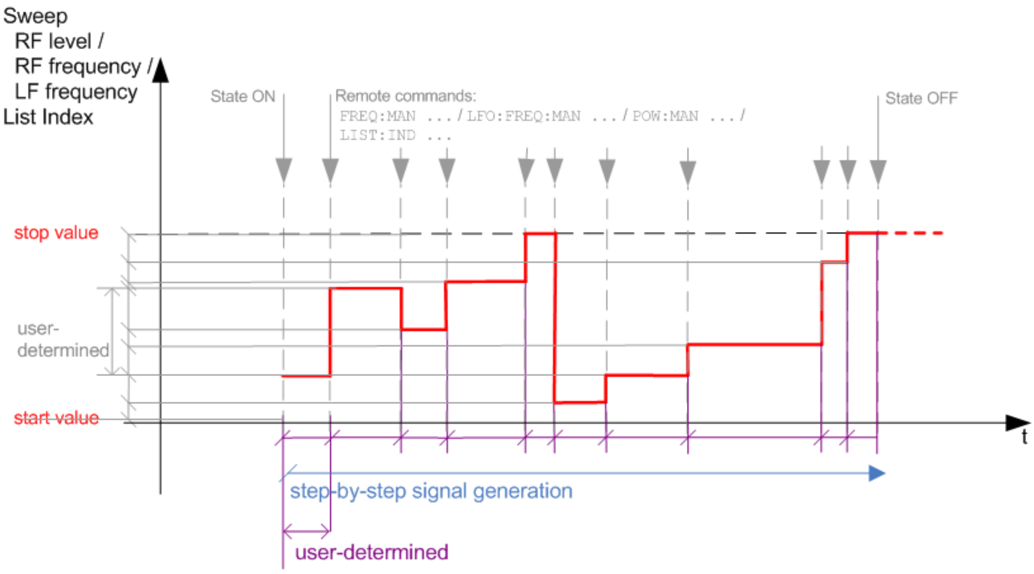


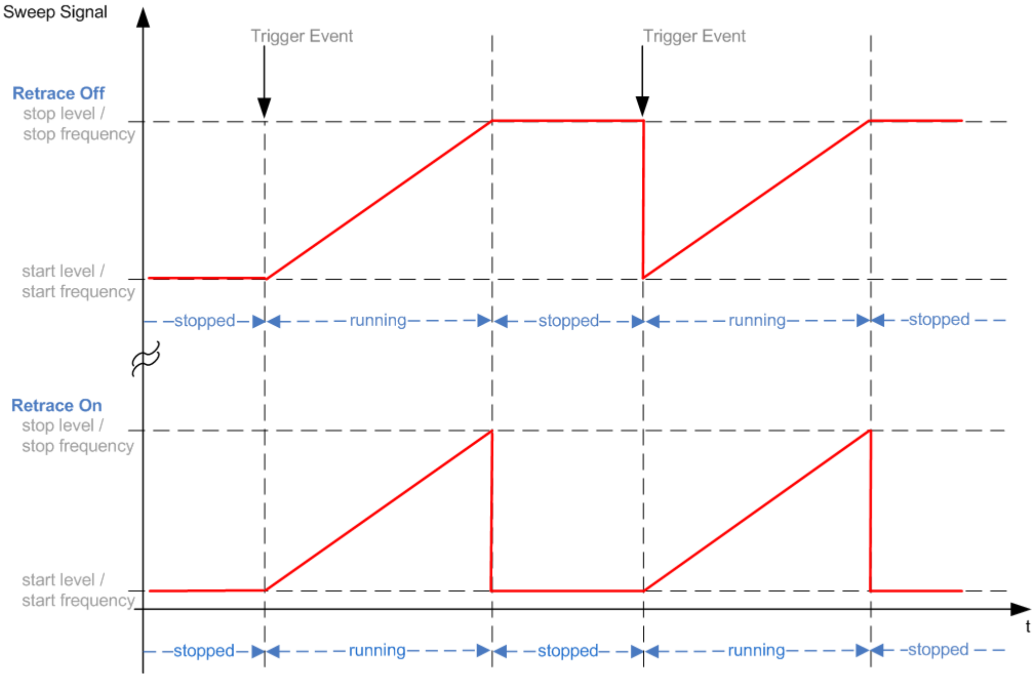
Figure 6-7: Manual mode in remote control (sweep / list)

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

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

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

The Retrace function



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

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

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

- " Shape" on page 173
- "Mode" on page 172

6.2 About Sweep Mode

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

See Chapter 6.2.2, "Sweep Signal Shapes", on page 166.

Configuration and operation of sweep mode signals

- The R&S SMA100B generates a sweep signal by varying one of the following parameters: the *RF frequency*, the *LF frequency* or the *RF level*.
- In all sweep modes, you can perform a complete sweep cycle once, repeat the cycle continuously or step through it gradually.
- The instrument generates the sweep signal according to the sweep settings.
- The "Reset Sweep" function, provided in the sweep settings dialogs enables you to reset the sweep to its initial value and restart it.

Impact of changing the sweep mode during performance

If you change the sweep mode during the execution, the signal generator stops the sweep and starts with the next trigger event at the initial value.

6.2.1 Correlating Parameters in Sweep Mode

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

The R&S SMA100B provides various possibilities to configure a sweep signal. For example, you can determine the sweep range by the start and end values, or based on the start value and span. In any case, related parameters are adjusted accordingly.

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

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

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

Sweep range

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

Offset = 0

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

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

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

Where:

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

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

Offset≠0

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

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

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

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

The value range of the instrument is calculated as follows:

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

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

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

Sweep steps

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

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

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

$f_2 = f_1 + step\_lin$

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

Successive frequencies are calculated as follows:

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

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

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

With "Shape = Triangle", the frequency values on the slope from f_{STOP} to f_{STARt} are the same as on the slope from f_{STARt} to f_{STOP}.

If you specify the number of steps within the sweep range, the step size is adjusted according to the following correlation:

- For **linear** sweeps and $f_{STARt} < f_{STOP}$
  $POINts_{frequency} = ((f_{STARt} - f_{STOP})/step\_lin) +1 = (f_{SPAN}/step\_lin) + 1$
- For **logarithmic** sweeps and $f_{STARt} < f_{STOP}$
  $POINts_{frequency} = ((\log f_{STOP} - \log f_{STARt})/\log step\_log) +1$

If step_log changes, the value of POINts is adjusted. The f_{STARt} and f_{STOP} values are retained.

6.2.2 Sweep Signal Shapes

The R&S SMA100B supports the following sweep shapes:

- Sawtooth
  The sweep sequence resembles a sawtooth. One sweep runs from start to stop frequency, or level value respectively. Each subsequent sweep starts again at the start value.

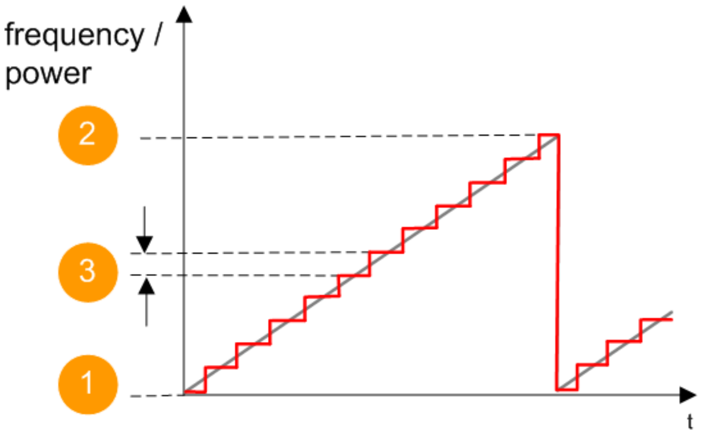


Figure 6-8: Sweep signal sawtooth shape

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

- Triangle
  The sweep sequence resembles a triangle. One sweep runs from start to stop value frequency and back. Each subsequent sweep starts at the start value.

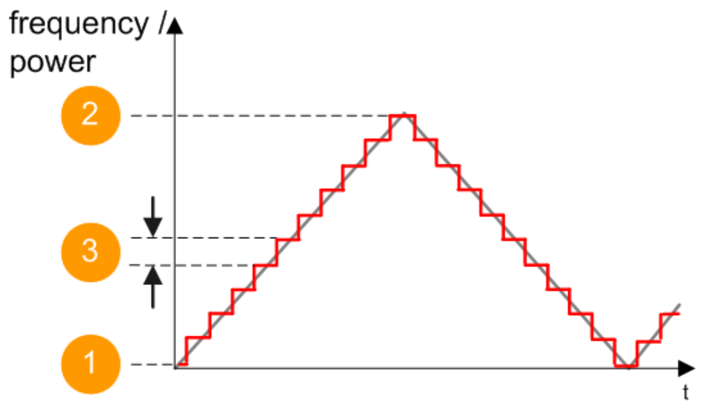


Figure 6-9: Sweep signal triangle shape

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

The current frequency or level of an RF frequency, level or LF frequency sweep is determined by the shape (e.g. sawtooth or triangle) and the spacing (linear or logarithmic), and the step size.

6.3 About List Mode

The list mode is used to generate the RF signal based on a set of predefined frequency and amplitude value pairs, with individual step times. You can define the values arbitrarily, in any order and varying step sizes, within the entire configurable value range of the instrument.

Configuration and operation of list mode signals

The parameters configuring the RF signal are defined in a list (table) and stored in a file.

Creating and handling lists

List files can be created in the following ways:

- **Internally**
  Use the build-in table editor with columns for the frequency-level values pairs and the dwell time.
  Define the values manually (row by row) or automatically, based on value range and step size.
  (See Chapter 6.7, "List Editor", on page 188)
  Lists are saved as files with user-definable filename and the predefined file extension `*.lsw`. To load a saved file, use the "File Manager".
  (See Chapter 10.8, "Using the File Manager", on page 298)
- Lists can be exported, too. For example, to exchange configuration between instruments or to modify the file content with an external program and reload them again.

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

Dwell time mode

You can choose whether you want to use different dwell times or a fixed value for all steps in the list mode:

- "From List"
  This mode uses the values from the data table.
  See Edit List Mode Data
- "Global"
  This mode processes the list with a fixed time interval you can set with Global Dwell Time.

List processing mode

See:

- "Live list processing mode" on page 169

6.4 Significant Parameters and Functions

This section provides some basic parameters, settings and functions that affect the operating modes CW, list and sweep, that means at all frequency and level transitions of the RF signal.

Dwell time

Dwell time is the length of time that elapses from the beginning until the end of a step in list or sweep mode.

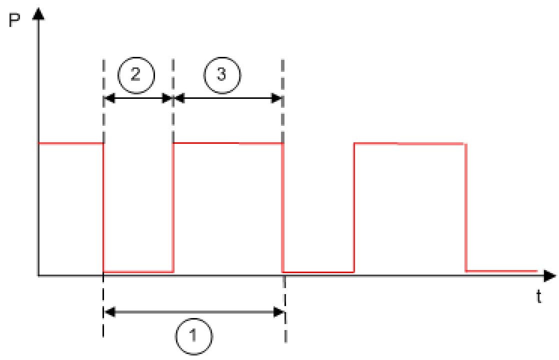


Figure 6-10: Dwell Time vs. settling time

1 = "Dwell Time" (as set with the parameter)
2 = Settling time
3 = Dwell time (effective)

However, the time the instrument requires for the signal to settle reduces the set dwell time:

$t_{dwell(effective)} = t_{dwell} - t_{setlting}$

If the dwell time in sweep or list mode is too short or external trigger signals come too fast, the signal generation delays. As the delay increases, the R&S SMA100B 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 SMA100B generates the signal directly from the value pairs in the database, and adjusts the hardware settings accordingly. The current instrument state and thus any change during the signal generation directly affects the RF signal. The temporary memory is not used.

You can conveniently modify parameters like modulation settings during run-time. Learning list mode data is not required. Impacts like temperature drift are also considered immediately.

This mode is optimized for **maximum signal quality**, and is useful if dwell times higher than 2 ms are sufficient.

6.5 Sweep Mode Settings

This section lists the settings of **all** available sweep modes.

Access:

1. Select "Sweep" > "RF Frequency Sweep"
2. Select "Sweep" > "RF Level Sweep"
3. Select "Sweep" > "LF Frequency Sweep"

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

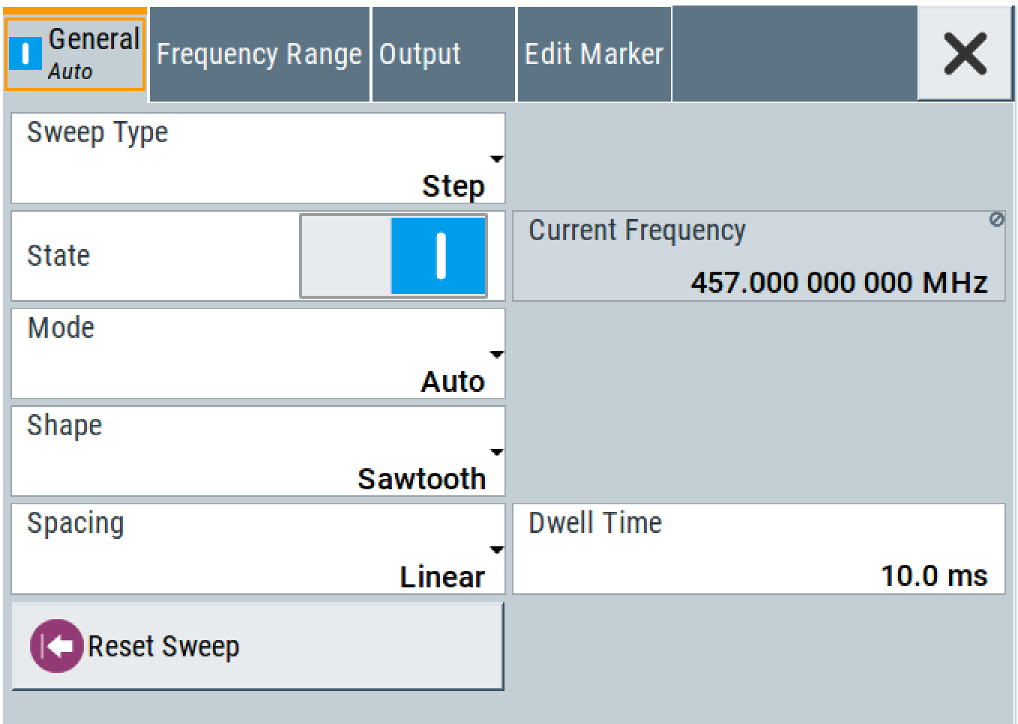
- Chapter 13.16.4, "SOURce:FREQuency Subsystem", on page 590
- Chapter 13.16.13, "SOURce:SWEep Subsystem", on page 643
- Chapter 13.16.6, "SOURce:LFOutput Subsystem", on page 599

Settings

6.5.1 General Sweep Settings

Access:

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



Settings

Sweep Type

Selects the kind of the frequency sweep.

"Step" Increases or decreases the frequency at each step.
To determine the frequency intervals, see Spacing.

"Ramp" Provides a synthesized continuous analog frequency sweep with the set Sweep Time .

Remote command:
`[:SOURce<hw>]:SWEep:GENeration` on page 646

State (RF frequency sweep)

Activates RF frequency sweep signal generation.

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

Remote command:
`[:SOURce<hw>]:FREQuency:MODE` on page 591

State (RF level sweep)

Activates RF level sweep signal generation.

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

Remote command:
`[:SOURce<hw>]:POWer:MODE` on page 633

State (LF frequency sweep)

Status of the LF frequency sweep signal.

You find this parameter in two dialogs:

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

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

Remote command:
[:SOURce<hw>]:LFOutput:FREQuency:MODE on page 603

Current Frequency
In "RF/LF Frequency Sweep" mode, displays the current frequency.

In Mode = "Step", the parameter is editable and you can enter the next frequency step.

Remote command:
[:SOURce<hw>]:FREQuency:MANual on page 593
[:SOURce<hw>]:LFOutput:FREQuency:MANual on page 603

Current Level
Applies to "RF Level Sweep" mode.

Displays the current level value.

In Mode = "Step", the parameter is editable and you can enter the next level step.

Remote command:
[:SOURce<hw>]:POWer:MANual on page 632

Mode
Selects the sweep mode.

For detailed information on the sweep modes and the triggering, see Chapter 6.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 156.

"Auto" Generates a continuously repeating sweep signal directly after activating the sweep mode.
The sweep steps are performed automatically, controlled by the dwell time.

"Single / Extern Single"
Generates a single sweep cycle after a trigger event.
The sweep steps within the cycle are performed automatically, controlled by the dwell time. If one cycle is completed, the instrument waits for the next trigger event.

"Step / Extern Step"
Generates the sweep signal step-by-step, manually triggered.

"Extern Start/Stop"
Generates a continuously repeating sweep signal that is started, stopped, and restarted by subsequent external trigger events.
The sweep steps are performed automatically, controlled by the dwell time.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:MODE on page 648
[:SOURce<hw>]:SWEep:POWer:MODE on page 646
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE on page 609
:TRIGger<hw>[:SWEep]:SOURce on page 683
:TRIGger<hw>:FSWeep:SOURce on page 683
:TRIGger<hw>:PSWeep:SOURce on page 683
:TRIGger<hw>:LFFSweep:SOURce on page 683

Retrace

For "Shape = Sawtooth" and "Mode = Single/External Single", enables changing the signal to the start value while it is waiting for the next trigger event. It returns to the start level or start frequency until the next trigger is applied.

Remote command:

`[:SOURce<hw>]:SWEep[:FREQuency]:RETRace` on page 650

`[:SOURce<hw>]:SWEep:POWer:RETRace` on page 650

`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace` on page 610

Shape

Selects the waveform shape of the sweep signal.

"Sawtooth" The sweep runs from start to stop frequency. The subsequent sweep starts at the start value, i.e. the shape of the sweep sequence resembles a sawtooth.

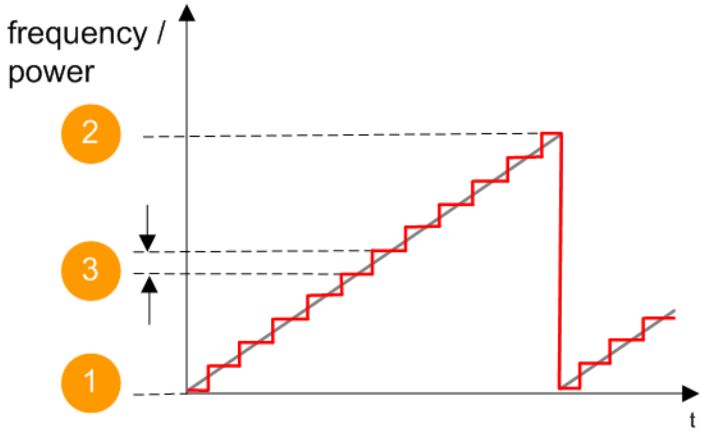


Figure 6-11: Sweep signal sawtooth shape

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

"Triangle" The sweep runs from start to stop value and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.
The triangle shape is only available for Sweep Type > Step.

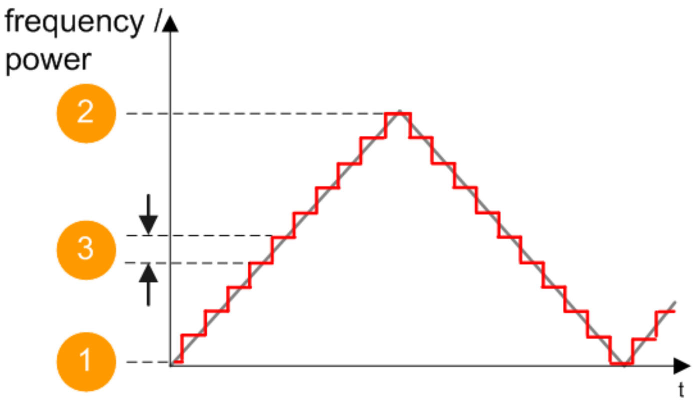


Figure 6-12: Sweep signal triangle shape

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

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe on page 649
[:SOURce<hw>]:SWEep:POWer:SHAPe on page 649
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe on page 611

Spacing
In "RF and LF Frequency Sweep" modes, selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

Enter the step size with the parameter Step Linear/Step Logarithmic .

This parameter is only available for Sweep Type > Step.

"Linear" Takes the frequency value entered as absolute value in Hz.

"Logarithmic" Takes the value entered as a logarithmic value, i.e. as a constant fraction of the current frequency in %.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 649
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing on page 611

Sweep Time
Option: R&S SMAB-B28

For frequency sweep with "Spacing > Ramp", sets the duration of a ramp sweep step.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:TIME on page 651

Dwell Time
Defines the duration of the individual sweep steps.

Note: The minimum dwell time varies, depending on the phase noise options (Option: R&S SMAB-B709, R&S SMAB-B710/-B710N or R&S SMAB-B711/-B711N) the instrument is equipped with. See the data sheet for the specifications.
In case of considerable overrun conditions, the R&S SMA100B turns off the sweep mode.

See also Chapter 6.4, "Significant Parameters and Functions", on page 168.

Remote command:
`[:SOURce<hw>]:SWEep[:FREQuency]:DWELl` on page 648
`[:SOURce<hw>]:SWEep:POWer:DWELl` on page 645
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl` on page 609

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 599

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 651

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

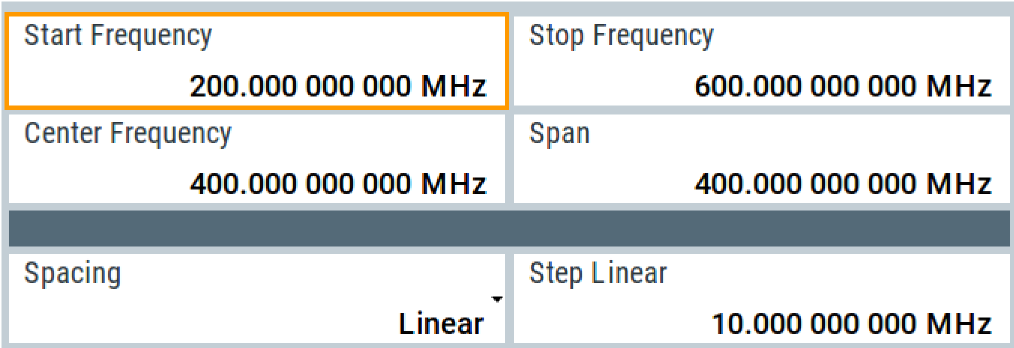
Remote command:
`[:SOURce<hw>]:SWEep[:FREQuency]:EXECute` on page 650
`[:SOURce<hw>]:SWEep:POWer:EXECute` on page 650
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute` on page 609
`:TRIGger<hw>[:SWEep][:IMMediate]` on page 684
`:TRIGger<hw>:FSWeep[:IMMediate]` on page 684
`:TRIGger<hw>:PSWeep[:IMMediate]` on page 684
`:TRIGger<hw>:LFFSweep:IMMediate` on page 684

6.5.2 Frequency Range Settings

Access:

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

2. Select "Frequency Range".



Settings

Start Frequency/Stop Frequency

Defines the frequency sweep range by setting the start and end values.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Remote command:
[:SOURce<hw>]:FREQuency:STARt on page 595
[:SOURce<hw>]:FREQuency:STOP on page 595
[:SOURce<hw>]:LFOutput:FREQuency:STARt on page 604
[:SOURce<hw>]:LFOutput:FREQuency:STOP on page 604

Center Frequency

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

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Remote command:
[:SOURce<hw>]:FREQuency:CENTer on page 594

Span

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

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Remote command:
[:SOURce<hw>]:FREQuency:SPAN on page 595

Spacing

In "RF and LF Frequency Sweep" modes, selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

Enter the step size with the parameter Step Linear/Step Logarithmic .

This parameter is only available for Sweep Type > Step.

"Linear" Takes the frequency value entered as absolute value in Hz.

"Logarithmic" Takes the value entered as a logarithmic value, i.e. as a constant fraction of the current frequency in %.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 649
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing on page 611

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.

This parameter is only available for Sweep Type > Step.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

"Step Linear" The step width is a constant value in Hz.

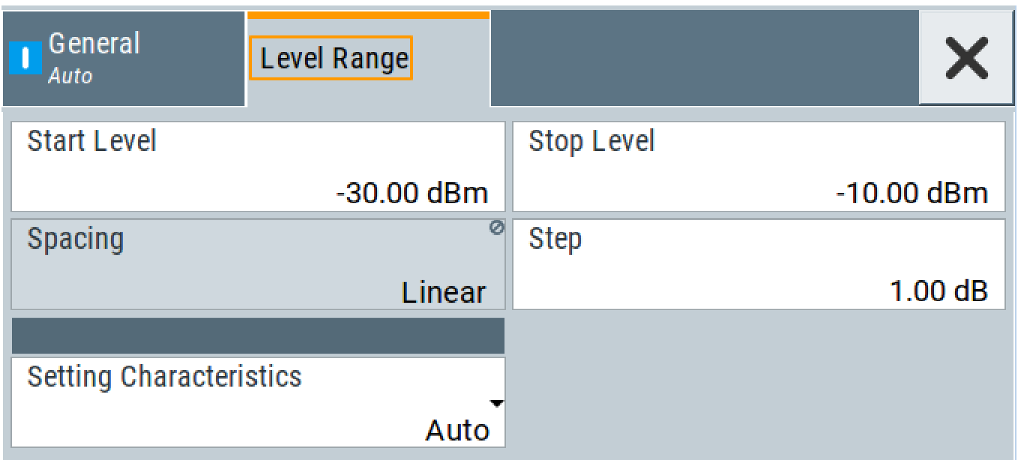
"Step Logarithmic"
The step width is determined logarithmically in %, i.e. as a constant fraction of the current frequency.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] on page 651
[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic on page 650
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] on page 612
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic
on page 611

6.5.3 Level Range Settings

Access:

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



Settings

Start Level / Stop Level

Defines the RF level sweep range by setting the start and end values.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Remote command:
`[:SOURce<hw>]:POWer:STARt` on page 634
`[:SOURce<hw>]:POWer:STOP` on page 634

Spacing

Indicates that the level step intervals are linearly (straight proportional) distributed, i.e. intervals are of equal size.

Set the step size with the parameter "Step".

Remote command:
n.a.

Step

Applies to "RF Level Sweep" mode.

Sets the step width for the RF level sweep steps logarithmically in dB.

Remote command:
`[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic]` on page 647

Setting Characteristics

Selects additional quality characteristics to optimize the behavior of the RF signal level for the corresponding application.

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

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

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

"Constant-VSWR"
Suppresses output impedance variations at the RF output connector, due to changed level settings.

"High Dyn. Uninterrupted"
R&S SMAB-K724
Provides a linear output power that is uninterrupted over a wide dynamic range.

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

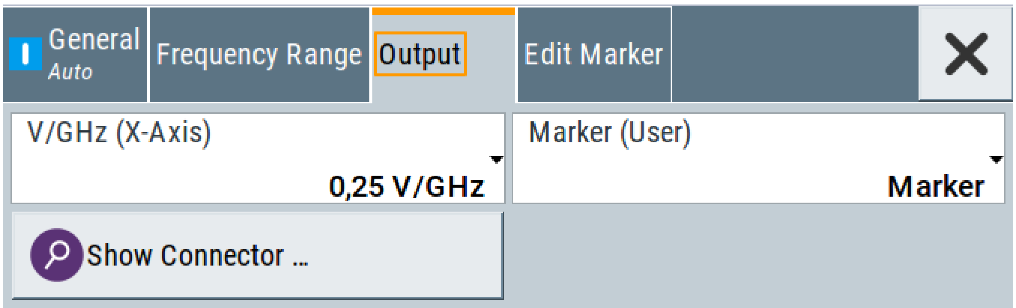
Remote command:
`[:SOURce<hw>]:POWer:LBEHaviour` on page 631

6.5.4 Output Settings

Option: R&S SMAB-B28

Access:

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



Settings

V/GHz / X-Axis

Option: R&S SMAB-B28

Selects the mode the voltage is supplied depending on the frequency.

The R&S SMA100B supplies the signal at the V/GHz X-Axis connector.

"0,25 V/GHz" / "0,5 V/GHz" / "1 V/GHz"
Supplies the voltage proportional to the set frequency, derived from the selected setting.

"X-Axis"
Supplies a voltage range from 0 V to 10 V proportional to the frequency sweep range, set with Start Frequency/Stop Frequency .

Remote command:
`:OUTPut:FPRoportional:SCALe` on page 446

Marker / User
Option: R&S SMAB-B28

Selects the signal to be supplied at the Marker User1 connector.

"Marker"
Assigns a marker signal to the output.
To configure and assign the marker signals, see Chapter 6.5.5, "Edit Marker Settings", on page 180.

"User"
Intended for future use.

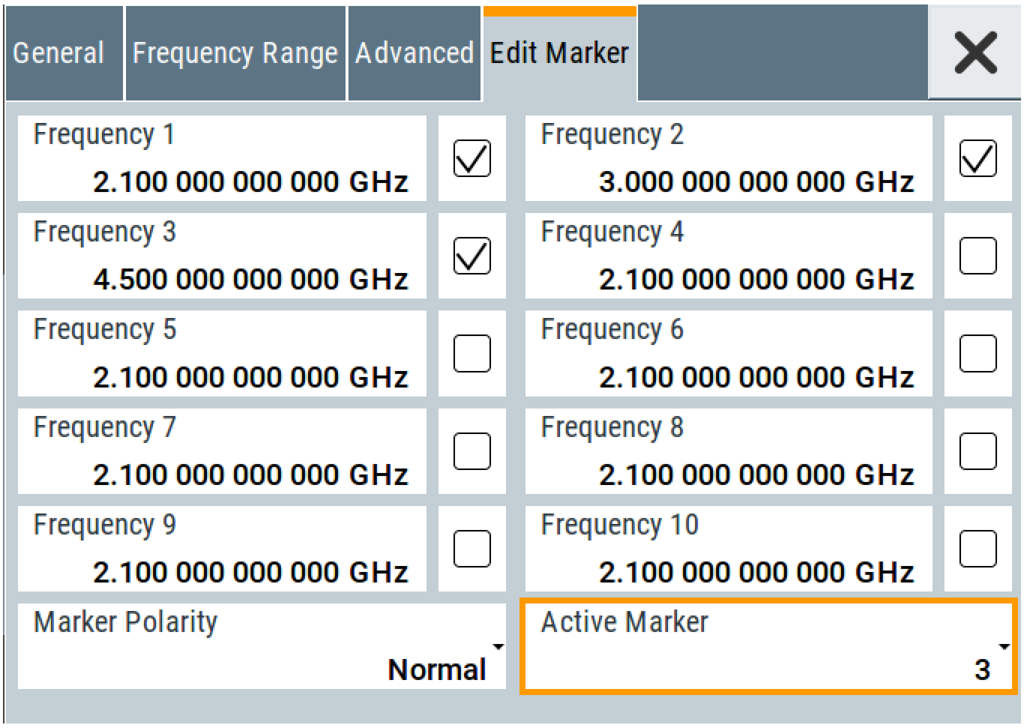
Remote command:
`:OUTPut:USER:MARKer` on page 447

6.5.5 Edit Marker Settings

Option: R&S SMAB-B28

Access:

1. Select "Sweep" > "RF Frequency Sweep"
2. Select "Marker".



You can define up to 10 markers, and assign one of them to the output at a time. When the sweep run has reached the marker frequency, the R&S SMA100B activates the marker signal and supplis it at the Marker User1 connector. The duration of the active signal corresponds to the dwell time of a step.

Settings

Frequency x

Sets the frequency that the selected marker indicates.

When the specified value is used, the polarity of the marker signal changes, as selected with the parameter .

Remote command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FREQuency` on page 652

State

Enables the selected marker.

A marker signal at the output connector marks the moment the specified frequency values is used.

Remote command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FSTate` on page 653

Marker Polarity
Sets the polarity of the marker signal.

The duration of the active signal is equal to the dwell time of a step.

Remote command:
`[:SOURce<hw>]:SWEep:MARKer:OUTPut:POLarity` on page 652

Active Marker
Boosts a specific marker signal so that it is output with higher voltage than all other markers.

Remote command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MARKer:ACTive` on page 652

6.6 List Mode Settings

The "List Mode" dialog contains all the functions and settings for creating and handling lists with RF frequency/level pairs including the corresponding dwell times for generating the RF signal based on these values.

Access:

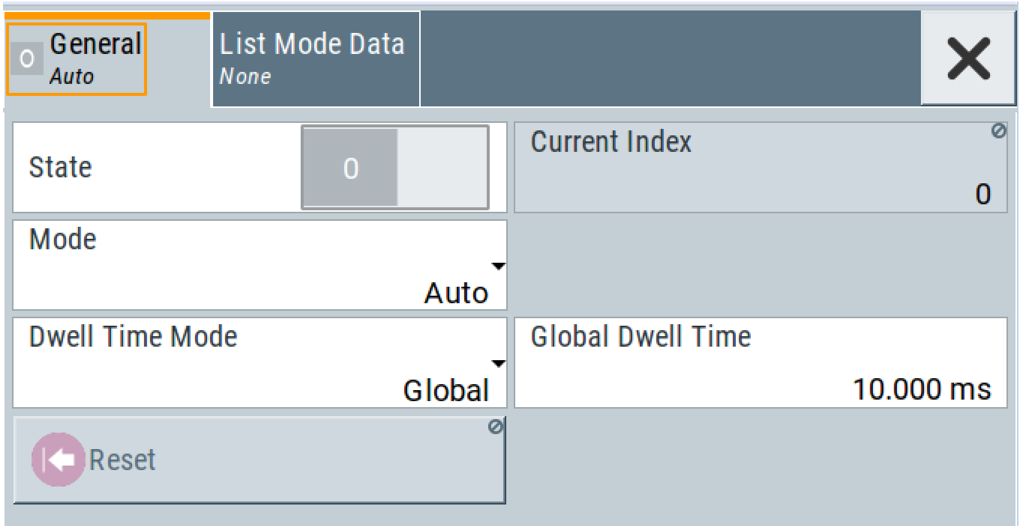
► Select "Sweep" > "List mode".

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 Chapter 13.16.7, "SOURce:LIST Subsystem", on page 612.

6.6.1 General Settings

Access:

► Select "Sweep" > "List mode".



In the "General" tab, you can configure the trigger and dwell time modes for list processing and activate signal generation.

Settings

State

Activates the list mode and processes the currently selected list.

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

Remote command:

[:SOURce<hw>]:FREQuency:MODE on page 591

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 617

Mode

Selects the mode for list processing.

For detailed information on the sweep modes and the triggering, see Chapter 6.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 156.

"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 619
`[:SOURce<hw>]:LIST:MODE` on page 618

Dwell Time Mode

Selects either variable dwell times or a fixed dwell time to perform signal generation in list mode.

"Global" Uses the same dwell time for all lists steps, set with Global Dwell Time.

"From List" Uses the dwell times from the list.
You can define the dwell time for each frequency/level value pair individually, see Chapter 6.7, "List Editor", on page 188.

Remote command:
`[:SOURce<hw>]:LIST:DWELl:MODE` on page 615

Global Dwell Time

Sets the dwell time for Dwell Time Mode > "Global".

Note: In case of considerable overrun conditions, the R&S SMA100B turns off the list mode.

See also "Dwell time" on page 168.

Remote command:
`[:SOURce<hw>]:LIST:DWELl` on page 615

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 599

Reset
Resets the list to the starting point.

Remote command:
`[:SOURce<hw>]:LIST:RESet` on page 622

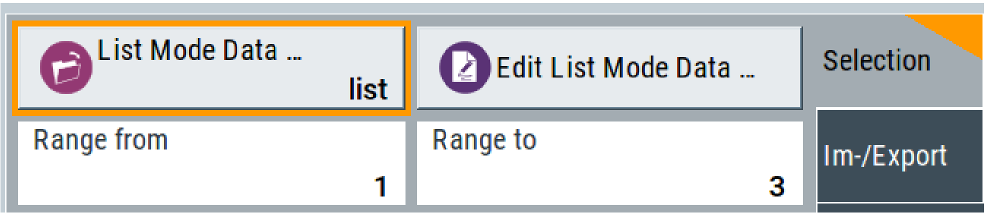
Execute Single
Manually starts list processing in "Single" mode.

Remote command:
`[:SOURce<hw>]:LIST:TRIGger:EXECute` on page 619

6.6.2 List Mode Data Settings

Access:

1. Select "Sweep" > "List mode".
2. Select "List Mode Data".



This dialog contains the parameters required for creating and editing lists, activating the learning function and selecting the list processing mode.

Settings

List Mode Data
Accesses the standard "Select List" dialog for selecting, creating and editing a list file. The currently loaded file is indicated.

You can create data lists with the internal editor or import externally created files, see "Creating and handling lists" on page 167.

Remote command:
`[:SOURce<hw>]:LIST:CATalog?` on page 620
`[:SOURce<hw>]:LIST:SELect` on page 622
`[:SOURce<hw>]:LIST:DELete` on page 621
`[:SOURce<hw>]:LIST:DELete:ALL` on page 621

Edit List Mode Data
Opens the editor to insert and save data lists with RF frequency, power and dwell time values, see Chapter 6.7, "List Editor", on page 188.

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.

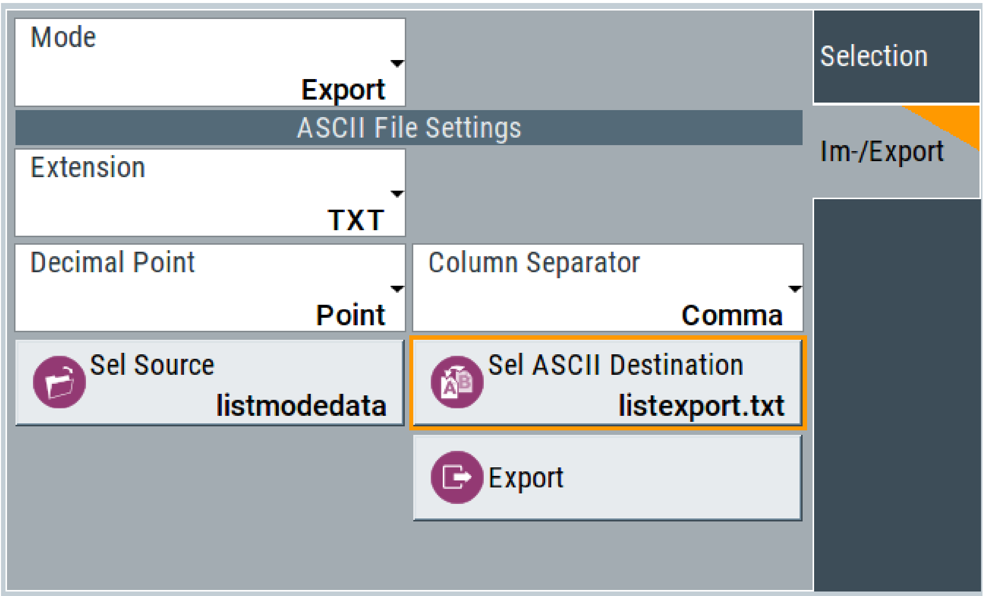
The instrument generates the signal with the values of the selected index range and ignores all other list entries.

Remote command:
`[:SOURce<hw>]:LIST:INDex:STARt` on page 617
`[:SOURce<hw>]:LIST:INDex:STOP` on page 617

6.6.3 Import/Export Settings

Access:

1. Select "Sweep" > "List Mode".
2. Select "List Mode Data" > "Im-/Export".



The "Im-/Export" dialog provides the parameters for importing or exporting files with user data in standard ASCII `*.txt` or `*.csv` file format.
The table separators and the decimal floating point numbers are customizable.

Settings

Mode

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

Remote command:
[:SOURce<hw>]:LIST:DEXChange:MODE on page 624
[:SOURce<hw>]:CORRection:DEXChange:MODE on page 590
[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE on page 538

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 623
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal on page 624
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 624
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 588
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal on page 589
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn on page 589
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 538
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal on page 539
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn on page 539

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 623
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 623
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 588
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 589
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 539
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 539

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 624
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 590
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 540

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

Remote command:
[:SOURce<hw>]:LIST:DEXChange:EXECute on page 623
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 589
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 540

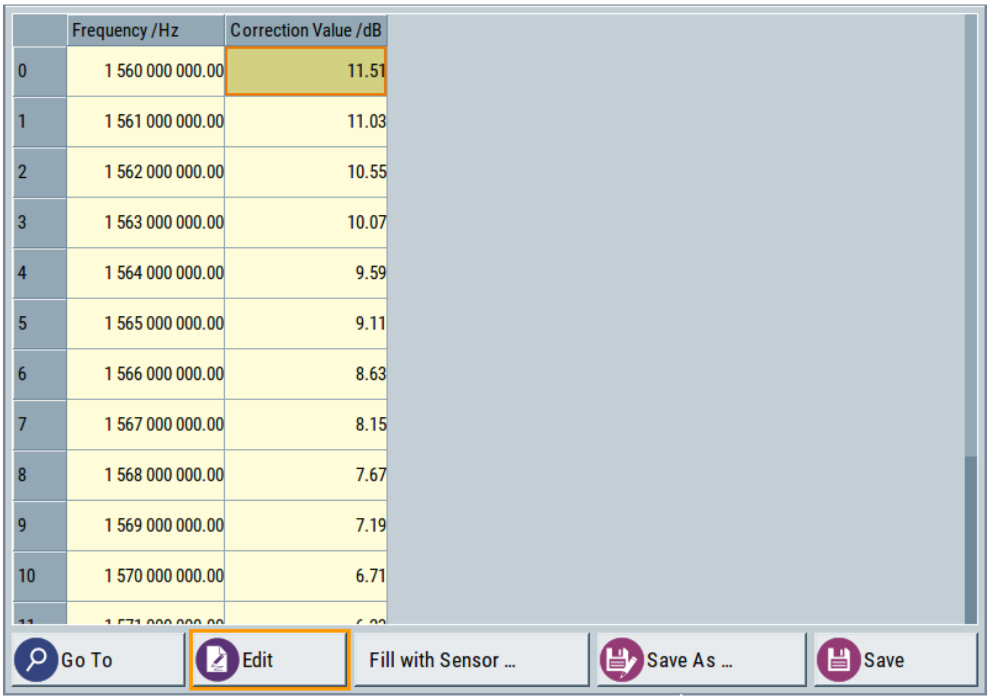
6.7 List Editor

The "User Correction" and "List Mode" dialogs provide a build-in list editor for defining the corresponding value pairs.

The table and navigation functions of the UCOR and list mode editors have the same structure and are therefore summarized below. The access is specified for both modes, the fields and functions are explained using the example of the list mode.

Access to "Edit List Mode Data":

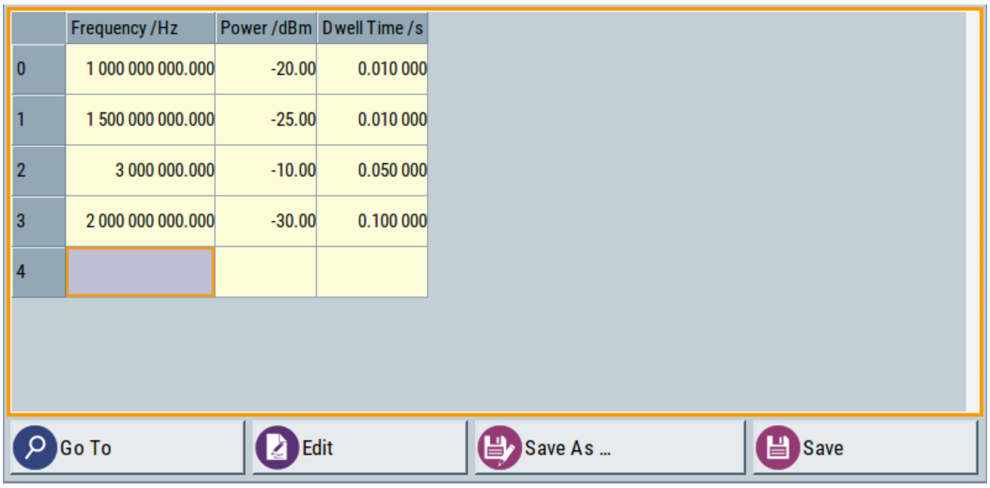
► "Sweep" > "List Mode" > "List Mode Data" > "Edit List Mode Data"



The editor for list mode data provides a table with RF frequency and power values and standard navigation functions.

Access to "Edit User Correction Data":

► "Level" > "User Correction" > "Edit User Cor. Data"



The editor for user correction provides a table with RF frequency and power values, an extra column for defining variable dwell times, and standard navigation functions.

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

If you use **global dwell time in list mode**, consider also that the instrument uses the value set with Global Dwell Time for all list steps and not the values from the list.

Since the table and navigation functions can be assumed to be known, the following description contains a brief overview, shown by the example of the "List Data Editor". If a function relates to a particular dialog, it is explicitly stated.

Settings

Edit List Mode Data

Table with values for list or user correction processing.

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

"Frequency /Hz"
Sets the frequency values.

Remote command:
[:SOURce<hw>]:LIST:FREQuency on page 616
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency on page 585

"Power /dBm" Sets the level values.

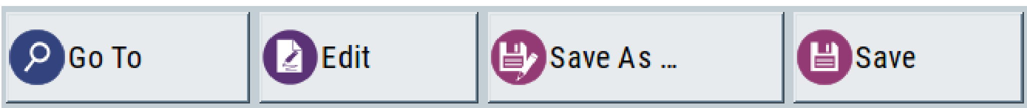
Remote command:
[:SOURce<hw>]:LIST:POWer on page 618
[:SOURce<hw>]:CORRection:CSET:DATA:POWer on page 585

"Dwell /s" In list mode, sets the dwell time values.

Remote command:
[:SOURce<hw>]:LIST:DWELl:LIST on page 616

Data handling keys

Standard functions for file and data handling.



Go To ← Data handling keys

Selects a row for editing.

Edit ← Data handling keys

Enables you to insert, or delete a row or ranges within a list, and provides access to a dialog for automatic filling, see " Fill... " on page 92.

Fill with Sensor ← Data handling keys

Opens a dialog to configure the automatic filling of user correction data with an R&S NRP power sensor. Available in UCOR mode only.

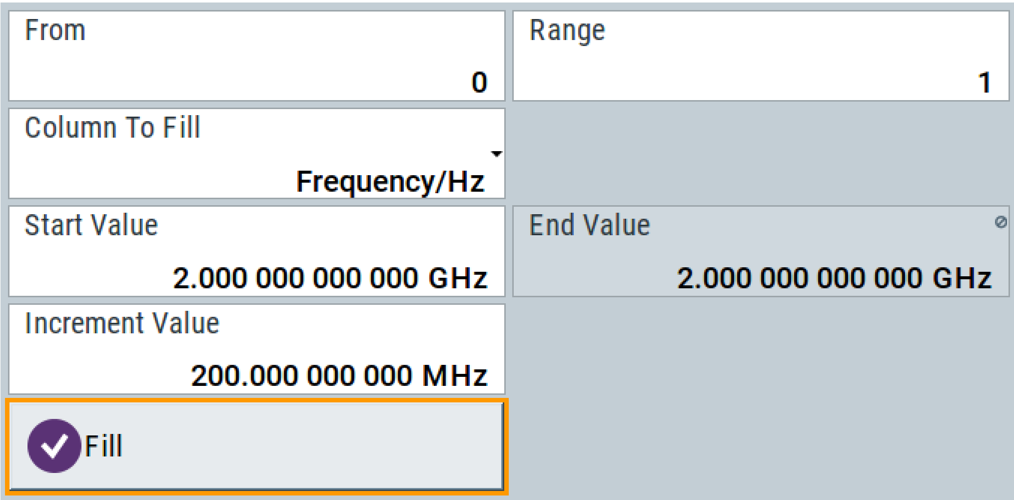
See Chapter 7.3.3, "Fill with Sensor", on page 207

Save As/Save ← Data handling keys

Stores the list in a file with user-defined name and predefined file extension. To save a copy or create a file, use the "Save as" function.

Fill...

Provides parameters for filling a table automatically with user-defined values.



To fill the table, select "Fill".

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

"From / Range"
: Defines the start line and number of lines to be filled.

"Column To Fill"
: Selects, if the column is filled up with frequencies in Hz, levels in dBm or dwell times in s.

"Start Value / End Value"
: Sets the start value for frequency, level or dwell time. The end value is read only and depends on the increment value and the range.

"Increment Value"
: Determines the step size.

"Fill"
: Fills the column specified in "Column To fill".

6.8 How to Generate a Signal in List or Sweep Mode

This section shows you how to configure a varying RF output signal for both, the list and sweep modes.

To configure the frequency sweep signal

► For a step-by-step description, see Chapter 2.3.2, "Generating an RF Frequency Sweep Signal", on page 46.

Example: Fast changing frequency and level settings in list mode

The following example shows you how to generate an amplitude modulated RF signal based on list mode data.

General workflow

Since any change of the hardware settings or list entries can affect the RF signal characteristics directly, we recommend that you proceed as follows:

1. Configure the modulation settings.
   Activate the RF signal.
2. Wait until the hardware settings have settled.
3. Create a list file.
4. Configure the list mode.
5. Activate list mode.

To configure amplitude modulation and switch RF on

1. Press [Preset] to start from an initial state.
2. Select "Modulation" > "Amplitude Modulation > On".
3. Select "Level" > "RF ON" to activate RF signal generation.

To create list mode data

1. Select "Sweep" > "List Mode".
2. In the "List Mode Data" tab, select "List Mode Data > New"
3. Enter the filename `ListMode_Test` for the data list and confirm with "Ok".

   The instrument creates a file and stores it in the `/var/user/` directory.
4. Select "Edit List Mode Data".
5. Enter the first values "Frequency > 2", "Power > 0" and "Dwell > 2".
6. Enter further frequency, power and dwell time values in the same way.
7. Select "Save" and close the dialog.

To configure the list mode and start signal generation

1. In the "General" tab, select "List Mode > Auto".
2. Select "Dwell Time Mode > From List".
3. Switch state to "On".
4. Select "General > State > On".

   The instrument continuously generates an amplitude-modulated RF signal whose frequency and level values change according to the dwell times, as defined in the list.

   With active list mode, the generator displays no frequency and level values in the status bar, but you can check the following parameters.
   - In the list mode dialog, the current index indicates the steps of the signal generation.
   - In remote control mode, you can query:
     – The current state with `[:SOURce<hw>]:LIST:RUNNing?`
     – Current parameters with the commands `FREQ?`, `POW?` and `LIST:DWEL?`.

7 Improving Level Performance

To adapt the RF output signal to specific needs in your application, the R&S SMA100B offers different functions:

- **Attenuator**
  The R&S SMA100B 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 194.
- **Automatic Level Control (ALC)**
  The automatic level control system ensures stable RF signals with highest absolute level accuracy over temperature and time.
  See "About ALC" on page 197.
- **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 199.
- **Power sensors**
  The R&S SMA100B has excellent absolute level accuracy. Since a DUT is rarely connected directly to the generator, but with cables or other components, the reference level shifts from the RF output to the DUT. To calibrate this level with high accuracy, i.e. in the tenth dB range, you can connect an R&S NRP power sensor to the generator. The power sensor transmits its readings to the generator, which indicates these measurement results in the display. Thus you can adjust the RF output power of the generator until you reach the target level at the DUT.
  See Chapter 7.4, "Using Power Sensors", on page 211

7.1 Attenuator

About the attenuator

The step attenuator is an electronic device without mechanical components, providing fast and wear free level settings.

According to the requirements of your application, you can select different attenuator characteristics.

The following are examples of test requirements and the corresponding configuration:

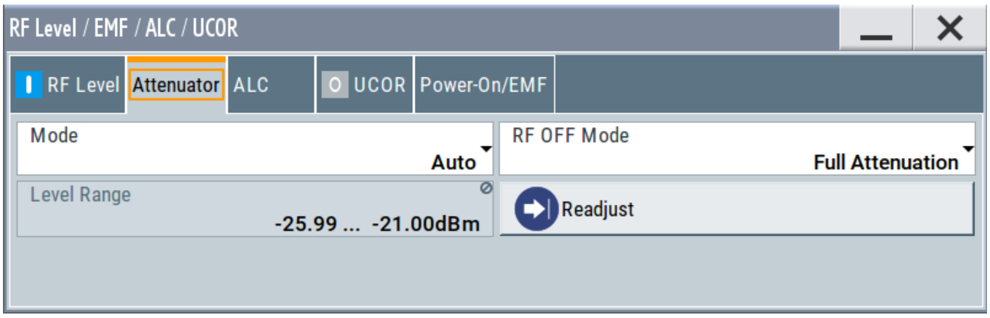
- Automatic configuration
  Select standard operation mode ("Auto"), in which the generator adjusts the attenuation of the RF output signal automatically.
- DUT tests under low signal to noise conditions
  Low output power is suitable to test the behavior of a DUT under low signal to noise conditions.

- Uninterrupted level settings with constant VSWR
  A fix attenuation value is required for obtaining uninterrupted level settings with constant VSWR.
  The configuration "RF Off Mode > Unchanged" ensures that constant VSWR is maintained if you turn the signal off and on again.
- Noise sensitive applications
  The parameter "RF OFF Mode > Full Attenuation" sets maximum attenuation and thus suppresses noise when you turn off the RF signal.

7.1.1 Attenuator Settings

Access:

► Select "Level" > "Level > Attenuator".



In the "Attenuator" dialog, you can select the operating mode of the electronic step attenuator.

The remote commands required to define these settings are described in Chapter 13.13, "OUTPut Subsystem", on page 444 and Chapter 13.16.11, "SOURce:POWer Subsystem", on page 629.

Settings

Mode

Determines the operating mode of the step attenuator.

"Auto"	Adjusts the attenuator settings automatically.
"Fixed"	Fixes the attenuator and amplifier paths for the current RF level and provides signal output with constant output VSWR. The resulting level range is indicated under " Level Range " on page 196.

Remote command:
`:OUTPut<hw>:AMODe` on page 445

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 447
`:OUTPut<hw>:AFIXed:RANGe:UPPer?` on page 447

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 630

7.1.2 Reverse Power Protection

The R&S SMA100B 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 448
`:OUTPut<hw>:PROTection:CLEar` on page 447

7.2 Automatic Level Control (ALC)

The R&S SMA100B 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 can lead to an incorrect RF output power.

ALC States and their effects

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

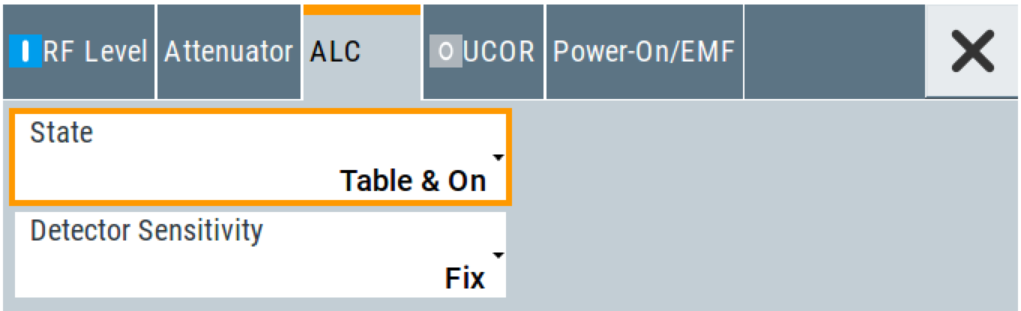
- "Auto"
  Adjusts the output level to the operating conditions automatically. ALC is active in almost all operating modes.
- "On"
  Activates the internal level control permanently, regardless of the operating conditions. This setting provides the highest level accuracy.
- "Off (Table)"
  Deactivates internal level control loop. The instrument calculates every level setting using the attenuation values from the internal (ALC) table. Level attenuation between two table values is done with linear interpolation. This mode enables you to perform a strictly monotonic, but not quite as precise level adjustment.
- "Table & On"
  Starts with the associated value of the internal level table and then activates the automatic level control. This mode achieves maximum level accuracy and fast setting times.
  If pulse modulation is applied, this mode ensures fast level setting even with narrow pulses at low repetition rate.

The R&S SMA100B displays the level control setting as a status message in the info line.

7.2.1 ALC Settings

Access:

► Select "Level" > "Automatic Level Control".



In the "ALC" dialog, you can configure the settings for the automatic level control of the RF signal to achieve optimal accuracy.

The remote commands required to define these settings are described in Chapter 13.16.11, "SOURce:POWer Subsystem", on page 629.

Settings

State

Selects the internal level control mode.

Find further details about the individual settings in "ALC States and their effects" on page 197. It covers an overview of the functionality and indicates what is to be considered.

"Auto" Selects the most appropriate ALC mode automatically.

"On" Activates ALC permanently.

"Off (Table)"
Controls the level using the attenuation values of the internal ALC table.

"Table & On"
Starts with the attenuation setting from the table and continues with automatic level control.

Remote command:
`[:SOURce<hw>]:POWer:ALC[:STATe]` on page 629

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.

"Fix" Fixes the last set sensitivity setting.

Remote command:
[:SOURce<hw>]:POWer:ALC:DSENsitivity on page 630

7.3 User Correction

The R&S SMA100B 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 SMA100B is flat. However, the DUT is usually not connected directly to the outputs of the instrument but rather via connecting cables. Components like cables, power combiners, switches or mixers can affect the signal flatness at the DUT input.

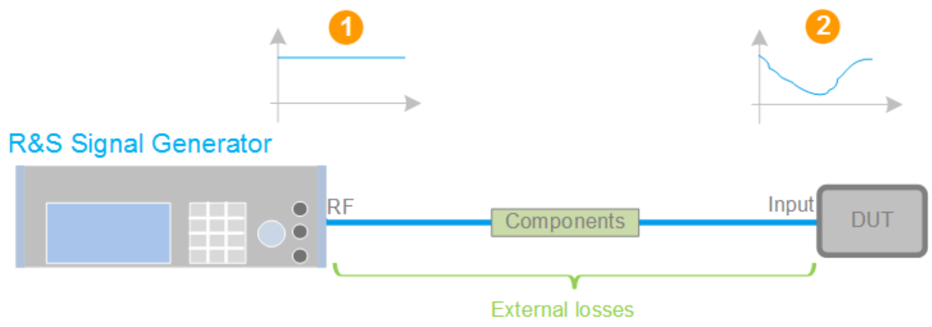


Figure 7-1: Effect of external losses on the signal flatness at the DUT input

DUT	= Device under test
Components	= Designation of all components between the measurement equipment and the DUT, e.g. cables
1	= Flat signal at the outputs of the R&S SMA100B
2	= Signal received at the DUT, incl. the external losses

About UCOR

User correction (UCOR) is a method that determines the external level loss over a frequency range in advance, see Figure 7-2.

The difference between the generator output level and the level at the DUT determines the correction value at the respective frequency. Alternatively, the attenuation characteristics over a certain frequency range of, for example, RF cables are also specified in the associated data sheet.

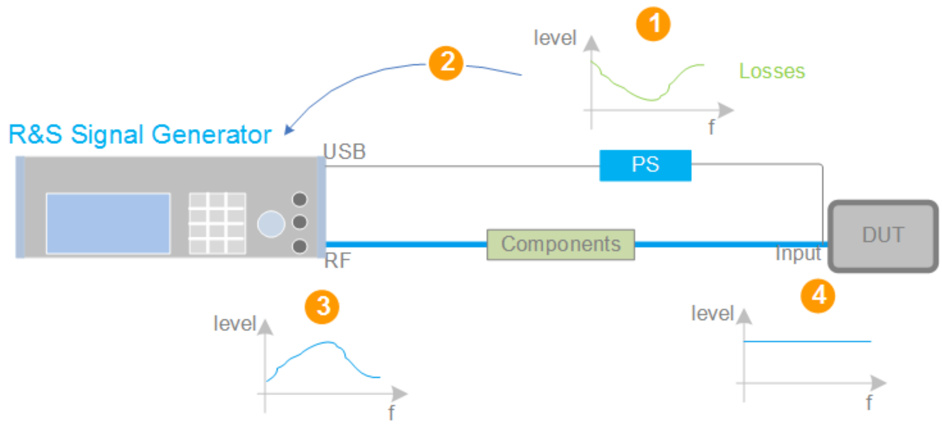


Figure 7-2: Understanding the principle of user correction

DUT	= Device under test
Compo-nents	= 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 SMA100B
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 SMA100B and the DUT
2	= Obtain the correction data by inverting the collected data; load the correction parameters in the R&S SMA100B
3	= In the R&S SMA100B, 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 Chapter 10.8, "Using the File Manager", on page 298.

Collecting correction data

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

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

Using a power sensor for frequency response measurements

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

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

Interactions and characteristics

Activated user correction is effective in all operating modes.

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

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

Activated user correction is indicated by the status indication "Lev Ucor" in the "Level" tile.

7.3.1 User Correction Settings

Access:

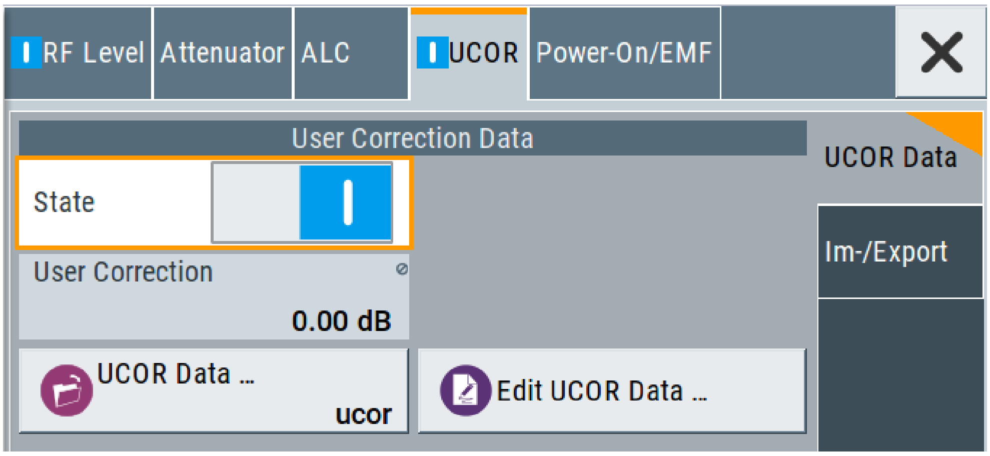
1. Select "Level" > "User Correction".
2. If you already have created a file with user correction data:
   a) Select "UCOR Data > navigate to the file *.uco > Select".

   b) Proceed with step 4.

3. If you need to create a file:
   a) Select "UCOR Data > New".
   b) Enter the filename `UCOR_Data` and confirm with "Ok".
   c) Choose the file and confirm with "Select".
   d) Select "Edit UCOR Data".
   e) To fill the user correction data table, proceed as described in Chapter 6.7, "List Editor", on page 188.

4. Select "RF Level > RF State > On".

5. Select "User Cor. Data > State > On".



   The "UCOR" dialog contains all settings for creating and handling files with user-defined level correction values.

The remote commands required to define these settings are described in Chapter 13.16.3, "SOURce:CORRection Subsystem", on page 582.

Settings

State

Activates user correction.

The R&S SMA100B displays the status icon "Lev Ucor" in the "Level" panel.

Remote command:
`[:SOURce<hw>]:CORRection[:STATe]` on page 587

User Correction

Indicates the corrected level value for a specific frequency point.

Remote command:

[:SOURce<hw>]:CORRection:VALue? on page 586

UCOR Data

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

Files with user correction values are files with predefined file extension `*.uco`. When a file is selected, the dialog indicates the filename.

You can create the file internally in the table editor or externally.

- To select an existing file, select "Select List > navigate to the file *.uco > Select"
- Use the general editor function to create internally new file or to edit an existing one.
- Use the standard file manager function to load externally created files to the instrument.

Remote command:

[:SOURce]:CORRection:CSET:CATalog? on page 587

[:SOURce<hw>]:CORRection:CSET[:SELect] on page 586

[:SOURce]:CORRection:CSET:DELete on page 588

Edit UCOR Data

Opens the build-in table editor to define a new correction table or edit an existing one.

See also:

- Chapter 6.7, "List Editor", on page 188
- " Fill... " on page 92
- Chapter 7.3.3, "Fill with Sensor", on page 207

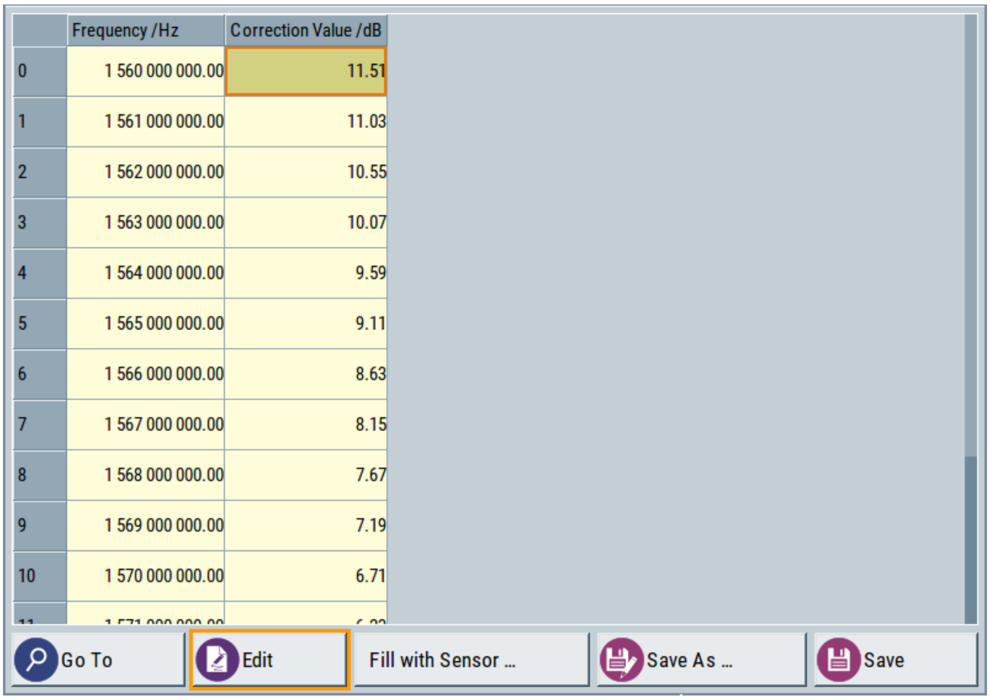
7.3.2 List Editor

The "User Correction" and "List Mode" dialogs provide a build-in list editor for defining the corresponding value pairs.

The table and navigation functions of the UCOR and list mode editors have the same structure and are therefore summarized below. The access is specified for both modes, the fields and functions are explained using the example of the list mode.

Access to "Edit List Mode Data":

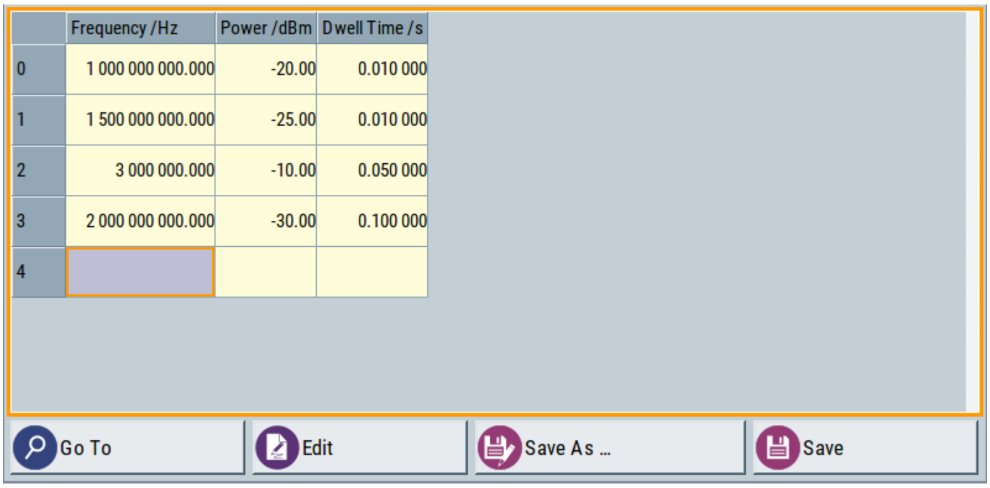
► "Sweep" > "List Mode" > "List Mode Data" > "Edit List Mode Data"



The editor for list mode data provides a table with RF frequency and power values and standard navigation functions.

Access to "Edit User Correction Data":

► "Level" > "User Correction" > "Edit User Cor. Data"



The editor for user correction provides a table with RF frequency and power values, an extra column for defining variable dwell times, and standard navigation functions.

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

If you use **global dwell time in list mode**, consider also that the instrument uses the value set with Global Dwell Time for all list steps and not the values from the list.

Since the table and navigation functions can be assumed to be known, the following description contains a brief overview, shown by the example of the "List Data Editor". If a function relates to a particular dialog, it is explicitly stated.

Settings

Edit List Mode Data

Table with values for list or user correction processing.

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

"Frequency /Hz"
Sets the frequency values.

Remote command:
[:SOURce<hw>]:LIST:FREQuency on page 616
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency on page 585

"Power /dBm" Sets the level values.

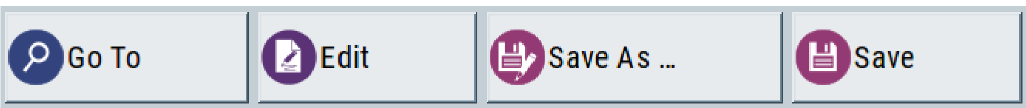
Remote command:
[:SOURce<hw>]:LIST:POWer on page 618
[:SOURce<hw>]:CORRection:CSET:DATA:POWer on page 585

"Dwell /s" In list mode, sets the dwell time values.

Remote command:
[:SOURce<hw>]:LIST:DWELl:LIST on page 616

Data handling keys

Standard functions for file and data handling.



Go To ← Data handling keys

Selects a row for editing.

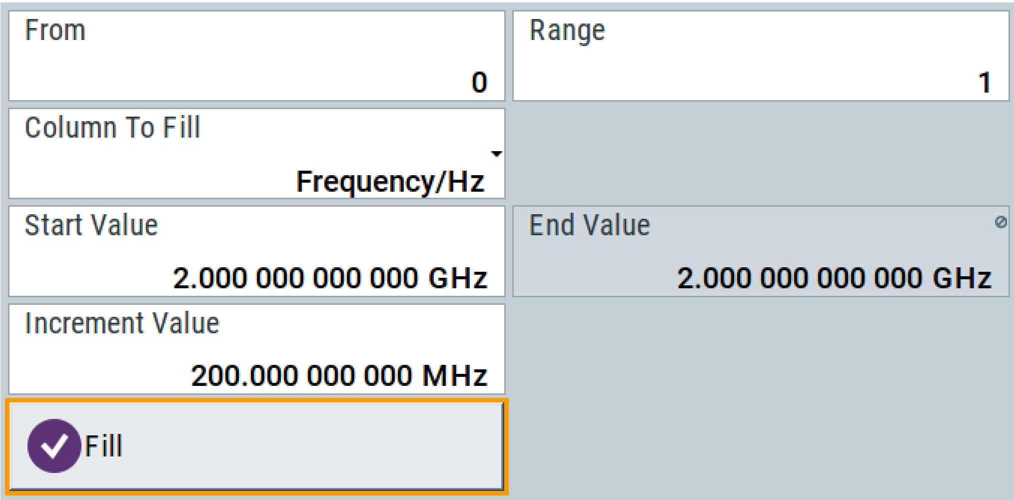
Edit ← Data handling keys
Enables you to insert, or delete a row or ranges within a list, and provides access to a dialog for automatic filling, see " Fill... " on page 92.

Fill with Sensor ← Data handling keys
Opens a dialog to configure the automatic filling of user correction data with an R&S NRP power sensor. Available in UCOR mode only.

See Chapter 7.3.3, "Fill with Sensor", on page 207

Save As/Save ← Data handling keys
Stores the list in a file with user-defined name and predefined file extension. To save a copy or create a file, use the "Save as" function.

Fill...
Provides parameters for filling a table automatically with user-defined values.



To fill the table, select "Fill".

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

"From / Range"
Defines the start line and number of lines to be filled.

"Column To Fill"
Selects, if the column is filled up with frequencies in Hz, levels in dBm or dwell times in s.

"Start Value / End Value"
Sets the start value for frequency, level or dwell time. The end value is read only and depends on the increment value and the range.

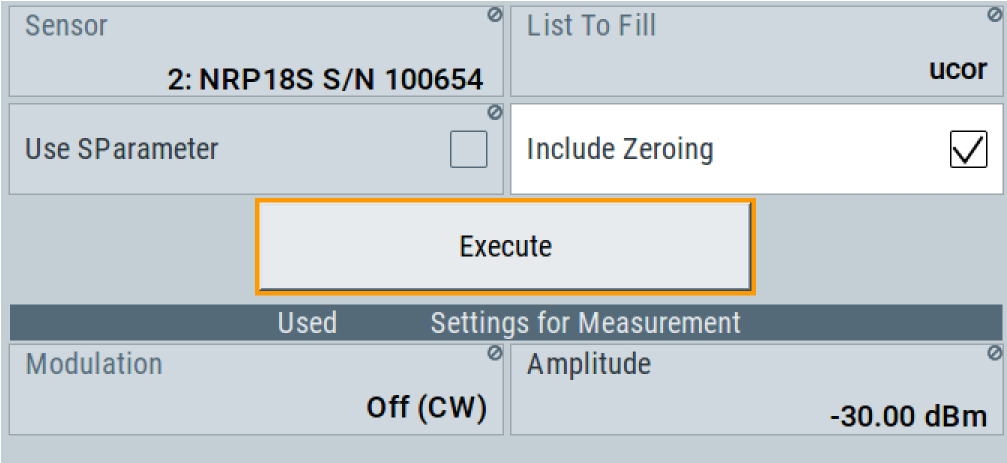
"Increment Value"
Determines the step size.

"Fill" Fills the column specified in "Column To fill".

7.3.3 Fill with Sensor

Access:

1. Select "Level" > "User Correction".
2. Select "UCOR Data > navigate to the file *.ucor > Select".
3. Select "Edit UCOR Data > Fill With Sensor...".



This dialog contains parameters for filling a table automatically with sensor readings.

To fill the table, select "Execute".

For information on power sensors an how to use them, see Chapter 7.5, "How to Calibrate the Power Level with an R&S NRP Power Sensor", on page 264.

Settings

Fill User Correction Data with Sensor

- "Sensor"
  Displays connected sensors for selection.
- "List To Fill"
  Indicates the used list.
- "Use SParameter"
  Indicates whether SParameter correction in the R&S NRP power sensor is used.
- "Include Zeroing"
  Performs a zeroing procedure before acquiring the user correction data to improve precision.
  No signal is applied to the sensor during zeroing. RF output is temporarily switched off during that time.

When unchecked, the zeroing procedure is skipped. However, the RF signal level might be blanked shortly. This setting is useful if blanking of RF is undesirable or the absence of power at the sensor cannot be guaranteed.

- "Execute"

The "Execute" button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

Remote command:
`[:SOURce<hw>]:CORRection:ZERoing:STATe` on page 587
`[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` on page 586

Used SMAB Settings For Measurement
Displays the settings relevant for the measurement.

"Modulation"	Indicates the modulation state
"Amplitude"	Shows the currently set level.

Remote command:
n.a.

7.3.4 Import/Export List Files

Access:

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

2. Select "Import/Export".

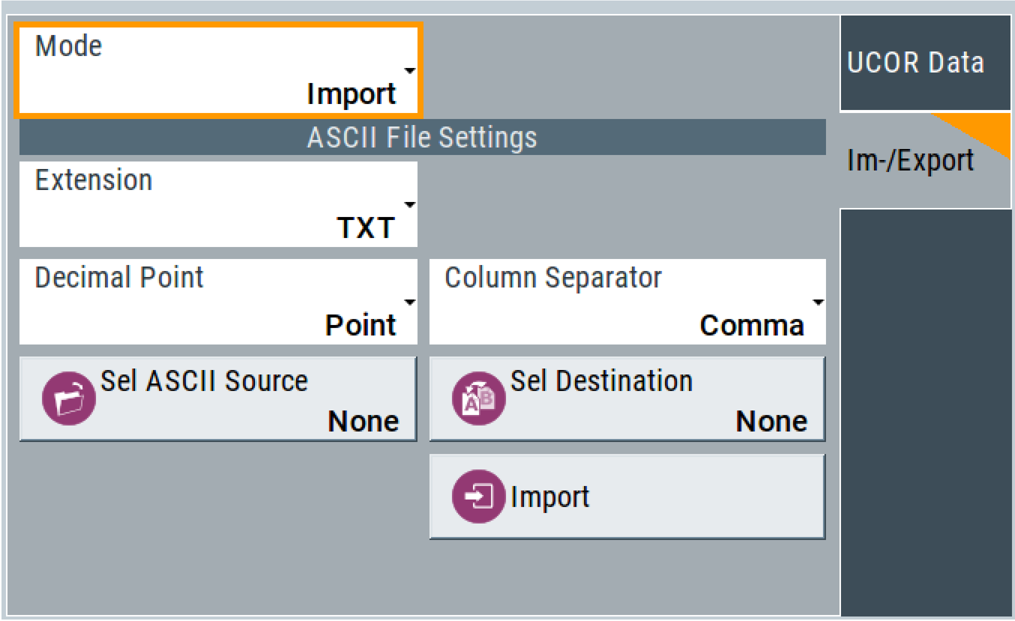


Figure 7-3: Im-/Export dialog (example with UCOR settings)

The "Import/Export" dialog contains all functions and settings to import externally created list data or to export it accordingly. You can process and store a list in the formats `*.txt` (ASCII), or `*.csv` (plain text with identical sequence of fields). The table separators and the decimal floating point numbers are customizable.

Settings

Mode

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

Remote command:

`[:SOURce<hw>]:LIST:DEXChange:MODE` on page 624
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 590
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 538

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 623
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal` on page 624
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn` on page 624
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension` on page 588
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal` on page 589
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn` on page 589
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension` on page 538
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal` on page 539
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn` on page 539

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 623
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect` on page 623
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?` on page 588
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect` on page 589
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog?` on page 539
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect` on page 539

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 624
`[:SOURce<hw>]:CORRection:DEXChange:SELect` on page 590
`[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect` on page 540

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

Remote command:

[:SOURce<hw>]:LIST:DEXChange:EXECute on page 623

[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 589

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 540

7.4 Using Power Sensors

The R&S SMA100B works with most of the R&S NRP power sensors and thus supports various application tasks. Using power sensors, you can for example determine attenuation characteristics of downstream equipment or cables. You can use the measured values to compensate the losses with internal control functions or with an external control circuit in real time.

R&S NRP sensors are highly accurate standalone measuring devices, suitable for a wide range of applications. The devices communicate directly with the signal generator, calculate the average or peak power internally, include S-parameter correction and return the measurement results to the generator.

The R&S SMA100B works with any sensor of the R&S NRP series and can perform up to four power measurements simultaneously.

Check the firmware version of the R&S NRP sensors regularly. Update the firmware, if necessary.

For updates, see the Rohde & Schwarz website http://www.rohde-schwarz.com in section "Power Meters & Voltmeters".

7.4.1 Connecting R&S NRP Power Sensors to the R&S SMA100B

R&S NRP sensors are connected to the R&S SMA100B in the following ways:

- Connection to the Sensor connector
  – R&S NRP-ZK8 (eight-pole interface cable) for R&S NRPxx power sensors
  – R&S NRP-ZK6 (six-pole interface cable) for R&S NRPxx power sensors
  – No additional cable for R&S NRP-Zxx power sensors (cable is fixed on the sensor)
- Connection to the USB connector

  Requires the following cables, depending on the used sensor type:
  – R&S NRP-ZKU (USB interface cable) for R&S NRPxx power sensors
  – R&S NRP-Z3 or R&S NRP-Z4 (USB adapter cables) for sensors of the R&S NRP-Zxx family

- Connection via R&S NRP-Z5 sensor hub
  The R&S NRP-Z5 USB sensor hub (high-speed USB 2.0) can host up to 4 R&S NRP sensors. It provides simultaneous internal and external triggering of all connected sensors.

  Requires additional cables, depending on the used output connector of the hub. Choose one of the following:
  – Short extension cable R&S NRP-Z2 for connection to the sensor connector. This six-pole connection provides the external trigger capability.
  – Standard USB cable (USB type A to USB type B) to any USB type A connector of the R&S SMA100B. This connection does not support external triggering.
- Connection via USB hub with external power supply unit

  Requires the following cables, depending on the used sensor type:
  – R&S NRP-ZKU (USB interface cable) for R&S NRPxx power sensors
  – R&S NRP-Z3 or R&S NRP-Z4 (USB adapter cables) for sensors of the R&S NRP-Zxx family
- Connection via LAN for R&S NRPxxxSN/xxxTN/xxxAN power sensors
  Using the Ethernet interface requires PoE (Power over Ethernet) to provide the electrical power.

  To establish the connection, you can use:
  – A PoE Ethernet switch, e.g. R&S NRP-ZAP1 and an RJ-45 Ethernet cable.
  – A PoE injector and an RJ-45 Ethernet cable.

For details, see the description R&S®NRP®Series Power Sensors Getting Started.

Detection and mapping

The R&S SMA100B automatically detects a connected R&S NRP power sensor and indicates it in the "NRP Power Viewer" and "NRP Sensor Mapping" dialogs.

By default, detected sensors are indicated as follows:

- A sensor connected at the Sensor socket is assigned as "Sensor 1".
  If no sensor is connected to this socket, channel 1 remains unassigned.
- Sensors 2 to 4 are assigned to the sensors at the USB connectors, according to their sequence of connection.

You can change the default mapping in the NRP Sensor Mapping dialog.

On connection, the R&S SMA100B immediately starts the measurement of a detected R&S NRP power sensor. If you perform an instrument preset ([Preset] key or `*RST`), the R&S SMA100B stops the measurements. The connection and the mapping of the power sensors remain, the measurements must be restarted.

7.4.2 NRP Sensor Mapping

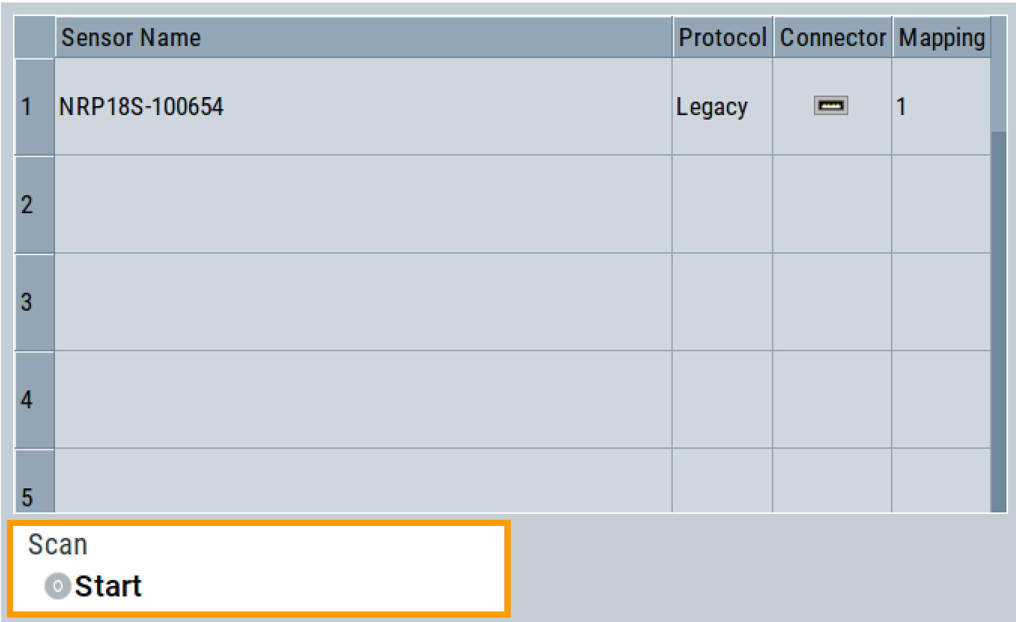
The "NRP Sensor Mapping" lists all R&S NRP sensors detected by the instrument.

Any R&S NRP sensor that supports the USB legacy protocol and is connected to one of the USB interfaces, is detected automatically and added to the list. Vice versa, the R&S SMA100B removes a sensor from the list, when it is disconnected.

R&S NRP sensors that are connected via LAN or use the USBTMC protocol are not automatically detected. They are detected by the scan search function.

Access:

► Select "Clk Syn/Power Sens" > "NRP Sensor Mapping".



The dialog lists all detected R&S NRP sensors for selection and mapping. You can also browse the network for sensors.
The detected sensors are characterized by the used protocol and the corresponding connector icon. In the "Mapping" column, you can assign the sensor to one of the available sensor channels. The list can contain several entries but the R&S SMA100B can only use up to four sensors simultaneously.
The remote commands required to define these settings are described in Chapter 13.15, "SENSe, READ, INITiate and SLISt Subsystems", on page 498.

Settings

Sensor Mapping List

Displays a list of all sensor entries with information on the sensor name, the used protocol, the connector and the assigned mapping.

If a sensor is connected via LAN or uses the USBTMC protocol, its protocol is indicated as "Visa".

Remote command:
:SLISt[:LIST]? on page 501
:SLISt:ELEMent<ch>:MAPPing on page 501
:SLISt:SENSor:MAP on page 502

Scan
Scans the network and the USB connections for sensors connected via the VISA communication protocol, i.e. sensors that are addressed via LAN or USBTMC.

Sensors communicating via the USB legacy protocol are detected automatically.

Remote command:
:SLISt:SCAN[:STATe] on page 501

7.4.3 NRP Power Viewer

The R&S SMA100B features the power viewer function for measuring or monitoring signals with R&S NRP power sensors.

7.4.3.1 About

The R&S SMA100B can perform up to four power measurements simultaneously.

Depending on the signal characteristic (CW, AM, pulsed, etc.) or the parameter to be measured (average, peak, etc...) a suitable R&S power sensor must be used.

About the measuring principle, averaging filter, filter length, and achieving stable results

A sensor measures the average or peak RF power of the source continuously. The measurement results are displayed in the "NRP Power Viewer" dialog.

The power viewer function uses **averaging filters** for getting a stable readout.

Measurement results could be interfered for instance by to much noise in your setup, by a bad supression of harmonics or non harmonics or when you reach the sensitivity level of your power sensor.

Measurements are continuously repeated in a predefined time window. The measurement result is obtained by averaging the measured values for the last 2N time windows. This approach is referred as a **two-step averaging process**.

The factor of 2 in the formula arises because the output signals from the microwave detector are chopped at the same rate as the time windows to suppress low-frequency noise. An independent measured value can only be obtained from two consecutive values.

The variable N in the formula indicates the **filter length**. The filter length then directly influences the measurement time. The filter length can be selected automatically or it can be manually set to a fixed value.

Depending on the R&S NRP power sensor type, the manual setting of the filter length varies in resolution:

- Resolution = 1 for the R&S NRPxx power sensor family
- Resolution = 2^n for R&S NRP-Zxx power sensors, with n = 1 to 16

Follow the following general recommendation to find out the **optimum filter length**:

- Always start a measurement in auto mode ("Filter > Auto").
  Check if the measurement results are sufficient.
- If the power is not constant, select the filter length manually ("Filter > User").
  Trigger the "Auto Once" function to search for the optimum filter length for the current measurement conditions.
  The estimated value is indicated as filter length.
- If the target measurement accuracy value is known, select "Filter > Fixed Noise".
  The averaging factor is selected automatically and so that the sensor's intrinsic noise (two standard deviations) does not exceed the specified noise content.
- Different sensor types achieve the same filtering result with different filter and time window lengths.

  The time window length depends on the sensor type:
  - For most sensors, it is fixed to 20 ms.
  - For the R&S NRP-Z81 sensor, it is 10 µs.
    The R&S NRP-Z81 uses filter length that is 1000 times larger than the filter length for other sensors.

About zeroing

Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor. If a Rohde & Schwarz power sensor receives an input power during the zeroing process, it aborts zeroing and generates an error message. Zeroing takes a few seconds, depending on the sensor model. Refer to the documentation of your power sensor for more information.

Tips for zeroing

When to perform zeroing:

- During warm up after switching on or connecting the instrument
- After a substantial change of the ambient temperature
- After fastening the power sensor module to an RF connector at high temperature
- After several hours of operation
- When low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
- Switch off the RF power source for zeroing, but do not disconnect it from the power sensor. This proceeding keeps the thermal equilibrium, and the zeroing process also compensates the noise that superimposes the measured signal (e.g. from a broadband amplifier).

Related settings and functions

- Measurements-related settings, like results, filter, filter length:
  Chapter 7.4.3.2, "NRP Power Viewer Settings", on page 216
- Software version of the connected power sensor:
  :SENSe<ch>[:POWer]:TYPE? on page 510
- Acquisition of level correction data:
  Chapter 7.3, "User Correction", on page 199

Additional information

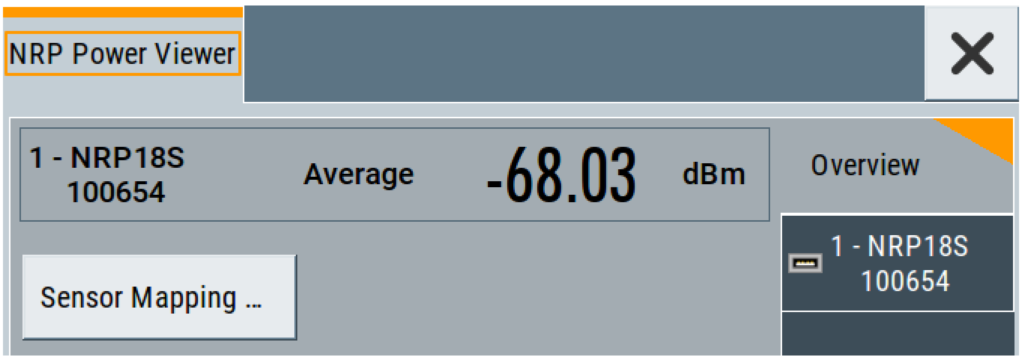
See Rohde & Schwarz website http://www.rohde-schwarz.com in section "Power Meters & Voltmeters" for:

- R&S NRP power sensor manual.
- Information on the R&S NRP-Z5 sensor hub and the available accessories.
- Sensor software updates.

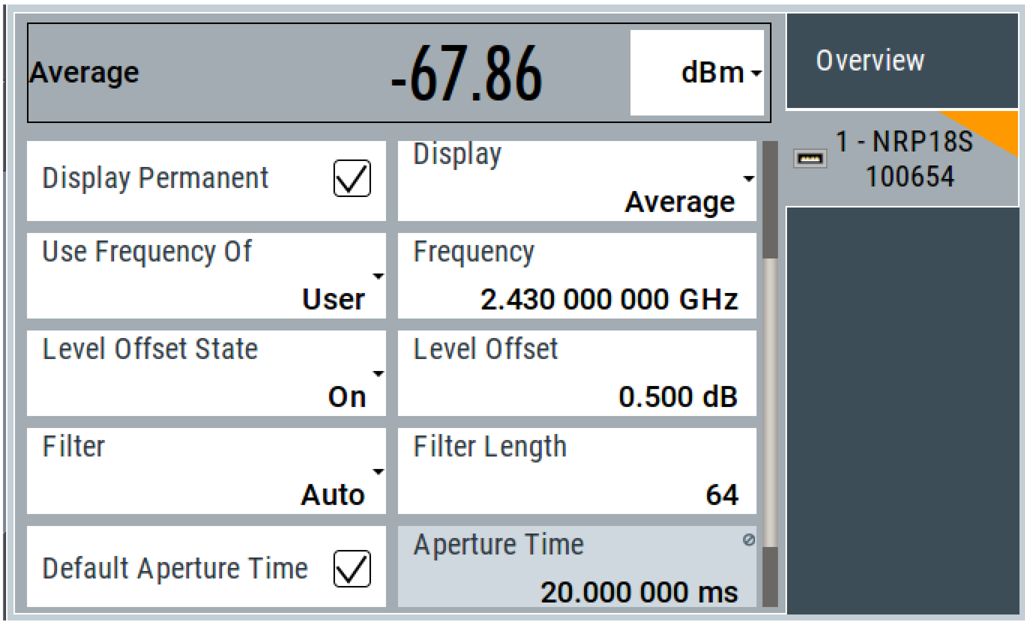
7.4.3.2 NRP Power Viewer Settings

Access:

► Select "Clk Syn/Power Sens" > "NRP Power Viewer".



The "Overview" tab shows the list of detected sensors, and provides a separate tab per sensor.



A sensor tab contains all parameters for configuring the sensor settings, like average or peak display, reference source, filter and level offset.
The remote commands required to define these settings are described in Chapter 13.15, "SENSe, READ, INITiate and SLISt Subsystems", on page 498, including the triggering of the measurement and the retrieval of measurement results.
See also Chapter 7.5, "How to Calibrate the Power Level with an R&S NRP Power Sensor", on page 264.

Settings

Sensor type and serial number

Indicates the type and the serial number of a selected R&S NRP power sensor, and the channel the sensor is assigned to.

The displayed Level (Peak) / Level (Average) values correspond to the particular sensor.

Remote command:
`:SENSe<ch>[:POWer]:TYPE?` on page 510
`:SENSe<ch>[:POWer]:SNUMber?` on page 509

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 502
`:SENSe<ch>:UNIT[:POWer]` on page 503

Sensor Mapping

Accesses the NRP Sensor Mapping dialog.

Sensor settings

One tab per sensor provides the corresponding settings.

State ← Sensor settings

Activates level measurement.

Remote command:
`:INITiate<hw>[:POWer]:CONTinuous` on page 502
To query the availability of a sensor at a given connector, use the command `:SENSe<ch>[:POWer]:STATus[:DEVice]?` on page 510.

Zero ← Sensor settings

Activates the auto zeroing.

For details, see "About zeroing" on page 215.

Remote command:
`:SENSe<ch>[:POWer]:ZERO` on page 511

Display ← Sensor settings

Sets the display mode for power readings.

Permanent ← Display ← Sensor settings

Activates the permanent indication of the power measurement result on the left side of the home screen.

You can activate the permanent display for several sensors.

Remote command:
:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe on page 505

Display ← Display ← Sensor settings
Sets the display of results on mean or peak power.

Remote command:
:SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority on page 505

Use Frequency Of ← Sensor settings
Selects the source for measurement.

"RF" The R&S SMA100B 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 SMA100B. 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 509

Frequency ← Sensor settings
Defines the frequency value if "Source > User" is used.

Remote command:
:SENSe<ch>[:POWer]:FREQuency on page 508

Level Offset State,Level Offset ← Sensor settings
Activates and defines a level offset which is considered in the power meassurement result. The level offset value is always expressed in dB, irrespective of the display of the measurement result.

This function allows you to consider, for example, an attenuator in the signal path.

Remote command:
:SENSe<ch>[:POWer]:OFFSet on page 509
:SENSe<ch>[:POWer]:OFFSet:STATe on page 509

Filter ← Sensor settings
Selects the way the length of the used filter is defined.

See also "About the measuring principle, averaging filter, filter length, and achieving stable results" on page 214.

"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 507

Filter Length ← Sensor settings
Sets or indicates the filter length, depending on the selected filter mode.
- "Filter > Auto" indicates the automatically adjusted filter length.
- "Filter > User" enables you to set the filter length manually.
- "Filter > Fixed Noise" hides the setting parameter.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?` on page 505
`:SENSe<ch>[:POWer]:FILTer:LENGth[:USER]` on page 506

Noise/Signal Ratio ← Sensor settings
For Filter > Fixed Noise, sets the noise content.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio` on page 506

Auto Once ← Sensor settings
Searches the optimum filter length for the current measurement conditions. The result is indicated with the parameter Filter Length.

See also "About the measuring principle, averaging filter, filter length, and achieving stable results" on page 214.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:SONCe` on page 507

Timeout ← Sensor settings
For "Filter > Fixed Noise", sets a time limit for the averaging process.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe` on page 507

Default Aperture Time ← Sensor settings
The sensor default setting is sufficient. Disable this parameter to specify a user-defined aperture time per sensor, if, for example, the readings vary.

To obtain stable readings, set the Aperture Time exactly to one modulation period.

Remote command:
`:SENSe<ch>[:POWer]:APERture:DEFault:STATe` on page 503

Aperture Time ← Sensor settings
If "Use Default Aperture Time > Off", defines the acquisition time per sensor.

For example, to obtain a sufficient low average value, set the aperture time exactly to one modulation period.

Remote command:
`:SENSe<ch>[:POWer]:APERture:TIMe` on page 504

S-Parameter ← Sensor settings
Lists the S-Parameter correction data files retrieved for the connected power sensor. To activate the correction data, select the corresponding file.

S-Parameter correction is used to mathematically shift the reference plane to the DUT by considering the S-parameters for any components connected upstream of the sensor.

The S-Parameter table can be changed with the S-Parameters tool, provided as part of the free R&S NRP Toolkit software. For more information, refer to the manual of the connected R&S NRP power sensor.

Remote command:
`:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe` on page 504
`:SENSe<ch>[:POWer]:CORRection:SPDevice:LIST?` on page 505
`:SENSe<ch>[:POWer]:CORRection:SPDevice:SELect` on page 504

Enable Logging ← Sensor settings
Activates recording of R&S NRP power sensor readings in a log file.

There is 1 log file per sensor. The log files are created automatically and filled in continuously. They are text files with predefined filename `SensLog<n>.txt`, where `<n>` indicates the connected sensor. Log files are stored on the internal memory, in the directory `/var/user/SensorLogging`.

Each log file contains the measured value (2 readings when you work with peak sensors), the sensor type, and the measurement time (timestamp). Logged data is not overwritten. When a new measurement is started, the collected logging data is appended in the log file.

Check the used disc space regularly and remove log files to maintain storage capacity.

Note: The logging function is intended for measurements with long time intervals. It is suitable source for data reconstructions if the connection to the sensor was interrupted.

Remote command:
`:SENSe<ch>[:POWer]:LOGGing:STATe` on page 508

7.4.4 NRP Power Analysis

With a connected R&S NRP power sensor, the R&S SMA100B enables the analysis of power measurements of DUTs. You can analyze the measured power under frequency, power and time aspects, while the instrument supports you with marker, graphic and reference value functions.

7.4.4.1 About

Characteristics and features of the NRP power analysis function

The NRP analysis displays the measurement data graphically. The measurement diagram covers up to four traces you can manually or automatically assign to one or more connected power sensors. For evaluation of the readings, you can save a defined reference trace or even freeze a reading temporarily on the screen. In addition, Markers and mathematic functions enable you to compare particular values.

The NRP analysis supports three measurement modes:

- Power versus frequency (frequency response).
  For this mode, all required generator settings are automatically configured except for the power level. The power level setting of the generator is used for the frequency sweep measurements.
  The frequency sweep settings are transferred to the sensor to automatically calculate the correct measurement value for each frequency point.
- Power versus power (power sweep, AM/AM)
  Power sweep measurements are executed using the frequency settings of the generator. Alternatively, the sensor can be adjusted to a frequency different from the generator, see Use Separate Frequency- Power Analysis .
  This frequency is transmitted to the sensor to automatically calculate the correct measurement value.
- Power versus time (power measurement in the time domain R&S NRP trace mode).
  In the time mode, you can analyze the signal of the generator but also externally supplied signals. This mode requires an additional trigger event, with selectable level, hysteresis and drop time. Provided the sensor used supports the power measurement of pulse signals, you can also analyze pulse data in time domain.

7.4.4.2 Accessing the NRP Power Analysis Functionality

Access:

► Select "Clk Syn/Power Sens" > "NRP Power Analysis".

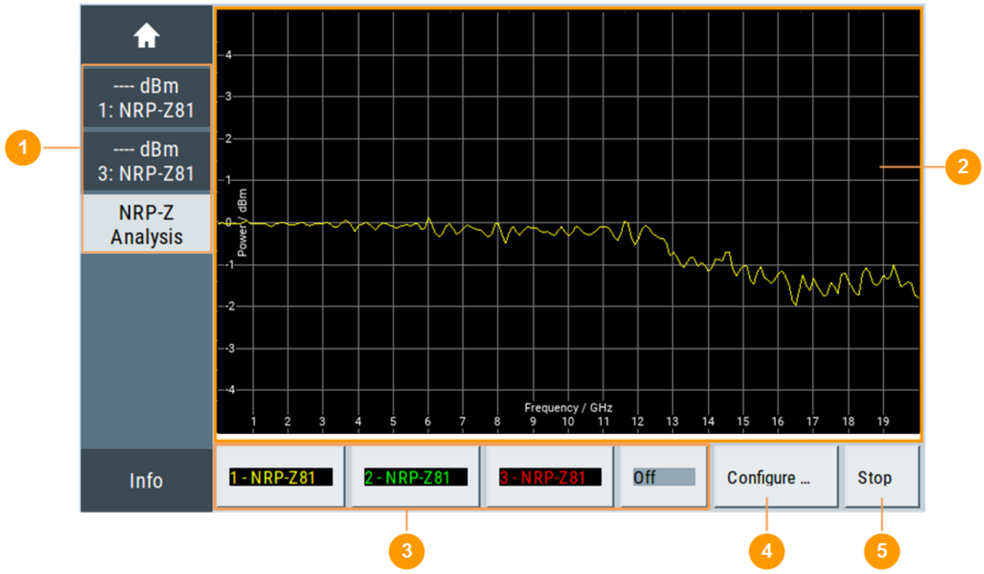


Figure 7-4: Power analysis window

1 = Buttons for accessing the "NRP Power Viewer" settings
2 = Power analysis diagram window
3 = Buttons for accessing the traces/marker dialogs
4 = Buttons for accessing the configuration dialogs with measurement and sensor parameters
5 = "Start" button to trigger/stop the measurement

The start screen of the NRP analysis contains the measurement diagram and labelled buttons/softkeys indicating connected power sensors. These button and a configuration button provide access to the dialogs for setting up the measurement and sensor parameters, for configuring the diagram and for the trace display. You can start or stop your measurement directly.

Context-sensitive menu

A context sensitive menu also provides access to the configuration dialogs and some additional functions.

Access:

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

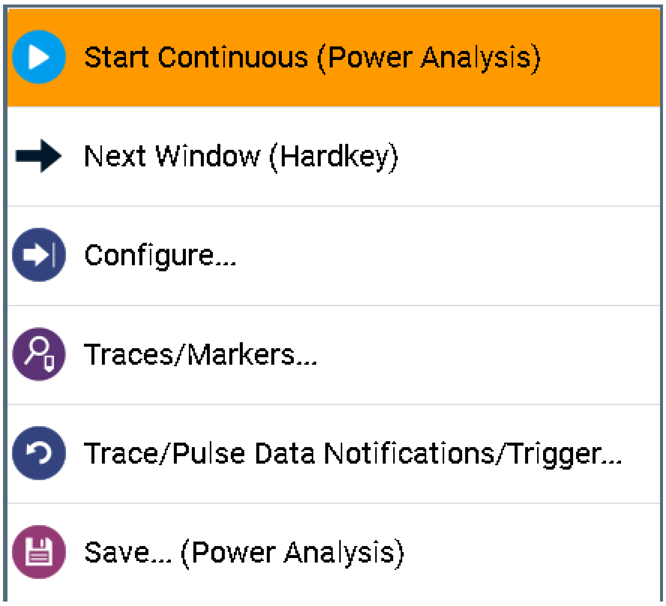


Figure 7-5: Power analysis context-sensitive menu

In the context-sensitive menu you can access:

- "Start Continuous/Stop (Power Analysis)": Triggers/stops the power analysis measurement
- "Next Window (Hardkey)": Switches between the measurement views that are enabled in the following order:
  - "Standard View"
  - "Marker View"
  - "Pulse Data View"
  - "Full Screen"

  At least one viewing mode has to be selected. For details on the different view modes, see "Next Window List" on page 250.
- "Configure...": opens a dialog for configuring the power analysis measurement. See Chapter 7.4.4.7, "Configure Settings", on page 230.
- "Trace/Markers...": opens a dialog for configuring the traces/marker. See Chapter 7.4.4.6, "NRP Traces Settings", on page 226.
- "Trace/Pulse Data Notifications/Trigger.... ": in the time mode, opens a dialog to configure the pulse data measurements. See "Configure Pulse Data" on page 241.
- "Save...(Power Analysis)": opens a dialog to save a hardcopy of the measurement. See Chapter 7.4.4.8, "Creating Screenshots of Power Analysis Settings ", on page 254.

Measurement window

Diagram indicating the measurement results graghically, including configured markers, functions, etc.

Off / NRP-Zxx

Accesses the dialogs for configuring the traces and markers, see Chapter 7.4.4.6, "NRP Traces Settings", on page 226

Configure...

Accesses the dialog for configuring the power analysis measurement, see Chapter 7.4.4.7, "Configure Settings", on page 230.

Start / Stop measurement

Starts and stops the power analysis measurement. Depending on the selected measurement mode, the label varies.

7.4.4.3 Required Options

The R&S SMA100B base unit equipped with the following options:

- Power Analysis (R&S SMAB-K28)

Requires an external R&S NRP power sensor. For more information, see the data sheet.

7.4.4.4 Test Setup Example

As a power meter has no built-in selection, it is measuring all signal components from nearly DC to 40 GHz and higher. Therefore, the DUT's signal must be rather pure or subjected to external filtering (harmonics, spurious) before measured.

The test setup for the power analysis in the power versus frequency or power versus power is as follows:

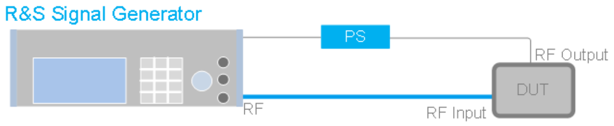


Figure 7-6:

DUT = Device under test
PS = Power sensor, e.g. R&S NRP, connected at the DUT's input and the USB connector of the R&S SMA100B

1. Connect the DUT RF input to the RF output of the instrument.
2. Connect the DUT RF output to the power sensor.
3. Connect the power sensor to the signal generator.
4. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
5. Press "Configure..." to open a dialog for setting up the measurement.
6. Click on the power sensor indication located at the bottom of the dialog to set the trace.

7. Press "Start Cont." to trigger the measurement.

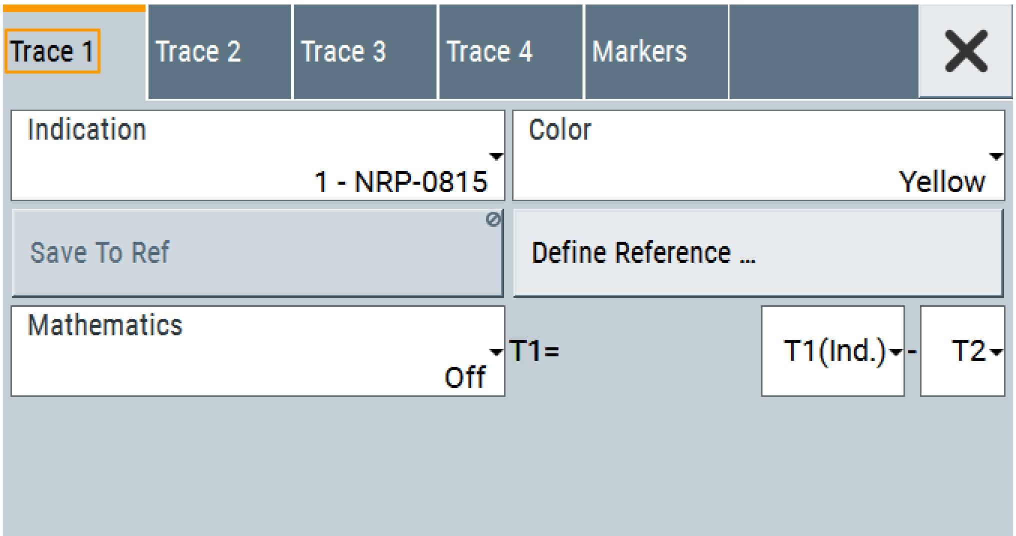
7.4.4.5 NRP Power Analysis Settings

Open the required dialog for configuring the NRP power analysis settings.

7.4.4.6 NRP Traces Settings

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select power sensor indication located at the bottom of the dialog.
3. To access the trace settings, select the respective "Trace x" tab.



The measurement data can be current (sensor trace) or stored trace data. You can store data either in a file (reference trace) or in a temporary memory (hold trace). Up to four traces can be indicated at one time. On connection, the sensors are automatically detected and assigned to a trace. By default, connected sensors are assigned to the traces in ascending order, that means sensor 1 to trace 1, sensor 2 to trace 2, etc. If the default trace is already used, the sensor has to be assigned manually in the trace dialog.

Using the reference and hold traces, you can compare traces. Assign a reference curve to one trace and your measured values to a second one, and switch on the display. With this feature you can compare results directly in the graph, or show the deviations in a graph by using the " Mathematics - Trace Power Analysis " on page 228 function.

Example

The current single measurement of sensor 2 which is assigned to trace 2 is used as reference trace.

1. Select "Trace 2" with "Indication 2" = NRP-Zx.
2. Select "Save To Ref".
3. Select "Trace 1" and "Indication Ref.".
4. Select "Diagram".
   The R&S SMA100B indicates two identical traces.
5. Select "Start single".
   Triggers a new measurement cycle with sensor 2. You can compare the resulting measurement trace with the former measurement, which is displayed as reference trace.

Traces Settings

Indication - Power Analysis
Selects the source for the trace data.

The selection is indicated on the trace button in the measurement diagram.

"Off"	No source is selected, the trace is not indicated.
"2 - NRP-Zxx"	The current measurement results of the selected power sensor are the source for the trace data. The index at the beginning of the sensor name indicates the used connector, for example "2" indicates that the sensor is connected via a USB interface. The data is either continuously updated (continuous measurement) or represents a single measurement cycle (single measurement).
"Ref"	Selects the reference trace. The reference trace is a static trace that was stored in a file and can be recalled. It is possible to store one reference trace at a time.
"Hold"	Freezes the current trace data. The hold trace is a temporary trace that is available until the power analysis is finished. Freezing the trace of a sensor in one trace and displaying the measurement values of the same sensor in another trace allows fast comparison between measurements.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:STATe` on page 495
`:TRACe<ch>[:POWer]:SWEep:COPY` on page 490
`:TRACe<ch>[:POWer]:SWEep:FEED` on page 491

Color - Trace Power Analysis
Selects the color of the trace.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:COLor` on page 489

Save to Ref - Trace Power Analysis
Saves the selected trace as reference trace. Only one reference trace is available at a time.

Remote command:
:TRACe<ch>[:POWer]:SWEep:COLor on page 489

Define Reference - Trace Power Analysis
Opens a dialog for defining a linear reference curve.

Freq (X) / Pow (Y) ← Define Reference - Trace Power Analysis
For Configure Measurement > "Frequency", determines the parameters of the frequency reference curve.

Remote command:
:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:XVALues on page 466
:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:YVALues on page 466

Pow (X) / Pow (Y) ← Define Reference - Trace Power Analysis
For Configure Measurement > "Power", sets the x- and y-axis values of the points A and B.

Remote command:
:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:XVALues on page 479
:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:YVALues on page 479

Time (X) / Pow (Y) ← Define Reference - Trace Power Analysis
For Configure Measurement > "Time", sets the time values for the x-axis and the corresponding y-axis power values.

Remote command:
:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:XVALues on page 484
:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:YVALues on page 484

Save To Ref ← Define Reference - Trace Power Analysis
Saves the selected trace as reference trace. One reference trace is available at a time.

Remote command:
:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:COPY on page 465
:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:COPY on page 478
:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY on page 483

Mathematics - Trace Power Analysis
Activates the mathematic function.

The function enables you to determine the deviation of two test series, either of measurement traces, or also of traces that contain math results or stored reference curves. That means you can also assign a math result to an operand for further calculation. Various nested computation steps are possible.

The math operation follows the formula:

$T<ch>_{result} = T<ch>_{Operand1} - T<ch>_{Operand2}$

How to proceed:

Determine T<ch> $_{Operand1}$ in the entry field next to "Tx", and then select T<ch>$_{Operand2}$ in the second entry field right to it.

The result ("T<ch>$_{result}$") is assigned to the above selected "Trace". If switched on, the graph shows the resulting curve.

Note:

Depending on the type of trace, the instrument automatically sets the appropriate unit on the y-axis:
- "dBm" if it shows only measurement traces.
- "dB" for purely mathematical curves.
- "dB/dBm" ratio scale for mixed display, that means measurements and mathematical curves.

Example:

Example of a nested calculation.
- T1 shows the result of the subtraction of the trace ("Trace 1"), and the reference curve.
- Trace2 subtracts Ref from T1.
  That illustrates the nested calculation, since T1 covers already a math operation.
  Note: "(Ind.)" denotes the currently selected trace.

Remote command:
`:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:STATe` on page 449
`:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:SUBTract` on page 450
`:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:STATe` on page 450
`:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:SUBTract` on page 450
`:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:STATe` on page 453
`:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:SUBTract` on page 453

Markers Settings

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select power sensor indication located at the bottom of the dialog.

3. Select the "Markers" tab.

This dialog comprises the markers settings display on the respective trace diagram.

Marker x Visible - Power Analysis
Selects if the respective marker and the marker list are shown in the diagram.

Remote command:
n.a.

Trace - Power Analysis
Selects the trace to which the marker is assigned.

Remote command:
n.a.

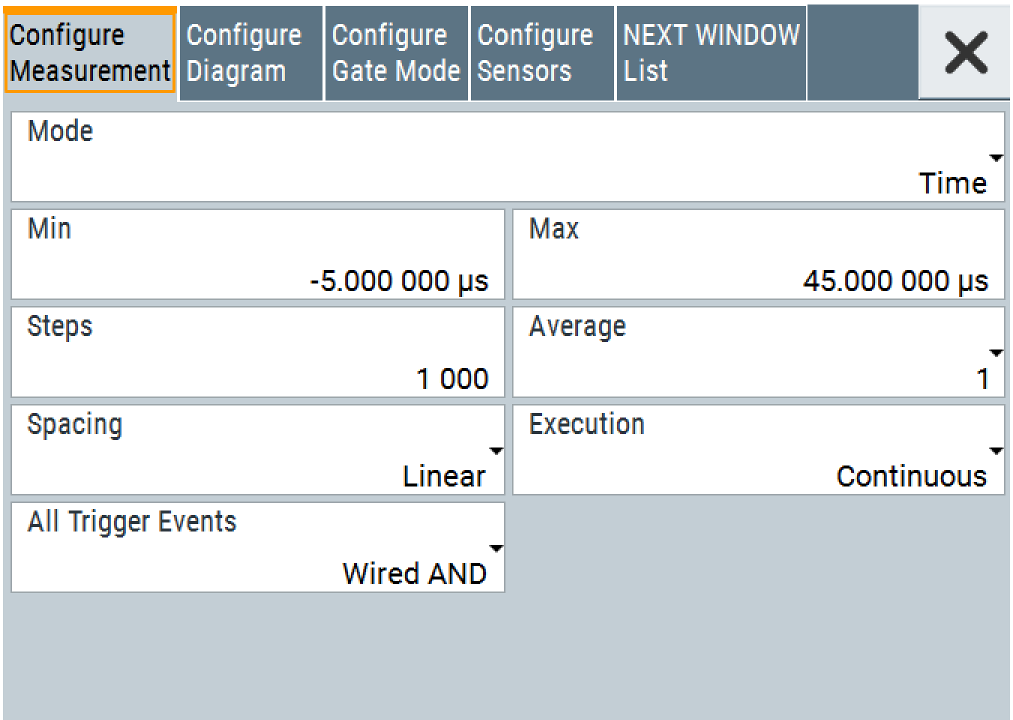
7.4.4.7 Configure Settings

The "Configure" dialog allows you to set measurement and sensor parameters.

Configure Measurement

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Measurement".



The measurement section provides the parameters for configuring the measurement either in frequency, power or time domain.

Mode - Power Analysis
Selects the measurement mode.

"Frequency" Power versus frequency measurement (frequency response).

"Power" Power versus power measurement (power sweep, AM/AM).

"Time" Power versus time measurement (envelope power measurement as a function of time, NRP trace mode). The R&S SMA100B samples power over a time interval and assigns the internal power values that have been determined to several points.
This mode also provides gated measurement and pulse data analysis, e.g. with a connected R&S NRP-Z81, and the corresponding graphical display "Gate View" and "Pulse Data View".

Remote command:
`:SENSe[:POWer]:SWEep:MODE` on page 478

Min - Power Analysis
Sets the minimum frequency/power/time of the measurement.

The available frequency/power range depends on the frequency/power range of the generator and the used power sensor.

The range for the start time is -1s to +1s. Value 0 defines the trigger point. By choosing a negative time value, the trace can be shifted in the diagram.

It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, the R&S SMA100B generates an error message.

If you change this value for a finished single measurement, only the scaling of the x-axis changes. This way, you can zoom the trace. However, for subsequent measurements, the measurement range is changed according to the new setting.

If you change this value during a continuous measurement, only the scaling of the x-axis changes for measurement cycles that have been triggered before the change. For subsequent measurement cycles, the measurement range changes according to the new setting.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:STARt` on page 467
`:SENSe[:POWer]:SWEep:POWer:STARt` on page 480
`:SENSe[:POWer]:SWEep:TIME:STARt` on page 485

Max - Power Analysis
Sets the maximum frequency/power/time of the measurement.

The available frequency/power range depends on the frequency/power range of the instrument and the used power sensor.

The range for the stop time is 0 s to 2 s. Value 0 defines the trigger point.

It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, an error message is output.

If you change this value for a finished single measurement, only the scaling of the x-axis changes. This way, you can zoom the trace. However, for subsequent measurements the measurement range is changed according to the new setting.

If you change this value during a continuous measurement, only the scaling of the x-axis changes for measurement cycles that have been triggered before the change. For subsequent measurement cycles, the measurement range changes according to the new setting.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:STOP` on page 468
`:SENSe[:POWer]:SWEep:POWer:STARt` on page 480
`:SENSe[:POWer]:SWEep:TIME:STOP` on page 485

Steps - Power Analysis
Sets the number of steps for the sweep. The number of measured points is steps + 1. The number of steps is one of the parameters that define the measurement speed. The higher the number of steps, the longer the measurement takes (frequency and power mode).

Remote command:
:SENSe[:POWer]:SWEep:FREQuency:STEPs on page 467
:SENSe[:POWer]:SWEep:POWer:STEPs on page 480
:SENSe[:POWer]:SWEep:TIME:STEPs on page 485

Timing - Power Analysis
Selects the timing mode.

This parameter is only available for Configure Measurement > "Frequency"/"Power".

"Fast" Fast measurement with an integration time of 2 ms for each measurement step.

"Normal" A longer but more precise measurement (integration time is 20 ms/step).

"High Precision" Responds with the highest possible accuracy, however, requires higher integration time for each step.

Remote command:
:SENSe[:POWer]:SWEep:FREQuency:TIMing[:MODE] on page 468
:SENSe[:POWer]:SWEep:POWer:TIMing[:MODE] on page 481

Average - Power Analysis
Selects the averaging factor.

The factor determines how many measurement cycles are used to form a measurement result. Higher averaging counts reduce noise but increase the measurement time. Averaging requires a stable trigger event so that the measurement cycles have the same timing. If factor 1 is selected, no averaging is performed.

This parameter is only available for Configure Measurement > "Time".

Remote command:
:SENSe[:POWer]:SWEep:TIME:AVERage[:COUNt] on page 483

Spacing - Power Analysis
Sets the mode for calculating the sweep steps.

In power versus frequency mode, selection between linear and logarithmic spacing is possible.

"Linear"
- Power versus frequency
  In a linear sweep, the frequency is swept in equidistant steps over the continuous frequency range. The x-axis is a linear frequency axis.
- Power versus power
  The sweeps are performed at constant frequency but with variable generator power that is swept in linear, equidistant steps over a continuous range. The x-axis is a dB-linear power axis.
- Power versus time
  The sweeps are performed at constant frequency and stimulus power. The measurement is repeated over a specified period of time at constant time intervals.

"Logarithmic" Power versus frequency
In a logarithmic sweep, the frequency is swept in equidistant steps on a logarithmic scale. The x-axis is a logarithmic frequency axis.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:SPACing[:MODE]` on page 467
`:SENSe[:POWer]:SWEep:POWer:SPACing[:MODE]` on page 480
`:SENSe[:POWer]:SWEep:TIME:SPACing[:MODE]` on page 485

Execution - Power Analysis
Selects single or continuous mode in power analysis.

The measurement is started in the diagram using the "Start" button. During measurement, the "Start" button is replaced by a "Stop" button which can be used to abort the measurement. The progress bar indicates the status of the measurement.

"Single" Selects single measurement.

"Cont." Selects continuous measurements.

Remote command:
`:SENSe[:POWer]:SWEep:RMODe` on page 483
`:SENSe[:POWer]:SWEep:POWer:RMODe` on page 479
`:SENSe[:POWer]:SWEep:FREQuency:RMODe` on page 466
`:SENSe[:POWer]:SWEep:TIME:RMODe` on page 484

All Trigger Events - Power Analysis
Determines, whether the measurement data processing starts with a trigger event in one of the sensors (Logical OR), or whether all channels have to be triggered (logical AND). Each sensor evaluates a trigger event according to its setting independently.

This function supports the internal or external trigger modes with multi-channel time measurements.

"Wired AND" the measurement starts when all channels are triggered.

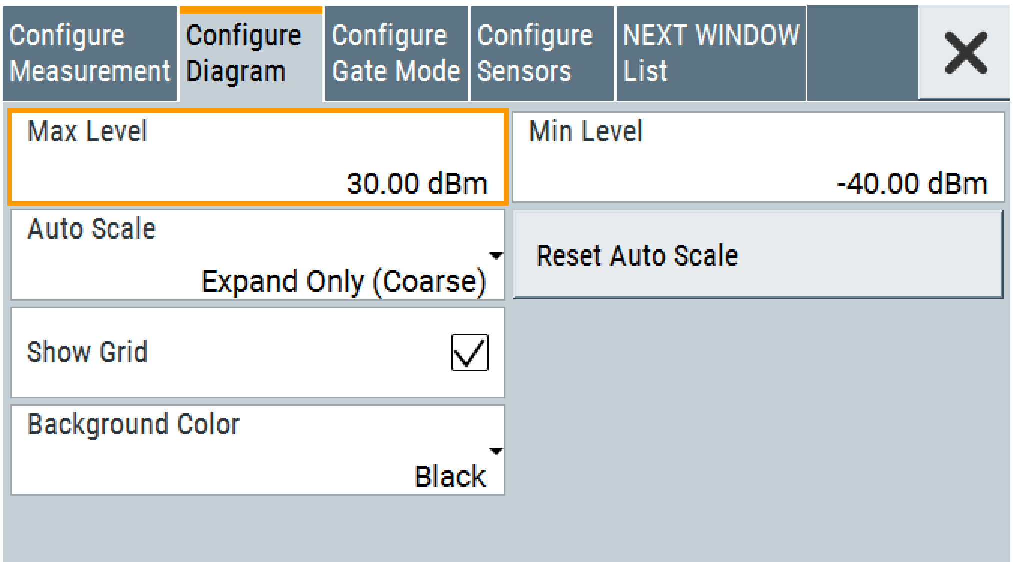
"Wired OR" The measurement starts when a trigger event occurs.

Remote command:
`:SENSe[:POWer]:SWEep:TIME:TEVents` on page 486

Configure Diagram

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Diagram"



The "Configure Diagram" covers the parameters for scaling the y-axis and the appearance of the diagram.

Min - Max Level - Power Analysis

Selects the minimum and maximum value of the y-axis.

Remote command:
:SENSe[:POWer]:SWEep:FREQuency:YSCale:MAXimum on page 469
:SENSe[:POWer]:SWEep:FREQuency:YSCale:MINimum on page 469
:SENSe[:POWer]:SWEep:POWer:YSCale:MAXimum on page 482
:SENSe[:POWer]:SWEep:POWer:YSCale:MINimum on page 482
:SENSe[:POWer]:SWEep:TIME:YSCale:MAXimum on page 487
:SENSe[:POWer]:SWEep:TIME:YSCale:MINimum on page 487

Auto Scale - Power Analysis

Activates autoscaling of the y-axis of the diagram. The "Auto Scale" function adjusts the scale divisions so that the entire trace fits into the diagram area.

"Off" Auto scale is deactivated. Switching from activated to deactivated, the scaling is maintained.

"Expand Only (Course/Fine)"
Auto scale is activated. Automatically selects the appropriate scaling of the y-axis so that the trace is always visible. The range is expanded when a value is out of the right or the left end-of-scale value. The step width is 5 dB for selection "Exp. (Coarse)" and variable in the range of 0.2 db to 5 dB for selection "Exp. (Fine)".

"Float (Coarse/Fine)"
Auto scale is activated, that means this parameter automatically selects the appropriate scaling of the y-axis so that the trace is always visible. The range is either expanded, when a value is out of the right/left end-of-scale value or it is reduced when the trace fits into a smaller scale area. The step width is 5 dB for selection "Flt. (Coarse)" and variable in the range of 0.2 db to 5 dB for selection "Flt. (Fine)".

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO` on page 468
`:SENSe[:POWer]:SWEep:POWer:YSCale:AUTO` on page 481
`:SENSe[:POWer]:SWEep:TIME:YSCale:AUTO` on page 486

Reset Auto Scale - Power Analysis
Resets the scaling of the y-axis to suitable values after the use of auto scaling in the expanding mode. For this mode, the Y scale can get too expanded because of temporary high-power values. The reset function resets the diagram again, to indicate smaller power values.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO:RESet` on page 469
`:SENSe[:POWer]:SWEep:POWer:YSCale:AUTO:RESet` on page 482
`:SENSe[:POWer]:SWEep:TIME:YSCale:AUTO:RESet` on page 487

Show Grid - Power Analysis
Activates the indication of a grid in the diagram area.

Remote command:
`:DISPlay[:WINDow][:POWer]:SWEep:GRID:STATe` on page 454

Background Color - Power Analysis
Sets the background color of the diagram to black or white. The background color is also effective for the hardcopy of the diagram.

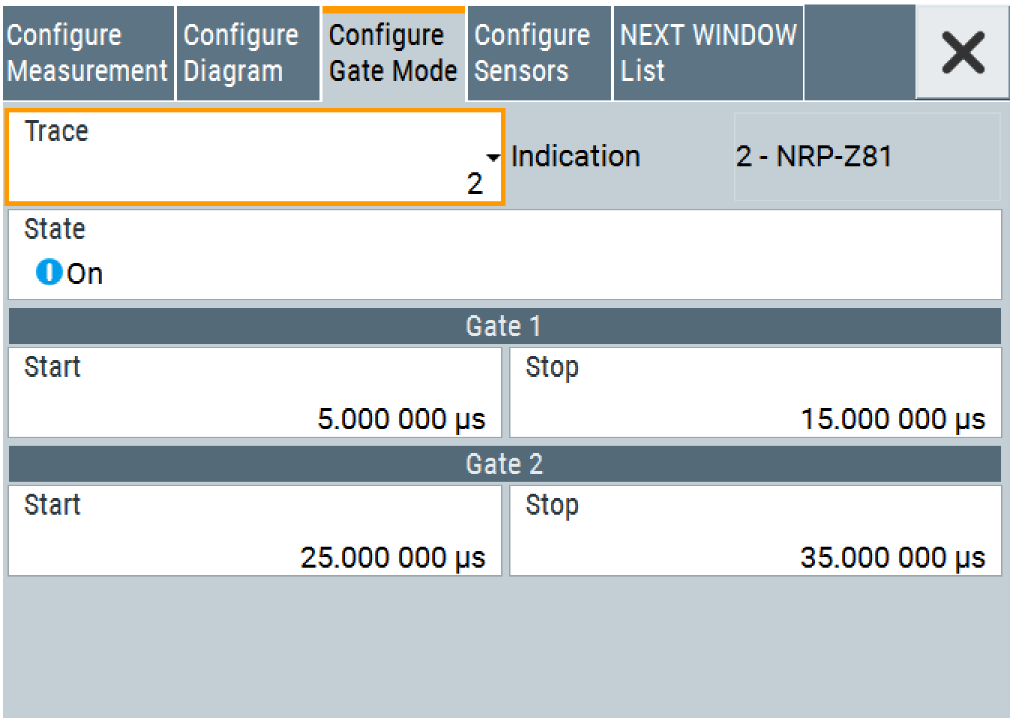
Remote command:
`:DISPlay[:WINDow][:POWer]:SWEep:BACKground:COLor` on page 453

Configure Gate Mode

For "Time" measurement mode only.

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Gate Mode"



Almost all R&S NRP sensors also support time gated measurements of peak and average power (see the data sheet or operating manual of the respective sensor). Two user-configurable gates can be assigned to one of the traces. Both gates are active at the same time. The values are calculated from the trace data, the time resolution is determined by the resolution of the sensor. An external trigger signal or signal triggering is required for synchronization.

The start and stop time of the gates are indicated as gate markers, a bar between the start and stop marker shows the gate length. The indication state of the gate borders and measurement values is only available for certain diagram views which are switched with the "Next Window List" key. The "Next Window List" dialog provides a selection of views, between which is toggled (see "Next Window List" on page 250).

Trace - Gate
Selects the trace to which the gates are assigned. The sensor assignment to the respective trace is performed in the measurement diagram (trace buttons). The two gates are assigned to the same trace.

Remote command:
`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:FEED` on page 451

Indication
Indicates the type of power sensor assigned to the selected trace. This field is automatically updated if the sensor is connected or disconnected. Also, this sensor is indicated on the trace button in the measurement diagram.

This parameter is only available for Configure Measurement > "Time".

Remote command:
n.a.

State - Gate
Enables time gated measurement. The measurement is started with the "Start" button in the main measurement diagram. Both gates are active at one time.

The gate borders and the measurement values (average and peak power) are indicated in/below the measurement diagram. The indication is only available for certain diagram views which are switched with the "Rearrange" key.

Remote command:
`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STATe` on page 452
`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:AVERage?` on page 451
`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:MAXimum?` on page 451
`:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe]` on page 496

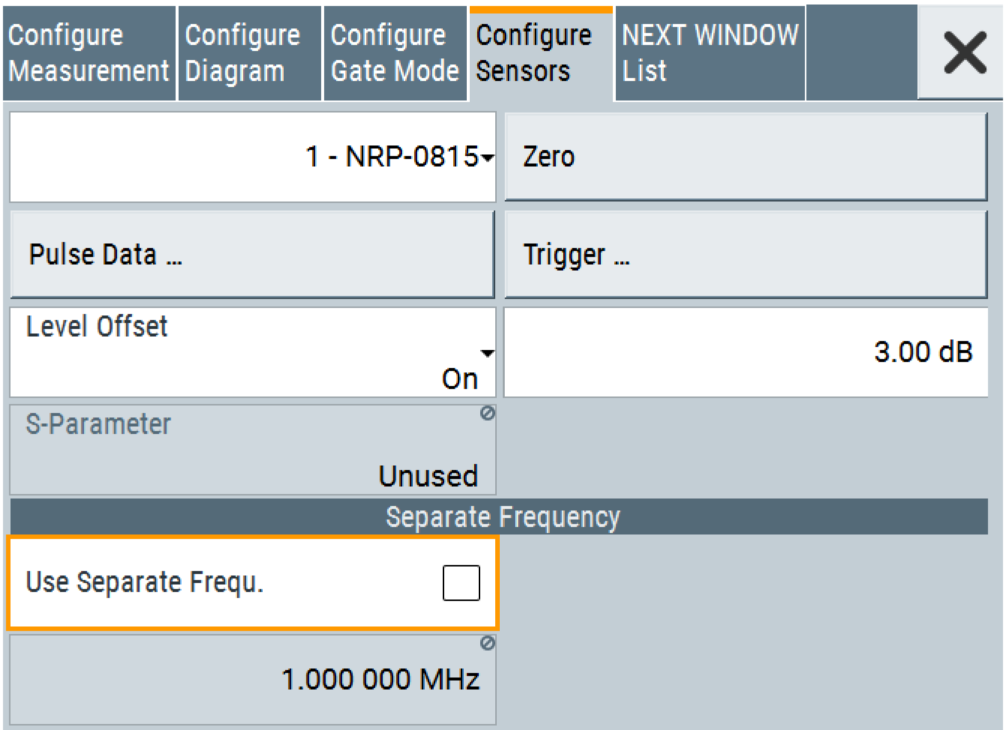
Start / Stop - Gate
Sets the start and the stop times for the respective gate.

Remote command:
`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STARt` on page 452
`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STOP` on page 452

Configure Sensors

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Sensors"



The "Configure Sensors" dialog provides specific parameters for the power sensor. This part of the dialog can differ from the following description depending on the sensor used. Refer to the manual of the power sensor in this case.

The "Pulse Data..." button is displayed only for measurement mode time and if an R&S NRP-Z81 power sensor is connected.

Power Sensor - Power Analysis
Selects the power sensor to be set if more than one sensor is connected to the instrument.

Remote command:
n.a.
In remote control, the sensor is selected via the numeric suffix in the sense key word of the command, for example `SENSe2:POWer:SWEep:...`.

Zero - Power Analysis
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).

Pulse Data
Opens the dialog for configuring the settings for pulse data analysis.

See "Configure Trace Pulse Data" on page 242.

Trigger..
Opens the dialog for configuring the trigger settings.

See "Configure Trigger" on page 248

Level Offset State- Power Analysis
Activates a level offset at the sensor input. Set the appropriate value in the entry field on the right.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet:STATe`
on page 457
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet:STATe` on page 461
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet:STATe` on page 461

Level Offset - Power Analysis
Sets the level offset at the sensor input. To consider the value, activate the offset.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet` on page 457
`:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet` on page 459
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet` on page 460

Use S-Parameter - Power Analysis
Activates the use of the S-parameters correction data of the connected power sensor. For sensors with attenuator, this checkbox is automatically checked.

Refer also to the manual of the connected R&S power sensor for a description on how to use the S-parameters table.

Use Separate Frequency- Power Analysis
This setting is offered for measurements with DUTs that change the measurement frequency (like modulators), thus changing the input frequency of the sensor.

The dialog differs depending on the measurement modes:

- Power versus frequency measurement
  Activates the use of a different frequency range other than the set signal generator frequency range for the measurement. The separate minimum and maximum frequency values are set below.
  The x-scale of the diagram can be adjusted to the separate frequency range with functions "Use as X Scale" and "Map to X Scale".
- Power versus power measurement / Power versus time measurement
  Activates the use of a different frequency other than the set signal generator frequency for the measurement. The separate frequency value is set in the entry window below.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge[:STATe]`
on page 458
`:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency:STATe`
on page 460
`:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency` on page 460
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency:STATe`
on page 463
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency` on page 463

Min Frequency - Power Analysis
This parameter is only available for Configure Measurement > "Frequency" and Use Separate Frequency- Power Analysis > "Active".

Sets the minimum frequency of the measurement.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt`
on page 458

Max Frequency - Power Analysis

This parameter is only available for Configure Measurement > "Frequency" and Use Separate Frequency- Power Analysis > "Active".

Sets the maximum frequency of the measurement.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP`
on page 458

Use as X Scale - Power Analysis

This parameter is only available for Configure Measurement > "Frequency" and Use Separate Frequency- Power Analysis > "Active".

Activates the use of the separate frequency min and max values for the scaling of the x-axis. Thus, the trace for this sensor is visible in the diagram , especially for frequency ranges that differ substantially from the generator settings.

If more than one sensor is active, which use separate frequencies, the option is only available for one sensor. To indicate the traces of the other sensors, use function "Map to X Scale".

Remote command:
n.a.

Map to X Scale - Power Analysis

This parameter is only available for Configure Measurement > "Frequency" and Use Separate Frequency- Power Analysis > "Active".

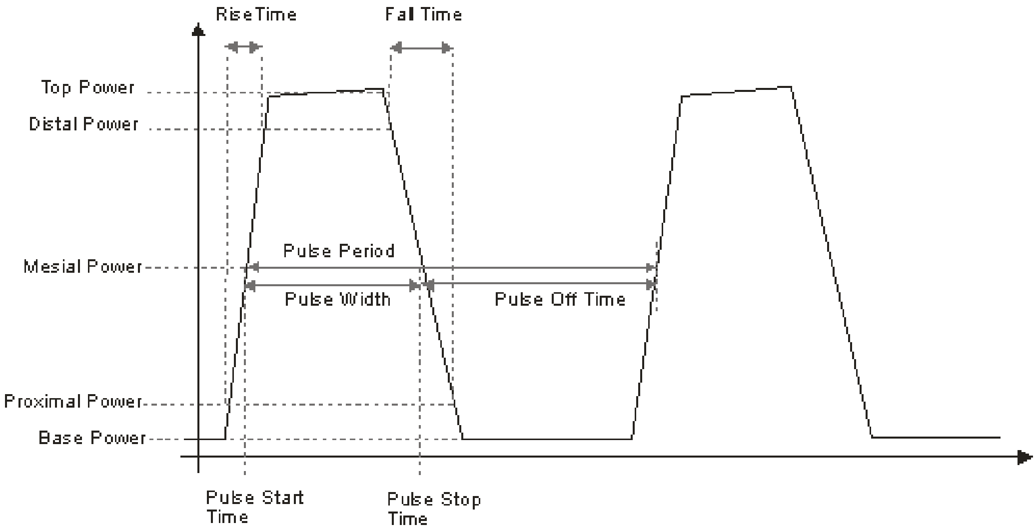
Maps the trace of a sensor that uses separate frequency to the current scaling of the diagram. Usually the scale is determined by the set frequency range of the generator. If more than one sensor is active, which use separate frequencies, the scale can also be determined by the separate frequency range of one of the other sensors.

Remote command:
n.a.

Configure Pulse Data

For R&S NRP-Z power sensors that support time domain analysis and automatic pulse analysis.

The power sensors enable pulse data analysis in measurement mode time. All important pulse parameters are measured after setting the threshold levels. The following graph shows most of these parameters:



The sensor calculates the pulse parameters from each measurement and delivers the results to the R&S SMA100B.

The indication state of the parameters also affects the save function. Storing the measurement diagram as hardcopy includes the parameters selected in this dialog.

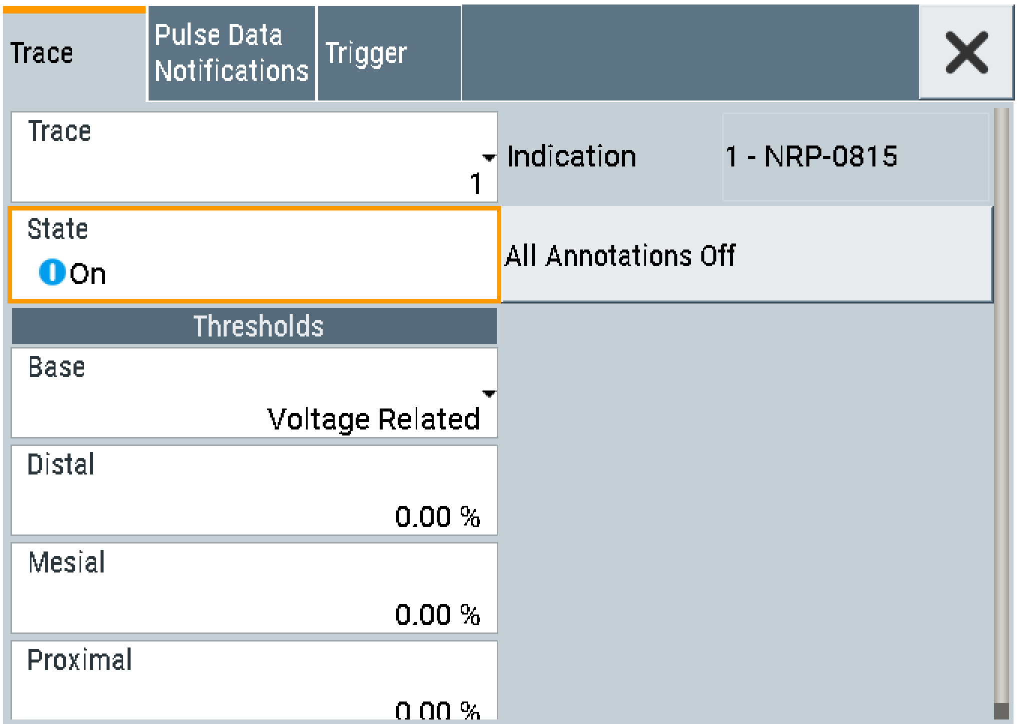
A total of 6 parameters can be indicated at one time. Structured hierarchically, trace 1 features top priority and trace 4 is addressed with the lowest weighting. This means that only the first 6 checked parameters are indicated, starting with the settings of trace 1.

The pulse data is only visible for certain zoom levels of the diagram.

Configure Trace Pulse Data

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. In the diagram window, open the context-sensitive menu.
3. Select "Trace/Pulse Data Notifications/ Trigger".
4. Select the "Trace" tab.



State - Pulse Data Analysis

Enables pulse data analysis. The measurement is started with the "Start Cont." button in the main measurement diagram.

Remote command:

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:STATe on page 461

Base - Pulse Data Analysis

Selects how the threshold parameters are calculated, either voltage related or power related. The voltage-related parameters represent the normal case, as the usual representation when defining the pulse parameters (rise/fall time, pulse width) is U(t). To achieve a display with equivalent power-related values, the voltage-related threshold values must be converted (squared) (see example in table below).

	Distal	Mesial	Proximal
Voltage related:	90%	50%	10%
Power related:	81%	25%	1 %
log. Scale (for example): (approximately, difference between top- base power > 30 dB)	-0.9dB	-6dB	-20dB

Remote command:

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:BASE on page 461

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:BASE? on page 494

Distal - Pulse Data Analysis
Sets the upper reference level in terms of percentage of the overall pulse level (power or voltage related). The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:HREFerence` on page 462
`:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:HREFerence` on page 494

Mesial - Pulse Data Analysis
Sets the medial reference level in terms of percentage of the overall pulse level (power or voltage related). This level is used to define the pulse width (τ) and pulse period.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:REFerence` on page 462
`:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:REFerence` on page 495

Proximal - Pulse Data Analysis
Sets the lower reference level in terms of percentage of the overall pulse level (power or voltage related).

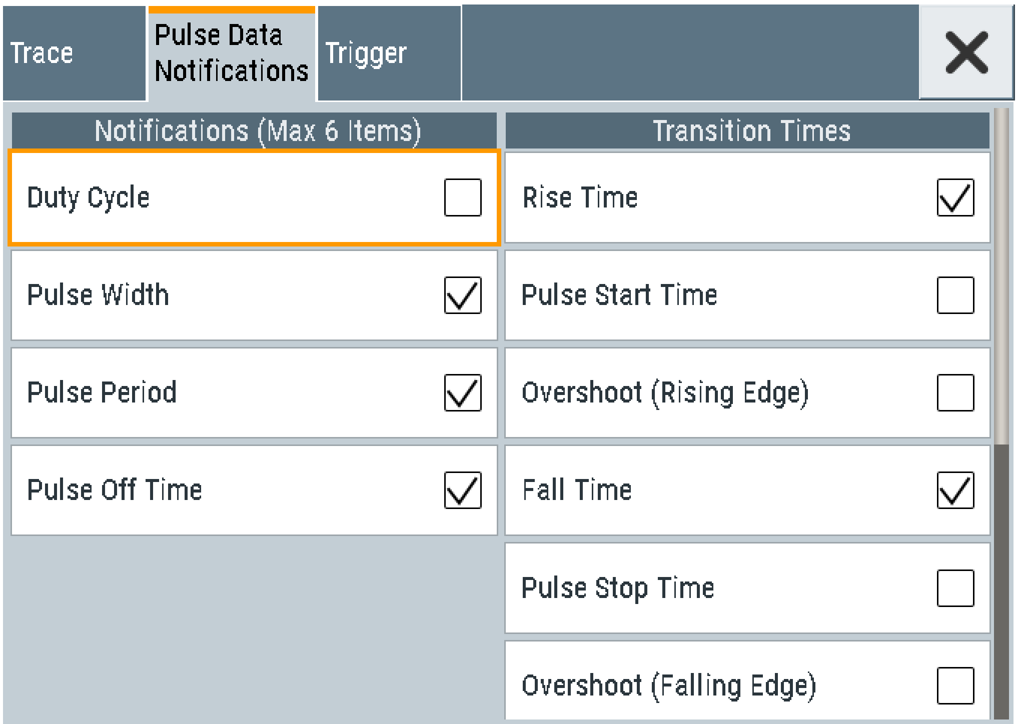
The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:LREFerence` on page 462
`:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:LREFerence` on page 495

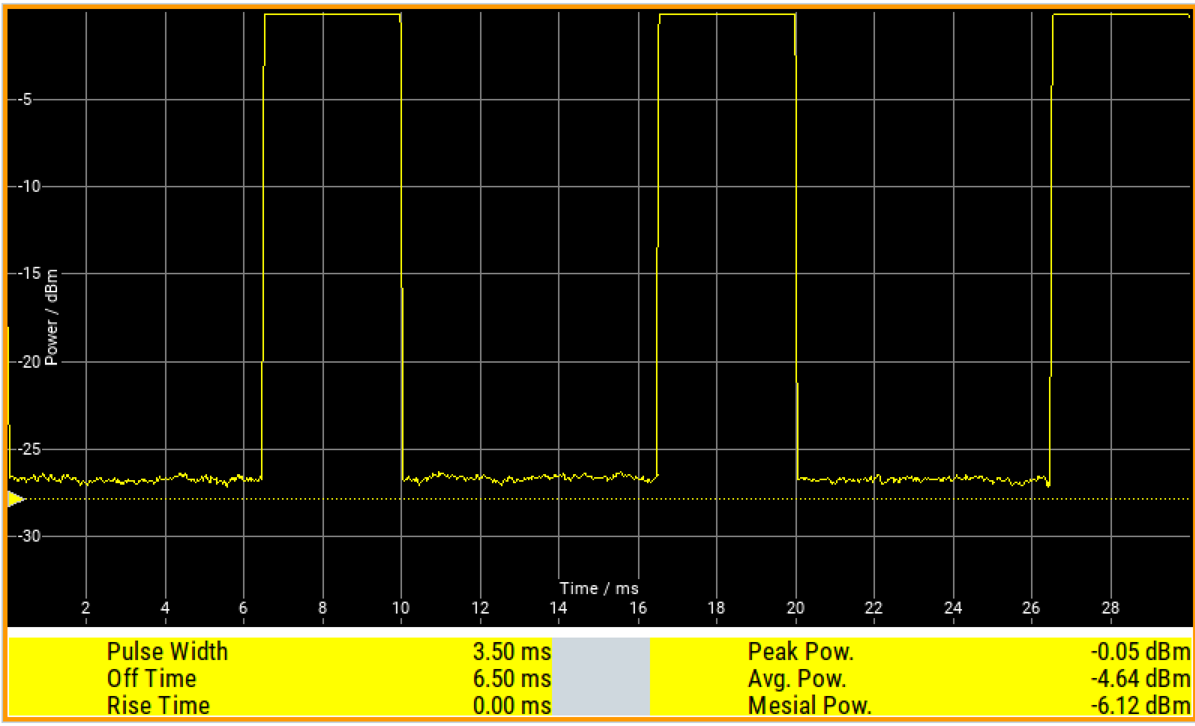
Configure Pulse Data Notifications

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. In the diagram window, open the context-sensitive menu.
3. Select "Trace/Pulse Data Notifications/ Trigger".
4. Select the "Pulse Data Notifications" tab.



Notifications - Pulse Data Analysis
Selects the pulse parameters to be indicated below the measurement diagram.



Duty Cycle ← Notifications - Pulse Data Analysis
Indicates the ratio between the pulse duration (τ) and the pulse period (T) of the measured pulse signal in per cent:

Duty Cycle = (pulse duration / pulse period) * 100

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle? on page 492
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:ANNotation[:STATe] on page 493

Pulse Width ← Notifications - Pulse Data Analysis
Indicates the pulse duration of the pulse data measurement in seconds.

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation? on page 492
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation:DISPlay:ANNotation[:STATe] on page 493

Pulse Period ← Notifications - Pulse Data Analysis
Indicates the time the pulse signal needs to complete one cycle.

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod? on page 492
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:ANNotation[:STATe] on page 493

Pulse Off Time ← Notifications - Pulse Data Analysis
Determines the time the pulse signal is low, that means as long as the signal level is below the proximal value.

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation? on page 492
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:ANNotation[:STATe] on page 493

Transition Times - Pulse Data Analysis
Selects the transition parameters of the pulse signal to be indicated below the measurement diagram.

The R&S NRP-Z sensor searches for the first rising edge and the first falling edge in the trace.

Rise Time / Fall Time ← Transition Times - Pulse Data Analysis
Displays the time the signal requires from crossing low reference until it reaches high reference level and vice versa.

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation? on page 492
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation:DISPlay:ANNotation[:STATe] on page 493
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation? on page 492
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation:DISPlay:ANNotation[:STATe] on page 493

Pulse Start Time / Pulse Stop Time ← Transition Times - Pulse Data Analysis
Displays the time when the pulse signal crosses the medial reference level.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence:DISPlay:ANNotation[:STATe]` on page 493
`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence:DISPlay:ANNotation[:STATe]` on page 493

Overshoot (Rising Edge / Falling Edge) ← Transition Times - Pulse Data Analysis
Display the maximum value of the pulse signal following a rising transition and the minimum value of the signal after a falling transition, respectively.

Overshoot values are given in per cent of the pulse amplitude as shown below:
- Overshoot(pos) = 100* (maximum - top level) / (top level - base level)
- Overshoot(neg) = 100* (base level - minimum) / (top level - base level)

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot:DISPlay:ANNotation[:STATe]` on page 493
`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot:DISPlay:ANNotation[:STATe]` on page 493

Signal Power - Pulse Data Analysis
Selects the power parameters of the pulse signal to be indicated below the measurement diagram.

Minimal / Peak / Average Power ← Signal Power - Pulse Data Analysis
Display the minimum, the maximum and the average power of the pulse signal in dBm.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum:DISPlay:ANNotation[:STATe]` on page 493
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum:DISPlay:ANNotation[:STATe]` on page 493
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage:DISPlay:ANNotation[:STATe]` on page 493

Pulse Power - Pulse Data Analysis
Selects which pulse power parameters are indicated in the diagram (pulse data view only).

Top / Base Power ← Pulse Power - Pulse Data Analysis
Indicate the pulse top and base level of the analyzed signal in dBm.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE:DISPlay:ANNotation[:STATe]` on page 493
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:ANNotation[:STATe]` on page 493

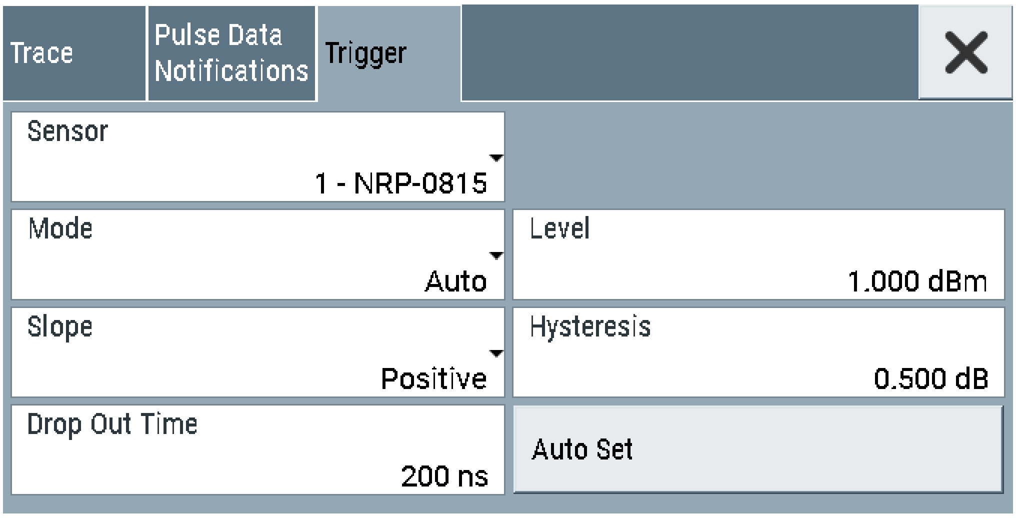
Distal / Mesial / Proximal Power ← Pulse Power - Pulse Data Analysis
Display the absolute power values of the medial, low and high reference level in dBm.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence:DISPlay:ANNotation[:STATe]` on page 493
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence:DISPlay:ANNotation[:STATe]` on page 493
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence?` on page 492
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence:DISPlay:ANNotation[:STATe]` on page 493

Configure Trigger

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Measurement".
3. Set "Mode" > "Time".
4. Select "Configure Sensors" > "Trigger..."



Power Sensor - Power Analysis
Selects the power sensor to be set if more than one sensor is connected to the instrument.

Remote command:
n.a.
In remote control the sensor is selected via the numeric suffix in the sense key word of the command, for example `SENSe2:POWer:SWEep:`....

Mode - Power Analysis
Selects if the measurement is free running, or starts only after an internal or external trigger event.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SOURce` on page 465

Level - Power Analysis
Sets the trigger threshold. This setting is also possible by the trigger marker on the left side of the diagram.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:LEVel` on page 464

Slope - Power Analysis
Sets the polarity of the active slope of the trigger signals.

"Positive"	The rising edge of a trigger signal is active.
"Negative"	The falling edge of a trigger signal is active.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SLOPe` on page 464

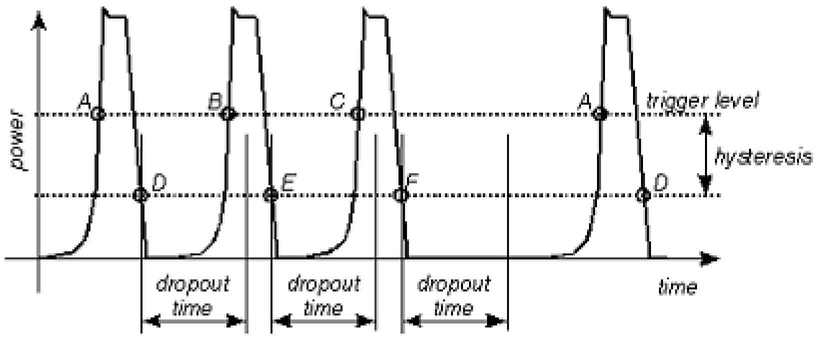
Hysteresis - Power Analysis
Sets the hysteresis of the internal trigger threshold. Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:HYSTeresis`
on page 464

Drop out Time - Power Analysis

Determines the minimum time for which the signal must be below (above) the power level defined by Level - Power Analysis and Hysteresis - Power Analysis before triggering can occur again. This prevents the trigger system from being activated too early if the trigger threshold is briefly underranged or exceeded.

The dropout time parameter is useful when dealing with, for example, GSM signals with several active slots. When performing a measurement in sync with the signal, a trigger event is to be produced at A, but not at B or C. As the RF power between the slots is below the threshold defined by Level - Power Analysis and Hysteresis - Power Analysis , the trigger hysteresis alone cannot prevent triggering at B or at C. This is why the dropout time parameter is selected to be greater than the time elapsed between points E and B and between F and C, but less than the time elapsed between G and A. This ensures that triggering takes place at A.



As the mechanism associated with the dropout time parameter is reactivated whenever the trigger threshold is crossed, unambiguous triggering can also be obtained for many complex signals. By contrast, all triggering is suppressed during the hold-off time. For the example described, this would mean that although stable triggering conditions could be obtained with a suitable hold-off time (regular triggering at the same point), it would not be possible to set exclusive triggering at A.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:DTIMe` on page 464

Auto Set - Power Analysis

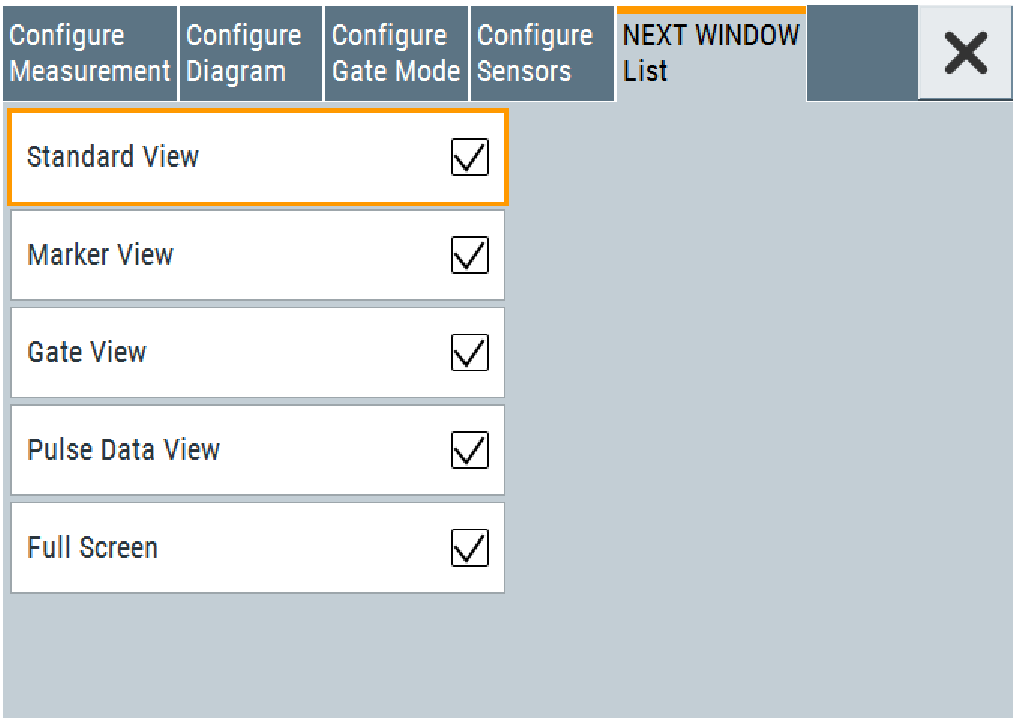
Sets the trigger level, the hysteresis and the drop out time to default values.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:AUTO` on page 463

Next Window List

Access:

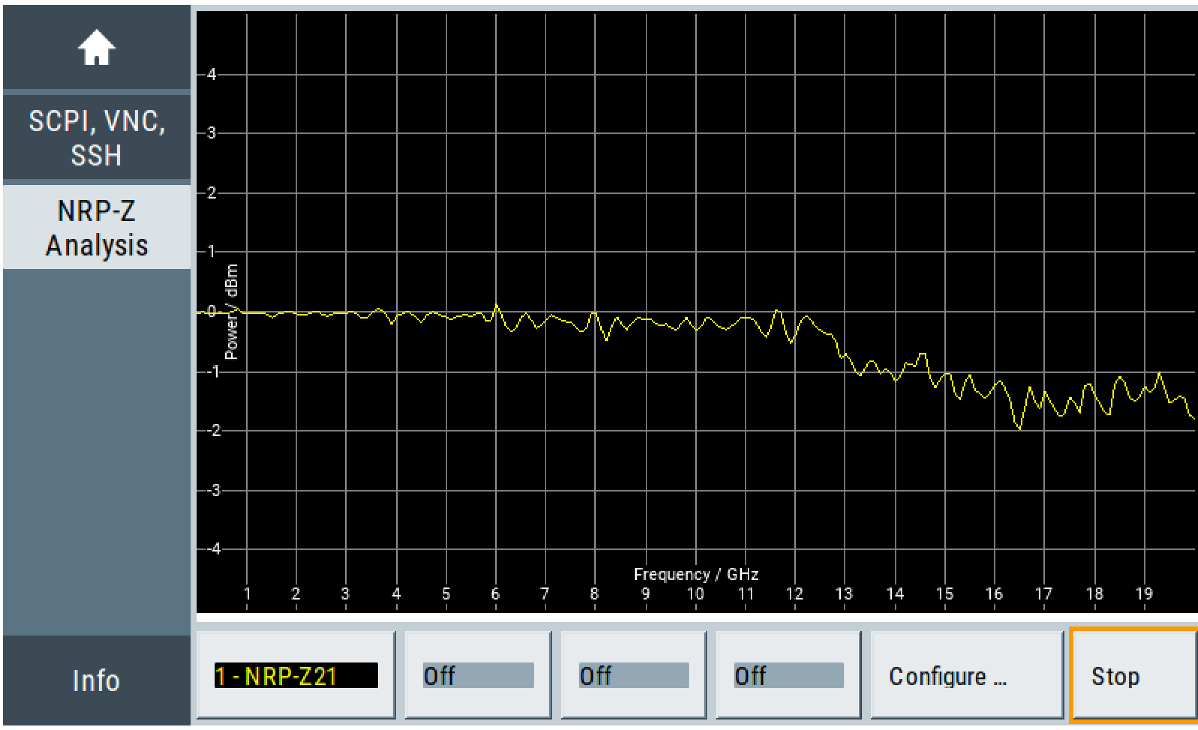
1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Next Window List"



The "Next Window List" dialog provides functions to activate only the required "Views" on the checkboxes to the right.

Standard View

Shows the graph and the button bar at the left for frequency power and level sweep measurement.



Remote command:
:TRACe[:POWer]:SWEep:MEASurement:STANdard:DISPlay:ANNotation[:STATe] on page 497

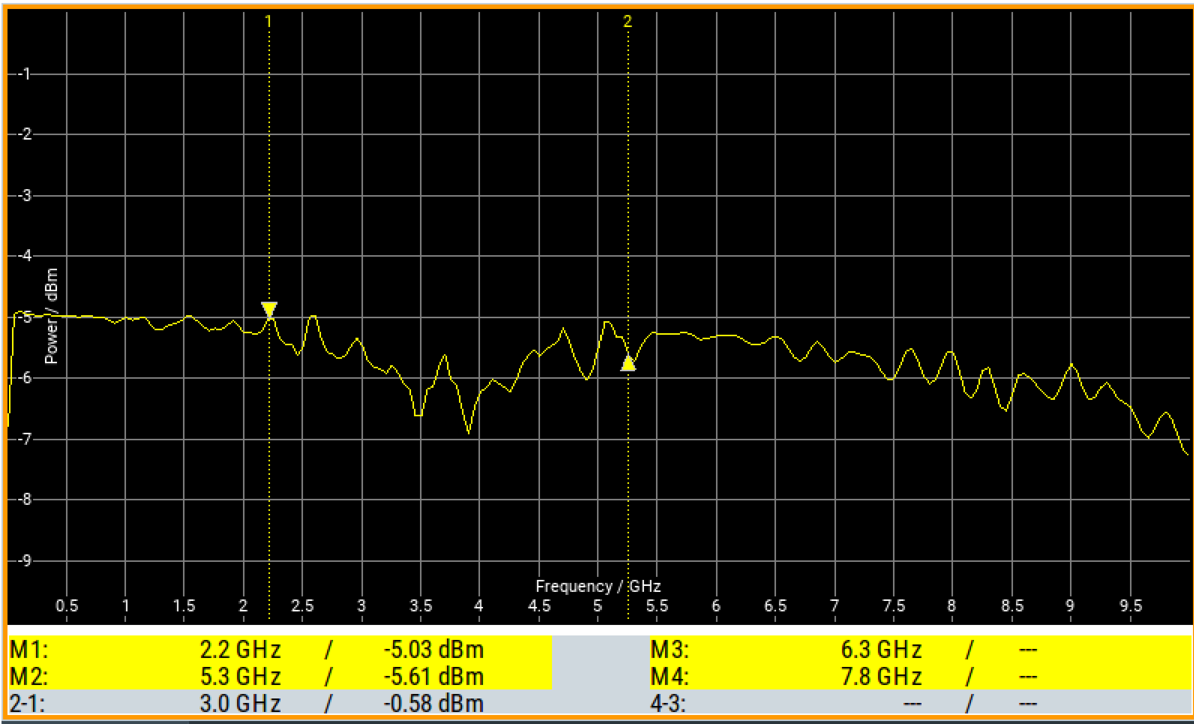
Marker View

Shows the graph and the corresponding marker values at the bottom for frequency power and level sweep measurement.

Up to four markers can be used to display the current power according to the position of the marker. The value(s) are displayed at the bottom of the window below the graph.

To move the marker lines you can select them and drag them with your finger. Alternatively you can move them with the rotary knob.

For details on configuring the markers, see "Markers Settings" on page 229.



Remote command:
:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe] on page 497

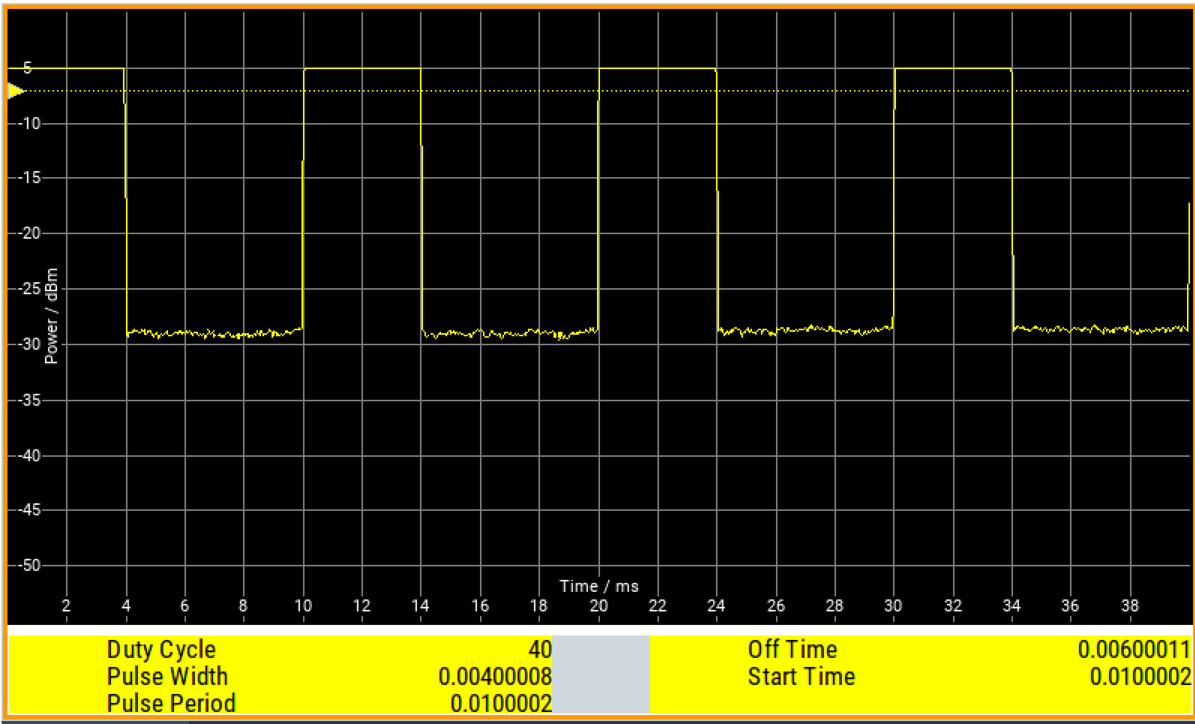
Gate View

Shows the graph with the corresponding gate data for time trace and pulse data measurements.

Remote command:
:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] on page 496

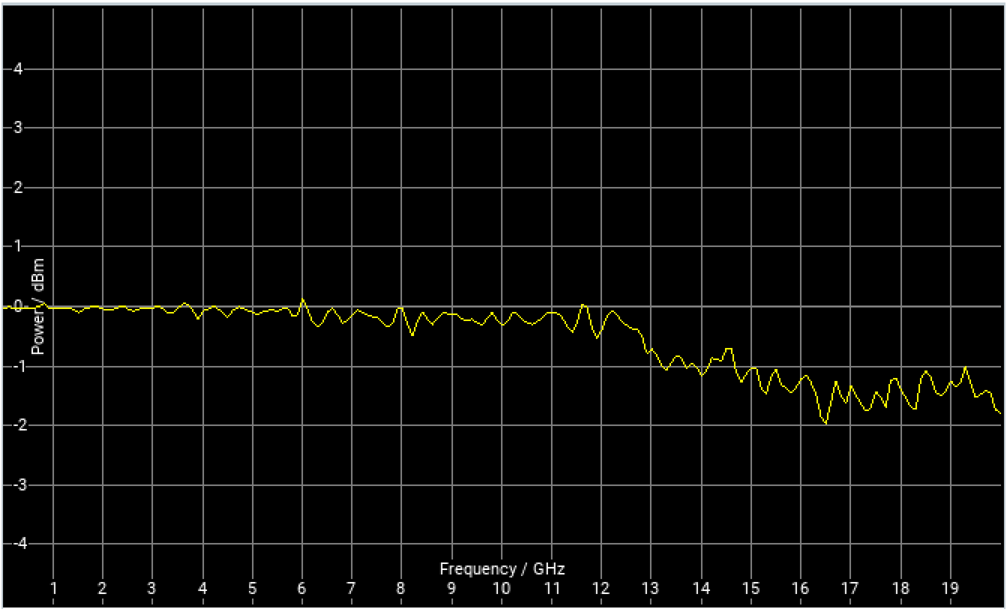
Pulse Data View

Shows the graph and the corresponding pulse data for time trace and pulse data measurements.



Remote command:
:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe] on page 497

Full Screen
Shows the graph in fullscreen, and fades out buttons and list values for frequency power and level sweep measurement.



Remote command:
`:TRACe[:POWer]:SWEep:MEASurement:FULLscreen:DISPlay:ANNotation[:STATe]` on page 496

7.4.4.8 Creating Screenshots of Power Analysis Settings

The power analysis save function enables you to save current settings in a file. To document the most important settings for a performed signal generation, you can also save a hardcopy of the current display.

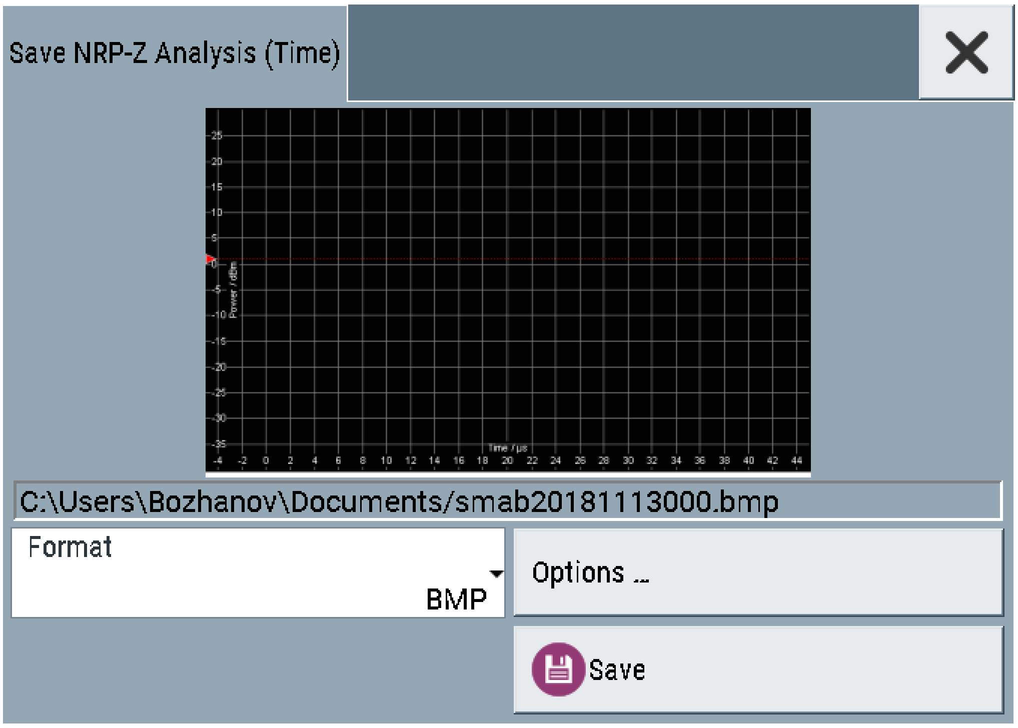
Save (Power Analysis) Settings

In the "Save …" dialog you can find the settings to store a screenshot of the current measurement diagram. The current screen shot is stored as indicated, that means with or without marker indication.

Main Settings

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. In the diagram window, open the context-sensitive menu.
3. In the menu, select "Save... (Power Analysis)".



File name - Power Analysis
Indicates the file name and directory.

Remote command:
:SENSe[:POWer]:SWEep:HCOPy[:EXECute] on page 478
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME] on page 473
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe on page 475
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE? on page 474

Format - Power Analysis
Selects the file format.

Several bitmap graphic formats are offered. In addition, format *.csv is available which stores the measurement values as ASCII data.

You can refine the csv settings further, see "CSV Options" on page 257.

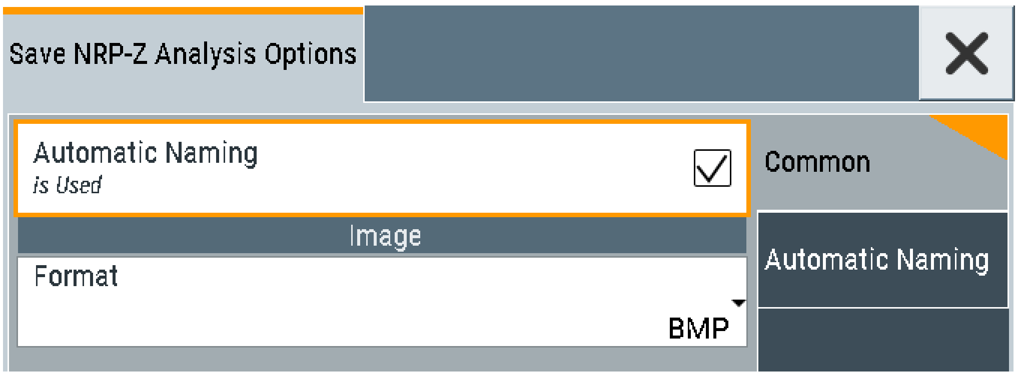
Remote command:
:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage on page 471

Options
Opens a dialog to select the screenshot format and also to activate and select the automatic naming settings.

Common Settings

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. In the diagram window, open the context-sensitive menu.
3. In the menu, select "Save... (Power Analysis)".
4. Select "Options".



Automatic Naming
If enabled, the file names are created by selected rules. The filename includes at least one number and optionally additional information.

Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe on page 475

Format - Power Analysis
Selects the file format.

Several bitmap graphic formats are offered. In addition, format `*.csv` is available which stores the measurement values as ASCII data.

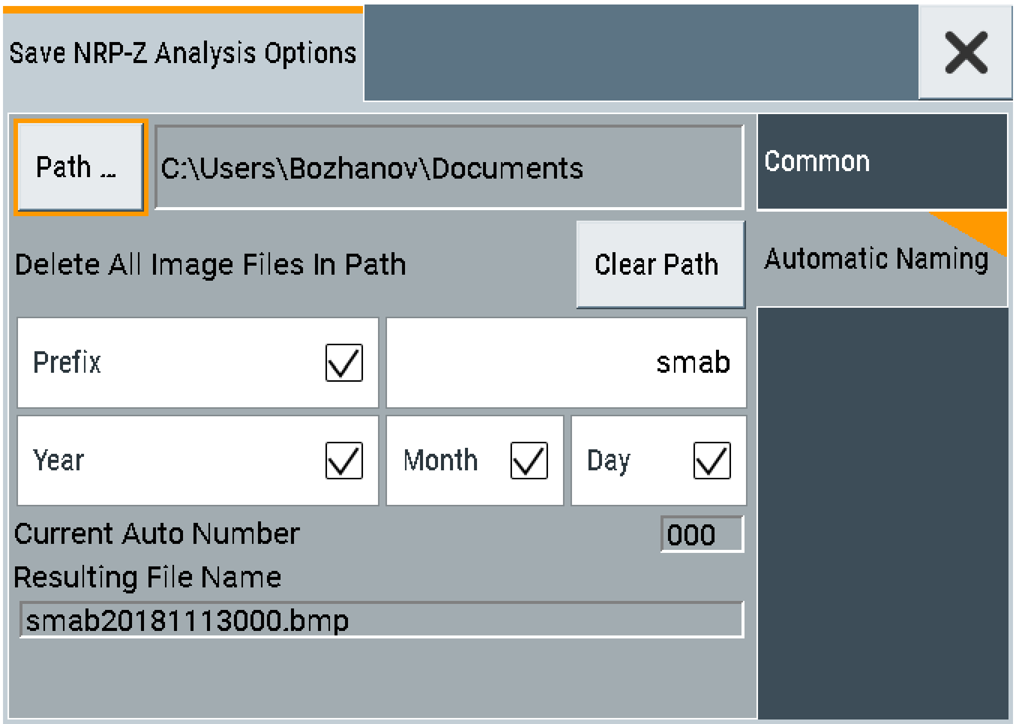
You can refine the csv settings further, see "CSV Options" on page 257.

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage` on page 471

Automatic Naming Settings

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. In the diagram window, open the context-sensitive menu.
3. In the menu, select "Save... (Power Analysis)".
4. Select "Options".
5. In the "Save NRP-Z Analysis Options" dialog, enable "Automatic Naming."



Path
Sets the directory for saving the files.

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory` on page 474

Clear Parth
Deletes all image files with extensions "bmp", "img", "png", "xpm" and "csv" in the directory set for automatic naming.

Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar
on page 474

Prefix, Year, Month, Day, Instrument Name
A selection of the prefix, year, month, day and instrument name are included in the file name.

Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe
on page 477
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix
on page 477
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe
on page 475
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?
on page 475
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe
on page 476
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?
on page 476
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe
on page 477
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?
on page 477

Current Auto Number
Indicates the number which is used in the automatically generated file name.

Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?
on page 476

Resulting File Name
Indicates the automatically generated file name.

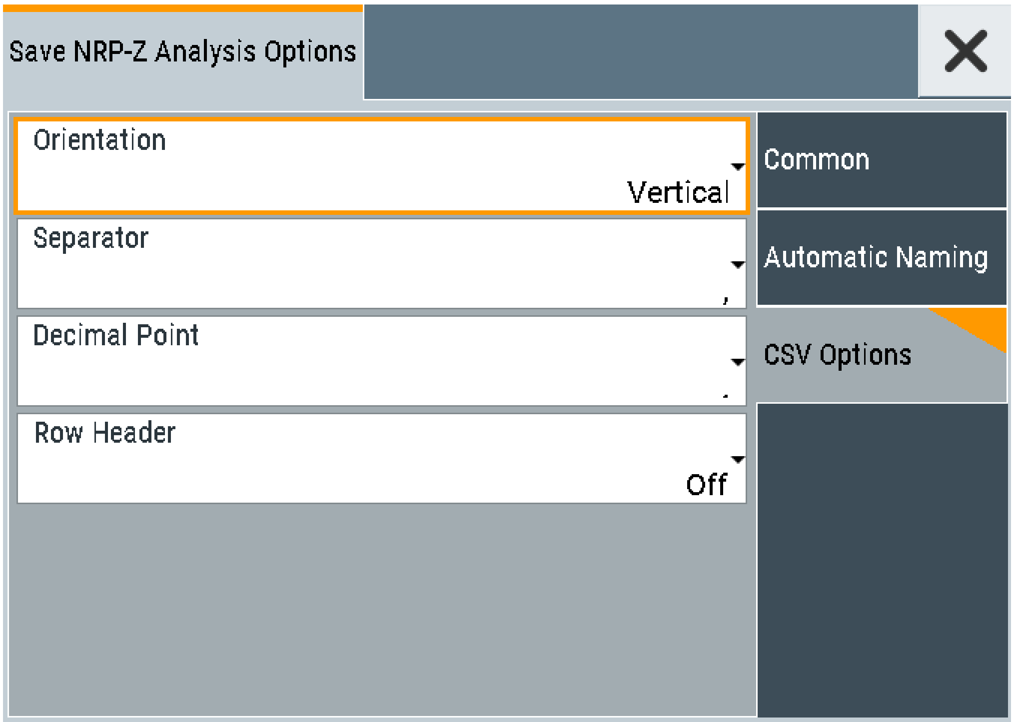
Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE? on page 474

CSV Options

Access:

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. In the diagram window, open the context-sensitive menu.
3. In the menu, select "Save... (Power Analysis)".

4. Set "Format" > "CSV".
5. Select "Options".
6. Select the "CSV Options" tab.



If file format `*.csv` is selected, the trace data is saved as an ASCII file with separated values. CSV files can be imported into the program MS Excel and then processed further. Adjust the value separator and the decimal point according to the language version, to import the data correctly.

Orientation
Defines the orientation of the X/Y value pairs:
- **Horizontal:**
  X/Y values of trace 1 in rows 1 and 2,
  X/Y values of trace 2 in rows 3 and 4,
  X/Y values of trace 3 in rows 5 and 6,
  X/Y values of trace 4 in rows 7 and 8.

Example:

Trace1,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

Trace1,Y[dBm]: -20.09; -19.17; -18.19; -15.43; ...

Trace2,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

Trace2,Y[dBm]: -19.09; -18.17; -17.19; -14.43; ...

Trace3,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

Trace3,Y[dBm]: -21.09; -20.17; -19.19; -16.43; ...

Trace4,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

Trace4,Y[dBm]: -22.07; -20.14; -21.56; -17.67; ...

- **Vertical:**
  X/Y values of trace 1 in column 1 and 2,
  X/Y values of trace 2 in column 3 and 4,
  X/Y values of trace 3 in column 5 and 6,
  X/Y values of trace 4 in column 7 and 8.

Example:

Trace1,X[Hz]; Trace1,Y[dBm]; Trace2,X[Hz]; Trace2,Y[dBm]; Trace3,X[Hz]; Trace3,Y[dBm]; Trace4,X[Hz]; Trace4,Y[dBm];

10000.0;-20.09;10000.0; -19.09;10000.0;21.09;10000.0;22.07;

10010.0;-19.17;10010.0;-18.17;10010.0; -20.17;10010.0; -20.14;

10020.0;-18.19;10020.0;-17.19;10020.0;-19.19;10020.0;-21.56;

10030.0; -15.43;10030.0; -14.43;10030.0;-16.43;10030.0;-17.67;...

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:ORIentation`
on page 472

Separator
Defines the character to be used to separate the values: tabulator, semicolon, comma or blank.

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV[:COLumn]:SEParator` on page 472

Decimal Point
Defines the character to be used as the decimal point of the values: dot or comma.

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:DPOint` on page 471

Row Header
Defines a header for each row or column, depending on the orientation. A header contains information on the trace, e.g. the trace index, or frequency, power or time values.

Example:

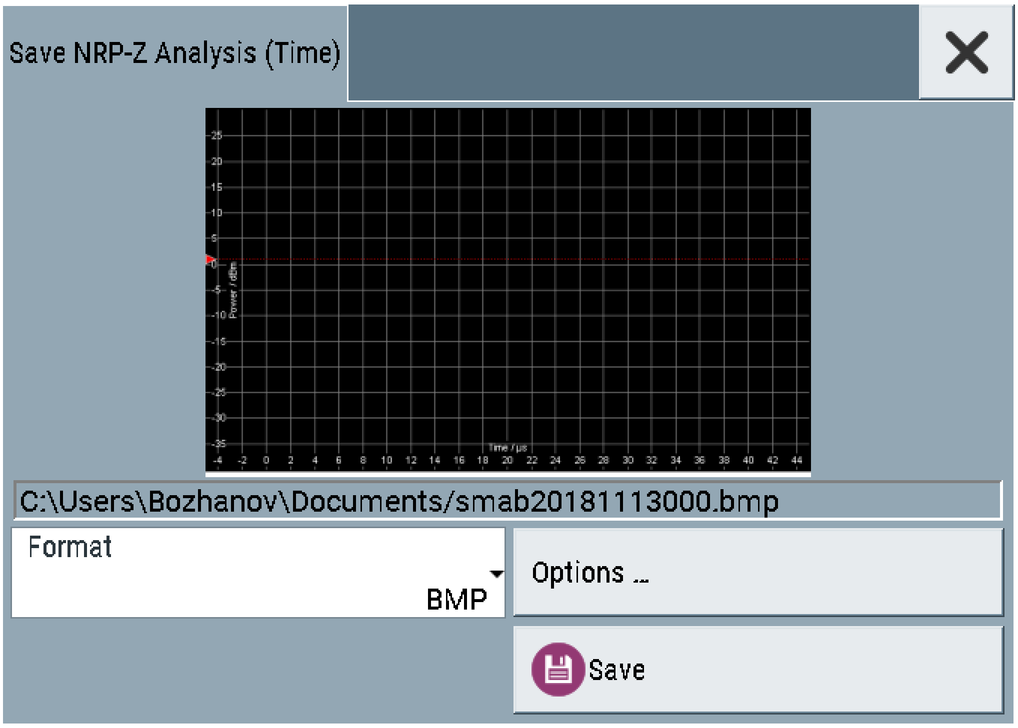
Trace=2;Source=detecting..;X[Hz]";"Trace=2;Source=detecting..;Y[dBm]"

Remote command:

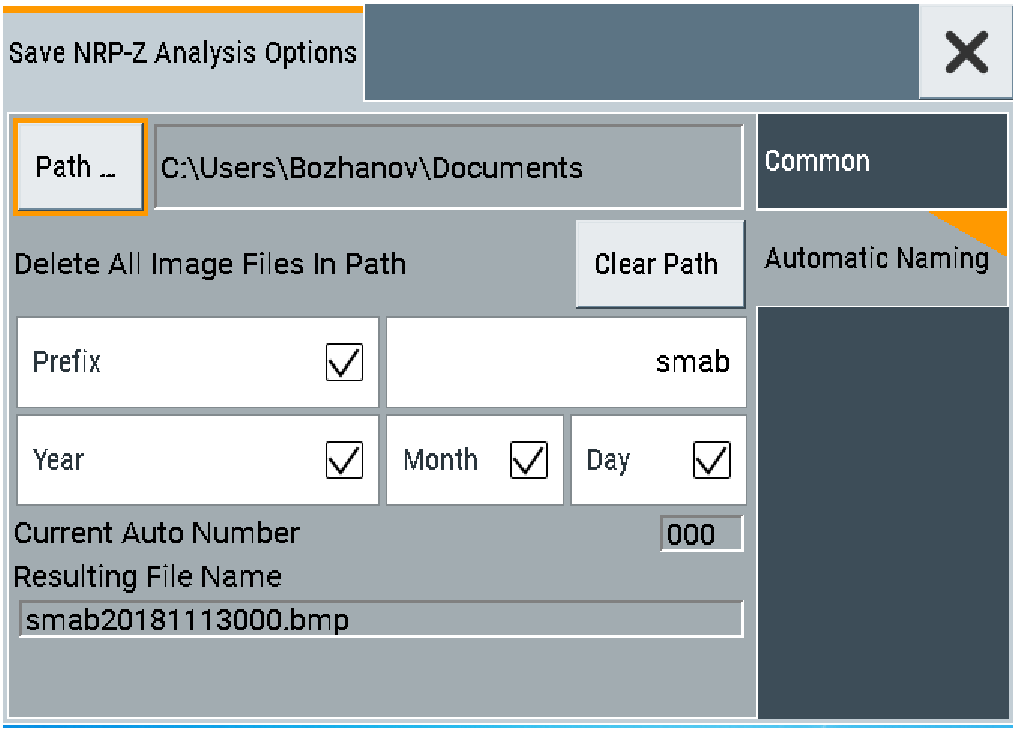
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:HEADer` on page 472

How to Save a Hardcopy of the Power Analysis Window

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. In the diagram window, open the context-sensitive menu.
3. In the menu, select "Save... (Power Analysis)".



4. To define the output format, select "Format > JPG".
5. Select "Options...".
6. To enable the instrument to create output filenames, select "Automatic Naming > On".

7. 

   In the "Automatic Naming" tab:
   a) To change the default directory the file is saved in, select "Path" and define a path and a filename. For example, select the default directory `/var/user`.
   b) If necessary, disable or change some of the parameters in the "Automatic Naming Settings".
   c) Close the "Save NRP-Z Analysis Options" dialog.
8. In the "Save NRP-Z Analysis" dialog, select "Save".
   The instrument saves a hardcopy of the current instrument display as a `*.jpg` file. The filename is automatically created.
9. To print the hardcopy, connect the instrument to a LAN and:
   a) Transfer the file to a remote computer as described in Chapter 10.9, "How to Transfer Files from and to the Instrument", on page 305.
   b) On the remote computer, navigate through the file system.
   c) Print the selected file.
      For more information, refer to the online help of the operating system.

7.4.4.9 How to Setup a Frequency Sweep Measurement

Prerequisites: the sensor is connected to the instrument and configured, see Chapter 7.4, "Using Power Sensors", on page 211.

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Measurement".

3. Set "Mode" > "Frequency".
4. Configure the measurement:
   a) Set "Min = 8KHz".
   b) Set "Max = 6Ghz".
   c) Set "Steps = 200".
5. Select the "Configure Diagram" tab. Configure the diagram, see Chapter 7.4.4.12, "How to Configure the Power Analysis Diagram", on page 264.
6. Select the "Configure Sensors" tab.
7. Select the connected sensor, e.g. "2-NRP-Z81".
8. If you want that the frequency settings of the sensor are configured differently than the generator settings, enable "Use Separate Frequ.".
   a) Set "Min = 1MHz".
   b) Set "Max =10Mhz".
9. In the "Next Window List" tab, enable the "Standard View".
10. Close the "Configure" dialog.
11. Press "Start Cont" to start the measurement.

7.4.4.10 How to Setup a Power Sweep Measurement

Prerequisites: the sensor is connected to the instrument and configured, see Chapter 7.4, "Using Power Sensors", on page 211.

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Measurement".
3. Set "Mode" > "Power".
4. Configure the measurement:
   a) Set "Min = -40 dBm".
   b) Set "Max = 40dBm".
   c) Set "Steps = 200".
5. Select the "Configure Diagram" tab. Configure the diagram, see Chapter 7.4.4.12, "How to Configure the Power Analysis Diagram", on page 264.
6. Select the "Configure Sensors" tab.
7. Select the connected sensor, e.g. "2-NRP-Z81".
8. If you want that the frequency settings of the sensor are configured differently than the generator settings, enable "Use Separate Frequ.".
   a) Set "1MHz".
9. In the "Next Window List" tab, enable the "Standard View".

10. Close the "Configure" dialog.
11. Press "Start Cont" to start the measurement.

7.4.4.11 How to Setup a Pulse Measurement

Prerequisites: the sensor is connected to the instrument and configured, see Chapter 7.4, "Using Power Sensors", on page 211.

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Measurement".
3. Set "Mode" > "Time".
4. Configure the measurement:
   a) Set "Min = -5 us".
   b) Set "Max = 45 us".
   c) Set "Steps = 200".
5. Select the "Configure Diagram" tab. Configure the diagram, see Chapter 7.4.4.12, "How to Configure the Power Analysis Diagram", on page 264.
6. Select the "Configure Sensors" tab.
7. Select the connected sensor, e.g. "2-NRP-Z81".
8. In the "Next Window List" tab, enable the "Pulse Data View".
9. Close the "Configure" dialog.
10. In the diagram window, open the context-sensitive menu.
11. Select "Trace/Pulse Data Notifications/ Trigger".
12. Select the "Trace" tab.
13. Set "State > On".
14. Set the thresholds:
    a) Set "Base > Voltage Related".
    b) Set "Distal = 90%".
    c) "Mesial = 50%".
    d) "Proximal = 10%".
15. Select the "Pulse Data Notifications" tab.
16. Enable up to six parameters, for example:
    - "Duty Cycle"
    - "Pulse Width"
    - "Pulse Period"
    - "Off Time"
    - "Start Time"

17. Close the "Trace/Pulse Data Notifications/ Trigger" dialog.
18. Press "Start Cont" to start the measurement.

7.4.4.12 How to Configure the Power Analysis Diagram

1. Select "Clk Syn/Power Sens" > "NRP Power Analysis".
2. Select "Configure" > "Configure Diagram".
3. Set "Max Level = 30dBm".
4. Set "Min Level = -40dBm".
5. Select "Auto Scale > Expand Only (Coarse)".
6. Enable "Show Grid".
7. Set "Background Color > Black."

7.5 How to Calibrate the Power Level with an R&S NRP Power Sensor

Using a R&S NRP power sensor and the user correction function of the instrument, you can compensate external frequency responses. The R&S SMA100B 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 SMA100B

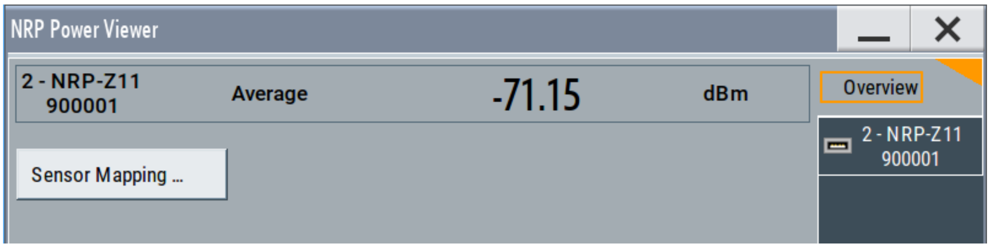
1. Connect the power sensor.
   See Chapter 7.4.1, "Connecting R&S NRP Power Sensors to the R&S SMA100B", on page 211.
2. Select "Clk Syn/Power Sens" > "NRP Sensor Mapping".
3. If the sensor is not detected automatically, select "Scan > Start".

   The instrument scans the network and the USB connections for connected sensors and lists all detected R&S NRP sensors in the mapping table.
4. In the "Mapping" column, assign the sensor to a sensor channel (see Chapter 7.4.2, "NRP Sensor Mapping", on page 212
5. Close the dialog.

To configure and calibrate the R&S NRP in the R&S SMA100B

Provided the power sensor is connected to the R&S SMA100B and is assigned to a sensor channel, we recommend that you calibrate and configure the power sensor in the "NRP Power Viewer" dialog.

1. Select "Level" > "RF ON > Off"
2. Select "Clk Syn/Power Sens" > "NRP Power Viewer".

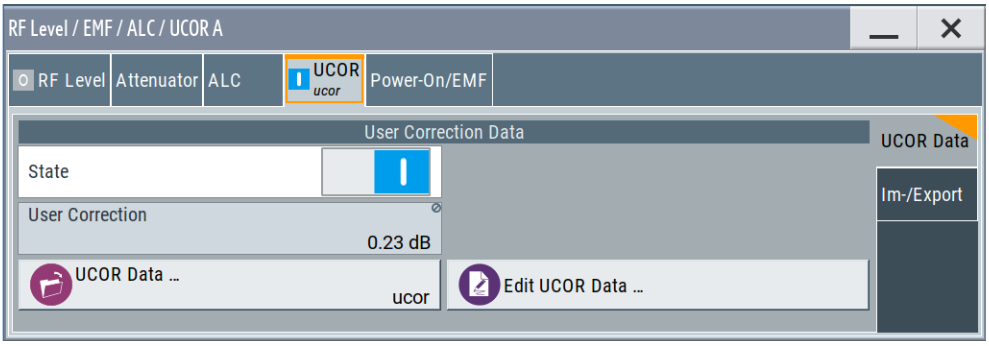


3. If the R&S SMA100B has detected several connected power sensors, select the tab of the sensor you want to use.
4. Select "Zero" to start zeroing of the sensor.
   Note: Always turn the RF power off or disconnect the sensor from RF before zeroing, since the function calibrates the power sensor at zero signal power.
   The zeroing process takes a few seconds, depending on the power sensor type.
5. Configure additional parameters for the selected sensor as required.
6. Select "State > On".
7. Close the dialog.

To create user correction data with an R&S NRP and the R&S SMA100B

We assume, that the power sensor is connected, assigned and ready for operation.

1. Select "Level" > "User Correction".

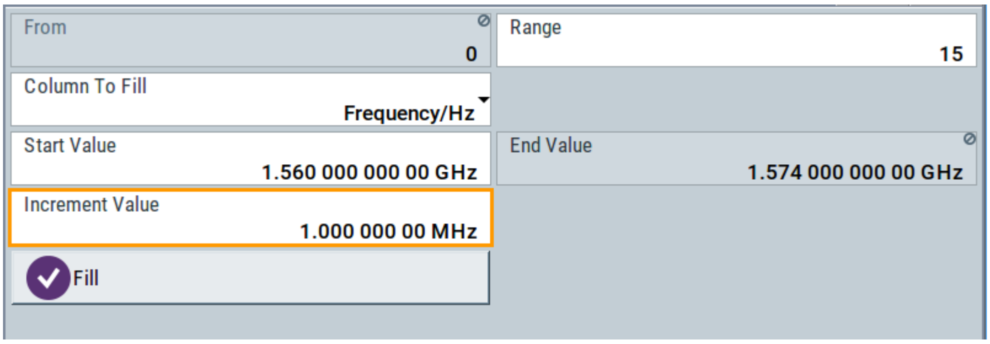


2. Select "UCOR Data > UCOR Data...".
3. Create a file: "New > Filename" and confirm with "OK".
4. Select the new file with "Select".
5. Select "Edit UCOR Data...".

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.

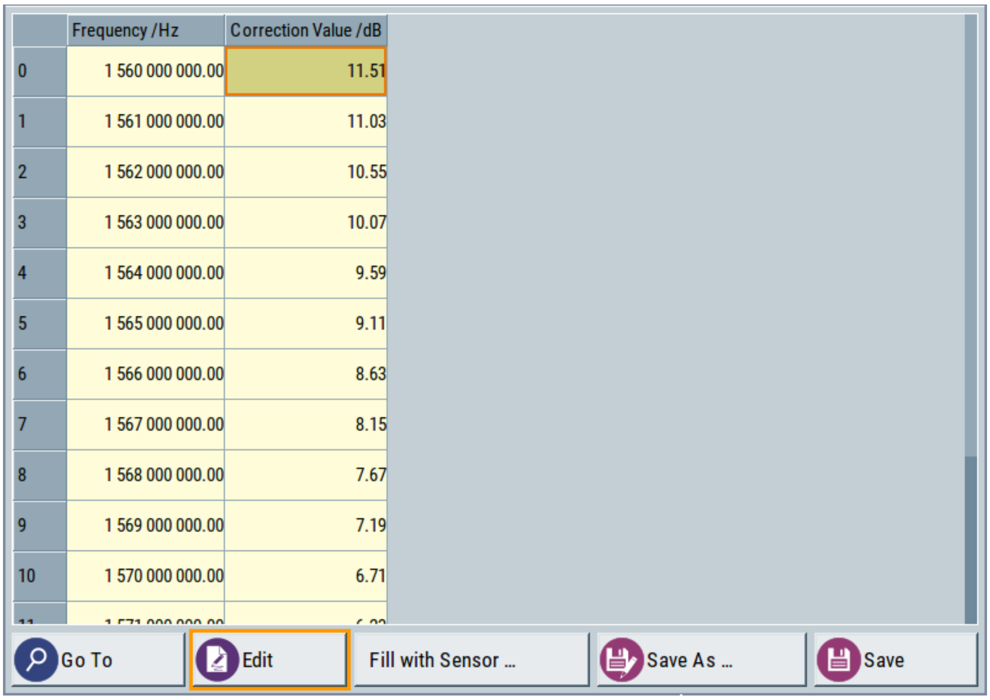
   The "Fill" function also fills the column of the "Correction Value / dB" values with a predefined value, since empty cells lead to the data loss of the entire line. If you need different values, you can change them manually, or you can use the automatic function "Fill with Sensor" as described in the 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 SMA100B successively sets each frequency point, reads the measured power of the sensor and fills in the value in the correction table.



10. Select "Save" to save the data in the file.
11. Close the dialog.

To perform power leveling calibration with user correction data

We assume that a user correction file is available in the user directory of the R&S SMA100B 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 SMA100B considers the user correction data and adjusts the signal level accordingly to compensate external frequency responses.

8 Reference Oscillator

The R&S SMA100B 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 SMA100B 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 SMA100B always outputs the reference frequency at the output connector. You can use it, for example to synchronize further connected instruments.

See:

- **Data sheet**, for a comprehensive description of the possible reference frequency inputs and outputs, their characteristics and the required options
- Chapter 8.2, "Using the Reference Frequency for Instruments Synchronization", on page 268, for an overview of typical test situations

The reference oscillator settings are not affected by an instrument preset ([Preset] key or `*RST`) and the "Save/Recall" function. They are reset only by factory preset.

The remote commands required to define these settings are described in Chapter 13.16.12, "SOURce:ROSCillator Subsystem", on page 637.

8.1 Required Options

R&S SMA100B base unit equipped with the following options:

- Reference frequencies 1 MHz to 100 MHz (R&S SMAB-K704)
- Ultra low noise 1 GHz (R&S SMAB-K703)

For more information, see data sheet.

8.2 Using the Reference Frequency for Instruments Synchronization

Test setups with two or more instruments often require that the instruments use a common reference frequency. Depending on the availability of external reference frequency source and its quality, the instruments are connected and configured in different ways.

This section gives an overview of the possible test setups and the related settings. The following situations are considered:

- External reference source is not available or the **built-in reference oscillator** is of better quality than the external source
(see "Distributing the internal 10 MHz reference signal to further instruments" on page 269)

- **Clean external reference source** with quality exceeding the quality of the built-in reference oscillator
(see "Using external reference source" on page 270)
- **Interfered or noisy external reference signal**
(see "Deriving 10 MHz from the external reference frequency" on page 271)
- **1 GHz reference coupling** for phase coherence of the RF signals with reasonable long-term phase stability
(see "Sharing the 1 GHz reference frequency to obtain phase-coherent signals" on page 270)

Connectors overview

Use the "Show Connector" function to indicate the connector on the front/real panel:

- Ref In/Ref Out
- Ref In/Ref Out 1GHz
- "EFC" on page 42

Distributing the internal 10 MHz reference signal to further instruments

The internal reference oscillator provides the reference frequency:

- Internal f_{ref} = 10 MHz (10 MHz at connector Ref Out)
- Source = "Internal"
- Reference Output/1GHz Reference Output = "10 MHz"
- Optional:
  – External Tuning Active = "On"
  – External Tuning Slope = "Low"

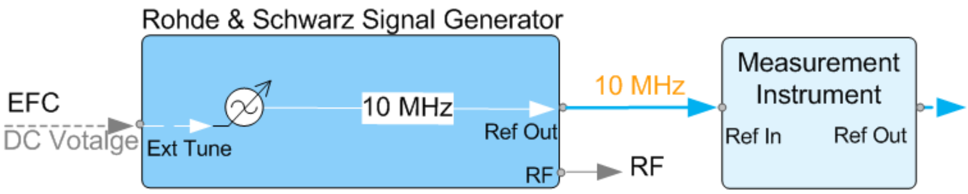


Figure 8-1: Synchronizing instruments using the internal 10 MHz reference signal of the R&S SMA100B

EFC = External frequency control
EFC,Ref In,Ref Out = Connectors

In phase noise measurement systems, for example, you can also use the EFC (external frequency control) function and shift the frequency. EFC is a function that transforms an external tuning voltage into frequency shift, where the value range of the resulting frequency is a technical characteristic listed in the data sheet. See the data sheet also for information on the sensitivity, input voltage range, impedance and maximum bandwidth for external tuning signal.

Consider the following interdependency:

- EFC in combination with an external PLL

If the EFC is applied in combination with an external PLL (phase locked loop), the PLL bandwidth must be smaller than the bandwidth of the external tuning signal.

- FM-DC mode
  If the measurement requires higher PLL bandwidth, we recommend that you use the external FM modulation (DC coupling) in low noise mode.
  The FM-DC mode yields a fixed tuning sensitivity that is independent of the RF output frequency and corresponds to the selected FM deviation.

Sharing the 1 GHz reference frequency to obtain phase-coherent signals

Compared to 10 MHz, a 1 GHz reference signal significantly improves the achievable phase stability between two signal sources. Because the synchronization increases by a factor of 100, the relative phase fluctuations between the sources can be reduced.

1 GHz at connector Ref In 1GHz and 1 GHz at Ref Out 1GHz

- External f_{Ref} = 1 GHz
- Source = "External"
- External Reference Frequency = "1 GHz"
- 1GHz Reference Output = "1 GHz"

Using external reference source

If you have a clean external reference signal with 10 MHz or 100 MHz frequency, for example, you can **directly pass it to the output**. The signal quality remains the same.

10 MHz/100 MHz at connector Ref Out and Ref In

- External f_{Ref} = 10 MHz or 100 MHz
- Source = "External"
- Reference Output = "10 MHz/100 MHz" or "Input Signal (loop through)"
- Set the synchronization bandwidth according to the requirements of the application.

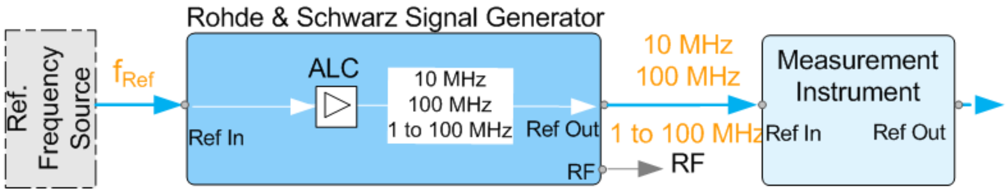


Figure 8-2: Synchronizing instruments with a 10 MHz external reference signal

Ref. Frequency Source	= e.g. Rohde & Schwarz signal analyzer
f_{Ref}	= 10 MHz/100 MHz/1 to 100 MHz external reference frequency
Ref In, Ref Out	= Connectors

You can forward reference frequency between 1 MHz and 100 MHz directly to the output in the same way.

- External f_{Ref} = 1 MHz to 100 MHz
  (**1 MHz to 100 MHz at connector Ref In and Ref Out**)
- Source = "External"

- Variable Reference Frequency = "Variable"
- External Reference Frequency = current external frequency
- Reference Output = "Input Signal (loop through)" or specify the reference frequency the synchronized instrument supports
- Set the synchronization bandwidth according to the requirements of the application.

Deriving 10 MHz from the external reference frequency

10 MHz reference frequency can be derived from the following external reference signals:

- 10 MHz from internal oscillator locked to external input
- 100 MHz and 1 GHz external reference signals
- External reference signal between 1 MHz and 100 MHz
- If the external reference signal is interfered (noisy)

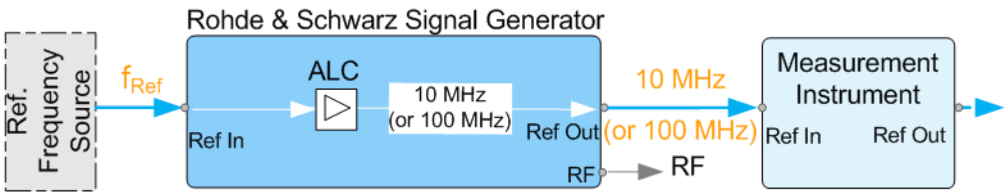


Figure 8-3: Synchronizing instruments with 10 MHz (derived from an external reference frequency)

Ref. Frequency Source	= e.g., Rohde & Schwarz signal analyzer
f_{Ref}	= 10 MHz/100 MHz/1 to 100 MHz/1GHz** external reference frequency
**	= 1 GHz uses Ref In 1 GHz connector
Ref In, Ref Out	= Connectors

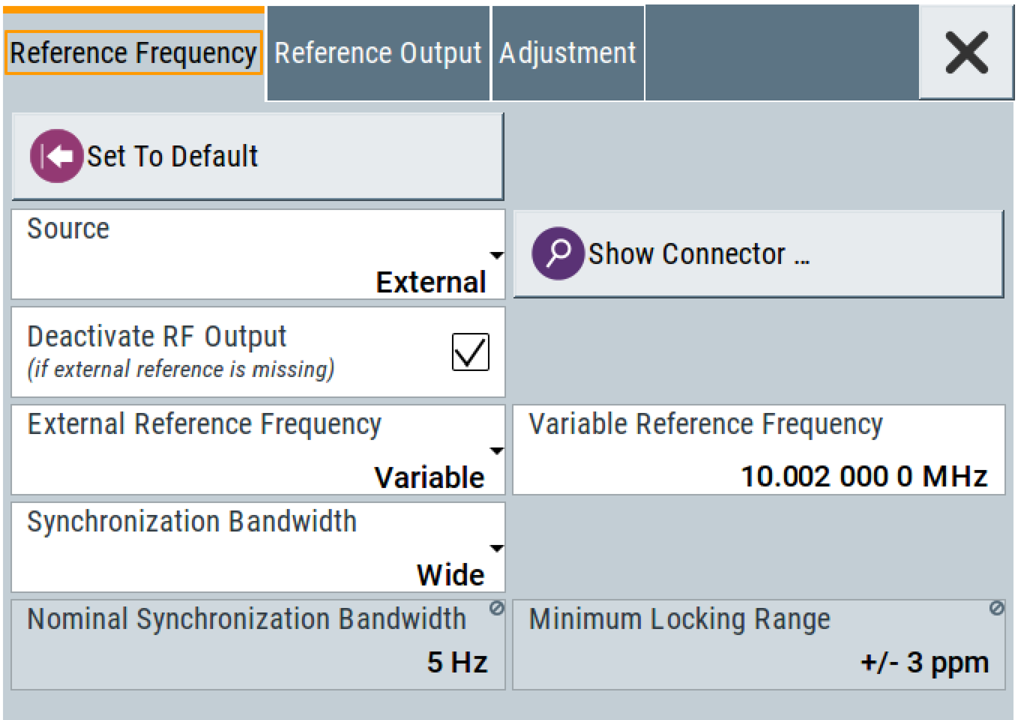
1 GHz/1 to 100 MHz at connector Ref In 1 GHz/Ref In and 10 MHz at Ref Out

- E.g., External Ref. f_{ref} = 100 MHz
- Source = "External"
- External Reference Frequency = "100 MHz"
- Reference Output/1GHz Reference Output = "10 MHz"
- Synchronization Bandwidth = "Narrow"

8.3 Reference Frequency Settings

Access:

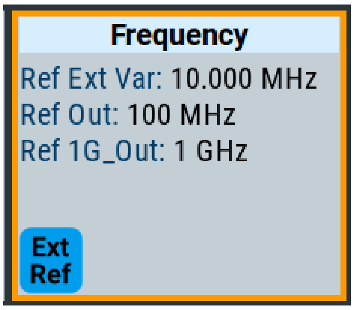
1. Select one of the following:
   - "Frequency" > "Reference Frequency"
   - "System Config" > "Setup" > "General" > "Reference Frequency"



In the "Reference Frequency" tab, you can select the signal source of the reference frequency and define the frequency of an external reference signal.

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

   The "Frequency" tile indicates the current reference oscillator configuration, incl. the reference oscillator source, external reference frequency (rounded value) and output connector. A warning symbol in the "Frequency" tile indicates a missing external source.



The remote commands required to define these settings are described in Chapter 13.16.12, "SOURce:ROSCillator Subsystem", on page 637.

Settings:

Set to Default

Calls the default settings.

Remote command:
`[:SOURce]:ROSCillator:PRESet` on page 639

Source

Selects the reference frequency source.

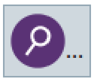
"Internal" Uses the internal reference oscillator, either with calibrated or a user-defined adjustment value.

"External" Uses an external reference signal.
The frequency of the external reference signal must be set with the parameter "External Reference Frequency".

Note: If the external reference is missing, the R&S SMA100B issues a warning message and indicates the icon (external reference missing).

See "External Reference Frequency" on page 273.

Remote command:
`[:SOURce]:ROSCillator:SOURce` on page 639



Show Connector

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

Deactivate RF Output (if external reference is missing)

Turns off the RF output when the external reference signal is selected, but no signal is supplied.

This function prevents that no improper RF signal due to the missing external reference signal is used for measurements. A message indicates that the RF output is deactivated.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe]` on page 640

External Reference Frequency

Sets the frequency of the external reference signal.

"Variable" Option: R&S SMAB-K704
The external reference signal has an arbitrary frequency, within the permissible range from 1 MHz to 100 MHz.
Set the output frequency with the parameters in the Reference Output dialog.

"10 MHz, 100 MHz, 1GHz"
Selects the external reference frequency.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:FREQuency` on page 640

Variable Reference Frequency
Option: R&S SMAB-K704

Sets the variably settable external reference frequency.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:FREQuency:VARiable` on page 640

Synchronization Bandwidth
("External Reference Frequency = 10 MHz, 100 MHz or 1 GHz")

Selects the synchronization bandwidth for an external reference signal.

The resulting bandwidth is indicated with the parameter Nominal Synchronization Bandwidth.

"Narrow" The internal reference oscillator is synchronized to the external signal with narrow bandwidth (< 1 Hz). This setting is recommended if the phase noise of the external signal is worse than the phase noise of the internal OCXO.

"Wide" This mode is the recommended standard mode and for precise reference sources of high spectral purity.

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.
An error message is displayed.

For more information, see data sheet.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:SBANdwidth` on page 640

Nominal Synchronization Bandwidth
Indicates the nominal synchronization bandwidth for the selected external reference frequency and synchronization bandwidth.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:NSBandwidth?` on page 641

Minimum Locking Range
Indicates the minimum locking range for the selected external reference frequency.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:MLRange?` on page 641

External Tuning Active
For "Source > Internal", activates the EFC (external frequency control).

EFC is a function that transforms an external tuning voltage into frequency shift, where the value range of the resulting frequency is a technical characteristic listed in the data sheet.

See the data sheet also for information on the sensitivity, input voltage range, impedance and maximum bandwidth for external tuning signal.

Remote command:

`[:SOURce]:ROSCillator:INTernal:TUNing[:STATe]` on page 639

External Tuning Slope

Sets the sensitivity of the external tuning voltage.

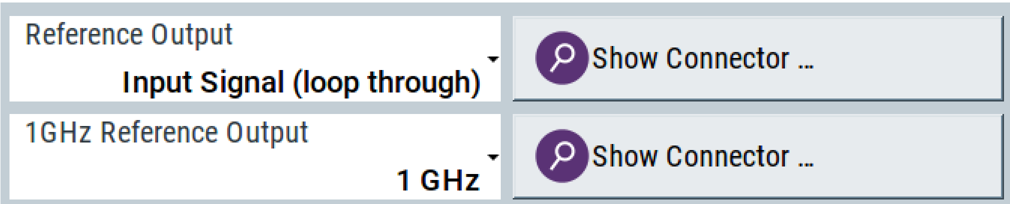
Remote command:

`[:SOURce]:ROSCillator:INTernal:TUNing:SLOPe` on page 639

8.4 Reference Output Settings

Access:

1. Select "Frequency" > "Reference Frequency"
2. Select "Reference Output".



In the "Reference Output" tab, you can set the reference frequency value at the output connectors.

As a result of parameter dependencies, "Preset This Parameter" sometimes does not affect output dialogs.

The remote commands required to define these settings are described in Chapter 13.16.12, "SOURce:ROSCillator Subsystem", on page 637.

Settings:

Reference Output/1GHz Reference Output

Selects the signal that is to be output as frequency reference for downstream instruments.

"Off" Disables the reference signal output.

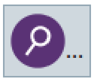
"10 MHz/100 MHz"

Derives a signal with 10 MHz or 100 MHz frequency from the internal reference oscillator and forwards this signal to the output.

"1 GHz" Outputs a 1 GHz signal.

"Input Signal (loop through)"
Forwards the external reference frequency to the output directly.

Remote command:
`[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE` on page 641
`[:SOURce]:ROSCillator:OUTPut:ALTernate:FREQuency:MODE` on page 642

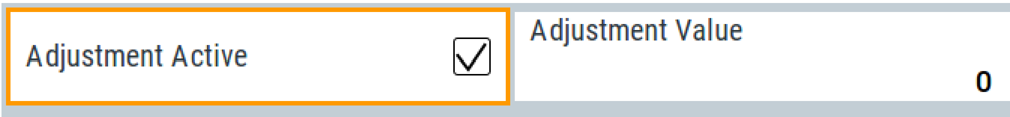


Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

8.5 Adjustment Settings

Access:

1. Select "Frequency" > "Reference Freq"
2. Select "Adjustment".



Settings:

Adjustment Active
Selects the adjustment mode.

"OFF" Uses the calibrated internal reference frequency.

"ON" Allows you to apply a deviation to the internal reference frequency, according to your requirements.
Enter the value in the Adjustment Value field.

Remote command:
`[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe]` on page 643

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 642

9 Clock Synthesis

The clock synthesis provides a separate system clock with a freely selectable frequency for test setups that require an additional clock reference. For example, in a test setup that uses an A/D converter, the required system clock for data sampling can be provided without the need of additional signal generator.

Output connectors

The generated clock reference is synchronized to the selected reference clock of the signal generator (internal or external). The differential signal is output at the [Clk Syn] and [Clk Syn N] connectors.

Required options

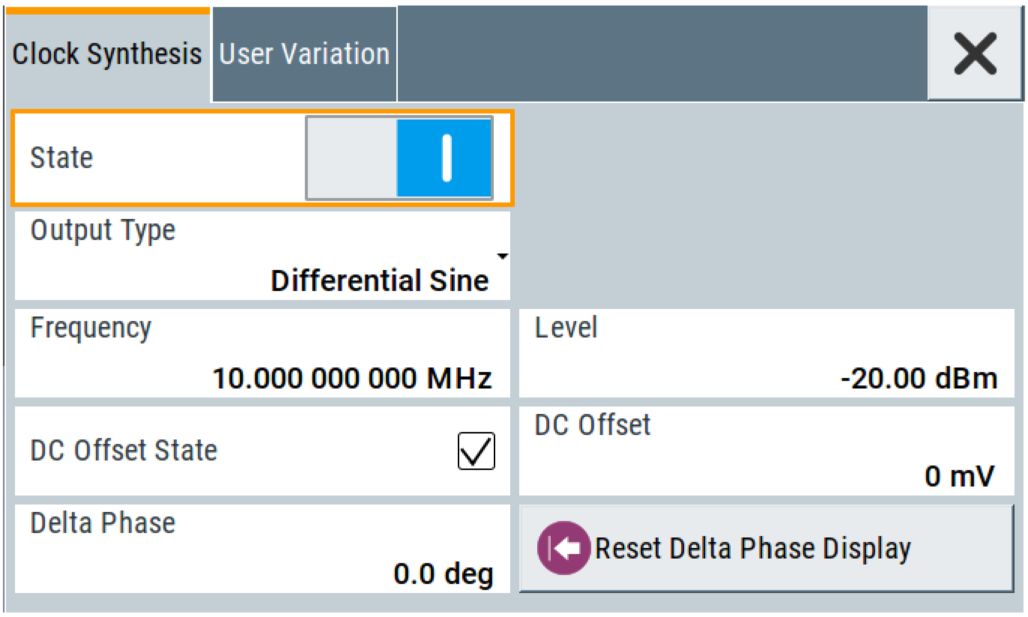
- Option frequency R&S SMAB-B10x
- Option differential clock synthesis up to 3 GHz R&S SMAB-B29
- Option clock synthesis extension 6 GHz R&S SMAB-K722 (requires at least R&S SMAB-B106)

For more information, see data sheet.

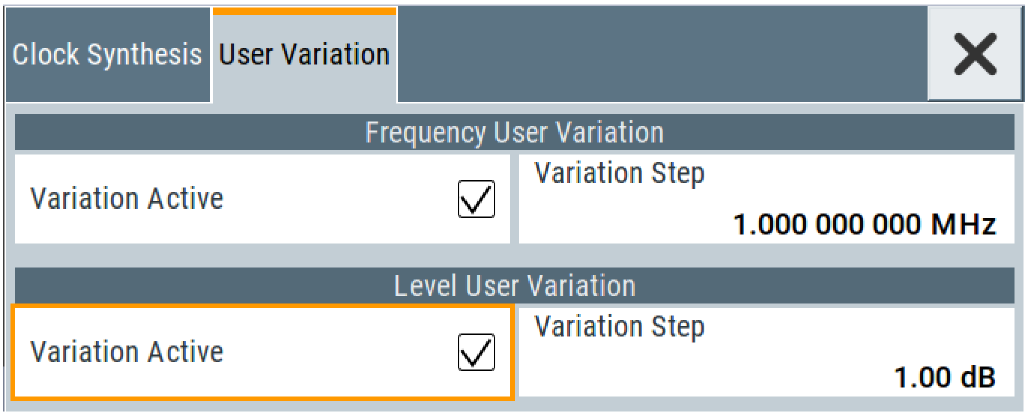
Settings

Access:

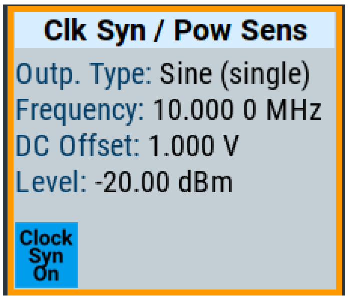
1. Select "Clk Syn/Power Sens > Clock Synthesis".



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



3. Observe the information on the home screen, "Clk Syn/Power Sens" tile.



The "Clk Syn/Power Sens" tile indicates that clock synthesis is activated and gives an overview of the key parameters.

Settings

State

Activates/deactivates generation of a system clock.

The signal is output at the [Clk Syn] connector.

Remote command:

`:CSYNthesis:STATe` on page 426

Output Type

Defines the shape of the generated clock signal.

"Single-Ended/Differential Sine"
Sine signals with user-definable amplitude.

"Differential Square"
Squared signal with fixed amplitude.

"CMOS" CMOS-like signal with user-definable amplitude and limited frequency range.

Remote command:
:CSYNthesis:OTYPe on page 426

Frequency

Sets the frequency of the generated clock signal.

Output Type	Min. frequency	Max. frequency
Single-ended sinus Differential sinus	100 kHz	6 GHz
Differential square	10 MHz	6 GHz
CMOS	100 kHz	200 MHz

Remote command:
:CSYNthesis:FREQuency on page 426

Level

For Output Type = "Single-Ended/Differential Sine", sets the amplitude of the generated clock signal.

Remote command:
:CSYNthesis:POWer on page 427

DC Offset State

Activates a DC offset for both clock synthesis signal outputs.

The DC offset can be used e.g. to shift the clock synthesis output signal into the trigger threshold of some logic elements.

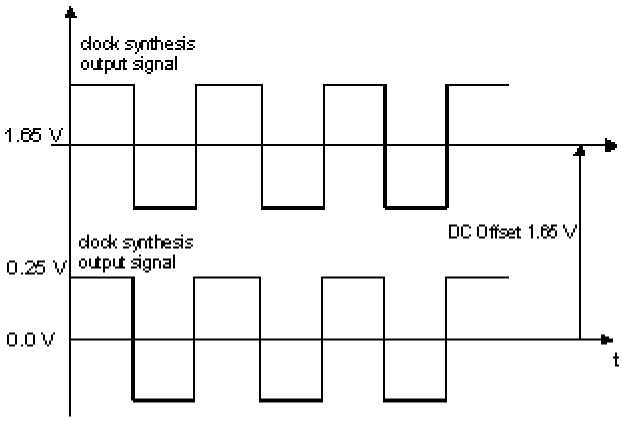


Figure 9-1: Example: DC offset = 1.65V and Output Type = Differential Square

Remote command:
`:CSYNthesis:OFFSet:STATe` on page 427

DC Offset
Sets the value of the DC offset for both clock synthesis signal outputs.

Remote command:
`:CSYNthesis:OFFSet` on page 427

Voltage
For Output Type = "CMOS", sets the high-level of the output signal.

Remote command:
`:CSYNthesis:VOLTage` on page 428

Delta Phase
Shifts the phase of the generated clock signal.

Remote command:
`:CSYNthesis:PHASe` on page 428

Reset Delta Phase Display
Resets the parameter Delta Phase.

User Variation
Defines and activates a user-defined step width for varying the frequency or 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:
`:CSYNthesis:FREQuency:STEP:MODE` on page 429
`:CSYNthesis:POWer:STEP:MODE` on page 429

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

Remote command:
`:CSYNthesis:FREQuency:STEP` on page 429
`:CSYNthesis:POWer:STEP[:INCRement]` on page 429

10 File and Data Management

The R&S SMA100B uses files to save all instrument data. The instrument allows you to store and to load instrument settings, and to import and to export user data for processing in another instrument or later. Finally, you can create a screenshot of the current settings displayed on the screen and save it as a file.

This section focuses on the functions provided for managing of user data files and covers the topics listed below.

For information on the related remote control commands, refer to Chapter 13.5, "MMEMory Subsystem", on page 412.

For information on how to save the displayed setting in a file, refer to Chapter 10.10, "Creating Screenshots of Current Settings", on page 311.

10.1 About the File System

Depending on the contained information, two file groups can be distinguished: system and user files.

Due to security reasons, system files and the system directory are protected and therefore not accessible.

The scope of this section is only the files with user data.

This section is an overview of the R&S SMA100B file system and covers the following topics:

- "Types of user data" on page 283
- "File storage location" on page 283
- "File handling" on page 284
- "File naming conventions" on page 284
- "File extensions" on page 284
- "File contents" on page 285

Types of user data

Depending on the **content**, the **user data** can be roughly divided into the following data types:

- *Settings*, e.g. the current instrument settings, can be saved and loaded later or used in other instrument of the same kind.
  See Chapter 10.4, "Saving and Recalling Instrument Settings", on page 291
- *SCPI scripts*, a series of commands that can be run to perform a task.
  See Chapter 10.6, "Exporting Remote Command Lists", on page 297
- Externally or internally generated *lists*, e.g. user correction lists, or data lists can be loaded in the instrument.
  See Chapter 10.7, "Loading, Importing and Exporting Lists", on page 298 and Chapter 10.5, "Accessing Files with User Data", on page 295

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 SMA100B is switched off.

File storage location

Without any additional measures, the R&S SMA100B stores user files on the internal memory, the removable 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**.

If option R&S SMAB-B85 is installed, the R&S SMA100B maps the user directory to the removable memory. If a memory is mounted, user data is saved there. Otherwise user data is redirected to the volatile memory.

Default storage location

The R&S SMA100B stores user data in the user directory.

Depending on the installed options, the user directory is physically located on the internal memory or on the removable memory.

In the file system, user directory is always indicated as **`/var/user/`**.

In manual control, you access this directory via the "File Manager", see Chapter 10.8, "Using the File Manager", on page 298. In remote control, you can query it with the command `:SYSTem:MMEMory:PATH:USER?`.

To query and change the default directory used for mass storage, use the command `:MMEMory:CDIRectory`.

File handling

To *access files* and the file system of the instrument or to use the general file management functions such as copying and moving data, use the standard "File Manager" dialog.

See Chapter 10.8, "Using the File Manager", on page 298.

To *transfer files* from and to the instruments or to exchange files, use one of the following alternatives:

- Connect a memory stick to one of the USB interfaces.
  The instrument recognizes automatically a connected memory stick and assigns the `/usb/` drive to it.
- Connect the instrument to a LAN.

  An instrument connected to a LAN supports two standard file transfer methods from a remote client:

  – FTP (file transfer protocol)

  – File sharing according to the SAMBA/SMB (server message block) protocol.

  Both file transfer methods access the folder `/user`, that is the `/var/user/` folder on the instrument.
  For step-by-step description, see Chapter 10.9, "How to Transfer Files from and to the Instrument", on page 305.
- Map a network folder or a computer to an instrument connected to a LAN.
  A mapped network folder is indicated as `/shares/<"Local Folder">`.
  For step-by-step description, see Chapter 10.8.4, "How to Map a Network Folder", on page 302.

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 SMA100B distinguishes the files according to their extensions; each type of file is assigned a specific file content and also a specific file extension. The extension is usually of no consequence to you since access to the files occurs in the individual dialogs where only the relevant type of file is available. For example, files with user correction data can only be saved and loaded in the "UCOR" dialog.

See Chapter C, "Extensions for User Files", on page 739 for an overview of the supported file extensions.

File contents

To maintain the file size and to accelerate the loading and processing times, not all instrument settings but rather the settings in state different than the preset one are stored. Considered is also configuration data for the operating elements and lists with user data, e.g. dialog positions and a list of user correction data. However, if a list data is part of the instrument settings, a reference to this list is stored, not the list itself.

This approach ensures that the created files contain only relevant information and allows you to transfer instrument settings even between different equipped signal generators. During the recall process, the instrument interprets only the relevant settings; all non-referenced parameters are set to their preset values. Error messages indicate the settings which cannot be implemented, like referencing non-existing lists or the attempt to activate settings which are not supported by the instrument.

Network settings and remote settings cannot be saved and restored.

10.2 Restoring the (Default) Instrument Configuration

The R&S SMA100B has various options to set default settings, see Figure 10-1. You can preset the R&S SMA100B to an initial state at any time as a known starting point for configurations. It is often useful as a first step in troubleshooting when unusual results arise.

The graph on Figure 10-1 shows the impact of the particular reset functions.

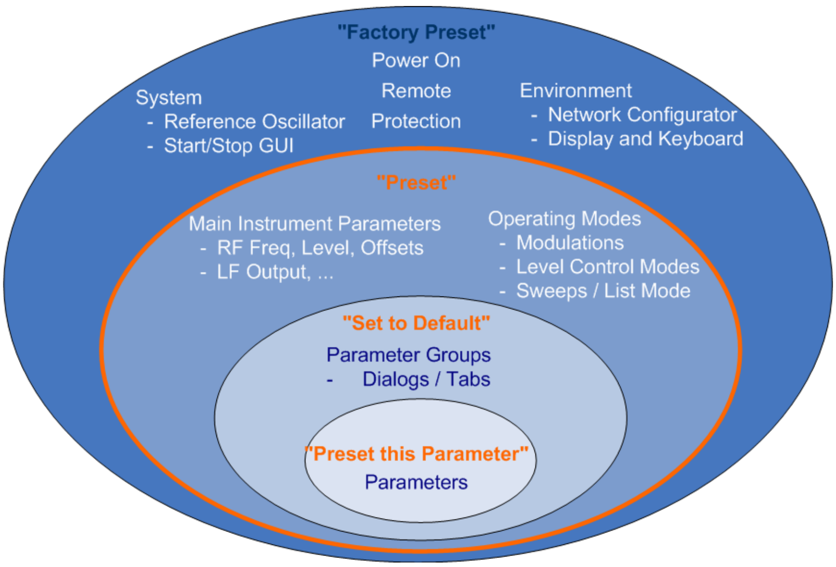


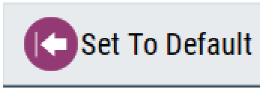
Figure 10-1: Parameter and operating modes, reset by the respective preset functions

Overview of the characteristics of the preset functions

Select the preset option that most fits to your particular application:

- [Preset]
  It is the most frequently used function.
  A Preset executes a defined instrument setup to provide an initial instrument state as a basis for a new configuration. It resets all parameters and switching states, including also the states of inactive operating modes.
  Network, remote access or system settings are retained.

► To execute a preset, press the [Preset] key at the front panel.

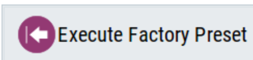


- "Set to Default"
  Set To Default relates to individual dialogs or tabs and resets the associated settings of the corresponding dialog. All other settings are retained.

► To reset the grouped settings, click "Set To Default".

- "Preset this parameter"
  Sets a single parameter to its default value.

► To reset an individual parameter: Open its context-sensitive menu and 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.
  Retained are the following settings:
  – Security, password, and settings protected by these passwords
  – User-defined data, like setups or data lists
  – Settings that relate to an integration of the instrument in a measurement setup.

► To restore the factory defaults, select System Config > Setup > Settings > Factory Preset.

  Note: Perform a "Factory Preset" only if it is necessary. After a "Factory Preset", the network connection to the instrument no longer exists.

Presetting the instrument to a user-defined instrument state

The reset functions set the parameters and operating modes to default values predefined by the factory. Alternatively to these default settings, you can:

- Define user-specific recall settings to be restored after a preset
(see Chapter 10.2.3, "How to Recall User Settings Automatically after Preset", on page 288)
- Store and reload user-defined instrument states
(see Chapter 10.4.2, "How to Save and Recall Instrument Settings", on page 294)

Mark / Do not mark parameters changed from preset

To survey the current state of the settings concerning default values, the R&S SMA100B offers a feature that visually identifies deviations from the default values.

For more information, see Chapter 10.2.2, "How to Identify Parameters Which Are Not in a Preset State", on page 288.

10.2.1 Preset, Set to Default and Factory Preset Settings

Preset
Resets all parameters and switching states, and closes all opened dialogs.

Consider also the following possibilities:
- You can define the settings that are restored when you preset the instrument
(see Chapter 10.2.3, "How to Recall User Settings Automatically after Preset", on page 288)
- You can reset the instrument to the factory state
(see "Execute Factory Preset" on page 287)

See also Table 10-1 that contains the key parameters that are reset by the corresponding preset functions.

Remote command:
`*RST` on page 409

Set To Default
Resets the associated settings of the corresponding dialog or tab.

Preset this Parameter
Restores the default value of a single parameter.

Execute Factory Preset
Resets the instrument to its factory settings.

Note: "Factory Preset" retains all security settings and does not delete any user files like setups or user data.
See also Table 10-1 that contains the key parameters that are reset by the corresponding preset functions.

Remote command:
`:SYSTem:FPReset` on page 412

10.2.2 How to Identify Parameters Which Are Not in a Preset State

To recognize the current state of the settings related to their default values at the first glance, enable a function that visually identifies parameters in states different than preset.

To activate this display:

1. Open the context-sensitive menu (touch and hold the screen anywhere in the GUI of the R&S SMA100B).
2. Select "Mark all parameters changed from preset".

If enabled, the corresponding settings are marked.

Example:

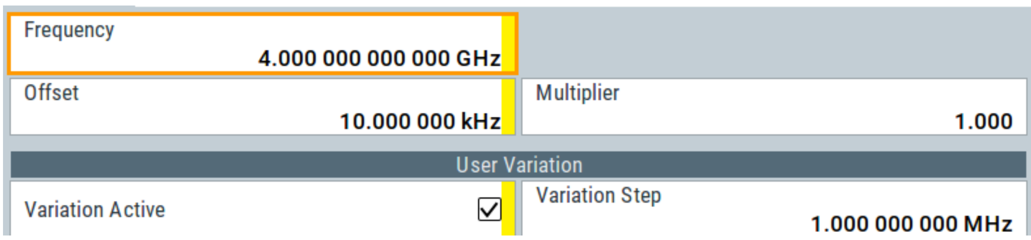


Figure 10-2: Labeled parameters show that the value deviates from its default

Frequency	= changed (default = 1 GHz)
Offset	= changed (default = 0 kHz)
Multiplier	= unchanged
Variation active	= changed (default = disabled)
Variation step	= unchanged

10.2.3 How to Recall User Settings Automatically after Preset

You can define the settings that are restored when you preset the instrument.

1. Configure the settings as required. Save them as described in Chapter 10.4.2, "How to Save and Recall Instrument Settings", on page 294.

2. Save the settings as a file with the predefined filename **UserPreset.savrcltxt**. Save this file in the directory **/var/user/**.

   The filename `UserPreset.savrcltxt` and the directory `/var/user/` are mandatory.

   Now when you press the [Preset] key or send the `*RST` command to the instrument, the defined settings are restored.
   An "Info" message appears and confirms, that a file with user-defined preset setting is loaded.

10.2.4 Reference

See Table 10-1 for an overview of the main generator settings that are affected by the corresponding preset functions. While the regular [Preset] key primarily resets the signal relevant parameters of the instrument, the "Factory Preset" affects almost all instrument settings.

For information on the default values of further parameters, refer to 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 OFF mode	-	-	x
Offsets	0	x	x
Modulation state	off	x	x
Uninterrupted level settings	off	x	x
Level attenuator mode	auto	x	x
Level ALC (internal level control)	auto	x	x
Level UCOR (user correction)	off	x	x
LF output state	off	x	x
Sweep state	off	x	x
List mode state	off	x	x
Reference frequency settings (reference oscillator)	-	-	x
Power on settings (Level/EMF)	-	-	x
Network settings	-	-	x
Hostname	-	-	x
GPIB address	-	-	x
Start/Stop display update	-	-	x

Parameter	Preset value	Preset	Factory Preset
Display and keyboard settings	-	-	x
Password and settings protected by passwords (e.g. disabled LAN or USB)	-	-	-
Security settings	-	-	-
User files (setups[2]), data lists, etc.)	-	-	-

- [2]) `UserPreset.savrcltxt` is renamed as `UserPresetInactive.savrcltxt`; an existing file with the same name is overwritten.

If the default values in the "Remote Access" dialog had been changed, a factory preset via remote control (`:SYSTem:FPReset`) terminates the connection to the instrument.

Security settings are never reset.

Resets all parameters and switching states, and closes all opened dialogs.

10.3 Protecting Data

During operation, the R&S SMA100B saves user data permanently in the user directory, see "File storage location" on page 283.

To protect any classified data and to avoid saving any sensitive data on the R&S SMA100B permanently, you can:

- Install the option **removable memory** R&S SMAB-B85
  This option ensures that user data is never saved on the internal memory.
  – Per default, if removable memory is **mounted**, user data is **saved permanently and only on this storage medium**.
    You can access data saved on the removable memory just as data stored in the `/var/user/`.
  – If volatile mode is activated or there is **no memory mounted or it is removed** during operation, user data is stored **temporarily in the volatile memory** of the instrument.
    This data is lost once the instrument is switched off.
- Store user files **temporarily in the `/var/volatile` directory**, which remains available only until the instrument is switched off.
  You can access data saved in volatile memory just as data stored permanently in the `/var/user/`.
  See also Chapter 10.8.3, "How to Display All Saved Files", on page 302.
- Activate the **volatile mode** so that no user data can be written to the internal memory permanently.
  The removable memory is protected, too.

Instead, you can only save user data:
– Temporary in the volatile memory
– On a connected external storage device, such as a memory stick

See also:
– "Default storage location" on page 283
– "Volatile Mode" on page 336
– Chapter 10.9.4, "Using a USB Storage Device for File Transfer", on page 310

10.4 Saving and Recalling Instrument Settings

Possibly you would like to restore or repeat a signal generation you performed under specific conditions on the instrument. Or, in a test setup with more than one signal generator, you want to transfer the used settings to another R&S SMA100B. In these cases, you can save and recall instrument and user settings, and possibly other related data.

Save/Recall the complete instrument settings

Two different methods are available for managing *complete instrument settings*:

- Immediate (quick) Save/Recall
  A defined set of instrument settings are saved or recalled quickly in just one step, without defining a filename or storage location. This function enables a fast switching between different instrument settings.
- Save/Recall in files with user-defined names
  The defined set of instrument settings are stored to a definable storage location.
  The file extension is `*.savrcltxt`.
  Settings files created in this way are visible in the file system and accessible with the supported methods for file handling.

In the general case, a recall process replaces the instruments settings with the saved values. An exception is the frequency and level settings. During recall of the instrument settings, it is possible to retain the current settings or to overwrite them with the stored values.

Accessing and recalling instrument setups

For quick access to a stored instrument setup file, assign the appropriate action to the [★ (User)] key.

See Chapter 11.2.3, "Assigning Actions to the [★ (User)] Key", on page 326.

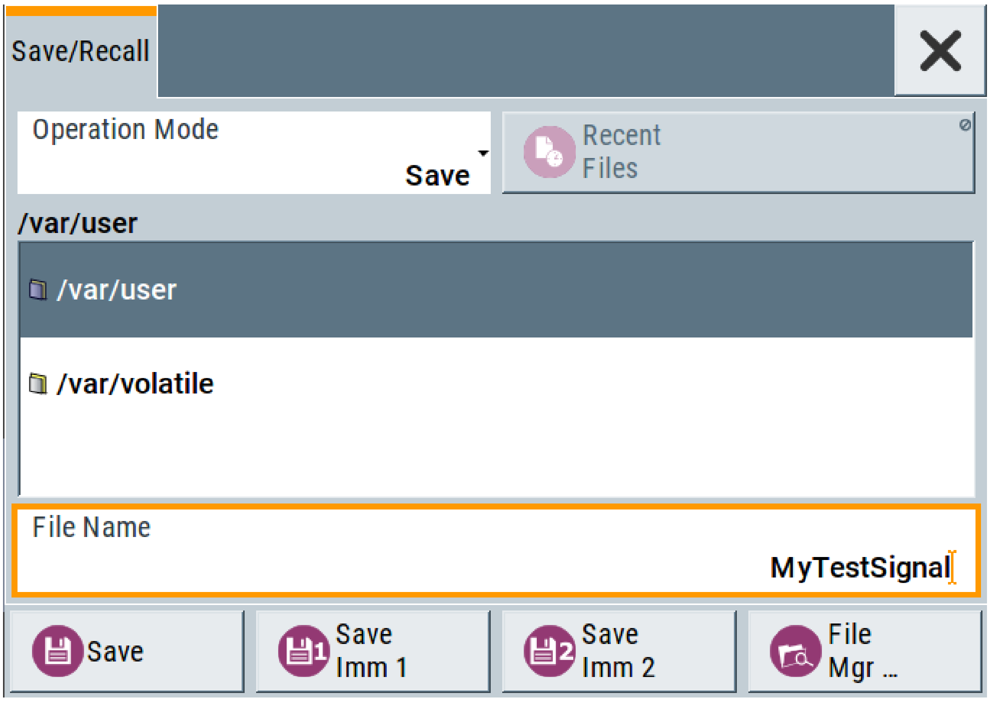
10.4.1 Save/Recall Settings

To access the dialog for storing and loading the complete instrument settings

1. Select "System Config > Save/Recall".

2. Select "Operation Mode > Save or Recall" to access the corresponding settings.

   The provided settings for both operations are similar and closely related.



Settings:

Operation Mode

Accesses the settings for storing ("Save") and loading ("Recall") of the instrument settings, or for exporting created SCPI files ("SCPI-Export").

See Chapter 10.6, "Exporting Remote Command Lists", on page 297.

Directory, File List and Filename

Note:

You access this generic standard function each time you perform one of the following:

- Save or load (settings) files
- Define a folder in that these files are saved

- Navigate through the file system.

The dialog name changes depending on the context. The provided functions are self-explanatory and similar.

Use the settings for example as follows:
- To navigate through the file system, use the directory tree.
- To create a file, load and save files, use the dedicated functions "New", "Select", Save, and Recent files.
- To access the general data list editor, use the"Edit" button (see also Chapter 6.7, "List Editor", on page 188).
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see Chapter 10.8, "Using the File Manager", on page 298).

Remote command:
To list all files in a directory:
`:MMEMory:CDIRectory` on page 418
`:MMEMory:CATalog?` on page 417
`[:SOURce]:CORRection:CSET:CATalog?` on page 587

Recent files
Displays the files last used.

Show SCPI List
Opens the "SCPI List", which lists the current settings of the R&S SMA100B as SCPI commands.

The R&S SMA100B provides this function for Operation Mode > SCPI-Export.

SCPI List
Contains a list of all SCPI commands corresponding to the current instrument settings.

See also "How to create a SCPI list with the current instrument settings in one step" on page 392

Save
Saves the current instrument settings under the defined filename.

Remote command:
`:MMEMory:STORe:STATe` on page 421

Save Immediate x
Stores the current instrument setting in one of the intermediate memories.

These instrument settings are retained until a different instrument setting is stored in the intermediate memory. When the instrument is switched off, the contents of the intermediate memories are retained.

Remote command:
`*SAV` on page 409

Exclude Frequency
The current frequency is retained when a stored instrument setting is loaded.

Remote command:
`[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL` on page 593

Exclude Level

The current level is retained when a stored instrument setting is loaded.

Remote command:
`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL` on page 635

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 420

Recall Immediate x

Loads the selected configuration from one of the intermediate memories. A message appears if no instrument configuration is stored in this memory.

Remote command:
`*RCL` on page 409

File Manager

Accesses the "File Manager" dialog, see Chapter 10.8, "Using the File Manager", on page 298.

10.4.2 How to Save and Recall Instrument Settings

Instrument settings can be saved to a file and loaded again later, so that you can repeat the tests with the same settings.

Accessing and recalling instrument setups

For quick access to a stored instrument setup, assign the appropriate action to the [★ (User)] key.

See Chapter 11.2.3, "Assigning Actions to the [★ (User)] Key", on page 326.

To save and recall instrument settings quickly

1. Select "System Config > Save/Recall" > "Operation Mode > Save".
2. Select "Save Immediate 1".

   The instrument saves its settings in the intermediate memory 1. The filename and the storage location cannot be changed.
3. Adapt the instrument settings as required. Select "Save Immediate 2"
4. To restore the settings, select the "Operation Mode > Recall"

5. Select "Recall Immediate 1"

   The instrument is restored to the previous state.
6. Select "Recall Immediate 2" to switch to the settings stored in the second file.

To save complete instrument settings

1. Select "System Config > Save/Recall" > "Operation Mode > Save".
2. In the file selection dialog, select a filename and storage location for the settings file.
3. Select "Save".

   A file with the defined name and path and the extension `*.savrcltxt` is created.

To restore instrument's configuration

Save the configuration as described in "To save complete instrument settings" on page 295.

1. To restore settings, select "System Config > Save/Recall" > "Operation Mode > Recall".
2. To retain the current frequency and level settings, enable "Save/Recall > Exclude Frequency/Level"
3. In the file selection dialog, select the filename and storage location of the settings file.

   The settings are restored, but the frequency and level settings are retained; you can repeat the signal generation with the same settings.
   See also Chapter 10.2.3, "How to Recall User Settings Automatically after Preset", on page 288.

10.5 Accessing Files with User Data

Signal generation in list mode, the generation of pulse train signals or applying user correction values use data from list files. Whenever a list file is required as a data source, the instrument provides direct access to the standard "File Select" function. This function enables you to select, create and edit the list files.

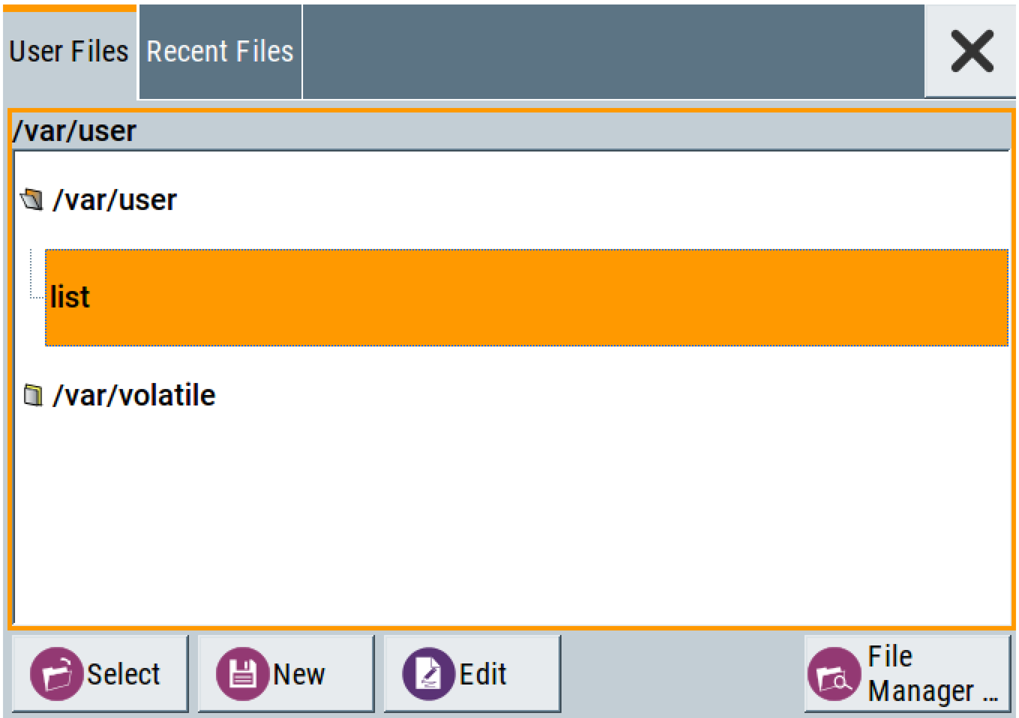
10.5.1 File Select Settings

The "File Select" dialog opens automatically each time the signal generation requires list file as data source.

To access a loadable data list file

1. Select ""Sweep" > List Mode Data > List Mode Data".

   A "File Select" dialog for loading, creating and modifying a file is displayed.



Tip: The name of the dialog is context-sensitive and differs depending on the particular function this dialog is from. However, the provided functions are similar.

2. To load an existing file:
   Navigate through the file system.
   Select the file and confirm with "Select".
3. To create a file, for example if there is no data list file specified:
   Navigate through the file system.
   Select "New" and specify the filename.

   A new empty file is created and saved in the selected folder.
4. To edit an existing or newly created file:
   Navigate through the file system.
   Select the file and select "Edit".

   The standard "Data List Editor" dialog opens
5. Edit the file content.
   Confirm with "Save".

Settings:

Directory, File List and Filename
Note:

You access this generic standard function each time you perform one of the following:
- Save or load (settings) files
- Define a folder in that these files are saved
- Navigate through the file system.

The dialog name changes depending on the context. The provided functions are self-explanatory and similar.

Use the settings for example as follows:
- To navigate through the file system, use the directory tree.
- To create a file, load and save files, use the dedicated functions "New", "Select", Save, and Recent files.
- To access the general data list editor, use the"Edit" button (see also Chapter 6.7, "List Editor", on page 188).
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see Chapter 10.8, "Using the File Manager", on page 298).

Remote command:
To list all files in a directory:
`:MMEMory:CDIRectory` on page 418
`:MMEMory:CATalog?` on page 417
`[:SOURce]:CORRection:CSET:CATalog?` on page 587

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 622
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 537
`[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 586

"New" Creates file with the specified "Filename".
To confirm, select "OK"; use "Cancel" to undo the operation.
To edit the file content, select "File Select > Edit".

"Edit" Accesses the "Data List Editor" and loads the selected file for editing

Recent files
Displays the files last used.

File Manager
Accesses the "File Manager" dialog, see Chapter 10.8, "Using the File Manager", on page 298.

10.6 Exporting Remote Command Lists

To set specific instrument settings or perform tasks automatically, you can create scripts that contain the settings in the form of remote control command sequences.

The R&S SMA100B also offers an SCPI macro recorder with code generator that is used to record manual settings and create an executable script, see Chapter 12.14, "How to Record / Create SCPI Lists", on page 391.

Completed scripts are stored in files and possibly converted to different formats, depending on the used language of the source code.

The R&S SMA100B supports the following commonly used languages:

- Plain SCPI: `*.txt`
- MATLAB: `*.m`
- NICVI: `*.c`

It is also possible to convert the SCPI command list to a user-specific language, see Chapter 12.15, "How to Convert and Save SCPI Lists", on page 394.

10.7 Loading, Importing and Exporting Lists

The R&S SMA100B provides built-in editors for creating list files, for example for the list mode or lists with user correction data. You can also create or evaluate them with an external application. The instrument provides interfaces with the following functionality:

- Import and export list files in a standard ASCII format file

Lists are saved and loaded in the corresponding dialogs. For example, the user correction data list is created and stored in the "User Correction" dialog.

10.8 Using the File Manager

The "File Manager" is a tool similar to a standard Windows Explorer. It helps you manage mass storage media and files stored on the R&S SMA100B.

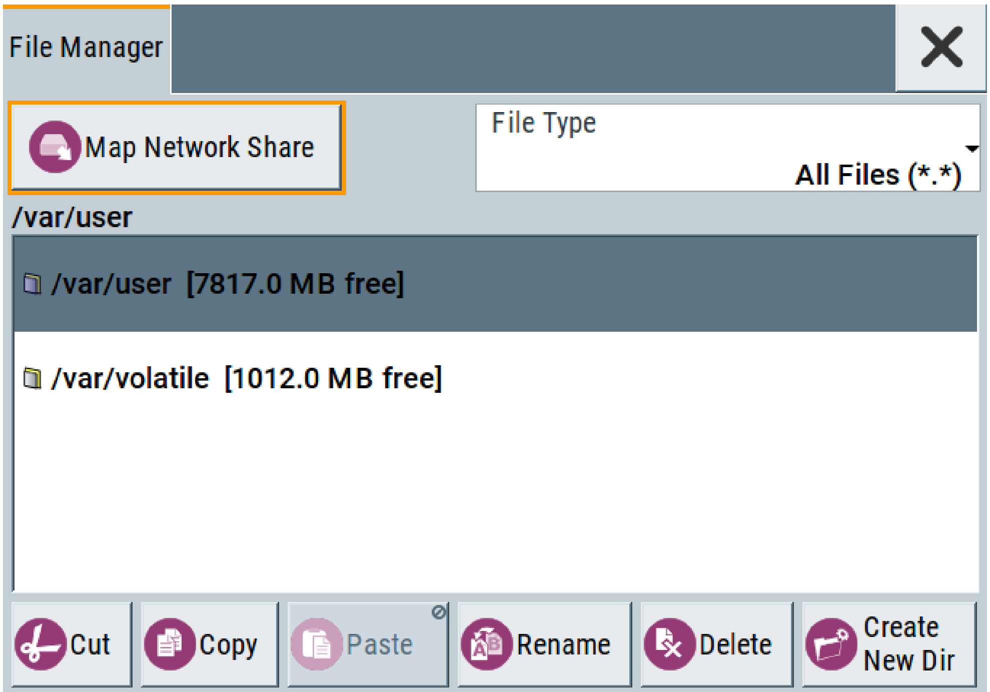
You can perform the following tasks:

- Copying multiple files from disk to other media
  See Chapter 10.9, "How to Transfer Files from and to the Instrument", on page 305
- Copying files into another directory
  See Cut, Copy&Paste and Delete
- Renaming and deleting files
- Creating directories
  See Create New Directory
- Mapping shared network folders
  See Chapter 10.8.4, "How to Map a Network Folder", on page 302
- Displaying saved files
  See Chapter 10.8.3, "How to Display All Saved Files", on page 302

Access:

► Select "System Config > Save/Recall" > "File Manager".

Tip: Each "Save/Recall" dialog and each "File Select" dialog provides a quick access to the "File Manger", i.e. whenever you select data lists or files with user data.



The "File Manager" dialog provides all standard functions required for file management. It displays the contents of the selected folder on the R&S SMA100B and provides functions to rename, delete, copy, or move individual files.

10.8.1 File Manager Settings

Access:

► Select "System Config > Save/Recall" > "File Manager".

Settings:

Map Network Share

Accesses the Map Network Share Settings dialog where you can map one or more network folders.

See also Chapter 10.8.4, "How to Map a Network Folder", on page 302.

File Type

Selects the file type to be listed. If a file type with a specific file extension is selected, only files with this extension are listed.

See Chapter C, "Extensions for User Files", on page 739 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 418

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 420
`:MMEMory:COPY` on page 418

Rename

Renames the selected file or directory.

Remote command:
`:MMEMory:MOVE` on page 421

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 420

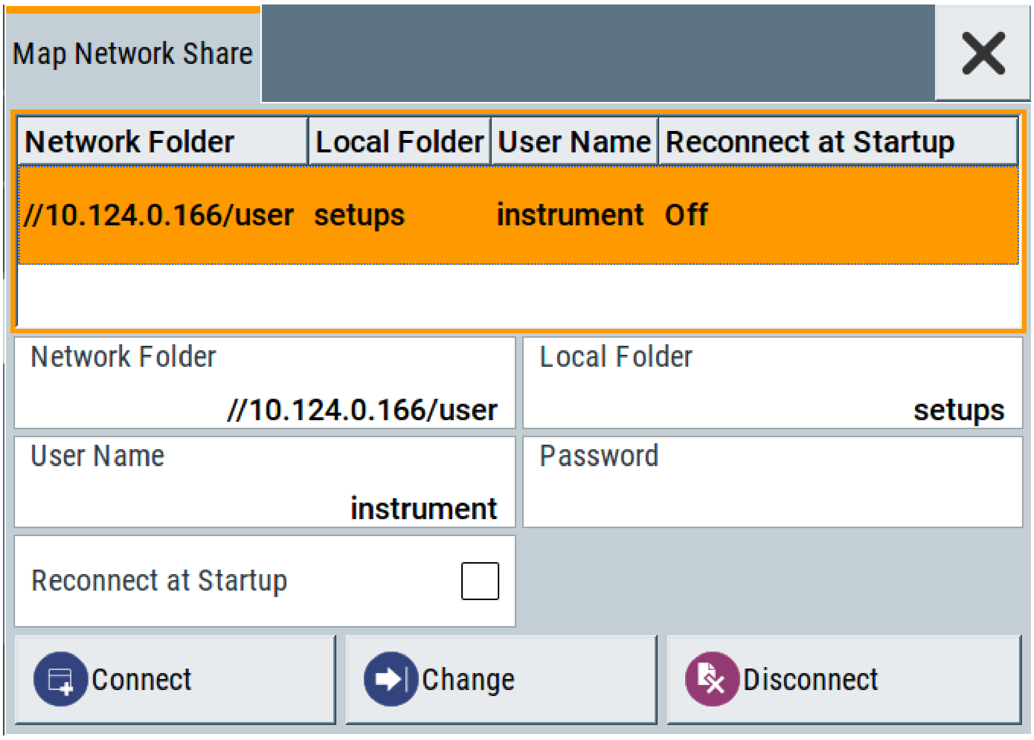
10.8.2 Map Network Share Settings

Access:

► Select "System Config > Save/Recall" > "File Manager > Map Network Share".

The "Map Network Share" dialog provides settings that are similar to the standard Windows Explorer function "Map network drive". These settings help you to create up to 10 "shortcuts" to shared folders or computers in the network.

The dialog displays a list of current mapped network folders. The directory tree of the "File Manager", "Save/Recall", and "File Select" dialogs indicate a mapped network folder as `/shares/<"Local Folder">`.



See also Chapter 10.8.4, "How to Map a Network Folder", on page 302.

Settings:

Network Folder

Enter the path of the folder or computer, e.g. `//<IP Address>/user` or `//<server name>/user`.

Local Folder

Enter a letter or an alias name to describe the folder.

In the directory tree, a mapped network folder is indicated as /shares/<"Local Folder">.

User Name
Enter a user name of a user that has the permission to access the selected network folder.

Password
Enter the password of the selected user.

Reconnect at Startup
Enables reconnecting every time you start up the instrument.

Connect
Triggers the instrument to prove the credential and to map (i.e. connect) the selected network folder or computer to the instrument.

You can map up to 10 network folders.

Change
Applies the changes.

Disconnect
Disconnects the network drive.

10.8.3 How to Display All Saved Files

To display all files on the internal memory

1. Select "System Config > Save/Recall" > "File Manager".
2. Navigate to /var/user/.

To display all files on a connected USB flash drive

1. Select "System Config > Save/Recall" > "File Manager".
2. Navigate to /usb/.

To display all files in the volatile memory

1. Select "System Config > Save/Recall" > "File Manager".
2. Navigate to /var/volatile/.

10.8.4 How to Map a Network Folder

Possibly you would like to transfer instrument or user settings to another R&S SMA100B, distribute waveform files to several instruments or you have to access frequently the same network drive. In these cases, on a R&S SMA100B connected to a LAN you can create a shortcut to this network folder or this computer.

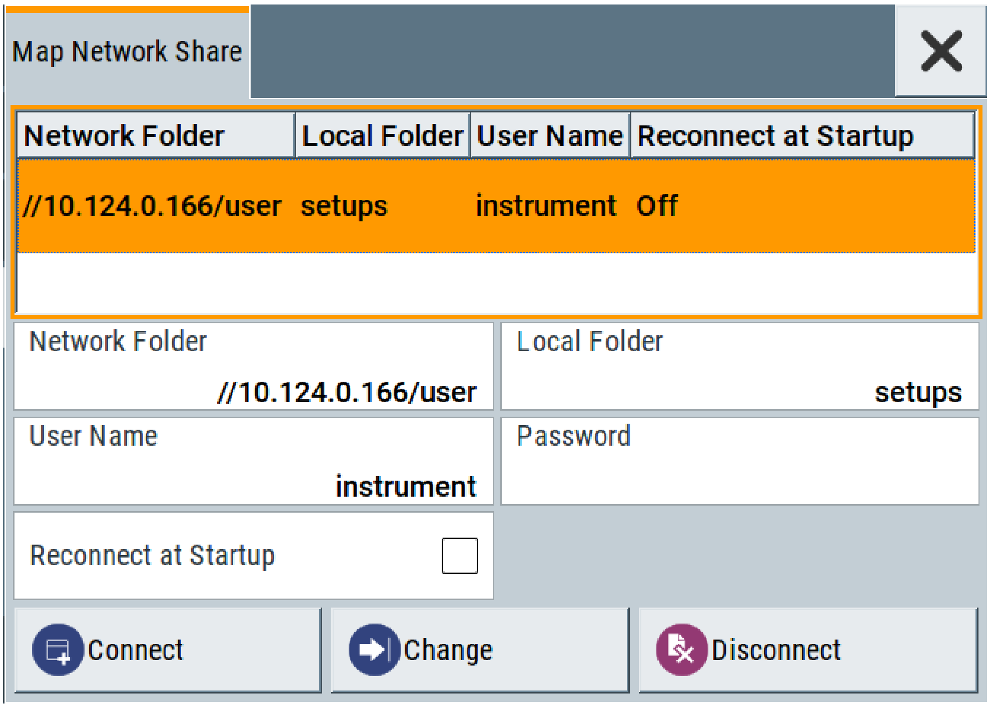
For information on how to set up a LAN connection, refer to:

- Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 28
- Chapter 12, "Network Operation and Remote Control", on page 346

To map a network folder, proceed as follows:

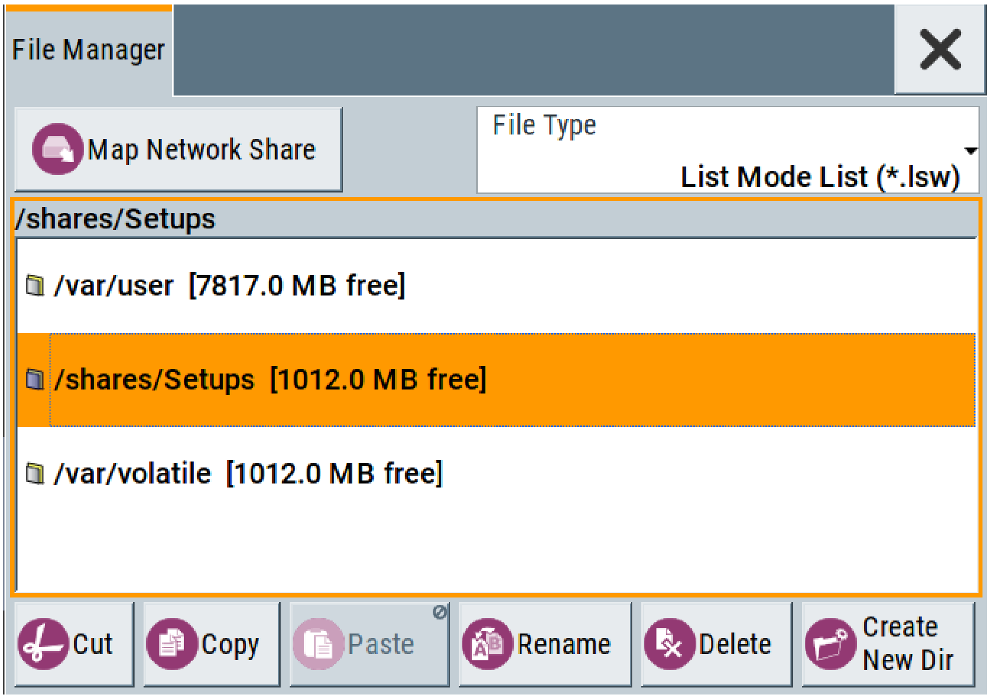
1. On the computer or the network folder you want to map, enable remote access.
   You can specify a list of users allowed for remote access.
   The remote access settings depend on the operating system the remote computer is using. For step-by-step instructions, refer to the documentation of the particular operating system.
2. On the R&S SMA100B, enable file transfer via SMB (samba).
3. Select "System Config > Setup > Remote Access > Network".
   Select:
   a) "Address Mode > Auto (DHCP)"
   b) Check that the "DNS Suffix" and "DNS Server" are correct.
4. In the "Save/Recall" dialog, select "File Manager > Map Network Share".
5. In the "Map Network Share" dialog, select:
   a) In the "Network Folder" field, enter `//<IP Address>/user` or `//<Server Name>/user`.
   b) In the "Local Folder" field, enter an alias name, e.g. *setups*.
   c) Enter the "User Name" and "Password" of a user with a remote access permission to the selected network folder.
   d) If necessary, enable "Reconnect at Startup".
   e) Select "Connect".

   The selected network folder is mapped to your instrument. The list of mapped network folders is updated.



6. Close the "Map Network Share" dialog.

   The navigation tree in the "File Manager" dialog displays the mapped network folder as `/shares/Setups`.



If the connection does not succeed, consider to check the following:
- Is the network folder or computer you try to map turned on?
- Is the network folder or computer enabled for remote access?
- Does the selected user name have the necessary permissions?

See also Chapter 10.9.5, "Using a File Server for Test Files Exchange", on page 310.

10.9 How to Transfer Files from and to the Instrument

As explained in "File handling" on page 284, you access the file system of the R&S SMA100B via one of the following ways:
- Via the built-in "File Manager"
  See Chapter 10.8, "Using the File Manager", on page 298.
- On an instrument connected to a LAN:
  - Via one of the standard functions ftp or SMB (samba)
    See Chapter 10.9.2, "Accessing the File System of the R&S SMA100B Via ftp", on page 307 and
    Chapter 10.9.3, "Accessing the R&S SMA100B File System Via SMB (Samba)", on page 308
  - Via mapped network drives
    See Chapter 10.8.4, "How to Map a Network Folder", on page 302.
- Via a connected USB storage device
  See Chapter 10.9.4, "Using a USB Storage Device for File Transfer", on page 310

Mainly because of security reasons, the access to the file system of your R&S SMA100B can be denied, because one or all these access methods are deliberately disabled. Access to the file system via LAN and/or USB requires that the corresponding service is enabled and a write access to the file system is enabled. Refer to Chapter 10.9.1, "Removing File System Protection", on page 305 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.

10.9.1 Removing File System Protection

Before you try to access the file system via ftp, SMB (samba) or USB, fulfill the following:
- Disable write protection on the file system

- Enable the corresponding service or interface

To enable write permission on the file system

1. Select "System Config > Setup > Security > Security > General"
2. Enable "Volatile Mode"
3. Enter the "Security Password".
   The default password is *123456*. For more information, see Chapter 11.4, "Using the Security Settings", on page 332.
4. Select "System Config > Setup > Maintenance > Shut Down"
5. Select "Reboot".

   The system reboots. The enabled settings are active.

To enable file transfer via ftp

1. Select "System Config > Setup > Security > Security > LAN Services".
2. Enable "LAN Interface"
3. Enable "FTP"
4. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 11.4, "Using the Security Settings", on page 332.
5. Select "Accept".

To enable file transfer via SMB (samba)

1. Select "System Config > Setup > Security > Security > LAN Services"
2. Enable "LAN Interface"
3. Enable "SMB (Samba)"
4. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 11.4, "Using the Security Settings", on page 332.
5. Select "Accept".

To enable file transfer via USB

1. Select "System Config > Setup > Security > Security > General"
2. Enable "USB Storage"
3. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 11.4, "Using the Security Settings", on page 332.
4. Select "Accept".

10.9.2 Accessing the File System of the R&S SMA100B Via ftp

If the R&S SMA100B is connected to a LAN, you can use file transfer protocol (ftp) to access the file system and to transfer files from and to the instrument.

For information on how to set up a LAN connection, refer to:

- Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 28
- Chapter 12, "Network Operation and Remote Control", on page 346

To access the file system via ftp

We assume that the instrument and the remote PC are connected to a LAN.

1. Enable file transfer via ftp
2. Enable write permission on the file system
3. On the remote PC, start the Windows Explorer.
4. In the address field, enter `ftp://<"IP Address" of the Instrument>`, e.g. *ftp://10.124.0.166*.
   Tip: The R&S SMA100B indicates its IP address on the home screen.

   A log-on dialog opens and requests a password.

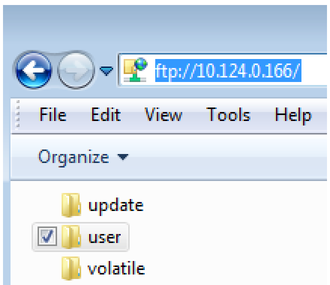
   The default user name and password is *instrument*.

   Tip:
   Default password

   The FTP and SAMBA file access use the user "instrument" with default password "instrument".

   We recommend that you change this password in the "Setup > Security > Password Management > Change User Password" dialog before connecting the instrument to the network.

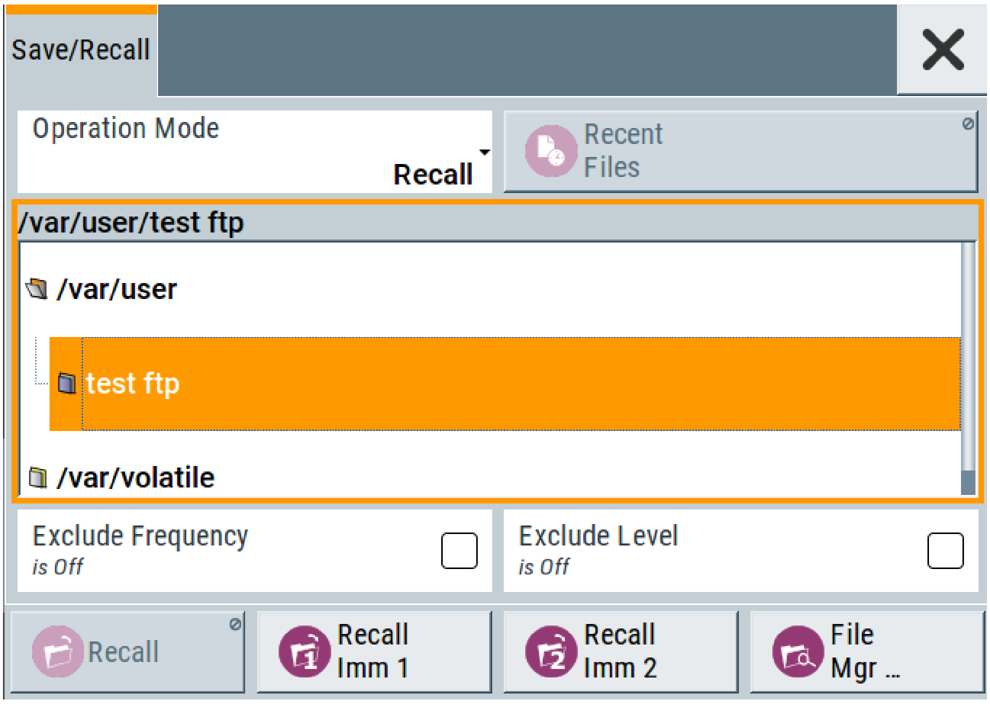
   See Chapter 11.4.4, "Password Management", on page 341.
5. Enter the password to access the `user` directory.
   The `user` directory corresponds to the `/var/user/` directory of the instrument.

   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.



10.9.3 Accessing the R&S SMA100B File System Via SMB (Samba)

The SMB (Samba) protocol is an alternative way to access the file system of the instrument from a remote PC. This protocol works if both the instrument and the PC are connected to a LAN.

For information on how to set up a LAN connection, refer to:

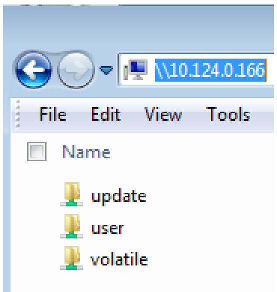
- Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 28
- Chapter 12, "Network Operation and Remote Control", on page 346

To access the file system via SMB

We assume that the instrument and the remote PC are connected to a LAN.

1. Enable file transfer via ftp
2. Enable write permission on the file system
3. On the remote PC, start the Windows Explorer.
4. In the address field, enter //<"IP Address" of the Instrument>, e.g. *ftp://10.124.0.166*.

Tip: The R&S SMA100B 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 SMA100B as a network drive to the remote PC

We assume that the instrument and the remote PC are connected to a LAN.

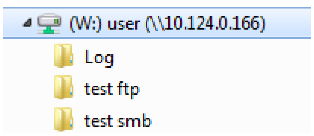
1. Enable file transfer via SMB (Samba)
2. Enable write permission on the file system
3. On the remote PC, start the Windows Explorer.
   Open the "Map Network Drive" dialog.
   a) Select a valid "Drive", e.g. *W*.
   b) In the "Folder" field, enter `//<"IP Address" of the Instrument>/user` or `//<"Hostname" of the Instrument>/user`
   For example: *//10.124.0.166/user* or *//SMA100B-102030/user*.
   Tip: The R&S SMA100B indicates its IP address on the screen.
   c) Select "Finish".

   A log-on dialog opens and requests a user name and a password.

   The default user name and password is *instrument*.

   Tip:
   Default password
   The FTP and SAMBA file access use the user "instrument" with default password "instrument".
   We recommend that you change this password in the "Setup > Security > Password Management > Change User Password" dialog before connecting the instrument to the network.
   See Chapter 11.4.4, "Password Management", on page 341.
4. Enter the user name and the password of your instrument.

   The `/var/user/` directory of the instrument is mapped to and displayed as a network drive of the remote PC.



You can access the files in the `/var/user/` directory, perform standard function like creating directory, or storing files.

10.9.4 Using a USB Storage Device for File Transfer

Alternatively to the file transfer possibility via LAN, you can use a USB storage device for direct file transfer from and to the instrument.

We recommend that you transfer files with user data (like lists or instrument setup files) to the instrument, rather than load and play them from a connected USB storage device.

To transfer a file with user data to the instrument

1. Connect a USB storage device, for example a USB memory stick to one of the USB interfaces of the instrument.
   The R&S SMA100B 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.

10.9.5 Using a File Server for Test Files Exchange

You can use a central file storage location like a file server in your company network to store setup files, SCPI scripts, application programs, or waveform files on it. Usually, you would like to distribute the files to several instruments. If the R&S SMA100Bs 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 SMA100B, map the required directory of the file server to the instrument.
   Perform the steps described in Chapter 10.8.4, "How to Map a Network Folder", on page 302.

2. On each R&S SMA100B, 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 SMA100B, 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.

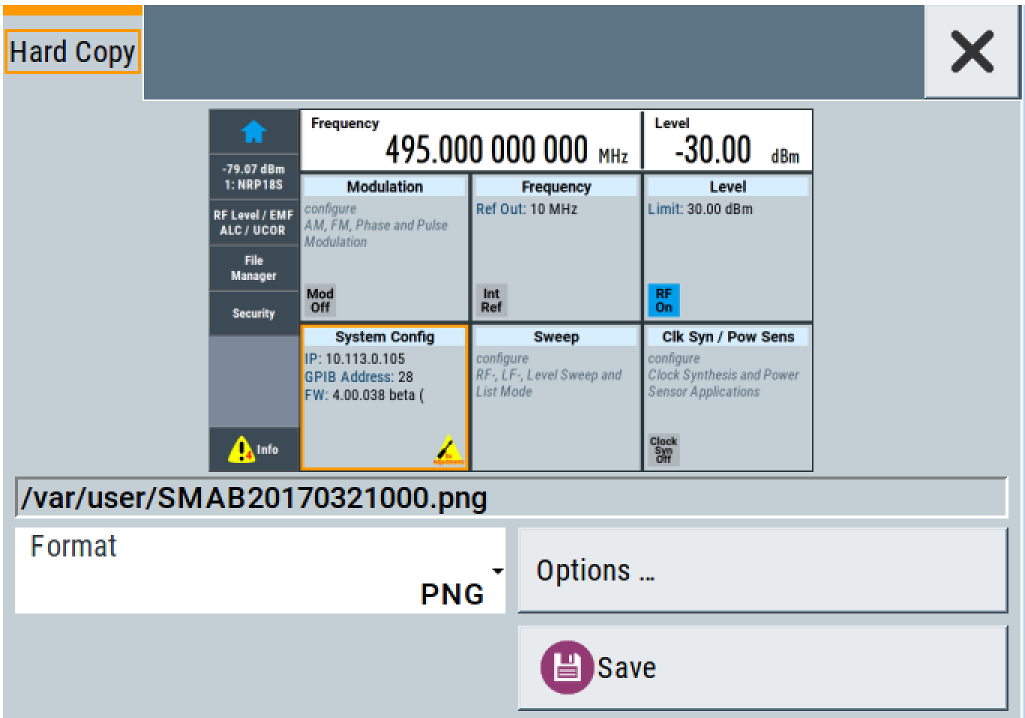
10.10 Creating Screenshots of Current Settings

The save/recall function enables you to save current settings in a file. To document the most important settings for a performed signal generation, you can also save a hardcopy of the current display.

10.10.1 Hardcopy Settings

Access:

► Select "System Config > Setup > User Interface > Hardcopy".



The remote commands required to define these settings are described in Chapter 13.11, "HCOPy Subsystem", on page 438.

Settings:

File...

In "Automatic Naming > Off" mode, accesses the standard file select dialog for selecting the filename and folder the hardcopy is stored in.

If you have enabled "Automatic Naming", the instrument displays the automatically generated filename.

Remote command:
`:HCOPy:FILE[:NAME]` on page 440

Format

Selects the output file format, for example `*.bmp`, `*.jpg*.xpm` and `*.png`.

Remote command:
`:HCOPy:IMAGe:FORMat` on page 440
`:HCOPy:DEVice:LANGuage` on page 440

Options...

Accesses Hardcopy Options dialog.

Save

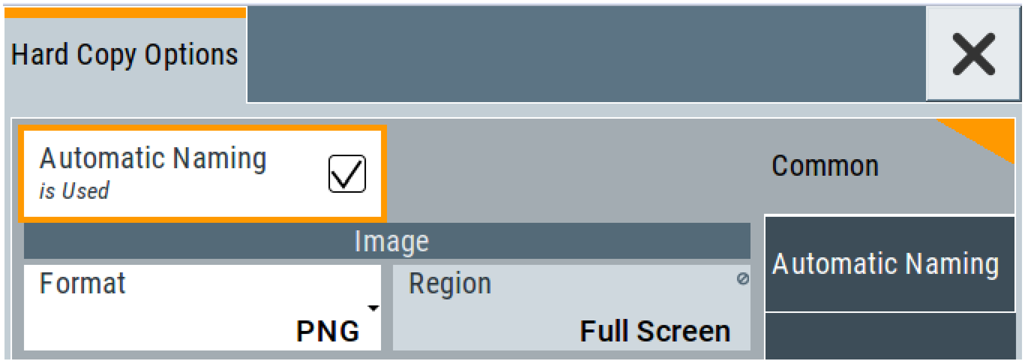
Saves a hardcopy of the current display as a file.

Remote command:
`:HCOPy[:EXECute]` on page 441

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 442

Format ← Hardcopy Options > Common

Selects the output file format, for example `*.bmp`, `*.jpg*.xpm` and `*.png`.

Remote command:
`:HCOPy:IMAGe:FORMat` on page 440
`:HCOPy:DEVice:LANGuage` on page 440

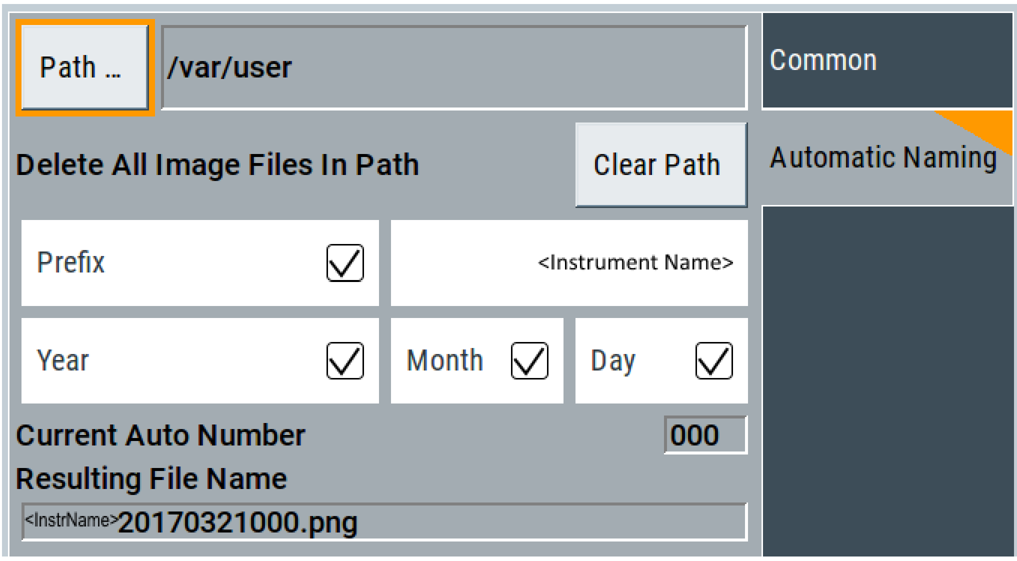
Region ← Hardcopy Options > Common

Displays the snapshot area.

Remote command:
`:HCOPy:REGion` on page 440

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 441

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 442

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 443
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe` on page 443
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe` on page 442
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe` on page 442
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe` on page 442

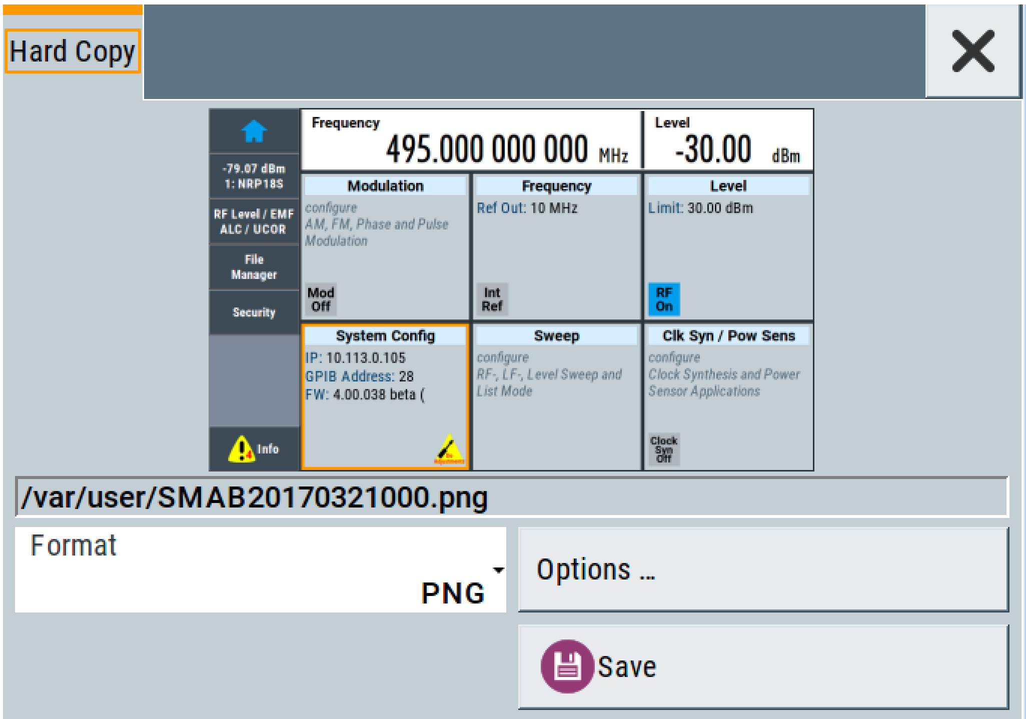
Current Auto Number ← Hardcopy Options > Automatic Naming
Indicates the number which is used in the automatically generated filename.

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 443

10.10.2 How to Save a Hardcopy of the Display

1. Select "System Config > Setup > User Interface > Hardcopy".



2. To define the output format, select "Format > JPG".
3. To enable the instrument to create output filenames, select "Automatic Naming > On".
4. Select "Options...".
5. In the "Hardcopy Options" dialog:
   a) To change the default directory the file is saved in, select "Automatic Naming Settings > Path" and define a path and a filename. For example, select the default directory `/var/user`.
   b) If necessary, disable or change some of the parameters in the "Automatic Naming Settings".
   c) Close the "Hardcopy Options" dialog.
6. In the "Hardcopy" dialog, select "Save".

   The instrument saves a hardcopy of the current instrument display as a `*.jpg` file. The filename is automatically created.
7. To print the hardcopy, connect the instrument to a LAN and:
   a) Transfer the file to a remote computer as described in Chapter 10.9, "How to Transfer Files from and to the Instrument", on page 305.
   b) On the remote computer, navigate through the file system.

c) Print the selected file.
For more information, refer to the online help of the operating system.

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:

- Chapter 11.1, "Customizing the User Interface", on page 317
  Allows you to adjust the display and keyboard language settings.
- Chapter 11.3, "Managing Licenses and License Keys", on page 328
  If you have purchased an additional option for the R&S SMA100B, you can enable it using a license key.
- Chapter 10.2, "Restoring the (Default) Instrument Configuration", on page 285
  At any time, you can restore a default configuration to start a measurement at a defined instrument state, or set the instrument to factory preset.
- Chapter 14.3, "Performing Maintenance Tasks", on page 688
  Special functions like calibration routines and self-tests put your instrument to an initial state.
- Chapter 11.4, "Using the Security Settings", on page 332
  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 SMA100B 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 SMA100B refreshes the displayed settings by default in almost real-time, to keep the display updated with the internally used values. However, you can turn off this function to reduce settling times when the instrument is remote controlled.

We recommend that you switch off the display update for optimum sweep performance with short dwell times and for fast settling times.
Consider that in this case the displayed values can differ from the operated values.

In detail described in the following paragraphs, you can:

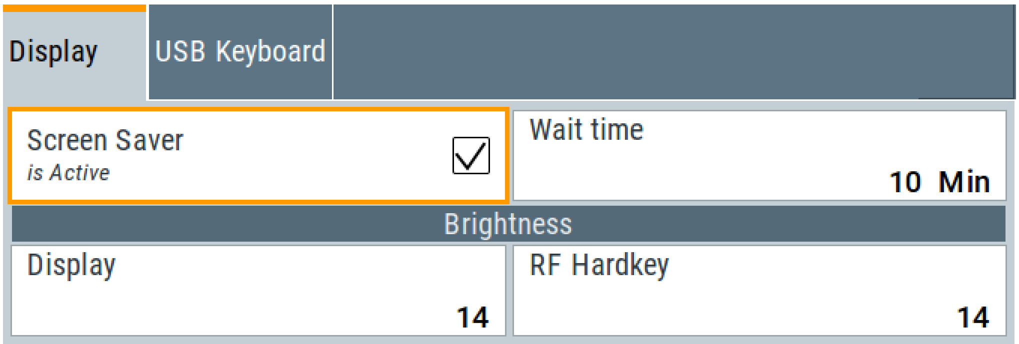
- Set display and keyboard language, see Chapter 11.1.1, "Display and Keyboard Settings", on page 318

- Set date and time for the system clock, see Chapter 14.3.1, "Date and Time Settings", on page 689
- Configure and activate a Screen Saver
- Deactivate display update to improve performance, see Chapter 11.1.2, "Display Update Settings", on page 319
- Determine the state of the RF signal, and the level display in the status bar when you turn on the R&S SMA100B, see Chapter 11.1.3, "Defining the RF Signal State On Power On ", on page 320.

11.1.1 Display and Keyboard Settings

Access:

1. Select "System Config > Setup > User Interface > Display/Keyboard > Display".



2. Select "Display/Keyboard > USB Keyboard".

In the "Display/Keyboard" dialog, you can change regional and language options for the GUI and an external keyboard, and define the screen saver settings.

The remote commands required to configure the display and keyboard are described in Chapter 13.9, "DISPlay Subsystem", on page 432 and Chapter 13.12, "KBOard Subsystem", on page 443.

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 433

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 433

Display
Adjusts the brightness of the display.

Increase the value to turn up the display brightness.

Remote command:
`:DISPlay:BRIGhtness` on page 434

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 434

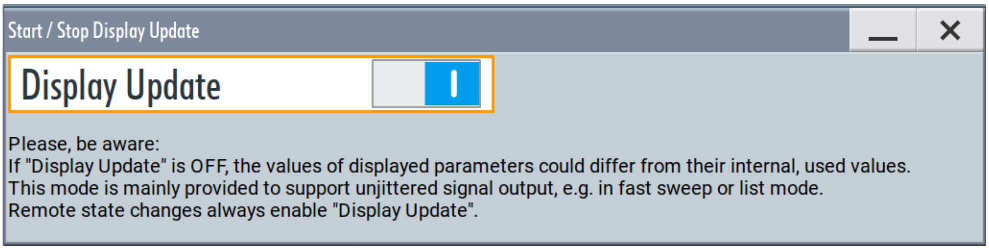
USB Keyboard > Layout
Selects the language of an externally connected keyboard via USB. The function assigns the corresponding keys automatically.

Remote command:
`:KBOard:LAYout` on page 443

11.1.2 Display Update Settings

Access:

► Select "System Config > Setup > User Interface > Start/Stop Display Update".



This dialog enables you, to deactivate updating the display.

The remote command to switch off the display update is described in Chapter 13.9, "DISPlay Subsystem", on page 432.

Display Update is
Disables the automatic refreshing of the displayed values.

Remote command:
:DISPlay:UPDate on page 434

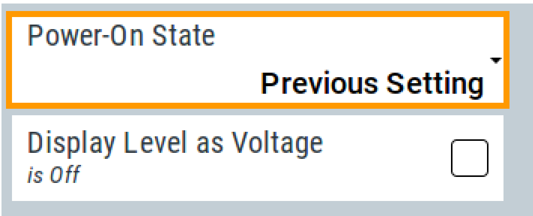
11.1.3 Defining the RF Signal State On Power On

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 SMA100B.

Power-On/EMF settings

Access:

► Select "Level" > "Power-On / EMF".



The "Power-On/EMF" dialog contains all settings for configuring the power-on behavior and the level display.

Settings:

Power-On State
Determines the RF signal output state when the instrument is switched on.

You can disable the RF output signal in general, or start it in the same state as it had been when it was switched off.

Remote command:
:OUTPut<hw>[:STATe]:PON on page 445

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 631

11.1.4 How to Set the Initial Instrument Settings

This section describes how to set up the R&S SMA100B 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".

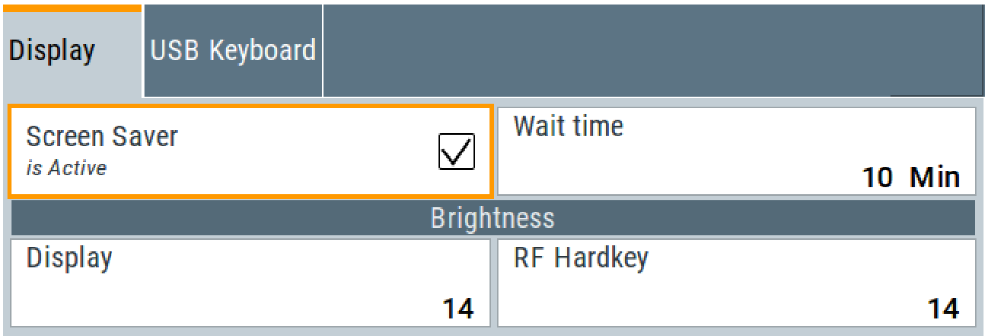
   The dialog closes and the changes take effect immediately.

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 [★ (User)] key is a key with customizable function. Per default, pressing the key opens the "User Menu" but you can add or remove actions, too. You can add actions to be executed or function to be accessed upon pressing this key.

User menu and [★ (User)] key

These two functions work similar to the favorites function of browser or other programs. They allow you to create a list of frequently used actions or to group frequently used settings in one single dialog.

Possible applications

The ★ (User) key is useful in the following situations:

- There are functions or tasks you have to perform in a defined order but they are distributed among several dialogs
- There are functions or tasks you have to perform more frequently than others but they are not accessible via a front panel key.
- The required functions are grouped in a dialog that is not directly accessible from the blocks on the home screen.
- Your task involves the frequently loading and executing of certain SCPI scripts. Refer to Chapter 12.14, "How to Record / Create SCPI Lists", on page 391 for information on how to create an SCPI script.
- A quick access to saved setups is required.

Dialog identification

To identify each dialog, the instrument uses a dedicated dialog ID. The dialog ID contains the dialog position on the display and the current active tab. The action that triggers the instrument to open a dialog uses this identification.

Save/Recall vs. recall setup

Sometimes, you would like to restore a specific signal generation setup and perform further configurations based on this particular instrument state. The R&S SMA100B provides two ways to achieve this, by the "Save/Recall" function and by the "Recall Setup" function.

- "Save/Recall"
  For a detailed description, refer to Chapter 10.4, "Saving and Recalling Instrument Settings", on page 291.
- "Recall Setup"
  If the "Recall Setup" is the only one user action assigned to the [★ (User)] key, pressing this key triggers the R&S SMA100B to load *immediately* the user-defined preset file.

11.2.1 Using the User Menu for Fast Adjustments

By default, there is one predefined action assigned to the [★ (User)] key.

1. Press the [★ (User)] key.

   The "User Menu" dialog opens.
   If you execute this action for the first time, the dialog is empty.
2. Follow the instructions displayed in the "User Menu" dialog to build your own dialog with settings.
3. Alternatively, proceed as follows:
   a) Open a dialog with settings you frequently use.
   b) Select a parameter.

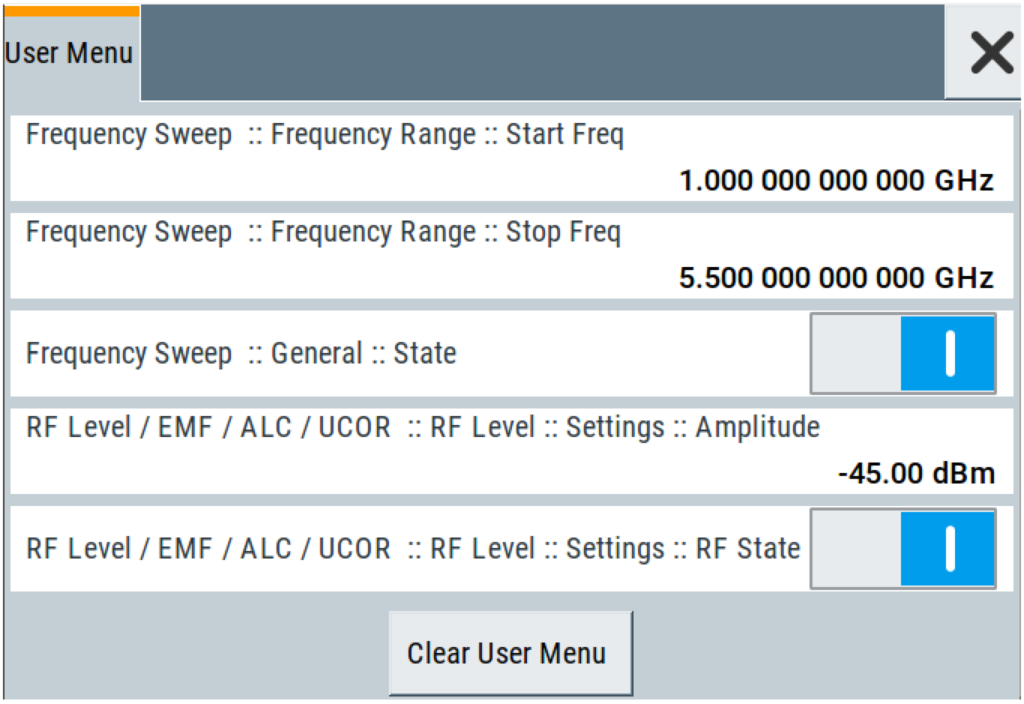
c) Open the context menu and select "Add to User Menu".

A favorites icon ★ indicates that the parameter is used in the "User Menu".

The "User Menu" indication in the task bar confirms that "User Menu" with favorites is created.

d) Press the [★ (User)] key.

The "User Menu" dialog shows all parameters that you have added to the list.



You can configure them, e.g .change state or set values, as you do in the particular dialog the entry originally appears.

4. To remove an entry, in select it (in the "User Menu" or in the particular dialog the entry originally appears.
   Open the context menu and select "Remove from User Menu".

5. In the "User Menu", select "Clear User Menu" to remove all entries at once.

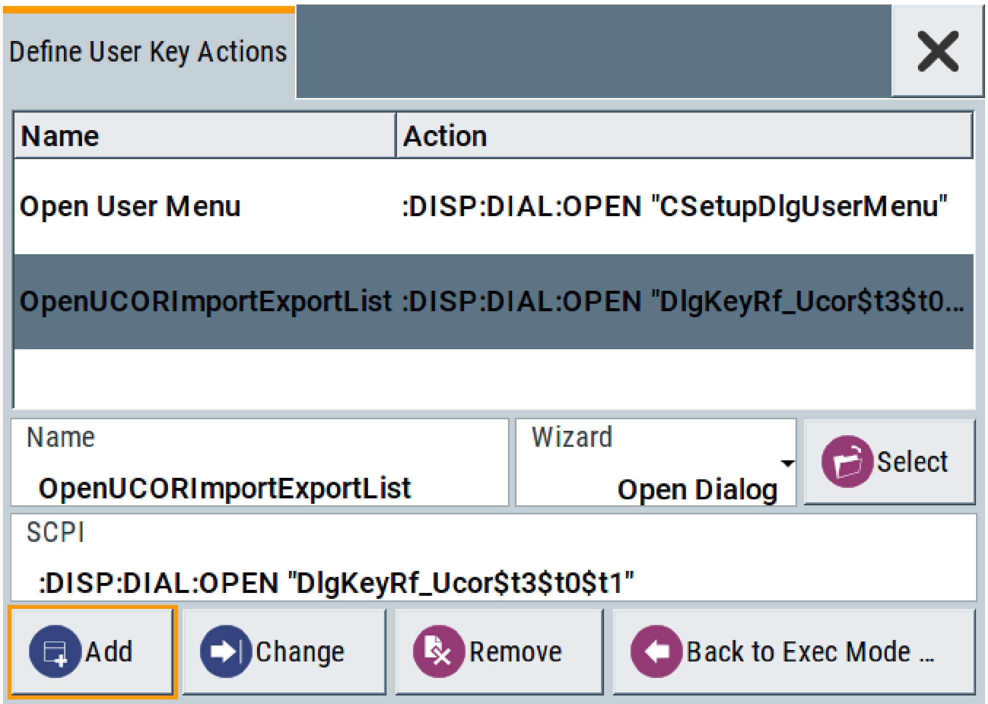
Settings

Clear User Menu
Removes all entries from the "User Menu" at once.

11.2.2 Define User Key Actions Settings

Access:

► Select "System Configuration > Setup > User Interface > Define User Key".



The dialog displays a list of the currently enabled actions and provides functions to define new, edit or remove existing actions. If no actions have been defined, the list is empty.
See Chapter 11.2.3, "Assigning Actions to the [★ (User)] Key", on page 326.

The remote commands required to define these settings are described in Chapter 13.9, "DISPlay Subsystem", on page 432.

Name
Enters a user-defined name for the action.

Wizard
Defines the action to be executed.

"Load SCPI Script"
Selecting the action load and executes the SCPI script.

"Recall Setup" Load a setup for quick access to the user-defined settings.

"Open Dialog"
Quick access to the selected dialog.

Select
Depending on the selected "Wizard", provides access to:

- The standard "File Select" function for loading of an SCPI script or setup file
- A list of the dialog IDs of all currently opened dialogs. The dialog ID is used for dialog identification in the remote control.
  See SCPI.

SCPI
For the currently selected action, displays the corresponding SCPI command with the associated parameter for dialog identification (dialog ID). The automatically displayed SCPIs are enabled for subsequent modification.

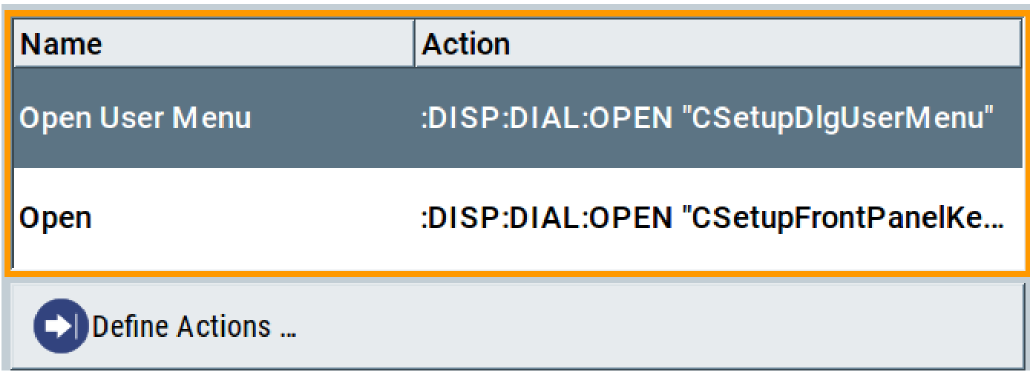
Remote command:
`:DISPlay:DIALog:OPEN` on page 436
See also `:DISPlay:DIALog:ID?` on page 435

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



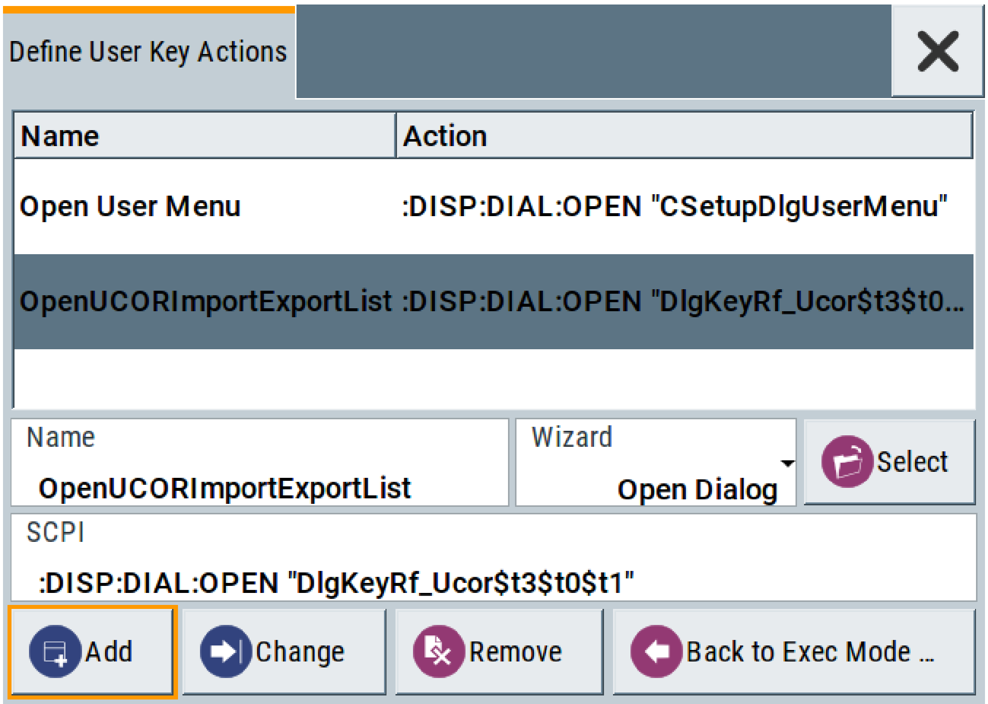
Accesses the "Define User Key Actions" dialog.

11.2.3 Assigning Actions to the [★ (User)] Key

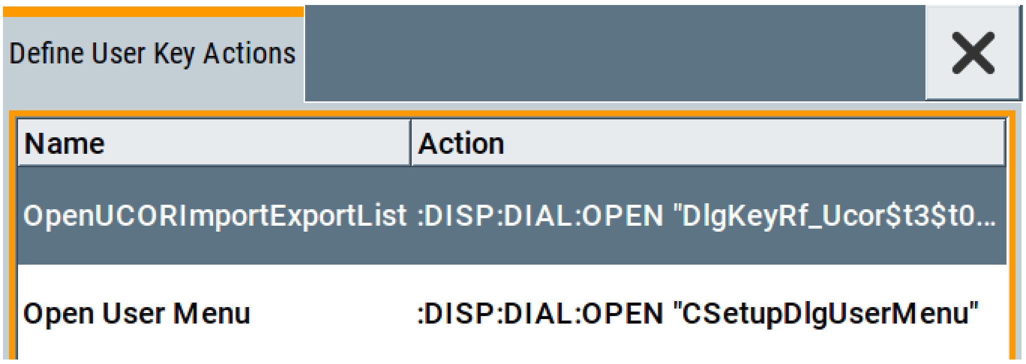
1. Open the dialog for that you are creating a quick access.
   For example, select "Level > UCOR > Import/Export"
2. Select "System Configuration > Setup > User Interface > Define User Key".

3. To create an action:
   a) Specify the "Name".
   b) Select "Wizard > Open Dialog"
   c) Select "Select" and select the dialog ID from the list

   The corresponding SCPI command is automatically displayed and can be later modified.
4. Select "Add" to store the new action in the list of user key actions.



5. To execute the created action, press ★ (User).
   In the list of actions ("Select Action to Execute" dialog), navigate to the required action.
   In this example, this is "OpenUCORImportExportList".



   The action is executed. The dialog opens.

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.

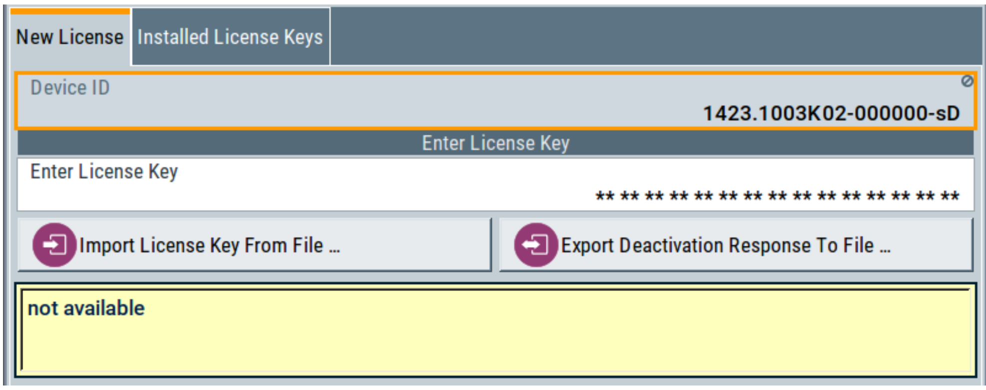
The firmware update is described in the R&S SMA100B service manual.

11.3.1 Manage License Keys Settings

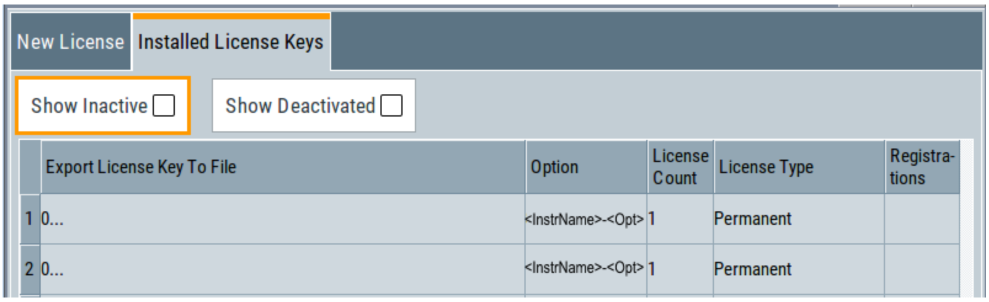
This dialog is the central dialog for licenses registration and performing the required instrument-related steps during the process of unregistration.

Access:

1. Select "System Config > Setup > Instrument Assembly > Manage License Keys > New License".



2. Select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys".



In the "New License" tab, you can activate licenses for newly purchased or newly registered options. The "Installed License Keys" tab enables you to cancel already registered options, or move licenses.

Settings

Device ID

Displays the instrument-specific identification number. The device ID is a unique string with the following structure:

<stock number>-<serial number>-<checksum>

Enter License Key

Type here the license key provided with the option.

For license keys delivered as a file, use Import License Key from File....

Import License Key from File...

Opens a dialog for selecting the file with the license key.

Use this function also to import the deactivation key file generated by the R&S License Manager online tool (see How to Move a Portable License).

Export Deactivation Response to File...

Exports the generated deactivation response key to a file and opens a file 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).

Info Line

Indicates status information on the performed actions.

Installed License Keys
Access: select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys".

Comprises information on the installed options.

Show Inactive ← Installed License Keys
Enables the display of the inactive (expired) licenses in the Installed License Keys Table.

Show Deactivated ← Installed License Keys
Enables the display of the deactivated licenses in the Installed License Keys Table.

See How to Move a Portable License for information on how to activate deactivated licenses.

Installed License Keys Table ← Installed License Keys
Shows information on the currently installed options.

"Export License Key to File"
Opens a dialog to save the generated license key file. This file is required during the unregistration process.
If you have a portable unregistered option, you can register it later on another instrument (see How to Move a Portable License).

"Option" Displays the option short designation.
Tip: Open the Hardware Options/Software Options dialog to retrieve more information about the installed options.

"License Count"
Displays the number of the licenses for the selected option key.

"License Type" Displays the type of license.
A license type determines the common qualification application duration and the portability of a license. The following license types are provided: evaluation, permanent, portable, quantified, time-controlled with a duration of 1, 3, 6 or 12 months. A license can also be deactivated or expired.
For time limited licenses, the left time of applicability is displayed too.

"Registrations" (reserved for future use)

11.3.2 How to Move a Portable License

This example is intended to explain how to perform the required steps at the instrument.

Use a USB flash drive to transfer the license key files between the instruments and the browser.

We assume knowledge about the handling of the R&S License Manager online tool and the description of the whole process.

1. Open your browser. Enter https://extranet.rohde-schwarz.com/service.
   Select "Manage Licenses > Move Portable License".

   The first step requires the Device IDs of the source and target instruments.

2. To find out the Device IDs, proceed as follows:
   a) On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New License > Device ID".
   b) On the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New License > Device ID".
   c) In the browser, select "Manage Licenses > Move Portable License > Select Devices" and enter the Device IDs.

3. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys > License Keys Table".
   Navigate to the portable license you want to move.
   Select the "Export License to File" column.

   A standard file manager dialog opens.

4. Enter a filename. Save the exported license key, e.g.
   `k123_portable_key_to_move.xml`.

5. In the browser, select "Manage Licenses > Move Portable License > Select License (from file)" and select the exported license key.
   Check the selection. Create the deactivation key. Save it to file.

6. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New Licences > Import License Keys from File".
   Select the transferred deactivation key.

7. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New Licences > Export Deactivation Response to File".

8. In the browser, go to "Manage Licenses > Move Portable License > Install Deactivation Key (from file)".
   Enter the deactivation response of the instrument.

   The license is deactivated for the source instrument.

9. In the "Manage Licenses > Move Portable License", go to step "Create License" to generate a license key for this portable option and the selected target instrument.
   Download the license key as a file. Transfer it to the target instrument.

10. In the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > New License > Import License Keys from File".
    Select the created license key file.

    The portable option is installed on the target instrument.

11.4 Using the Security Settings

The protection function of the R&S SMA100B offers several levels to activate particular functions like self-test or tests for service purposes specifically.

Protection

The five protection levels are automatically active on startup, the protection levels, that means all protected functions are locked.

To unlock a protection level:

► In the "System Config > Setup > Security > Protection", enter the correct password.

To lock a protection level:

► Clear the corresponding checkbox.

Protection levels

The following functions are protected in the respective levels:

- Protection level 1
  Protects against accidental changes, like, for example, the clock and date, several internal adjustments functions and the self-test, as well as network settings or the instrument hostname.
  You can access this level with the password 123456.
- Protection level 2
  Unlocks protected service functions. It is accessible to authorized personnel of Rohde & Schwarz service department only.
- Protection level 3 to 5
  Are reserved for factory internal use.

Security

The security concept of the R&S SMA100B helps you to protect your instrument against uncontrolled access and changes. All provided security services require that you enter the security password.

Provided security services are:

- **General** security parameters, such as:
  – **USB storage** that secures controlled access to the mass memory of the instrument
  – **Volatile mode** that prevents information to be written to the internal memory permanently.
  – **Sanitizing** that prevents the instrument from leaving a secure environment with stored user information.
  – **Annotation** frequency and amplitude prevent reading the display.
  – **Secure Update Policy** check that verifies the integrity and origin of the firmware package to be installed.

To access the settings of these topics, see Setting Security Parameters > "Secure Update Policy" on page 335.

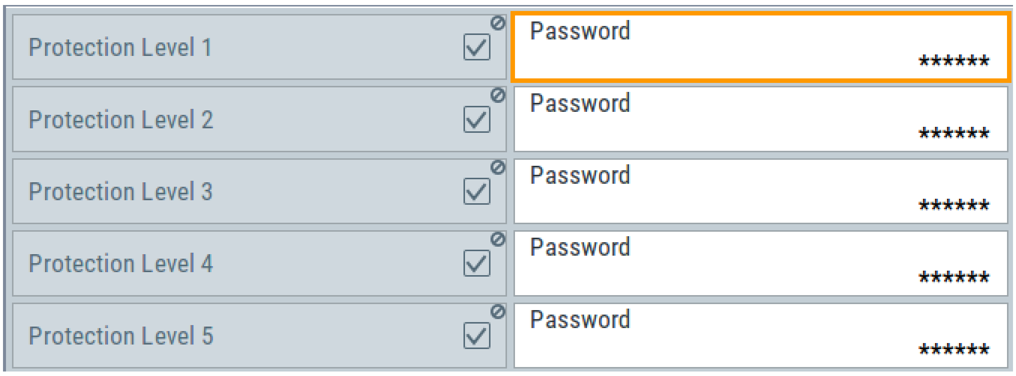
- **Password** management secures controlled user access to the instrument
  With the two-step password concept, you can assign a user-defined password for the operating system, and a security password for accessing the mass storage of the instrument.
  See also Chapter 11.4.4, "Password Management", on page 341.
- **LAN services** secure controlled network access
  You can individually lock and unlock the supported LAN interface services, see Chapter 11.4.3, "Configuring LAN Services", on page 340.
  Remote control via LAN interface requires that the interface is activated, but you can enable the required services specifically.
- **User interface** prevents front panel operation and/or reading the display.

For more information, see the document R&S SMA100B Instrument Security Procedures.

11.4.1 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 332.

The remote commands required to unlock a protected stage are described in Chapter 13.17, "SYSTem Subsystem", on page 653.

Protection Level/Password

Unlocks the selected level of protection, if you enter the correct password.

The default protection level 1 password is 123456.

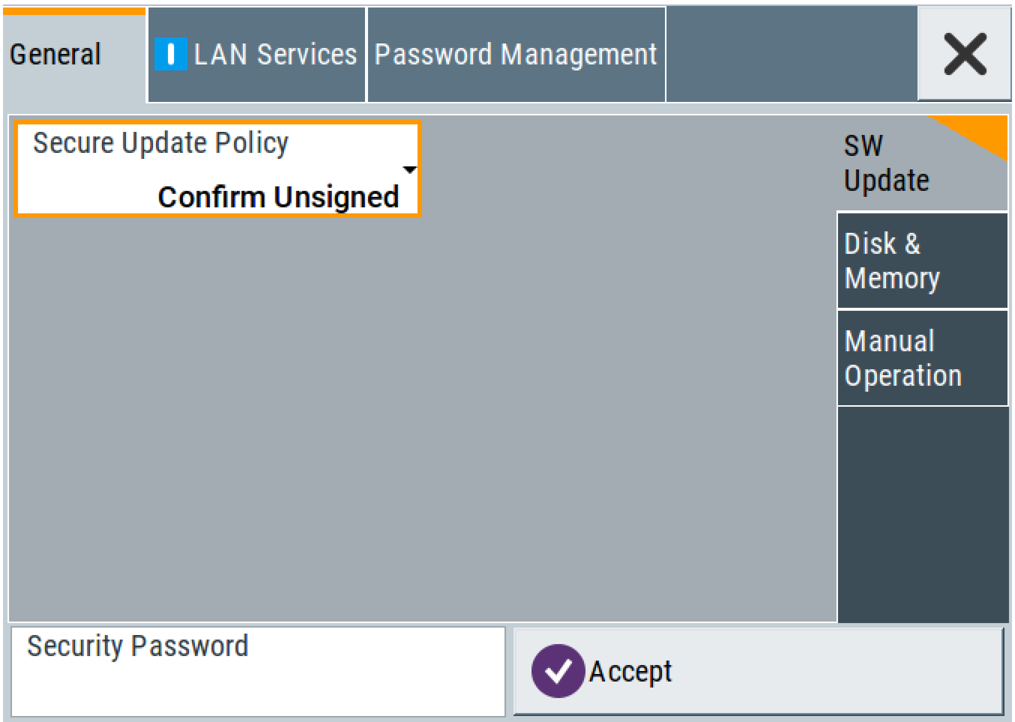
To lock the protection level again, clear the checkbox.

Remote command:
`:SYSTem:PROTect<ch>[:STATe]` on page 661

11.4.2 Setting Security Parameters

Access:

► Select "System Config > Setup > Security > Security > General".



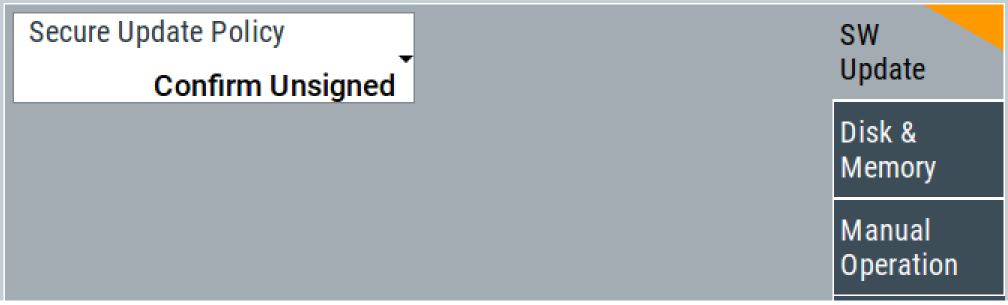
In the "General" tab, you can determine the security level for firmware updates, and configure the security settings for the mass memory and manual operation.

All modified settings in this dialog are not applied until you enter the Security Password and confirm with Accept.

11.4.2.1 Update Policy Security Settings

Access:

► Select "System Config > Setup > Security > Security > General > SW Update".



The SW Update tab enables you to select the security mode for firmware updates.

The remote commands available to control security settings are described in Chapter 13.17, "SYSTem Subsystem", on page 653.

Secure Update Policy

Allows you to configure the automatic signature verification for firmware installation.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See also:

- Chapter 11.4, "Using the Security Settings", on page 332 for more information on the security concept.
- The release notes for details on signature verification when installing new or former firmware versions, available at www.rohde-schwarz.com/firmware/sma100b.

"Confirm Unsigned"
: Performs the signature verification.
If the check detects any discrepancies, the instrument issues a warning message. You can still update the firmware or reject updating.
This setting also enables you to downgrade the firmware version.

"All Packages"
: Accepts all packages without signature verification.

"R&S Signed Packages"
: Performs the signature check.
If the check detects any discrepancies, the instrument issues a warning message and locks the update to this firmware.

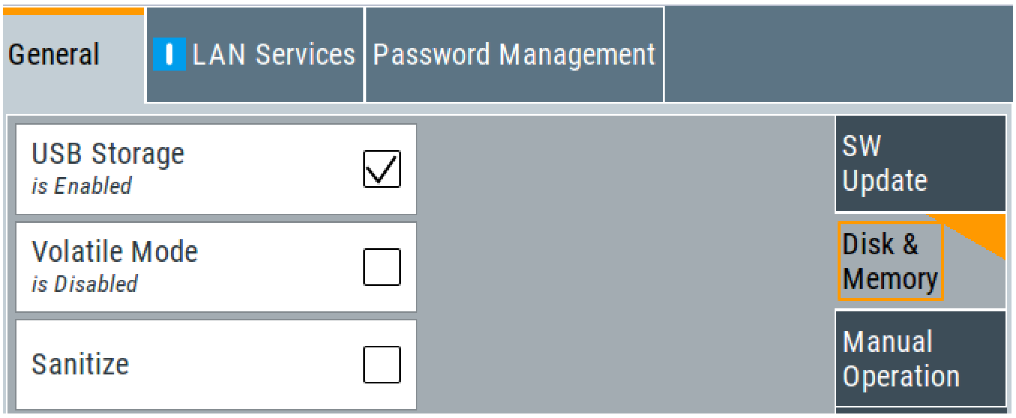
Remote command:

`:SYSTem:SECurity:SUPolicy` on page 670

11.4.2.2 Disk & Memory Security Settings

Access:

► Select "System Config > Setup > Security > Security > General > Disk & Memory".



The "Disk & Memory" tab secures controlled access to the mass memory and prevents information from leaving a secure environment.

The remote commands available to control security settings are described in Chapter 13.17, "SYSTem Subsystem", on page 653.

USB Storage

Activates the access to external USB storage media.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See also Chapter 10.9.4, "Using a USB Storage Device for File Transfer", on page 310.

Volatile Mode

Activates volatile mode, so that no user data can be written on the internal memory permanently.

In volatile mode:

- Data that the instrument normally stores on the internal memory is redirected to volatile memory.
- The user directory is mapped to the volatile memory. You access the temporary data just as data stored in the `/var/user/`, see Chapter 10.3, "Protecting Data", on page 290.
- Data on the internal memory cannot be changed. It is protected against modification or erasure.
- You can only save data:
  – Temporarily in the volatile memory
  – On a connected external storage device, such as a memory stick

To activate volatile mode: enter the security password, confirm with "Accept" and reboot the instrument. Otherwise the change has no effect.

Activated volatile mode is indicated by an icon.

Remote command:
`:SYSTem:SECurity:VOLMode[:STATe]` on page 662

Sanitize

Executes the erase procedure that sanitizes the internal memory.

If the instrument is subject to high security, and you have not enabled the volatile mode, the internal flash memory holds user-data, i.e. id poses a security risk. The sanitizing function makes sure that no user information is stored on the instrument when it leaves the secure environment.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

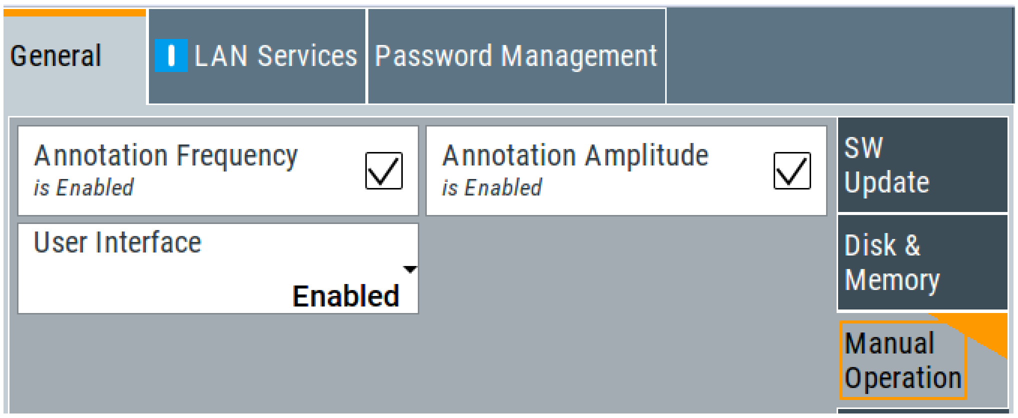
See also Chapter 11.4, "Using the Security Settings", on page 332 for more information on the security concept.

Remote command:
`:SYSTem:SECurity:SANitize[:STATe]` on page 670

11.4.2.3 Manual Operation Security Settings

Access:

► Select "System Config > Setup > Security > Security > General > Manual Operation".



The "SW Update" tab enables you to lock front panel operation and/or reading the display.

The remote commands available to control security settings are described in Chapter 13.9, "DISPlay Subsystem", on page 432, and the Chapter 13.17, "SYSTem Subsystem", on page 653.

Annotation Frequency
Enables the display of the currently used frequency in the status bar.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

Remote command:
`:DISPlay:ANNotation:FREQuency` on page 435

Annotation Amplitude
Enables the display of the currently selected level in the status bar.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

Remote command:
`:DISPlay:ANNotation:AMPLitude` on page 434

User Interface
Allows you to lock the controls for manual operation and the display individually.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See also Chapter 11.4, "Using the Security Settings", on page 332 for more information on the security concept.

"Enabled"
Enables the display and all controls for the manual operation of the instrument.

"Touchscreen Off"
Locks the touch sensitivity of the screen.
This security feature protects the instrument against unintentional change of settings by accidentally touching of the screen.

Still available controls for manual operation are:
- The keys at the front panel, including the rotary knob
- The external mouse and keyboard
- Remote operation over VNC

The instrument indicates the locked touchscreen by an icon .
Unlocking is possible via VNC, external controls or remote control.

"VNC Only"
Locks the keys at the front panel, the touchscreen and externally connected keyboard and mouse.
The display on the screen remains and shows the current settings and changes.
The instrument indicates the activated "VNC only" feature by the icon .
Unlocking is possible via VNC or turning off and on again.

"Display Only"
Locks the manual operation of the instrument. The display on the screen remains and shows the current settings and changes.
This security feature protects the instrument against unauthorized access, but still shows the current settings and processes, for example when you operate the instrument via remote control.

The function disables:
- The touchscreen functionality of the display
- The keys at the front panel of the instrument
- The external mouse and keyboard

The instrument indicates the locked controls by a padlock softkey.
Unlocking is possible by entering the security password, see Enabling a locked user interface for manual operation.

"Disabled" Locks the display and all controls for the manual operation of the instrument.
This security feature protects the instrument against unauthorized reading and access, for example when you operate the instrument via remote control.

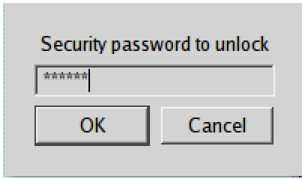
The function disables:
- The display
- The touchscreen
- The keys at the front panel of the instrument
- The external mouse and keyboard

The screen shuts off and displays a padlock symbol instead.
Unlocking is possible by entering the security password, see also Enabling a locked user interface for manual operation.

Remote command:
:SYSTem:ULOCk on page 659
:SYSTem:DLOCk on page 660
:SYSTem:KLOCk on page 660

Enabling a locked user interface for manual operation

To unlock the user interface for manual operation, use one of the following:
- On the instrument's keypad or external keyboard, press any key.
  The instrument prompts you to enter the security password for unlocking.

  Note: The character of the first key you pressed is immediately added in the input field. Delete the entry before inserting the password.
  Enter the security password *123456*.
- In remote control mode, send the command `SYST:ULOC ENABled` to release all locks at once.
  Alternatively:
  – Send the command `SYST:KLOC OFF` to unlock the keyboard and touchscreen
  – Send the command `SYST:DLOC OFF` to release all locks.

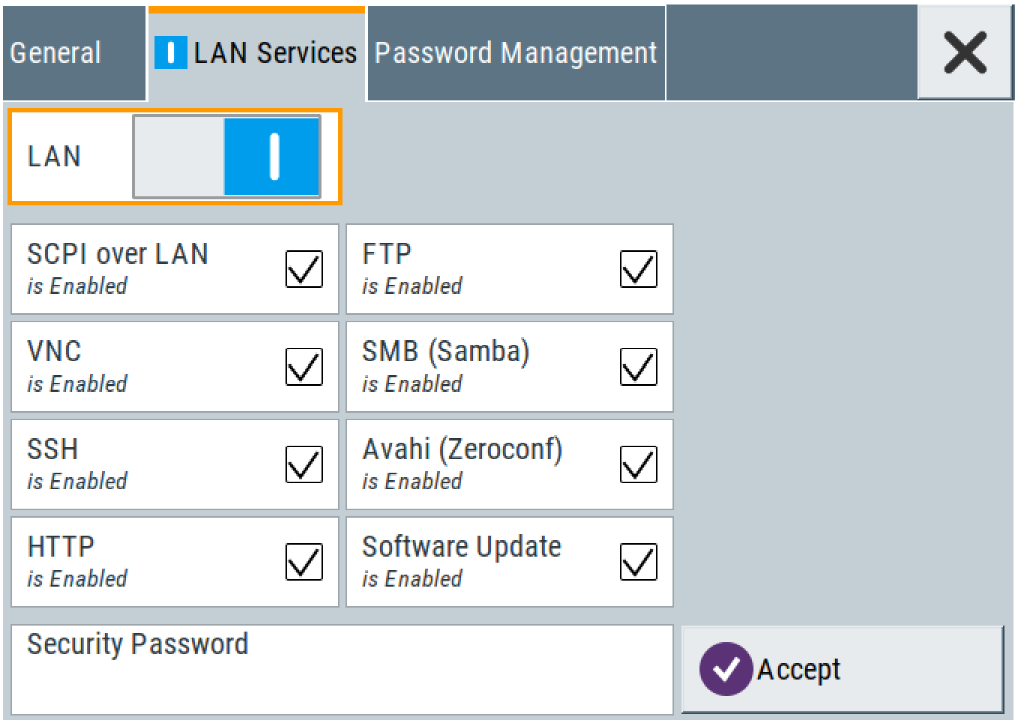
  Via remote control, there is no password required.

Remote command:
:SYSTem:ULOCk on page 659
:SYSTem:DLOCk on page 660
:SYSTem:KLOCk on page 660

11.4.3 Configuring LAN Services

Access:

► Select "System Config > Setup > Security > Security > LAN Services".



In the "LAN Services" dialog, you can individually enable or disable the supported LAN interface services.

> The activated LAN services are not activated until you enter the "Security Password" on page 341 and confirm with Accept.

LAN
Enables the LAN interface in general, and thus provides remote access via all unlocked services.

Enable LAN Services individually
Enables or disables the following interface services individually.

"SCPI over LAN"
Activates access over LAN to control the instrument remotely, by using SCPI (Standard Commands for Programmable Instruments) commands.
See also "Starting a remote control session over LAN with R&S VISA" on page 379.

"VNC" Activates access via VNC (Virtual Network Computing) interface, a graphical desktop sharing system that uses RFB protocol to control the instrument remotely.
See also Chapter 12.16, "How to Set Up Remote Operation via VNC", on page 395.

"SSH" Activates access via SSH (Secure Shell), a network protocol for secure data communication.

"HTTP" Activates access via HTTP (Hyper Text Transfer Protocol), the application protocol for hypermedia information systems.

"FTP" Activates access via FTP (File Transfer Protocol), used to transfer files from a host to the instrument and vice versa.
See also Chapter 10.9.2, "Accessing the File System of the R&S SMA100B Via ftp", on page 307.

"SMB (Samba)"
Activates access to SMB (Server Message Block), used for providing shared access to files, printers and serial ports of a network.
See also Chapter 10.9.3, "Accessing the R&S SMA100B File System Via SMB (Samba)", on page 308.

"Avahi (Zeroconf)"
Activates Avahi, a service for automatic configuration of the instrument in a network environment.

"Software Update"
Allows updating the software.

Security Password
Enters the password that is required to enable or to disable the settings protected by a security password. Default is *123456*.

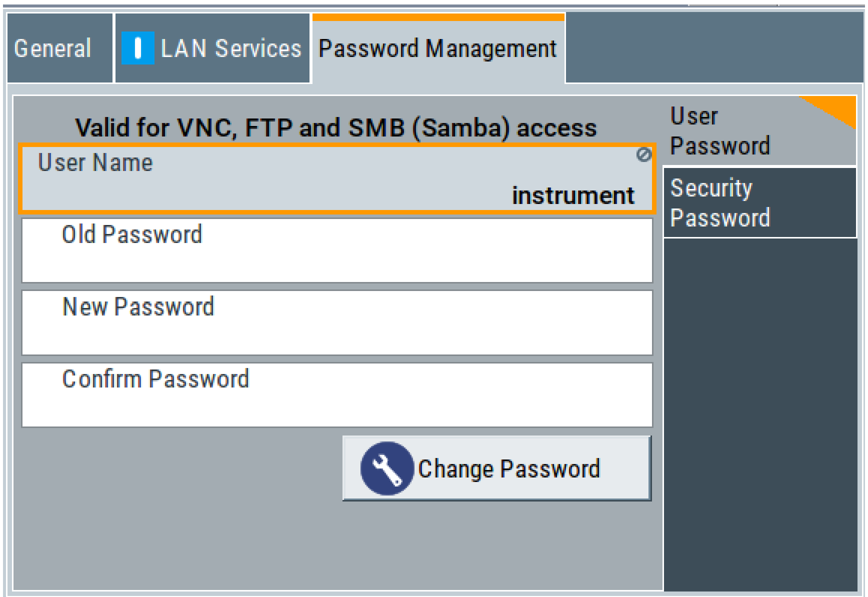
Note:
- We recommend that you change the default security password before connecting the instrument to the network.
- The security settings are not assigned until you select the "Accept" button.

Accept
Applies the modified settings, provided the security password is entered and correct.

11.4.4 Password Management

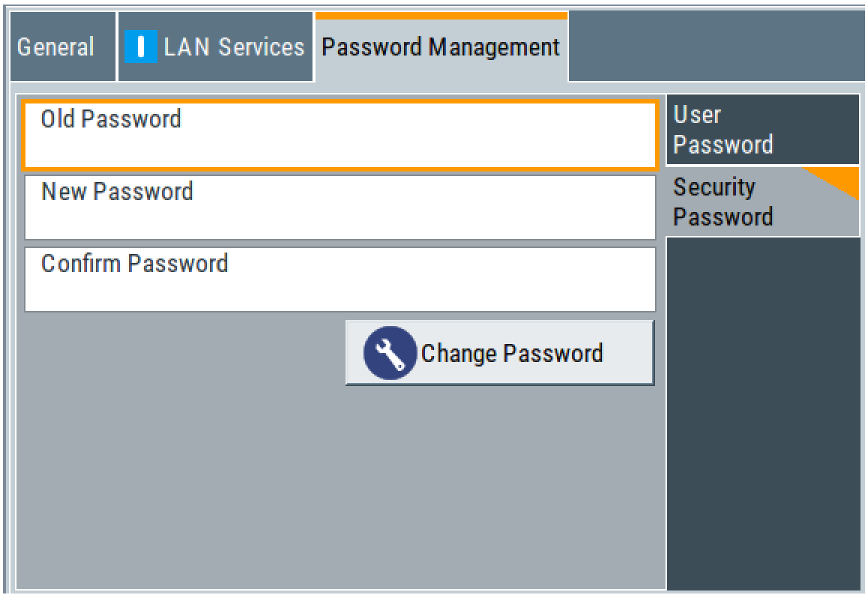
Access:

1. Select "System Config > Setup > Security > Security > Password Management > User Password".



In this tab, you can assign the security and a user-defined password.

2. Select "System Config > Setup > Security > Security > Password Management > Security Password".



A new password does not take effect until you confirm it with the corresponding "Change Password" button.

To confirm the new password, always press:

- "User Password" > Change Password
  Or
- "Security Password" > Change Password

User Name
Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SMB (Samba) access.

User Password
Access: select "System Config > Setup > Security > Security > Password Management > User Password".

Allows you to change and confirm the user password.

Old Password ← User Password
Enters the current user password. The default password is "instrument".

Note: We recommend that you change the default password before connecting the instrument to a network.

New Password ← User Password
Enters the new user password.

The security password can contain decimal characters only.

Confirm Password ← User Password
Confirms the new user password by repeating.

Note: The new password is not assigned until you select the Change Password button.

Change Password ← User Password
Changes the user password accordingly.

Security Password
Access: select "System Config > Setup > Security > Security > Password Management > Security Password".

Enables you to change and confirm the security password.

Old Password ← Security Password
Enters the currently used security password. The default password is '123456'.

Note: We recommend that you change the default password before connecting the instrument to a network.

The security password is required when changing the status of the USB and LAN interface.

New Password ← Security Password
Enters the new security password.

The security password can contain decimal characters only.

Confirm Password ← Security Password
Confirms the new security password by repeating.

Note: The new password is not assigned until you select Change Password button.

Change Password ← Security Password
Changes the password accordingly.

11.5 Undoing or Restoring Actions

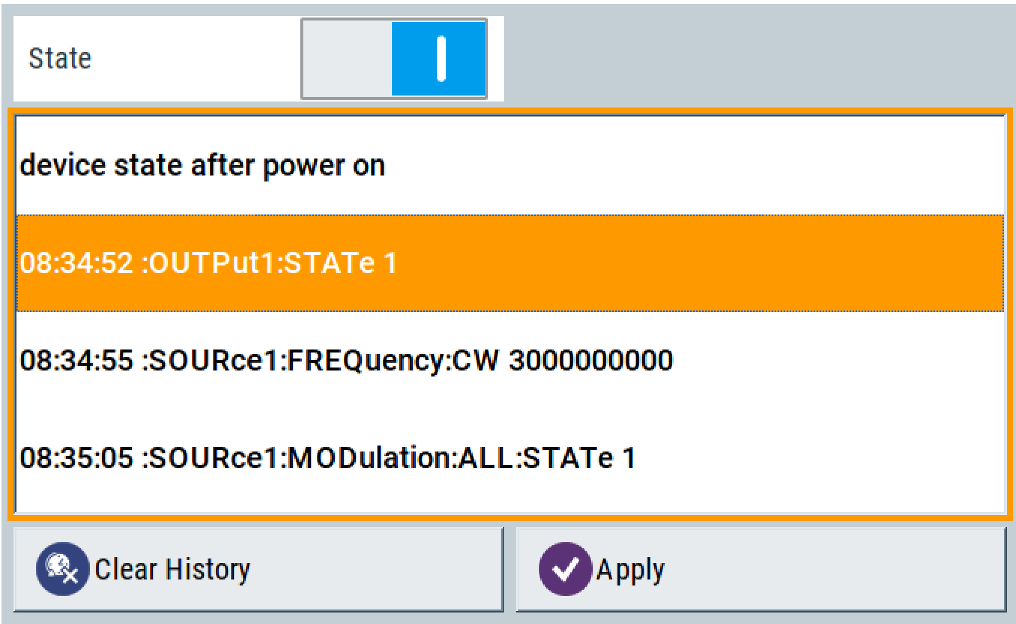
"Undo" is a function that removes the effect of the last action on the instrument and reverts it to an older state. Conversely, "Redo" restores a previously undone action.

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

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.

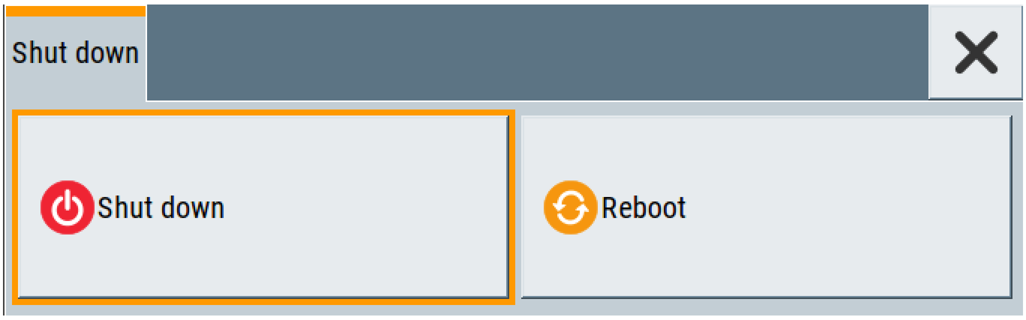
If you select a subsequently executed action, you can restore all the actions undone up to this state.

11.6 Shutting Down and Rebooting the Instrument

The [Power On/Standby] front panel key switches the instrument from the standby to the ready state or vice versa. In remote operation from a remote computer or in manual control, there is another possibility to shut down the instrument or to reboot the system.

Access:

► Select "System Config > Setup > Maintenance > Shut Down".



Remote command:

- `:SYSTem:REBoot` on page 676
- `:SYSTem:SHUTdown` on page 677

12 Network Operation and Remote Control

The description in this section requires basic knowledge of the remote control operation. Definitions specified in the SCPI standard are not provided.

You find some basic information to the SCPI syntax, command lists, and general programming recommendations in Chapter A.1, "Additional Basics on Remote Control", on page 710. See also Chapter A.1.5, "Status Reporting System", on page 722 for information on the status reporting system of the instrument.

As an alternative to the interactive operation directly at the instrument, you can operate the R&S SMA100B also from a remote location.

The Figure 12-1 shows the possibilities of the physical connection (interfaces) for the remote access.

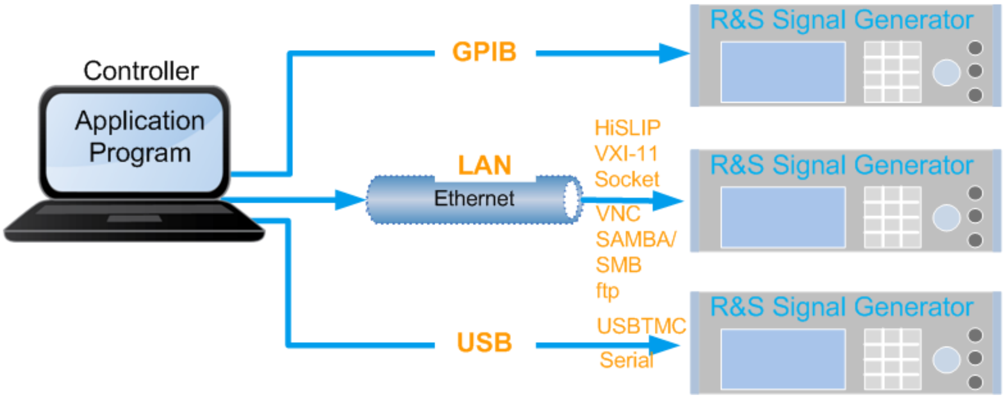


Figure 12-1: Supported remote connections

For information on how to configure a network, see the Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 28.

The various interfaces provide flexible access to the instrument, such as *remote control*, *remote operation* or *remote file access*. These remote access modes are fundamentally different, although they are often considered interchangeable. Refer to Overview of Remote Access Modes for details on these modes.

For comprehensive information on these topics, refer to the application note 1GP72: Connectivity of Rohde&Schwarz Signal Generators.

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)

NOTICE

Risk of unauthorized access

If the VNC service is enabled on the instrument, any user in the network who knows the computer name and password can access it.

Disable the VNC service on the instrument to prevent unauthorized access.

- A remote device accesses the instrument via the common platform technology VNC (Virtual Network Computing).
- The protocol allows simultaneous operation from several remote devices and the instrument nevertheless remains locally operable.
- The GUI is visible.
- To perform the settings, you can operate the instrument as with the manual control.
- Clients supporting remote operation depend on the used remote device, see Table 12-1.

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.
	• Web browser with HTML5	*Web sockets* must be supported.	Slower than the other modes. No additional installation or activation required. No security concern.

Remote device	VNC client	Requirements	Characteristics
Smart device (Tablet/ smartphone)	• Dedicated client App	*App* must be installed.	Fast, supports several options like full screen mode or auto-login.
	• Web browser with HTML5	*Web sockets* must be supported.	Support of QR code scanning Slower than a dedicated App.

Remote file access (FTP, SAMBA/SMB)

- A remote client accesses the instrument's file system, using the protocols FTP (file transfer protocol) and SAMBA/SMB (server message block).
- The protocols enable you to transfer files from or to the instrument and to get direct access to its file sharing directory `share`.

For more information, refer to Chapter 10.9, "How to Transfer Files from and to the Instrument", on page 305.

12.2 Remote Control Interfaces and Protocols

The instrument supports various interfaces for remote control. The table 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 on the rear panel of the instrument.
		The interface is based on TCP/IP and supports various protocols.
		For a description of the protocols, refer to:
		• Chapter 12.2.1.2, "HiSLIP Protocol", on page 351
		• Chapter 12.2.1.3, "VXI-11 Protocol", on page 351
		• Chapter 12.2.1.4, "Socket Communication", on page 351

USB	• **USBTMC** `USB::<vendor ID>::<product ID>::<serial number>[::INSTR]` VISA	The USB In connector is located at the rear panel of the instrument. For a description of the interface, refer to Chapter 12.2.2, "USB Interface", on page 352
GPIB (IEC/IEEE Bus Interface)	• – `GPIB::<address>[::INSTR]` (no secondary address) VISA	Optional GPIB bus interfaces according to standard IEC 625.1/IEEE 488.1 are located on the rear panel of the instrument. For a description of the interface, refer to Chapter 12.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 353.

[*)] VISA (Virtual Instrument Software Architecture) is a standardized software interface library providing input and output functions to communicate with instruments. A VISA installation on the controller is a prerequisite for remote control over LAN (when using VXI-11 or HiSLIP protocol), USB and serial interface. For remote control via socket communication VISA installation is optional. For more information, see Chapter 12.3.1, "VISA Library", on page 354.

Rohde & Schwarz provides the standardized I/O software library R&S VISA for communication with the instruments via TCP/IP (LAN: HiSLIP, VXI-11 and raw socket) or USB (USBTMC) interfaces.

R&S VISA is available for download at the Rohde & Schwarz website http://www.rohde-schwarz.com/rsvisa.

How to configure the remote control interfaces is described in Chapter 12.8, "How to Set Up a Remote Control Connection", on page 374.

SCPI (Standard Commands for Programmable Instruments)

SCPI commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers. The tutorial "Automatic Measurement Control - A tutorial on SCPI and IEEE 488.2" from John M. Pieper (Rohde & Schwarz order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

For more information, see also Chapter A.1, "Additional Basics on Remote Control", on page 710.

12.2.1 LAN Interface

To be integrated in a LAN, the instrument is equipped with a LAN interface, consisting of a connector, a network interface card and protocols.

For remote control via a network, the PC and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol. The TCP/IP network protocol and the associated network services are preconfigured on the instrument. Software for instrument control and (for specified protocols only) the VISA program library must be installed on the controller.

Identifying instruments in a network

If several instruments are connected to the network, each instrument has its own IP address and associated resource string. The controller identifies these instruments by the resource string.

12.2.1.1 VISA Resource Strings

The VISA resource string is required to establish a communication session between the controller and the instrument in a LAN. The resource string is a unique identifier, composed of the specific IP address of the instrument and some network and VISA-specific keywords.

TCPIP::host address[::LAN device name][::INSTR]

TCPIP = designates the network protocol
host address = designates the IP address or hostname of the instrument
[::LAN device name] = defines the protocol and the instance number of a subinstrument
[::INSTR] = indicates the instrument resource class (optional)

The **IP address** (host address/computer name) is used by the programs to identify and control the instrument. It is automatically assigned by the DHCP server the first time the device is registered on the network. Alternatively, you can also assign its **LAN device name**.

If assigned, the IP address is displayed on home screen. You can adjust it manually with the parameter the "System Config > Remote Access > Network" > IP AddressEnabling a locked user interface for manual operation.

The following section lists the characteristics of the VISA resource strings for the corresponding interface protocols. The highlighted characters are crucial.

HiSLIP

TCPIP::host address::**hislip0**[::INSTR]

hislip0 = HiSLIP device name, designates that the interface protocol HiSLIP is used (mandatory)

hislip0 is composed of `[::HiSLIP device name[,HiSLIP port]]` and must be assigned.

For details of the HiSLIP protocol, refer to Chapter 12.2.1.2, "HiSLIP Protocol", on page 351.

VXI-11

TCPIP::host address**[::inst0]**[::INSTR]

[::inst0] = LAN device name, indicates that the VXI-11 protocol is used (optional)

inst0 currently selects the VXI-11 protocol by default and can be omitted.

For details of the VXI-11 protocol, refer to Chapter 12.2.1.2, "HiSLIP Protocol", on page 351.

Socket communication

TCPIP::host address::**port::SOCKET**

port = determines the used port number
SOCKET = indicates the raw network socket resource class

Socket communication requires the specification of the port (commonly referred to as port number) and of "SOCKET" to complete the VISA resource string with the associated protocol used.

The registered port for socket communication is port 5025.

See also Chapter 12.2.1.4, "Socket Communication", on page 351.

12.2.1.2 HiSLIP Protocol

The HiSLIP (**Hi**gh **S**peed **L**AN **I**nstrument **P**rotocol) is the successor protocol for VXI-11 for TCP-based instruments specified by the IVI foundation. The protocol uses two TCP sockets for a single connection - one for fast data transfer, the other for non-sequential control commands (e.g. `Device Clear` or `SRQ`).

HiSLIP has the following characteristics:

- High performance as with raw socket network connections
- Compatible IEEE 488.2 support for Message Exchange Protocol, Device Clear, Serial Poll, Remote/Local, Trigger, and Service Request
- Uses a single IANA registered port (4880), which simplifies the configuration of firewalls
- Supports simultaneous access of multiple users by providing versatile locking mechanisms
- Usable for IPv6 or IPv4 networks

Using VXI-11, each operation is blocked until a VXI-11 device handshake returns. However, using HiSLIP, data is sent to the device using the "fire and forget" method with immediate return. Thus, a successful return of a VISA operation such as `viWrite()` does not guarantee that the instrument has finished or started the requested command, but is delivered to the TCP/IP buffers.

For more information see also the application note:

1MA208: Fast Remote Instrument Control with HiSLIP

12.2.1.3 VXI-11 Protocol

The VXI-11 standard is based on the ONC RPC (Open Network Computing Remote Procedure Call) protocol which in turn relies on TCP/IP as the network/transport layer. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection-oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

12.2.1.4 Socket Communication

An alternative way for remote control of the software is to establish a simple network communication using sockets. The socket communication, also referred to as "Raw Ethernet communication", does not necessarily require a VISA installation on the remote controller side. It is available by default on all operating systems.

The simplest way to establish socket communication is to use the built-in telnet program. The telnet program is part of every operating system and supports a communication with the software on a command-by-command basis. For more convenience and to enable automation by means of programs, user-defined sockets can be programmed.

Socket connections are established on a specially defined port. The socket address is a combination of the IP address or the host name of the instrument and the number of the port configured for remote-control. All R&S SMA100B use port number 5025 for this purpose. The port is configured for communication on a command-to-command basis and for remote control from a program.

12.2.2 USB Interface

Option: R&S SMAB-B86

For remote control via the USB connection, the PC and the instrument must be connected via the USB type B interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S instrument automatically when the USB connection is established. You do not have to install a separate driver.

USBTMC (USB Test & Measurement Cass Specification) is a protocol that is built on top of USB for communication with USB devices, like GPIB. It defines class code information of the instrument, that identifies its functionality to load the respective device driver. Using VISA library, it supports service request, triggers, and other specific operations, similar to GPIB.

12.2.2.1 USB Resource String

The resource string represents an addressing scheme that is used to establish a communication session with the instrument. It is based on the instrument address and some instrument- and vendor-specific information.

The USB resource string syntax is as follows:

USB::**<vendor ID>::<product ID>::<serial number>**[::INSTR]

USB	= denotes the used interface
<vendor ID>	= is the manufacturer ID for Rohde & Schwarz
<product ID>	= is the product identification of the instrument
<serial number>	= is the individual serial number on the rear of the instrument
[::INSTR]	= indicates the instrument resource class (optional)

To set the USB resource string, see Remote Access Settings.

Example:

`USB::0x0AAD::0x01DD::100001`

0x0AAD is the vendor ID for Rohde & Schwarz.

0x01DD is the product ID for the R&S SMA100B

100001 is the serial number of the particular instrument.

12.2.3 GPIB Interface (IEC/IEEE Bus Interface)

Option: R&S SMAB-B86

To be able to control the instrument via the GPIB bus, the instrument and the controller must be linked by a GPIB bus cable. A GPIB bus card, the card drivers and the program libraries for the programming language used must be provided in the controller.

GPIB address

The controller must address the instrument with the GPIB bus channel (see Chapter 12.4.3, "GPIB Address Settings", on page 362). GPIB provides channel addresses from 0 to 30.

The GPIB resource string syntax is as follows:

GPIB::**<address>**[::INSTR]

GPIB = denotes the used interface
<channel address> = the used channel
[::INSTR] = indicates the instrument resource class (optional)

Note: If the VISA implementation supports the GPIB interface, you can optionally define the VISA Instrument Control Resource (INSTR). It is used to define the basic operations and attributes for a device, such as reading, writing, or triggering.

Notes and characteristics

In connection with the GPIB interface, note the following:

- Up to 15 instruments can be connected.
- The total cable length is restricted to a maximum of 15 m, or 2 m times the number of devices, whichever is less. The maximum recommended cable length between two instruments is 2 m.
- A wired "OR"-connection is used if several instruments are connected in parallel, since the slowest instrument determines the speed.

Any connected IEC bus cable must be terminated by an instrument or controller.

12.2.4 LXI Browser Interface

The LXI browser interface allows easy configuration of the LAN and remote control of the R&S SMA100B without additional installation requirements. The instrument's LXI browser interface works correctly with all W3C compliant browsers.

See Chapter 12.17.1, "LXI Functionality", on page 401 for more about LXI.

The LAN settings are configured using the instrument's LXI browser interface described in Chapter 12.5.2.1, "LAN Configuration", on page 369. The LXI status settings in the R&S SMA100B are described in Chapter 12.5.1, "LXI Status Settings", on page 367.

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 appropriate interface protocols.

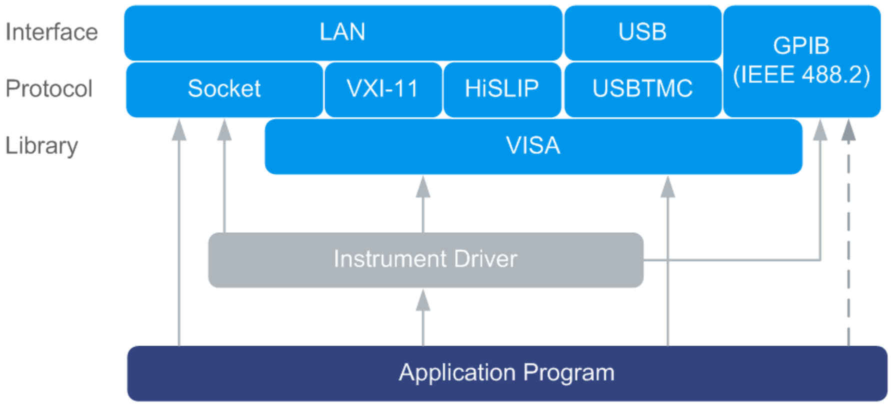


Figure 12-2: Overview of remote control interfaces, protocols and libraries

12.3.1 VISA Library

VISA is a standardized software interface library providing input and output functions to communicate with instruments. Thus, you can configure the interface without having to adjust the application program to the used interface. The I/O channel (LAN or TCP/IP, USB, GPIB,...) is selected at initialization time with the channel–specific address string ("VISA resource string"), or by an appropriately defined VISA alias (short name). See also Table 12-2 for an overview.

Instrument access via VXI-11 or HiSLIP protocols is achieved from high level programming platforms using VISA as an intermediate abstraction layer. VISA encapsulates the low-level VXI or GPIB function calls and thus makes the transport interface transparent for the user.

A VISA installation is a prerequisite for remote control using the following interfaces:

- LAN interface using HiSLIP Protocol
- LAN interface using VXI-11 Protocol
- USB Interface

Instrument access via the LAN socket protocol or GPIB connections can be operated both, with or without the VISA library. See also Chapter 12.2.1.4, "Socket Communication", on page 351 and Chapter 12.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 353.

For more information about VISA library, refer to the user documentation.

12.3.2 Possible Setups and Access Functions

The following examples give an overview of dependencies between the available libraries, the possible interfaces and protocols, and whether an instrument driver is provided. The involved parts are **highlighted**. For more information, see the application note 1GP72: Connectivity of Rohde&Schwarz Signal Generators.

- Remote control (application) program using VISA

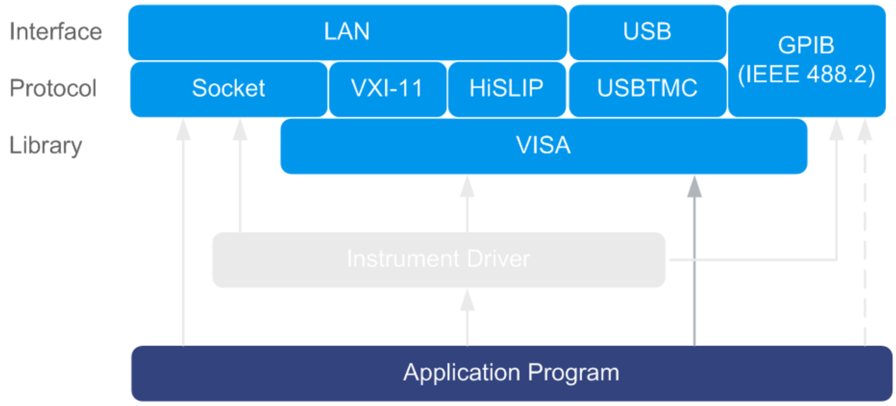


Figure 12-3: Application program using VISA

Protocol	Remote control program
Socket	`viOpen (..., "TCPIP:SMA100B-102030::5025::SOCKET", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
VXI-11	`viOpen (..., "TCPIP:SMA100B-102030::inst0::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
HiSLIP	`viOpen (..., "TCPIP:SMA100B-102030::hislip0::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
USBTMC	`viOpen (..., "USB::0x0AAD::0x01DD::100001::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
GPIB	`viOpen (..., "GPIB::28::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`

- Remote control program using instrument driver (VISA available)

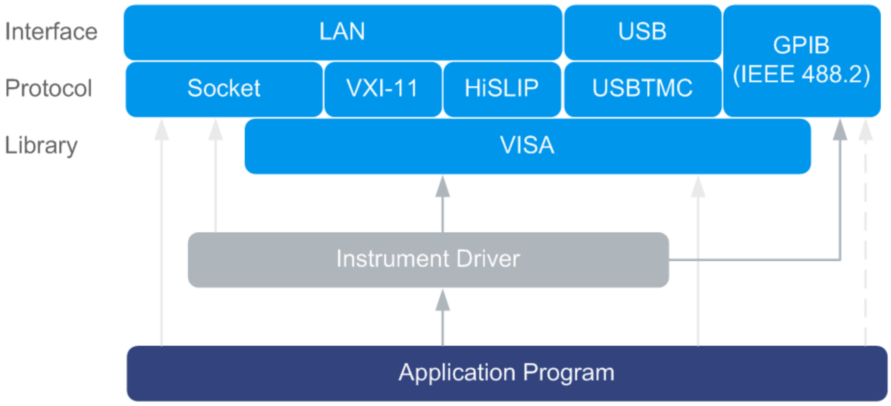


Figure 12-4: Application using instrument driver (VISA available)

Protocol	Remote control program
Socket	`rssma_init ("TCPIP:SMA100B-102030::5025::SOCKET", ...)` `rssma_SetFrequency (..., 2e9)`
VXI-11	`rssma_init ("TCPIP:SMA100B-102030::inst0::INSTR", ...)` `rssma_SetFrequency (..., 2e9)`
HiSLIP	`rssma_init ("TCPIP:SMA100B-102030::hislip0::INSTR", ...)` `rssma_SetFrequency (..., 2e9)`
USBTMC	`rssma_init ("USB::0x0AAD::0x01DD::100001::INSTR", ...)` `rssma_SetFrequency (..., 2e9)`
GPIB	`rssma_init ("GPIB::28::INSTR", ...)` `rssma_SetFrequency (..., 2e9)`

- Remote control program using instrument driver (VISA **not** available)

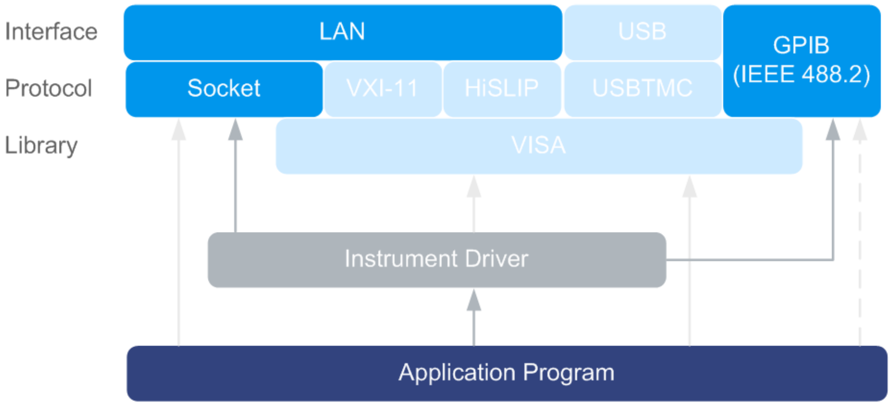


Figure 12-5: Remote control program using instrument driver (VISA not available)

Protocol	Remote control program
Socket	`rssma_init ("TCPIP:SMA100B-102030::5025::SOCKET", ...)` `rssma_SetFrequency (..., 2e9)`
GPIB	`rssma_init ("GPIB::28::INSTR", ...)` `rssma_SetFrequency (..., 2e9)`

12.4 Remote Access Settings

This section outlines the settings required for accessing and configuring the provided remote control interfaces. It includes network settings, access addresses, emulation settings for using the command sets of other generators, and the access via smart devices.

About instrument emulations

You can also remotely control the R&S SMA100B via the command set of another signal generator, as, for example, of an HP generator. With this function you can, for example, replace a signal generator with an R&S SMA100B in an automated test setup, without adjusting the command scripts used.

The R&S SMA100B also covers command sets of Rohde & Schwarz signal generators. To achieve optimal compatibility when replacing an instrument, we recommend that you select the emulation command set for the corresponding signal generator.

You find all the remote control command sets supported by the R&S SMA100B in a selection list.

For more information, see the application note:

1GP120: Remote Emulation with the R&S SMA100B Signal Generator.

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 SMA100B specific command set is disabled and the SCPI command `:SYSTem:LANGuage` is discarded.

To return to the SCPI command set of the R&S SMA100B, use the appropriate command of the selected command set. If for example an HP generator is emulated, the HP command `EX` returns to the instrument-specific GPIB command set.

12.4.1 Network Settings

NOTICE

Risk of network failure

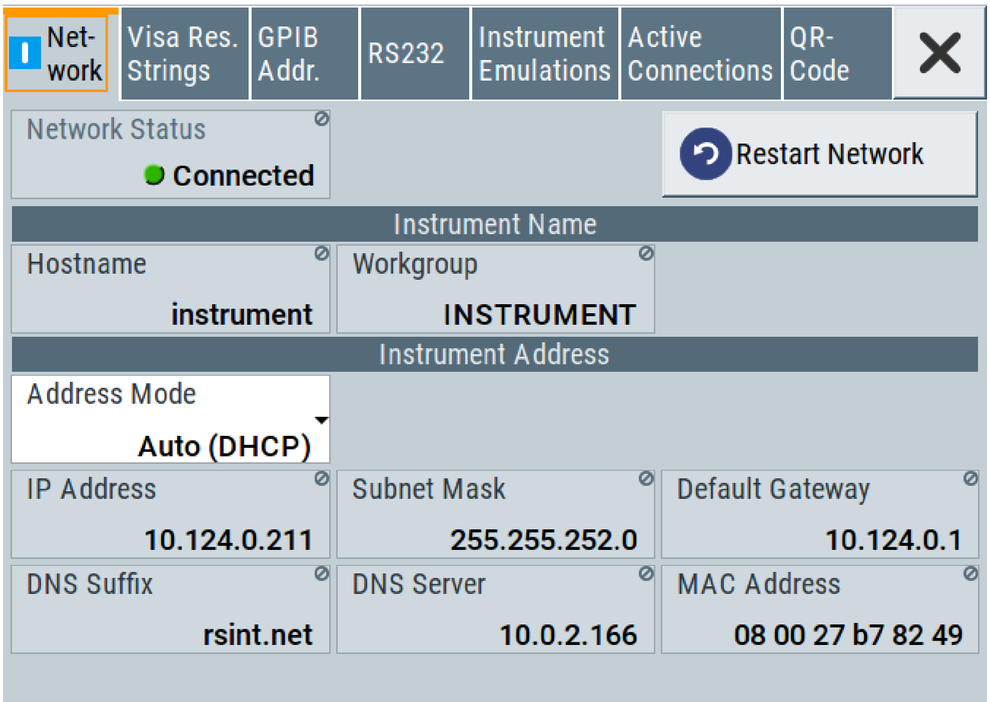
Consult your network administrator before performing the following tasks:

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

Errors can affect the entire network.

Access:

► Select "System Config > Remote Access > Network".



In the "Network" dialog, you can configure the settings of the general network environment and specific identification parameters of the instrument in the network.

The remote commands required to configure the network remotely are described in Chapter 13.17, "SYSTem Subsystem", on page 653.

How to connect the signal generator to the network is described in the Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 28.

Network Status

Indicates that the instrument is connected to the network.

Remote command:
`:SYSTem:COMMunicate:NETWork:STATus?` on page 664

Restart Network
Terminates the network connection of the instrument and subsequently sets it up again. You can use this function to fix network problems.

Note: This function restarts only the connection of the instrument to the network. It does not impact the network itself.

Remote command:
`:SYSTem:COMMunicate:NETWork:RESTart` on page 664

Hostname
Displays the hostname.

Each instrument is delivered with an assigned hostname, a logical name which can be used instead of the IP address. With the default network settings, the IP address is allocated by the DHCP server. This address can change each time the instrument is reconnected. Unlike the IP address, the hostname name does not change.

Note:
This function is password-protected. Unlock the protection level 1 to access it.

- We recommend that you do not change the default network settings or the host-name to avoid problems with the network connection.
  If you change the hostname, be sure to use a unique name.

Remote command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname` on page 665

Workgroup
Sets the individual windows workgroup name of the R&S SMA100B. 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 665

Address Mode
Selects the mode for assigning the IP address.

NOTICE! Risk of network failure.
Consult your network administrator before performing the following tasks:
- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses

Errors can affect the entire network.

"Auto (DCHP)"
Assigns the IP address automatically, provided the network supports DHCP (Dynamic Host Configuration Protocol).

"Static" Enables you to assign the IP address manually.

Remote command:
`:SYSTem:COMMunicate:NETWork:IPADdress:MODE` on page 663

IP Address

Displays the IP address of the instrument in the network.

By default, the R&S SMA100B is configured to use dynamic TCP/IP configuration and to obtain the whole address information automatically.

If the network does not support DHCP or the attempt does not succeed, the instrument tries to obtain the IP address via Zeroconf (APIPA) protocol. IP addresses assigned via Zeroconf start with the number blocks `169.254.*.*`.

Note: An IP address that is assigned via the Zeroconf protocol although the network requires an IP address assigned via the DHCP server can cause network connection failures.
See Chapter 15.5, "Resolving Network Connection Failures", on page 706.

To assign the IP address manually, select Address Mode > "Static".

Remote command:
`:SYSTem:COMMunicate:NETWork:IPADdress` on page 663

Subnet Mask

Displays the bit group of the subnet in the host identifier.

To assign the subnet mask manually, select Address Mode > "Static".

Remote command:
`:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK` on page 666

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 666

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 665

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 665

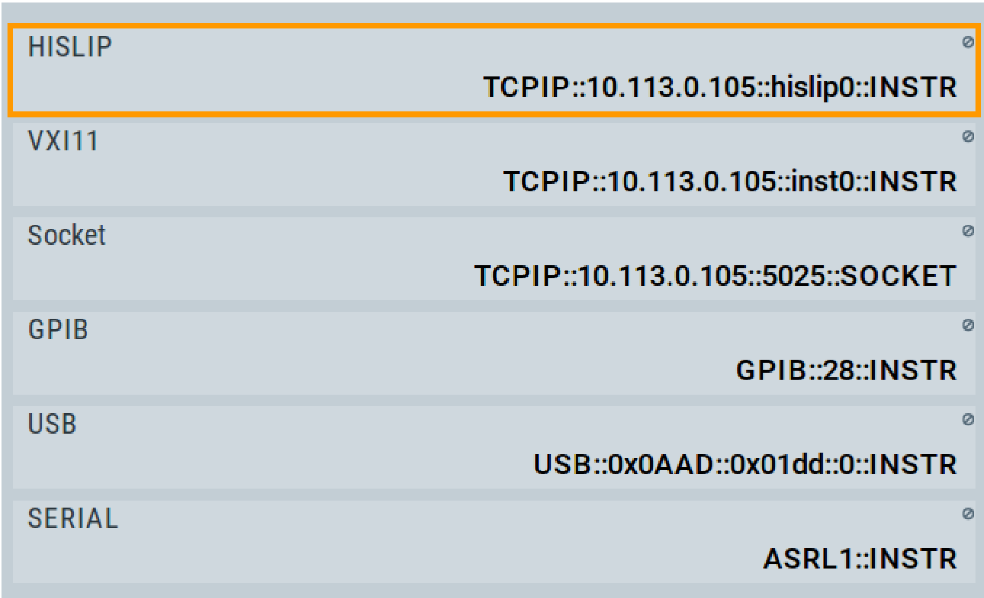
MAC Address
Indicates the MAC (Media Access Control) address, a unique identifier of the network adapter in the R&S SMA100B.

Remote command:
:SYSTem:COMMunicate:NETWork:MACaddress on page 664

12.4.2 VISA Resource Strings

Access:

► Select "System Config > Remote Access > Visa Resource Strings".



The "Visa Resource String" dialog displays the Visa resource strings provided for remote control via the different interfaces.

Remote command:

:SYSTem:COMMunicate:HISLip:RESource? on page 663

:SYSTem:COMMunicate:NETWork:RESource? on page 664

:SYSTem:COMMunicate:SOCKet:RESource? on page 667

:SYSTem:COMMunicate:GPIB:RESource? on page 662

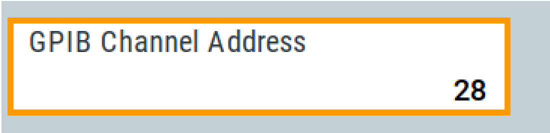
:SYSTem:COMMunicate:USB:RESource? on page 667

:SYSTem:COMMunicate:SERial:RESource? on page 667

12.4.3 GPIB Address Settings

Access:

1. Select "System Config > Remote Access > GPIB Address".



2. Set the GPIB channel address of the connected instrument.

Remote command:

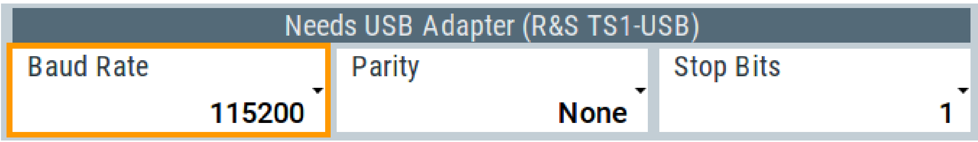
:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess on page 663

12.4.4 RS232 Settings

Remote control via a serial interface is possible via a USB. The controller and the instrument must be connected with the external USB/serial-adapter R&S TS1-USB (see recommended extras in the data sheet) and a serial crossover (null modem) cable. A USB connection requires the Visa library to be installed on the controller. Visa detects and configures the R&S SMA100B automatically when the USB connection is established.

Access:

► Select "System Config > Remote Access > RS232".



In the "RS232" dialog, you can configure the settings of the serial interface.

The remote commands required to configure the settings remotely are described in Chapter 13.17, "SYSTem Subsystem", on page 653.

Baud Rate
Sets the baudrate for the serial remote control interface.

Remote command:
:SYSTem:COMMunicate:SERial:BAUD on page 666

Parity
Sets the parity for the serial remote control interface.

Remote command:
:SYSTem:COMMunicate:SERial:PARity on page 666

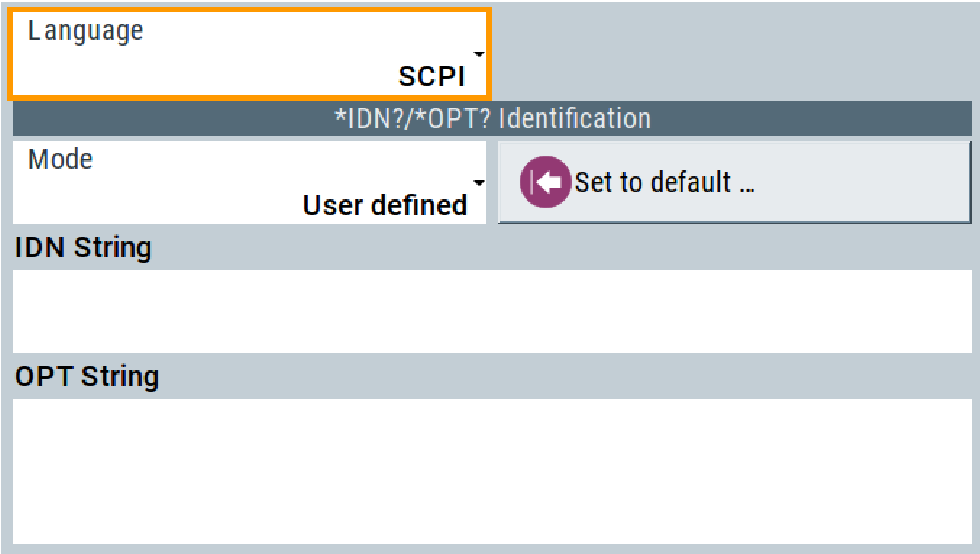
Stop Bits
Sets the number of stop bits for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:SBITs` on page 667

12.4.5 Instrument Emulations Settings

Access:

► Select "System Config > Remote Access > Instrument Emulations".



The "Instrument Emulations" dialog enables you to emulate a remote control command set of another signal generator.

The remote commands required to configure the emulation settings remotely are described in Chapter 13.17, "SYSTem Subsystem", on page 653.

Language
Selects the instrument whose remote command set is emulated by the R&S SMA100B.

Remote command:
`:SYSTem:LANGuage` on page 669

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 668

Set to Default
In "Mode > User Defined", resets the `*IDN` and `*OPT` strings.

Remote command:
`:SYSTem:IDENtification:PRESet` on page 668

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 407
`:SYSTem:IRESponse` on page 668

OPT String
Indicates the option string of the instrument as queried with common command `*OPT?`.

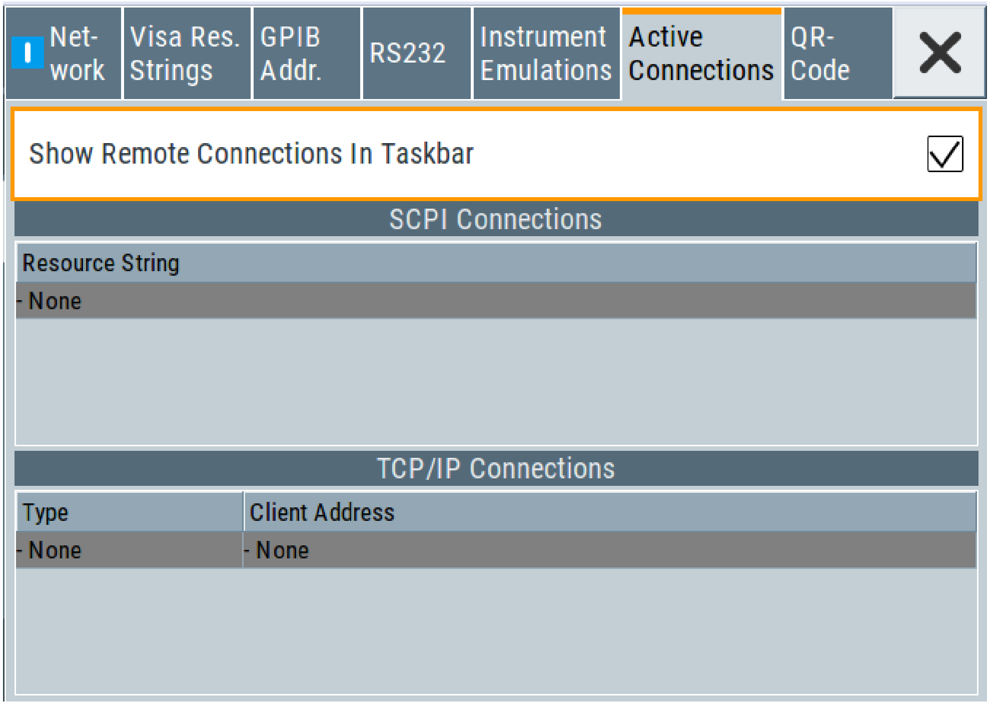
In Mode > "User Defined", you can define your own option string, additionally to the automatically created one.

Remote command:
`*OPT?` on page 408
`:SYSTem:ORESponse` on page 669

12.4.6 Active Connections Settings

Access:

► Select "System Config > Remote Access > Active Connections".



The "Active Connections" dialog indicates all active SCPI and TCP/IP connections.

Show Remote Connections in Taskbar
Displays the currently active connections in the taskbar.

SCPI Connections
Shows the active VISA resource string of the interface via which the instrument is remotely controlled.

Remote command:
n.a.

TCP/IP Connections
Shows the type and client address of the LAN interface connection.

Remote command:
n.a.

12.4.7 QR Code

Access:

► Select "System Config > Remote Access > QR Code".

The "QR Code" dialog shows the current instrument address (IP address) in quick response (QR) format.

This functionality provides fast access to the instrument via VNC with, for example, a smartphone or a tablet.

See Chapter 12.16.2, "Setting Up a Remote Operation from a Smart Device", on page 398.

12.5 LXI Settings

On the R&S SMA100B the LXI functionality is already installed and enabled, see LXI Status Settings. Thus, the instrument can be accessed via any web browser (like the Microsoft Internet Explorer) to perform the following tasks:

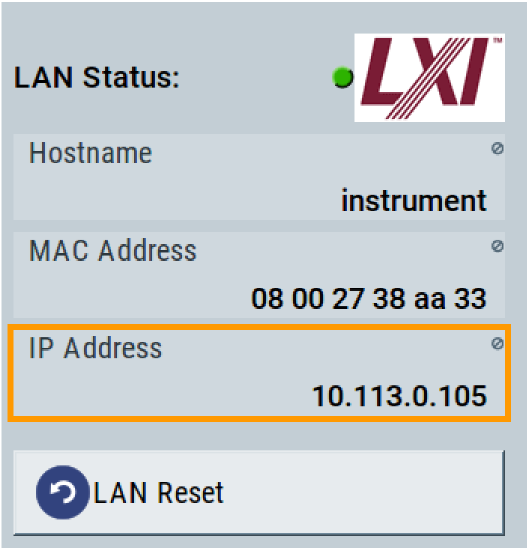
- Modifying network configurations
- Remote control the instrument
- Performing SCPI remote diagnostics

The LAN settings are configured using the instrument's LXI browser interface described in Chapter 12.5.2.1, "LAN Configuration", on page 369.

12.5.1 LXI Status Settings

Access:

► Select "System Config > Setup > Remote Access > LXI Status...".



The "LXI - Status" dialog shows the parameters of the LAN connection.

Alternatively, you can change the LAN settings using the LXI web browser interface, see Chapter 12.5.2.1, "LAN Configuration", on page 369.

LAN Status

The LED indicates the LXI status.

"green" Normal operation

"green (flashing)"
Device identification

"red" LAN fault

Hostname / MAC Address / IP Address

See "Hostname" on page 359.

LAN Reset

Initiates the network configuration reset mechanism for the instrument and resets the hostname, MAC address, and IP address.

According to the LXI standard, a LAN reset must place the following network settings to a default state:

Parameter	Value
TCP/IP mode	DHCP + Auto IP address
Dynamic DNS	Enabled

Parameter	Value
ICMP ping	Enabled
Password for LAN configuration	LxiWebIfc

The LAN reset also resets the following parameters for the Signal Generator:

Parameter	
Hostname	`Instrument-specific hostname`
Description	Vector signal generator
Negotiation	Auto detect
VXI-11 discovery	Enabled

12.5.2 LXI Browser Settings

To access the instrument via the web browser:

► In the address field of the browser on your PC, type the instrument's host name or IP address, for example *http://10.113.1.151*.
Note: Do not add the missing zeros in the IP address, while opening the instrument homepage.

The instrument homepage (welcome page) opens.

The navigation pane of the browser interface contains the following elements:

- "LXI"
  – "Home" opens the instrument homepage.
    The homepage displays the device information required by the LXI standard, including the VISA resource string in read-only format.
  – "Device Indicator" activates or deactivates the LXI status indication.
    When activated, the LXI LEDs flash, both in the browser dialog and in the LXI dialog of the connected instrument, see LAN Status. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates that no LAN cable is connected.
  – "Lan Configuration" allows you to configure LAN parameters and to initiate a ping, see "Ping Client" on page 371.
  – "Status" displays information about the LXI status of the instrument.
  – "Utilities" provides access to the LXI event log functionality required by the LXI standard.
- "Instrument Control"
  – "Web Control" provides remote access to the instrument, see "Starting a remote control via the LXI web browser" on page 375.
- "Diagnostics"
  – "SCPI Remote Trace" records messages exchanged via the remote control interface, see "SCPI Remote Trace" on page 371.
- "Help"
  – "Glossary" explains terms related to the LXI standard.

   – www.rohde-schwarz.com opens the Rohde & Schwarz homepage.
- "Data Sheet"
  Provides the data sheet with the specification data of the instrument at the time of delivery, see "Data Sheet" on page 372.

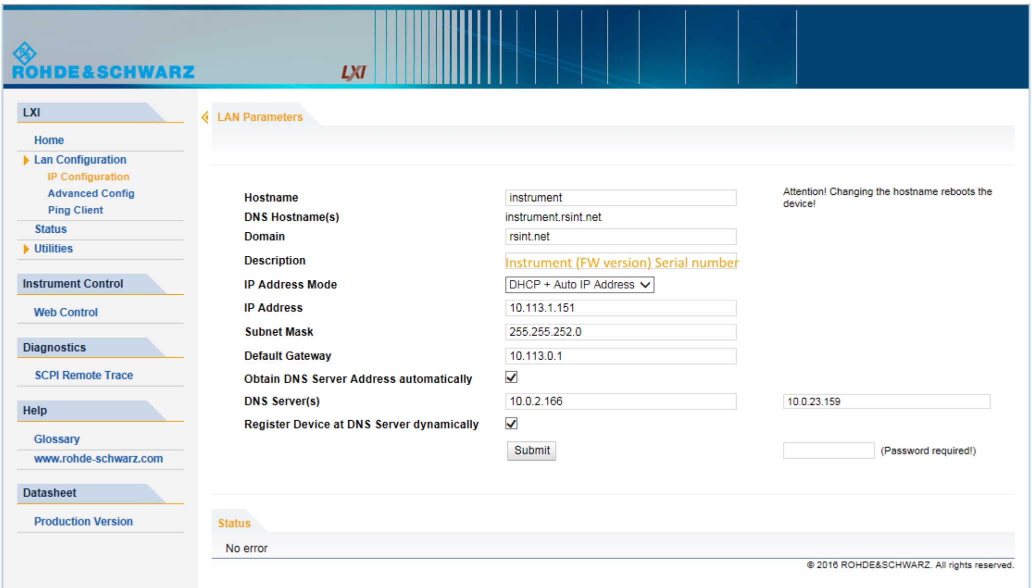
12.5.2.1 LAN Configuration

The "LAN Configuration" web page displays all mandatory LAN parameters and allows their modification.

It comprises the following navigation entries.

IP Configuration

The "IP configuration" web page displays all mandatory LAN parameters and allows their modification.



The "IP Address Mode" selects a configuration mode for the IP address of the instrument. With static configuration, the entered IP address, subnet mask, and default gateway are used. With dynamic configuration, DHCP or dynamic link local addressing (automatic IP) is used to obtain the instrument IP address.

Changing the LAN configuration

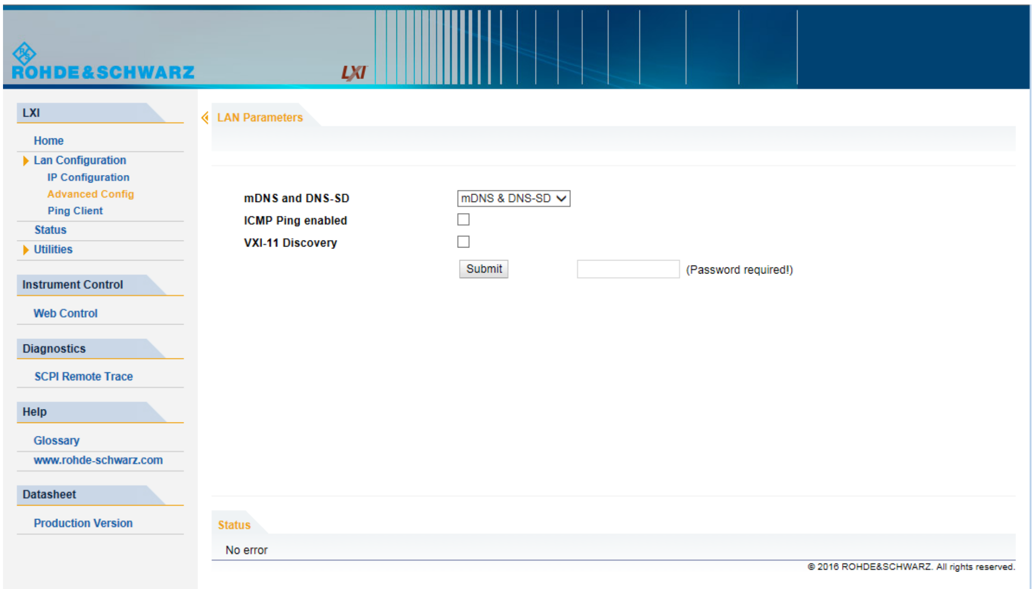
This function is password-protected. Unlock the protection level 1 to access it.

Note: We recommend that you change the default password before connecting the instrument to a network.

See Chapter 11.4.4, "Password Management", on page 341.

Advanced Config

The "Advanced Config" web page provides LAN settings that are not declared mandatory by the LXI standard.



The following advanced parameters are available:

- "mDNS and DNS-SD": The additional protocols "multicast DNS" and "DNS service discovery" are used for device communication in zero configuration networks, working without DNS and DHCP.
- "ICMP Ping": Must be enabled to use the ping utility.
  If you disable this setting, the instrument does not answer ping requests. The setting does not affect the LXI ping client. You can ping other hosts from the instrument, even if the setting is disabled.
- "VXI-11 Discovery": Must be enabled to detect the instrument in the LAN.
  If you disable this setting, the instrument cannot be detected by the VXI-11 discovery protocol mechanism. The setting does not affect other detection mechanisms. Setting up a VXI-11 connection via the IP address or the host name is independent of this setting.

Changing the LAN configuration

This function is password-protected. Unlock the protection level 1 to access it.

Note: We recommend that you change the default password before connecting the instrument to a network.

See Chapter 11.4.4, "Password Management", on page 341.

Ping Client

The "Ping Client" page provides the ping utility to verify the connection between the LXI-compliant instrument and another device.

The ping is initiated from the instrument. Using the `ICMP` echo request and echo reply packets, this function checks whether the communication with a device via LAN is working. Ping is useful for the diagnosis of IP network or router failures.

To initiate a ping at the instrument:

1. On the "Ping Client" page, enter the IP address of the host in the "Destination Address" field (for example 10.113.1.151).
2. Select "Submit".

SCPI Remote Trace

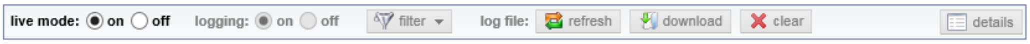
The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S SMA100B, see Chapter 12.9, "Tracing SCPI Commands and Messages Exchanged via the LXI Web Browser Interface", on page 383.

A recorded trace (message log) can be evaluated directly in the dialog. Use the highlighting and navigation functions provided by the lower toolbar to locate error messages and messages containing arbitrary search strings. You can also export the message log to a `*.csv` file and evaluate the file using a suitable program.

To trace and display messages, switch on "logging" and "live mode" in the toolbar.

Toolbars

The toolbar at the top of the dialog provides basic settings and functions.



- "Live mode" / "logging": If logging is switched on, messages are traced. They are stored in an internal database and can be displayed upon request, using the refresh button (live mode off) or they can be displayed automatically (live mode on).
- "Filter": applies a filter to columns and/or rows when working (live mode off)
- "Refresh": reads the message log from the internal database and displays it
- "Download": stores the SCPI trace log to a `*.csv` file
- "Clear": deletes all message log entries in the database and at the screen
- "Details": displays details of the selected message, for example an SCPI command in hex format (also possible by double\-clicking a message)

Columns

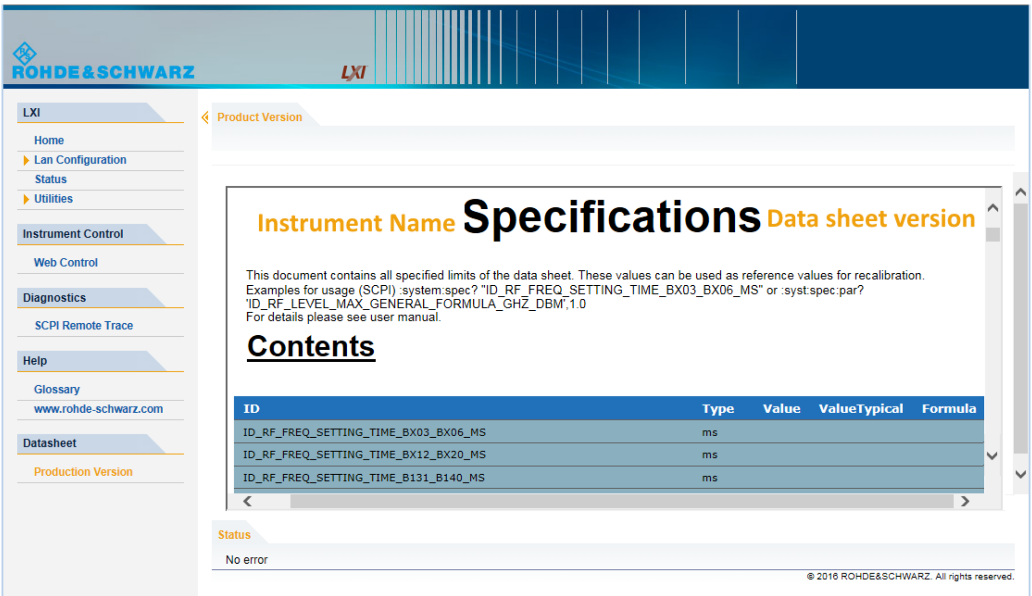
The following columns are available if no column filter is applied:

- "Rec": record number of the message within the message log
- **I**: number of the subinstrument
- "MT": indicates the type of the message. Possible values and related message contents are:
  – > = incoming command
  – < = outgoing response to a query
  – E = error message, highlighted by red color
  – T = execution time, i.e. time required by the instrument to process the command internally.
- "message": indicates the type of the message. Possible values and related message contents are:
  – > = incoming command
  – < = outgoing response to a query
  – E = error message, denoted in red
  – T = execution time, i.e. time required by the instrument to process the command internally

Data Sheet

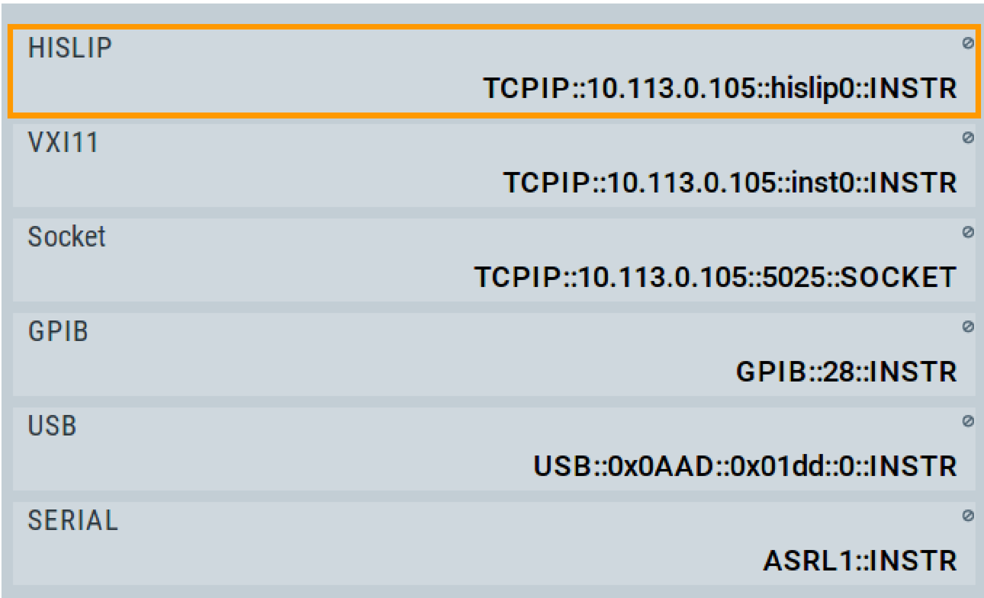
The data sheet functionality allows you to retrieve the specification data of the instrument at the time of delivery.

The document contains all specified value ranges and information of the data sheet, for example important as reference values for recalibration.



12.6 How to Find the VISA Resource String

► Select "System Config > Remote Access > VISA Resource Strings".



The dialog shows all specified resource strings of the supported remote control interfaces.

- For information on how to assign the IP address manually, see Chapter 2.1.3.3, "Assigning the IP Address", on page 30.
- Also note that using the RS232 serial interface via USB requires the USB serial adapter R&S TS-USB1.

12.7 How to Change the GPIB Instrument Address

Option: R&S SMAB-B86

To control the instrument remotely via the GPIB bus, it must be addressed using the GPIB address. The remote control address is factory-set to 28, but it can be changed if it does not fit in the network environment. For remote control, addresses 0 through 30 are allowed. The GPIB address is maintained after a reset of the instrument settings.

To set the GPIB address:

1. Select "System Config > Remote Access > GPIB Address".
2. Select "GPIB Channel Address" and enter a value between 0 and 30.

Risk of losing remote connection

If the remote access and network settings had been configured to values different to the default, executing a factory preset via remote control terminates the connection to the instrument.

12.8 How to Set Up a Remote Control Connection

This section guides you through the steps required to set up remote control connections of the available interfaces.

- Chapter 12.8.1, "Establishing a Remote Control Connection over the LXI Browser Interface", on page 375
- Establishing a Remote Control Connection over LAN Using VXI-11 Protocol
- Setting Up a Remote Control Connection over LAN Using Socket Communication
- Setting Up a Remote Control Connection over GPIB
- Setting Up a Remote Control Connection over USB

The instrument and the controller have to be connected with the suitable cable and switched on.

A remote control program must open a connection to the instrument, before it can send commands to and receive device responses from the instrument.

Instrument address

To operate the instrument via remote control, it must be addressed using the defined interface address.

See:

- Chapter 12.2.1, "LAN Interface", on page 349
- Chapter 12.2.2, "USB Interface", on page 352
- Chapter 12.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 353

You find the VISA resource strings in the "System Config > Remote Access > VISA Resource Strings" dialog.

Securing the display

To prevent unauthorized personnel from reading the display, you can disable the frequency and level display explicitly. This is useful when you remotely control the instrument from a different location.

For more information, see:

- "Annotation Frequency" on page 337
- "Annotation Amplitude" on page 337

12.8.1 Establishing a Remote Control Connection over the LXI Browser Interface

Via the LXI browser interface to the R&S SMA100B one or more users can control the instrument remotely from another PC without additional installation. Most instrument controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available.

Starting a remote control via the LXI web browser

This section assumes that the instrument and the controller PC are connected in the LAN.

1. Start a web browser that supports HTML5 (W3C compliant).
2. Enter the IP address of the R&S SMA100B in the browser's address bar.

   The R&S SMA100B's welcome page is displayed.
3. In the navigation pane, select "Instrument Control" > "Web Control".

   Remote access to the instrument requires the password. The default password is *instrument*.
4. Enter the password and confirm with the [Enter] key.

   After the connection is established, the current screen of the R&S SMA100B is displayed in the browser window.

5. Use the mouse cursor and keyboard to access the functionality of the instrument as you would directly perform on the instruments touchscreen and front panel.

12.8.2 Establishing a Remote Control Connection over LAN Using VXI-11 Protocol

In this example, the I/O software library R&S VISA from Rohde & Schwarz is used to set up a LAN remote control link and remotely control the R&S SMA100B. R&S VISA is running on a controller PC with Windows operating system. When the connection is set up, you can send commands to the instrument and receive the responses.

The remote control connection requires a VISA installation but no additional hardware on the controller PC. The LAN I/O channel is selected at initialization time using the VISA resource string (also referred to as "address string"). A VISA alias (short name) is used to replace the complete resource string. The host address is the R&S SMA100B's hostname or its IP address.

See also Chapter 12.2.1, "LAN Interface", on page 349.

In the following, we assume that:

- A LAN remote control link between the controller and the R&S SMA100B is set up.
- The R&S VISA program is installed on the remote PC
  See http://www.rohde-schwarz.com/rsvisa > "RS VISA Release Notes".

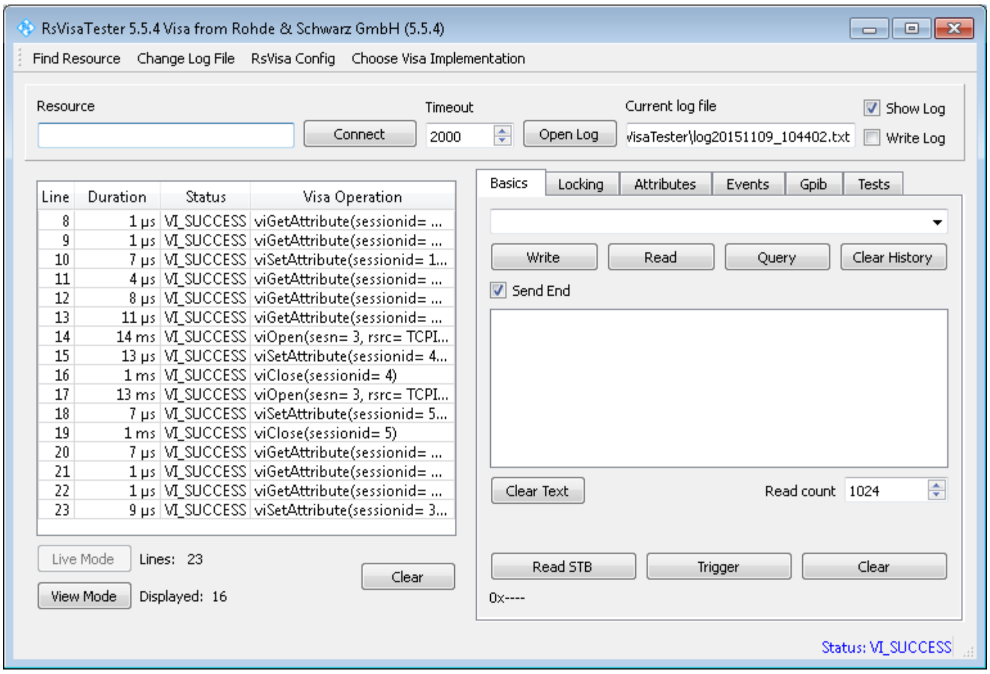
Setting up the controller with R&S VISA

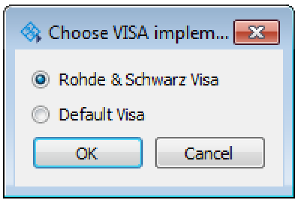
To remote control the R&S SMA100B, we use the R&S VISA Tester application. The application communicates via TCP/IP protocol.

The instrument is preconfigured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, enter the computer name in the position of the IP address.

1. Connect the controller and the instrument in the same network (network cable). Switch them on.

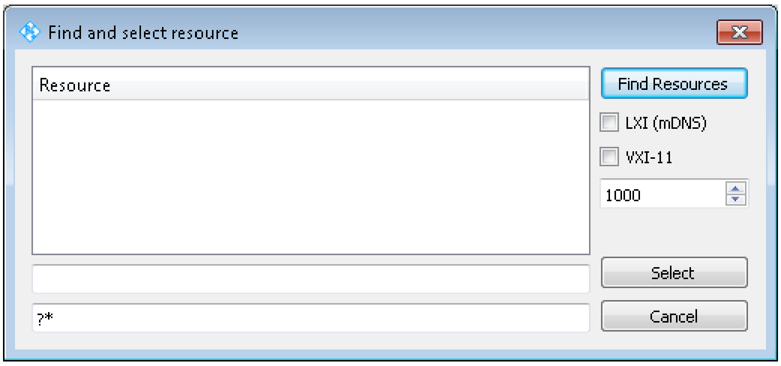
2. On the controller, start "R&S VISA > Tester 32bit" or "R&S VISA > Tester 64bit".





3. In the menu bar, select "Choose VISA Implementation > Rohde & Schwarz Visa" and confirm with "OK".

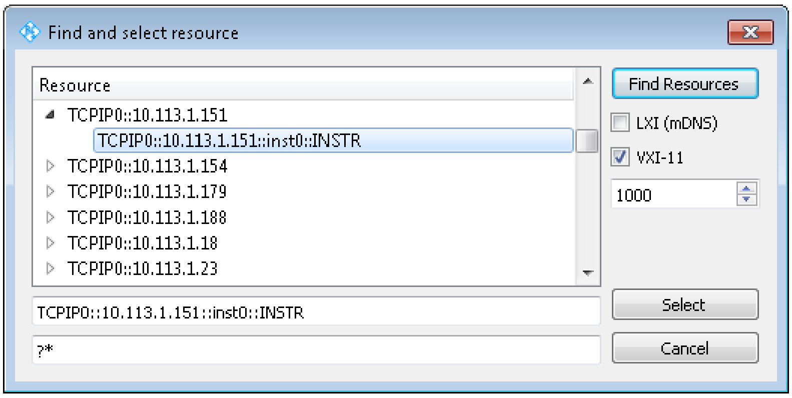
4. In the menu bar, select "Find Resource" to search for the instrument in the LAN.



5. Select "VXI-11" and "Find Resources".

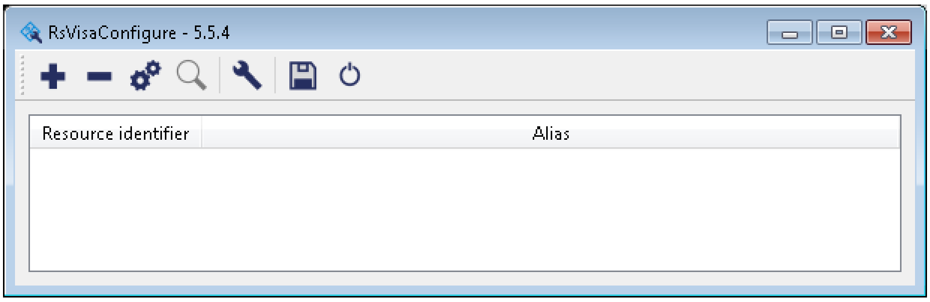
   R&S VISA scans the network for connected instruments and lists all detected instruments in the "Resource" list.
   Note: The search may take some time, particularly in large networks.

6. Select the required instrument and confirm with "Select".



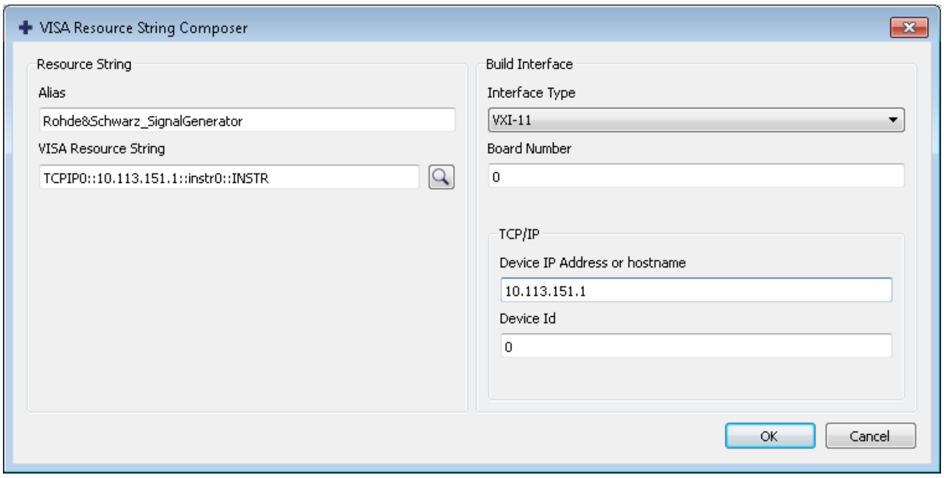
The "Find and select resource" dialog closes and R&S VISA indicates the IP address in the "Resource" field of the main application window.

7. As an alternative to the IP address, you can assign an alias name to the R&S SMA100B:
   a) In the menu bar, select "RsVisaConfig".

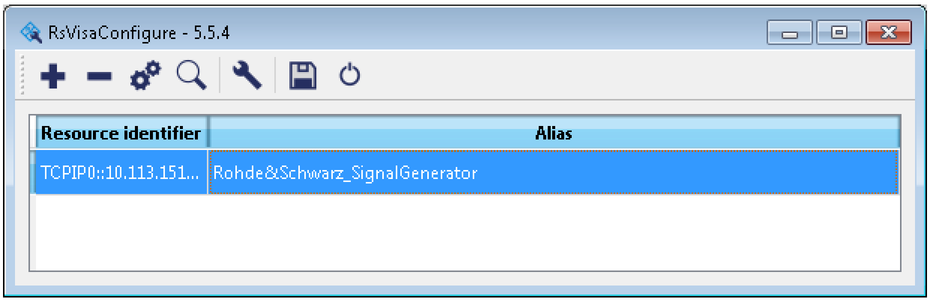


   b) In the toolbar, select "+" to access the "VISA Resource String Composer".

c) Fill in the "Alias" name, the "VISA Resource String" and the "Device IP Address or host name" as shown in the figure, and confirm with "OK".



The "Alias" name is assigned.



d) Close the dialog.
The R&S SMA100B is registered in the program. It can be addressed via the resource string or alias name.

8. In the main window, select "Connect".

   R&S VISA establishes the connection to the R&S SMA100B.

   You can send settings to configure the instrument and receive its responses.

   Note: If the connection cannot be set up, R&S VISA displays an error in the log view.
   For information on how to proceed when network failures occur, see Chapter 15.5, "Resolving Network Connection Failures", on page 706.

   For further information on the functions to read and write to an open session, and the utility applications the software provides, see the R&S VISA user manual.

Starting a remote control session over LAN with R&S VISA

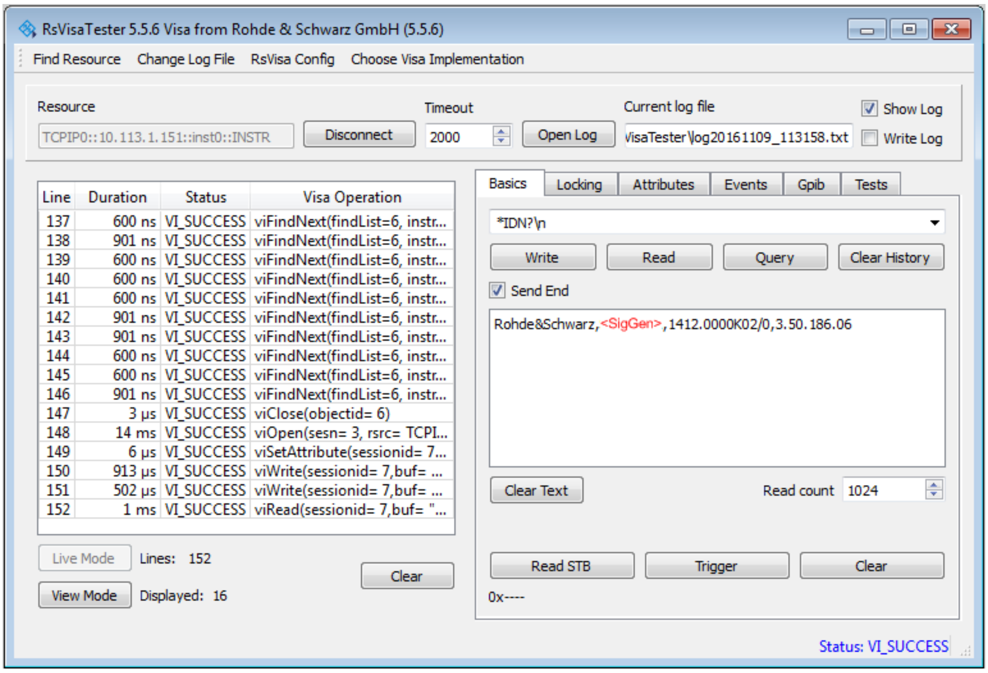
To set the instrument to remote control, you can use the addressed command `&GTR` or send any command from the controller.

1. Start the R&S VISA Tester. Establish the connection to the R&S SMA100B.
   See "Setting up the controller with R&S VISA" on page 376.

2. In the R&S VISA "Basics" tab, enter an SCPI command, e.g. "*IDN?". Confirm with "Query".

   The instrument is switched to remote control when it receives a command from the controller.

3. Select "Read" to obtain the instrument response.



   Tip: If the "Show Log" checkbox is checked, R&S VISA displays each VISA function call in the log-view on the left. If you check the "Write Log" checkbox, the log-view entry is written to the log file as well. You can operate the log-view in two modes: the "Live Mode" shows only the most recent messages whereas the "View Mode" allows you to scroll the history.

4. To set, e.g. the frequency, enter `SOUR1:FREQ 4 GHz` and select "Write".
   To check the performed setting, `SOUR1:FREQ?` and select "Query".
   The instrument response is `4000000000`. The value corresponds to the frequency in Hz.

   While remote control is active, the "Remote" icon in the status bar indicates that the instrument is in remote control mode. Currently ongoing communication (data transfer) is indicated by green colored arrows in the icon.
   Operating via the front and touch panel or via mouse and keyboard are locked, allowing a remote control program to be performed without interruption. On the display, keys and entry fields are grayed out and cannot be activated or modified, but you can still open dialogs, for example to verify settings.

5. To disable the access to the dialogs, use the command `SYST:KLOC ON`.

6. To prevent unintentional return to manual operation, use the command `&LLO`.
   See also Chapter A.1.2, "LAN Interface Messages", on page 711.

The instrument switches to "Remote LLO" state. The [Setup] key is disabled.

7. To enable the [Setup] key, use the command `&GTR`.
8. To return to manual operation, see Chapter 12.10, "How to Return to Manual Operation", on page 384.

   Tip: Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

12.8.3 Setting Up a Remote Control Connection over LAN Using Socket Communication

This section provides an example on how to establish a remote control connection over Telnet client and a simple sockets-based program example that can be further developed (see also Chapter A.2, "Telnet program examples", on page 731).

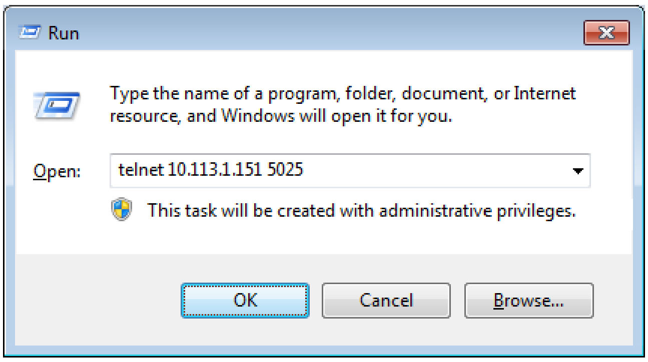
The telnet client transmits information unencrypted. Therefore, for sensitive information we recommend that you use a client which supports secure protocols, like SSH.

In the following example, we assume basic knowledge of programming and operation of the controller. You can find information on the interface commands in the corresponding manuals.

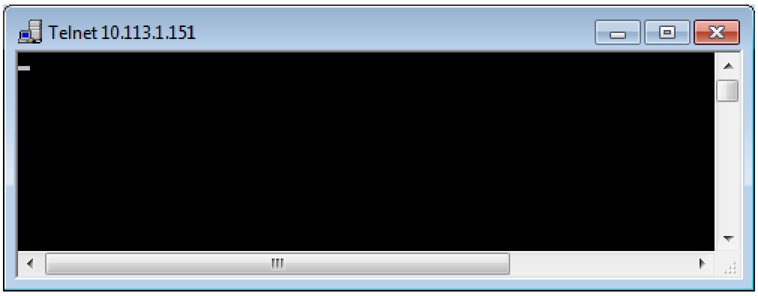
Setting up a Telnet connection

To control the software, only a Telnet program is required. The Telnet program is part of every operating system.

1. To establish a Telnet connection with the R&S SMA100B, start the Telnet program. Enter the socket address.
   The socket address is a combination of the IP address or the hostname of the R&S SMA100B and the number of the port configured for remote-control via Telnet.
   Tip: The R&S SMA100B uses the port number 5025 for remote connection via Telnet.

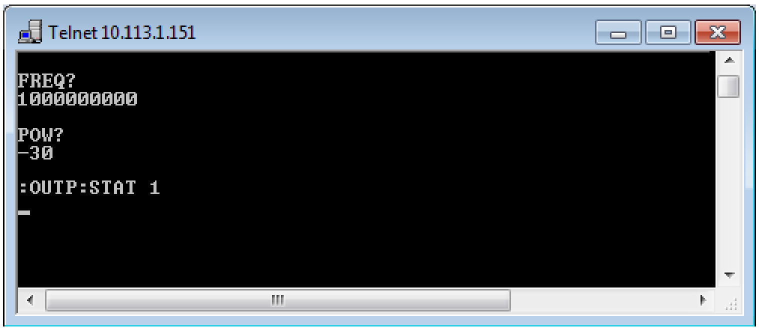


   The connection to the instrument is set up and you can send remote-control commands.



2. Note that Telnet does not reflect your first entry. Insert a command, e.g. `*IDN` and confirm with "Enter".
3. Observe the screen.

   A response on the query confirms that the connection is working. The client displays all subsequent inputs and responses.
4. Even if the cursor is not visible on the screen, blindly enter a remote-control command. Confirm with Enter.



12.8.4 Setting Up a Remote Control Connection over GPIB

The program example in this section is written in VISUAL BASIC. A condition for programming in VISUAL BASIC is that the modules NIGLOBAL (`Niglobal.bas`) and VBIB32 (`Vbib_32.bas`) are added to the projects.

Drivers for instrument, for example IVI-COM and LabVIEW drivers, are available for download area on the product page at:
https://www.rohde-schwarz.com/driver/sma100b/

Starting a remote control session over GPIB

As a prerequisite, the GPIB address of the instrument must be the default value, which is factory-set to 28.

1. Connect instrument and controller using a GPIB cable. Switch them on.
2. Execute the following commands on the controller:

a) Open the port to the instrument.
`CALL IBFIND("DEV1", generator%)`
b) Inform the controller about instrument address.
`CALL IBPAD(generator%, 28)`
c) Reset the instrument.
`CALL IBWRT(generator%, "*RST;*CLS")`
d) Set the instrument to new address.
`CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 18")`
e) Inform the controller about new address.
`CALL IBPAD(generator%, 18)`

The GPIB address of the instrument is changed.

3. To return to manual operation, press the Local key at the front panel.

12.8.5 Setting Up a Remote Control Connection over USB

For remote control via the USB connection, the PC and the instrument must be connected via the USB type B interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S instrument automatically when the USB connection is established. You do not have to enter an address string or install a separate driver.

Starting a remote control session over USB

1. Connect instrument and controller using USB cable. Switch them on.
2. Execute the following commands on the controller:
   a) Open the port to the instrument.
   `viOpen (..., "USB::0x0AAD::0x01DD::100001::INSTR", ...)`
   b) Reset the instrument.
   `viRST (generator%, "*RST;*CLS")`
   c) Set 2 GHz frequency
   `viPrintf (..., "SOUR:FREQ 2GHz\n")`
   d) Set 20 dBm output level
   `viPrintf (..., "SOUR:POW -20dBm\n")`

   The RF frequency and signal level of the instrument are changed.
3. To return to manual operation, press the [Local] key.

12.9 Tracing SCPI Commands and Messages Exchanged via the LXI Web Browser Interface

The remote trace functionality allows you to trace commands and messages exchanged via a remote control interface of the R&S SMA100B.

To activate the SCPI remote trace:

1. Start a web browser that supports HTML5 (W3C compliant).
2. Enter the IP address of the R&S SMA100B in the browser's address bar.

   The R&S SMA100B's welcome page is displayed.
3. In the navigation pane, select "Diagnostics > SCPI Remote Trace".
4. In the toolbar bar of the "SCPI Remote Trace" page, select "live mode > on" and "logging > on".

   "live mode > on" displays all commands and responses, and "logging > on" also traces messages.

   If you now control the R&S SMA100B with SCPI commands, using an appropriate tool, the LXI function records the information sent and received.
   The function records all sent commands, received responses and messages, and saves them in an internal database. If "live mode" is disabled, you can display the recent traces upon request, using the "refresh" button. You can also save the log in a file.
   Note: The diagnostics functionality will be extended in later releases, e.g. to download or upload SCPI command files from / to the instrument.

12.10 How to Return to Manual Operation

Before returning to manual control, command processing must be completed. Otherwise, the instrument switches back to remote control immediately.

1. To return from "Remote" state to manual state, perform one of the following:
   - On the controller, use the command `&GTL`
     Note: If `&NREN` has been set before `&GTL` is locked. Use `&GTR` instead.
   - In the status bar, select the "Remote" icon.
   - On the front panel, press the [Local] key.
   - In the block diagram, select "Context sensitive menu > Key Emulation > Local"
2. To return from "Remote LLO" state to manual or to "Remote" state, perform one of the following:

   Note: In the local lockout state, the command `&GTL` and the [Local] key are locked. You can unlock this state only via remote control.
   - On the controller, use the command `&LOCS`.
     This command switches directly to manual operation.
   - Send the command `&REMS`.
     This command changes the remote control state from "Remote LLO" to "Remote".
   - Use the Visual Basic command `CALL IBLOC (generator%)`.

The command switches directly to manual operation.

- VISA function `viGpibControlREN()`
  This function switches directly to manual operation.

12.11 Automating Tasks with Remote Command Scripts

To achieve fast configuration, make complex test setups or repeating measurements reproducible, you can automate the required settings with scripts. A script contains a series of SCPI commands corresponding to the settings. When completed, it is converted to an executable format, saved in a file and can be run whenever needed.

If you frequently need to load and run a script, assign the script to the [★ (User)], and you can quickly and easily perform the task.

See Chapter 11.2.3, "Assigning Actions to the [★ (User)] Key", on page 326.

Note: In contrast to "Recall Setup" via the [★ (User)] key, an assigned script execution does not close active dialogs and windows. On the contrary, even active window control (open / close) is possible.

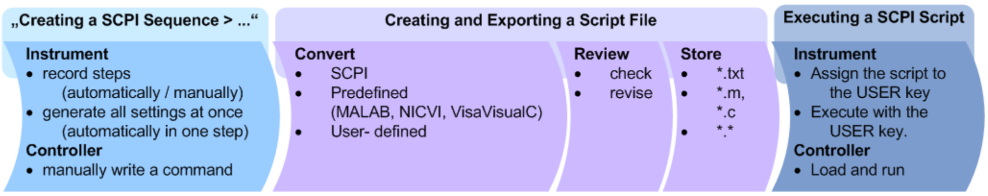


Figure 12-6: Steps for performing SCPI Scripts

In the graph, you can see the main steps required to work with an SCPI script.

Creating a SCPI list

With the SCPI record functions, you can create a SCPI command list directly in the instrument and then export the list to the controller. If you want to edit or write a script manually, use a suitable editor on the controller. Even for manually creating, the instrument supports you by showing the corresponding command syntax and the current settings value.

Directly in the instrument, you can create a SCPI list at any time of operation, in the following ways:

- Recording steps

  Both, automatic and manual SCPI recording of settings is possible. You can start, stop and resume automatic recording, and also record individual commands manually.

  – Manually record the steps selectively
    In manual recording mode, you can deliberately record a SCPI command with the "Add CPI Command to Recording List" function, see How to record SCPI lists manually.

  – Automatically record all performed steps
    The instrument records the SCPI command and settings value of each step you perform, and then writes the commands to the file system, see How to record SCPI lists automatically.
    You can also add a SCPI command manually to the recording list during automatic SCPI recording.

  Note: The Signal Generator clears the SCPI list after booting automatically.

- Generating all settings at once
  Generates the SCPI commands of the current instrument settings in one step, and writes the command list in a temporary list, see How to create a SCPI list with the current instrument settings in one step.
  Note: This function lists all commands in alphabetical order, in contrast to the recording or manual creation, which consider the order the settings are configured.
  Using this function can slow down the runtime or cause errors during execution. Therefore, always check and revise a script if necessary, see "How to check an SCPI list" on page 393.
- Manually create a command script with "Copy" and paste
  Enables you to copy the SCPI command and the current setting, see Chapter 12.11.1, "Show SCPI Command", on page 387.

Some parameters cannot be set by an SCPI command.

If so, *no SCPI command found* is entered instead of a command when you record or generate all settings at once.

The difference between "Show SCPI Command" and the provided cross-reference

If you want to enter your settings in a script, or use a remote control program, you must know the corresponding SCPI command and the exact syntax.

If you need to look up the SCPI command, the instrument offers two ways to figure it out quickly.

- "Show SCPI command" (context-sensitive menu)
  Displays the SCPI command syntax of a selected parameter including the current setting value, see Chapter 12.12, "How to Find Out the SCPI Command Corresponding to the Manual Operation via Show SCPI Command", on page 390. The "Copy" function enables you to write an SCPI script conveniently by hand.
- Instrument help ([Help] key)
  Opens a help topic that describes the selected parameter or instrument function, including a cross-reference to the corresponding SCPI command. The reference leads you to the description of the SCPI command comprising the complete SCPI syntax, all available setting values, value ranges, etc., see Chapter 12.13, "How to Find Out the SCPI Command Corresponding to the Manual Operation Using the Online Help", on page 390.

Creating and exporting a script file

When the script list is completed, a code generator translates the SCPI commands into the source code of a proprietary programming language, using a code template. Therefore, each language requires an appropriate code template. When converted, you can save the script in a file with an extension corresponding to the programming language.

The R&S SMA100B provides the following predefined code templates by default:

- Plain SCPI
  Represents SCPI base format, that is ASCII format, saved as text file (`*.txt`).
- MATLAB
  A programming environment, frequently used in signal processing and test and measurement applications (`*.m`).
  You can directly use this format with MATLAB(c) Toolkit. For comprehensive information on this topic, refer to the application note 1GP60: MATLAB Toolkit for R&S Signal Generators.
- NICVI
  An ANSI C programming environment designed for measurements and tests (`*.c`).
  You can directly use this format with National Instruments LabWindows CVI.

You can also convert a script to a user-specific format. In this case, you need a code template with the extension `*.expcodetmpl`.

For information on how to select the code template and save the script in a file, see Chapter 12.11.3, "SCPI Recording Export Settings", on page 388.

Executing an SCPI script

An SCPI script primarily runs on the controller PC. In addition, you can execute a script directly on the instrument, by assigning the script to the [★ (User)] key.

See Chapter 11.2.3, "Assigning Actions to the [★ (User)] Key", on page 326.

12.11.1 Show SCPI Command

Access:

1. Select the parameter.
2. Open the context-sensitive menu (tap and hold).
3. Select "Show SCPI Command".

This function provides the syntax of the remote command with the current setting.

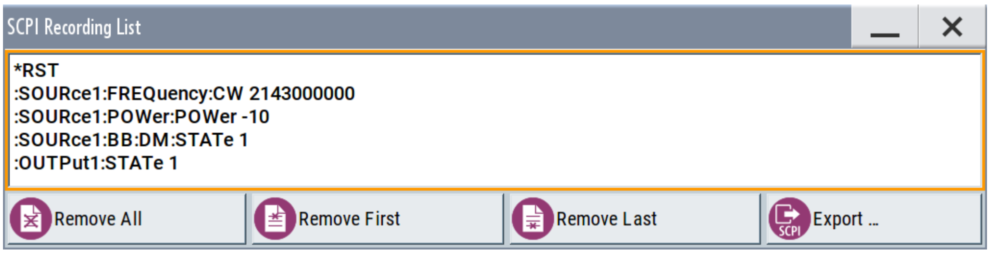
Copy
Copies the command and the current setting.

Close
Exits the "SCPI Command" dialog.

12.11.2 Displaying an SCPI List

The instrument displays a recorded SCPI list and thus provides viewing the recorded results before exporting.

► Depending on the starting point, you can access the "SCPI Recording List" dialog as follows:
- During recording
  Select "Show SCPI Recording List" in the context-sensitive menu.
- At any time outside recording
  Select "Show SCPI Recording List" in the context-sensitive menu.
  This function assumes that at least one recording has been executed after power-on.
- At the end of the recording
  Select "Stop automatic SCPI recording". The dialog opens automatically.
- After you have exported the script to a file.
  Select "SCPI Recording Export > Show file content"
  See Chapter 12.11.3, "SCPI Recording Export Settings", on page 388.



The "SCPI Recording List" shows the last recorded and exported commands.

SCPI Recording List
Lists the automatically or manually recorded recorded SCPI commands.

Export
Opens the SCPI Recording Export dialog for configuring the file parameters for export.

Remove All, Remove First, Remove Last
Deletes either the first, the last or all recorded SCPI commands.

To remove several recorded commands, repeat the removing.

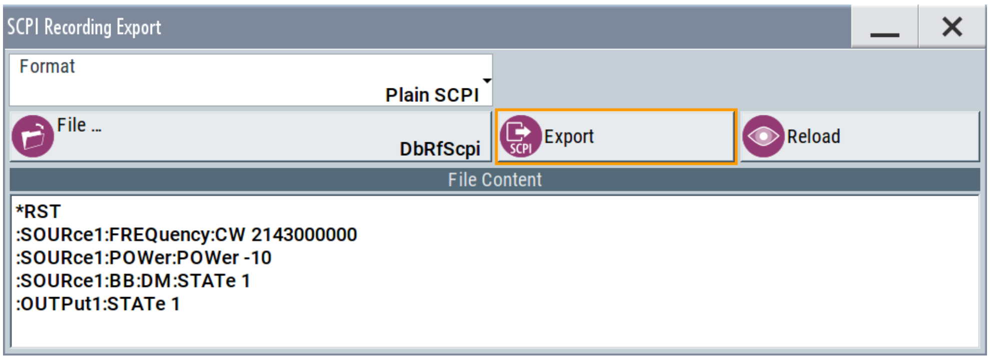
For post processing, export the SCPI command list in a file, see Chapter 12.15, "How to Convert and Save SCPI Lists", on page 394.

12.11.3 SCPI Recording Export Settings

Scripts are configured and saved in the "SCPI Recording Export" dialog. This dialog opens automatically, when you stop recording.

Access:

1. Select "Show SCPI Recording List" in the context-sensitive menu.
   The "SCPI Recording List" dialog opens.
2. Select "Export".



The "SCPI Recording Export" dialog contains all functions required for export of command lists to a file. It enables you to select the source code format, assign an individual filename and display the file content.

Format
Selects the source code format for the command list.

"Plain SCPI" Uses SCPI syntax.

"Predefined Code Generator"
Accesses the predefined templates for common source code generators that convert the recorded settings in the programming languages MATLAB or NICVI.

"User Code Generator"
Provides the ability to convert a script by a user-specific code generator.

Select Code Template
Opens the standard "File Select" dialog and lists the predefined or user-defined code templates.

See Chapter 10.5.1, "File Select Settings", on page 295.

File
Opens the standard file select dialog "Select Output File", see Chapter 10.5.1, "File Select Settings", on page 295.

Export
Executes data export.

The SCPI list is saved in as file with the selected filename and in the selected directory, see File.

Reload
Reloads a SCPI list from a file.

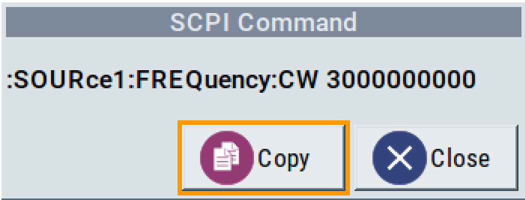
You can export recorded SCPI lists to files (see File and Export), that can be modified.

File content
Displays the content of the script in the selected format and code template.

12.12 How to Find Out the SCPI Command Corresponding to the Manual Operation via Show SCPI Command

1. To find out the SCPI command of a parameter in manual operation, select the respective parameter.
2. Open the context-sensitive menu and select "Show SCPI command"

You get the detailed command syntax, including the currently set value.



With the "Copy" function, you can conveniently paste the command including the current setting, e.g., in a command script.

12.13 How to Find Out the SCPI Command Corresponding to the Manual Operation Using the Online Help

If you are looking for the remote command to a function in manual operation, you find it in the description of the online help.

1. To find out the SCPI command of a parameter in manual operation, select the respective parameter.
2. To open the corresponding help topic, select one of the following:
   - In the display, select "context-sensitive menu > Help".

   - On the front panel, press the [Help] key.

   The help topic opens. Apart from the function description, it contains the SCPI command in detailed syntax.

How to find the corresponding GUI function to a command

Conversely, if you are looking for a function in the GUI, which belongs to a SCPI, you find it via a cross-reference in the online help and in the user manual.

12.14 How to Record / Create SCPI Lists

How to record SCPI lists automatically

The following example briefly explains how to proceed when you want to record SCPI lists.

For comprehensive information on this topic, refer to the application note 1GP98: SCPI Recorder Test Automation on a Fingertip.

1. On the screen, open the context-sensitive menu (touch and hold, or right mouse click) and select "Start SCPI recording".

   Starting from now, all steps you perform are recorded.

2. To stop SCPI recording, select "context-sensitive menu > Stop SCPI recording".

   The "SCPI Recording List" dialog opens automatically.

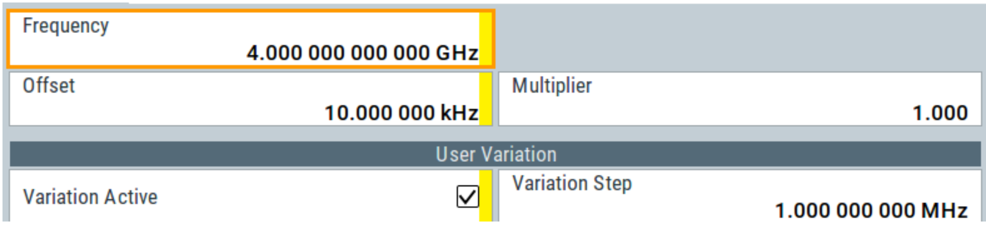
3. Proceed with How to check an SCPI list.

How to record SCPI lists manually

We recommend that you activate the "Mark All Parameters Changed from Preset". This function facilitates to track the changes.

1. To retrace your settings, open the context-sensitive menu and select "Mark all Parameters Changed from Preset".

   This function identifies and highlights all settings you have changed, both in the block diagram, and in the dialogs.



2. For selectively recording your steps:
   a) Set the parameter.
   b) Open the context-sensitive menu.
   c) Select "Add SCPI Command to Recording List"

   Tip: You cannot see "Add SCPI ..." in the menu?
   A possible reason is opening the menu outside of a dialog or input field, for example in a block diagram. Open the context-sensitive menu within the corresponding dialog or input field, and the feature is available.
   d) Continue with the next setting, and repeat steps *a to b* whenever needed.

   Each time you select "Add SCPI ...", the SCPI command is appended to a temporary list.
3. To check the progress of the recording, select "Context-Sensitive > Show SCPI Recording List".

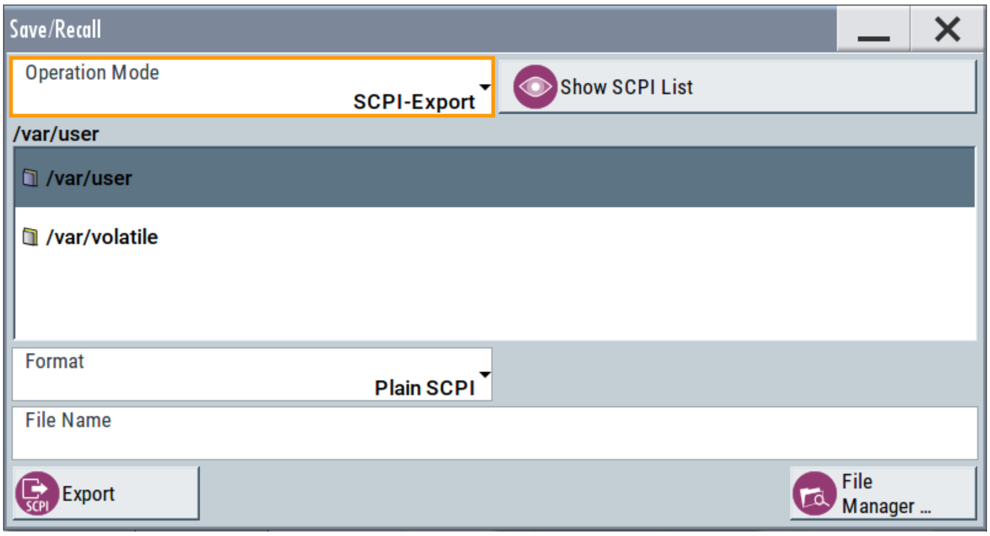
   The "SCPI Recording List" dialog opens, displaying all recorded settings so far.
4. Proceed with How to check an SCPI list.

How to create a SCPI list with the current instrument settings in one step

You can also generate a SCPI list from a manually created instrument state at any time, in only one step.

To generate an SCPI list with commands for all settings performed:

1. Select "Save/Recall > SCPI Export".



The instrument opens the standard file select dialog, see Chapter 10.4.1, "Save/ Recall Settings", on page 291.

2. In the "Format" entry field, select the source code.
3. Depending on the selected format, convert the script as described in Chapter 12.15, "How to Convert and Save SCPI Lists", on page 394
4. Enter a filename.
5. Select "Export".
   The instrument writes all SCPI commands of the key parameters and the modified settings in the file. Also assigns the file extension automatically according to the source code format.
6. To preview the content of the SCPI list:
   a) Select ""System Config > Save/Recall"".
   b) Select "Operation Mode > SCPI-Export".
   c) In the `/var/user/` directory, select a previously saved file.
   d) Select "Show SCPI List".

   The list of all SCPI commands is displayed, for example, for a final check.

Exporting the SCPI list of the instrument state in one step is a fast and convenient method. Nevertheless, it usually requires postprocessing on an external PC.

How to check an SCPI list

The easiest way to check a list, is to execute it. The generator returns a warning if a setting could not be performed.

However, we recommend that you check the list and possibly rework. It can be that ...

- A parameter has not assigned an SCPI command or an element of the user interface has not an assigned parameter. In these cases, `:SYST:INF:SCPI 'SCPI command not available'` is entered in the list instead.

Such entries are also detected during execution. The instrument recognizes these incomplete commands and displays an error message.

- A preset has been executed, but several standards subsequently perform some internal settings that are also assigned to the list with "SCPI Export".
- After a preset still some settings are defined, which are then written to the list generated with "SCPI Export."

Some suggestions on how you can check and revise a list:

1. Search and remove missing command entries.
2. Remove unnecessary content written after a preset.
3. Rearrange the commands to a reasonable order. If you, for example, set a `STATe` command to the last position of a list, you can avoid intermediate calculations of the signal.
4. Preview the list for completeness by comparing it with the modified settings in the manual mode.
   a) To retrace your settings in manual operation, open the context-sensitive menu and select "Mark all parameters changed from preset".
   The function identifies all settings you have changed, both in the block diagram, and in the dialogs. They appear orange.
   b) Check whether there is a command in the list for all modified settings.
5. To perform modifications, export the list to a PC, using for example a USB flash drive.

12.15 How to Convert and Save SCPI Lists

After completing the recording, the "SCPI Recording Export" dialog opens.

1. Select the "Format" for the command syntax in which you want to save the list.
2. "Select Code Template"
   Depending on the selected format, proceed accordingly:
   Note: Select the code template **before** exporting.
   a) Plain SCPI
   Continue with the next step.
   b) Predefined code generator
   The "SCPI Recording Export - Select Predefined Code Template" dialog opens. Select one of the predefined code templates.
   c) User code generator
   A file system ("SCPI Recording Export - Select User Code Template") dialog opens.
   Select your user-defined code template. The code template must have file extension `*.expcodetmpl`.

3. Select "File..."
   The "SCPI Recording Export - Select Output File" dialog opens.
4. Select "New" and assign a filename for saving the recorded list.
5. In the "SCPI Recording Export" dialog, select "Export".
   Saves the recorded data either in ASCII format (plain SCPI), or in the corresponding format of the used code template, and shows the SCPI list in the "File Content" section.

12.16 How to Set Up Remote Operation via VNC

This section shows you some examples of the various possibilities to set up remote operation.

- Using a desktop system
  – Chapter 12.16.1.1, "Using a Web Browser", on page 395
  – Chapter 12.16.1.2, "Using a VNC Client Software", on page 396
- Using a smart device
  – Chapter 12.16.2.1, "Using a VNC App", on page 399
  – Chapter 12.16.2.2, "Using a Web Browser with HTML5", on page 399
  – Chapter 12.16.2.3, "Special Mode QR Code ", on page 400

Enabled direct control

The direct control of the instrument is not disabled and the instrument can be controlled from the front panel and via the remote computer alternately.

12.16.1 Setting Up a Remote Operation from a Desktop System

12.16.1.1 Using a Web Browser

The R&S SMA100B supports remote operation via VNC with any web browser, like Windows Internet Explorer or Mozilla Firefox for instance, or alternatively, an HTML5 web browser.

To operate the instrument via a web browser remotely:

1. Install the *JRE (Java Runtime Environment)* on the remote computer.
   Note: Skip this step if you are working with an HTML5 web browser.
2. Type the instruments' IP address in the address field of the web browser on your PC, e.g. *http://10.113.1.151*

   The VNC authentication screen appears.

3. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

12.16.1.2 Using a VNC Client Software

A VNC client software is an application which can be used to access and control the instrument from a remote computer through a LAN connection.

The VNC client software for setting up the connection is included in the operating system Linux/Unix per default. For Windows operating systems, a VNC client software must be installed manually.

Various free-of charge programs such as Ultr@VNC or similar VNC client programs are available for download on the Internet.

Setting up the VNC connection on a Linux/Unix desktop client

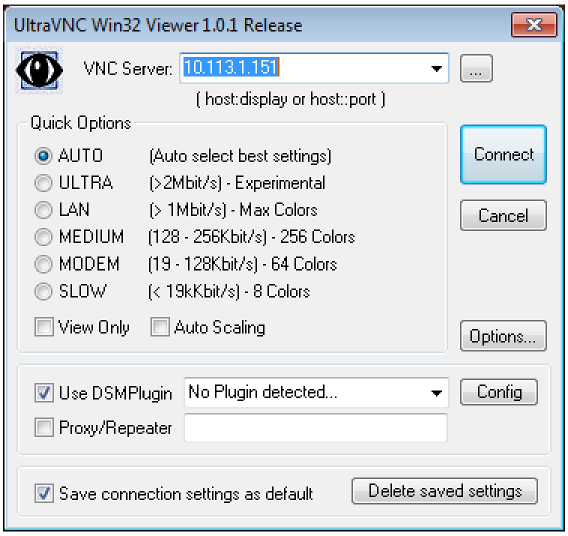
1. Start a web browser on the remote computer. Enter the IP address of the instrument.
2. Enter the following address:
   `vnc://<IP-address of the instrument>`, for example *vnc://10.113.1.151*.

   A dialog opens requesting the password for the remote VNC connection.
3. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

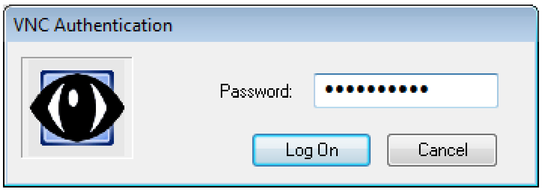
Setting up the VNC connection on a Windows desktop client

1. Install the VNC viewer program component on the remote computer.
   a) On the Internet, select a VNC client program and download it onto your PC.
      For example the free of charge software Ultr@VNC (`vncviewer.exe` is available, see http://www.uvnc.com/download/index.html.
   b) Execute the VNC client installation.
   c) Select the VNC viewer program component and follow the installation instructions.
2. Start VNC viewer program component on the PC.



3. Select "VNC Server" and enter the IP address of the instrument.
4. To initialize the connection, select "Connect".

   A dialog opens requesting the password.



5. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

Terminating VNC connection

► Perform one of the following:

   a) On an external Unix/Linux PC, close the Internet browser or the signal generator window.
   b) On an external Windows PC, close the VNC viewer program.

   The connection is terminated but not disabled. It can be established again any time.
   In the "Active Connections" tab, the displayed TCP/IP connection disappears.
   Consider, however, the note concerning unauthorized access due to VNC connection ("Risk of unauthorized access" on page 347).

12.16.2 Setting Up a Remote Operation from a Smart Device

The R&S SMA100B supports remote operation via VNC from a smart device (remote client), like a tablet (tablet computer) or a smartphone. The smart device accesses the instrument via WLAN, either by a suitable App, or an HTML5 web browser, that means with embedded *javascript*.

There are several possibilities to establish a WLAN connection between the smart device and the R&S SMA100B, which are, however, not all described here. This section gives an example of how a network environment can be built up, and some essential configuration steps.

For comprehensive information on this topic refer to the application notes:

- 1MA216: Remote Operation of Windows Based Instruments with Apple iPad
- 7BM82: Apple iPad Remote Control of Broadcasting T&M Instruments

Example:

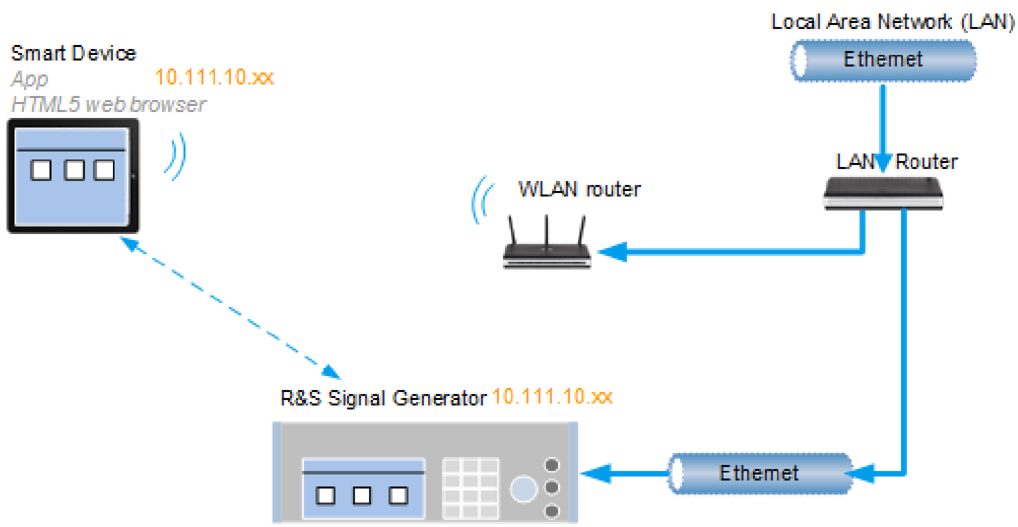


Figure 12-7: Example of a network configuration for remote operation with a smart device

As shown in the figure, the R&S SMA100B and the WLAN router are connected to the LAN router. The smart device accesses the Rohde & Schwarz instrument via the WLAN router.

Prerequisites

For this network configuration, the following prerequisites must be met:

- The required equipment is:
  - A LAN router
  - A WLAN router (hot spot)
    Required for accessing the R&S SMA100B
- The smart device must be known and accepted in the network of the R&S SMA100B.

- The *App* or web browser implements the VNC functionality on the smart device for remote operation.

It is recommended that all components in the network use DHCP, which automatically assigns the relevant address information.

With the configuration in the example, you can reach the instrument from a great distance, since the WLAN router acts as an additional access point.

12.16.2.1 Using a VNC App

Using a *VNC App* enables the smart device to access the R&S SMA100B via WLAN.

The VNC Apps are available from various manufacturers of the smart devices. The list of supported devices is different according to the smart device. Refer to the manufacturer's website to find out whether a VNC App is available for your device, and how it is installed.

1. In the network, establish the connection of the WLAN router to the LAN router.
   We assume the connection of the LAN router and the R&S SMA100B and their configuration in the LAN.
2. Configure the WLAN router according to the manufacturer's instructions.
3. Install the required *VNC App* on your smart device.
4. On the smart device, start the *VNC App*.
5. In the address field, enter the IP address of the instrument.
   Tip: The R&S SMA100B indicates IP address on the screen.

   A log-on dialog opens and requests the password for the VNC connection.

   The default user name and password is *instrument*.

   Tip: Default password. Remote access via VNC uses the user name "instrument" with default user password "instrument".
   Note: We recommend that you change the default password before connecting the instrument to a network.

   See Chapter 11.4.4, "Password Management", on page 341.
6. Enter the password to establish the remote access.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

12.16.2.2 Using a Web Browser with HTML5

The R&S SMA100B supports remote operation from a smart device via VNC with any HTML5 compliant web browser, like Internet Explorer, Firefox, Google Chrome, or Safari for instance.

To operate the instrument remotely via a web browser, proceed as follows:

1. In the web browser enter the IP address of the instrument, e.g. *http://10.113.1.151*.
2. Type the instrument IP address in the address field of the web browser on your PC, e.g. *http://10.113.1.151*
   Tip: The R&S SMA100B indicates IP address on the screen.

   The VNC authentication screen appears.
3. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

12.16.2.3 Special Mode QR Code

If your smart device is equipped with a camera and a QR code reader, you can scan the instrument's IP address or access the instrument with the Safari web browser.

QR code readers are available from various manufacturers of the smart devices. The list of supported devices is different according to the smart device. Refer to the manufacturer's website to find out whether a reader is available for your device, and how it is installed.

1. Install the required QR code reader software on your device.
2. Start the reader.
3. On the R&S SMA100B, select "System Config > Remote Access".
4. In the "Remote Access" dialog, select the "QR-Code" tab.
5. Scan the QR code of the instrument with your smart device.
6. On the device, decode the scanned QR code and pass it to the web browser.

   A dialog opens requesting the password for the VNC connection.
7. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

12.17 References

12.17.1 LXI Functionality

LAN Extensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology. LXI is intended to be the LAN-based successor to GPIB, combining the advantages of Ethernet with the simplicity and familiarity of GPIB.

Like GPIB, LXI determines and standardizes the way the instrument behaves in a LAN. The LXI implementation in the R&S SMA100B allows you to change certain LAN settings, to reset the LAN connection, and to identify the instrument.

For information about the LXI standard, refer to the LXI website at http://www.lxistandard.org.

See also "News from Rohde & Schwarz, article 2006/II - 190".

The LXI functionality in the R&S SMA100B is characterized by a common LAN implementation, including an ICMP ping responder for diagnostics. The instrument can be configured via a web browser. A LAN Configuration Initialize (LCI) mechanism resets the LAN configuration. The instrument also supports automatic detection in a LAN via the VXI-11 discovery protocol and programming by IVI drivers.

In addition the R&S SMA100B provides the following LXI-related functionality:

- Integrated "LXI Status" dialog for LXI status indication and reset of the LAN configuration, see Chapter 12.5.1, "LXI Status Settings", on page 367.
- "LXI Browser Interface", as described in Chapter 12.5.2.1, "LAN Configuration", on page 369.
- "SCPI Remote Trace" utility, see "SCPI Remote Trace" on page 371.

Firmware update

To enable the full LXI functionality after a firmware update, shut down and restart the instrument.

12.17.2 Code Generator Templates

This section describes the main structure of the code generator templates, and shows the method by means of the NICVI template.

The code generation is controlled by templates with the following blocks:

Command	Function
#EXTENSION_START #EXTENSION_END	Defines the output file extension.
#INIT_CODE_START #INIT_CODE_END	Contains initial entries, such as included files and libraries, buffer size, commands for synchronization, or creating a VISA session. All entries between start and end are written once at the beginning of the output file.
#COMMAND_CODE_START #COMMAND_CODE_END	Frame for an SCPI command. A command is accessed with %COMMAND.
#NO_COMMAND_CODE_START #NO_COMMAND_CODE_END	Frame for a parameter with no SCPI command available. A parameter is accessed with %PARAMETER.
#EXIT_CODE_START #EXIT_CODE_END	Closes the visa session. All entries between start and end are written once at the end of the output file.

Templates are created in ASCII format with file extension `*.expcodetempl`.

Example:

Example to the code generator template `NICVI.expcodetmpl`:

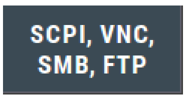
```
#EXTENSION_START
.c
#EXTENSION_END

#INIT_CODE_START
#include <ansi_c.h>
#include <visa.h>
#include <cvirte.h>

#define MAX_BUFFER_SIZE 200
static ViStatus status;
static ViSession defaultRM, handle;

static void write_command(char *command)
{
  char writeBuffer[MAX_BUFFER_SIZE];
        char readBuffer[MAX_BUFFER_SIZE];
        int length;
        int readCount;

        strcpy(writeBuffer, command);
        //append "*OPC?" to sync
        strcat(writeBuffer, ";*OPC?");
        length = strlen (writeBuffer);
        writeBuffer[length]='\n';
```

```
        length = length+1;
        viWrite (handle, writeBuffer, length, VI_NULL);
        //read result
        viRead(handle, readBuffer, 100, &readCount);
}
int main (int argc, char *argv[])
{
  if (InitCVIRTE (0, argv, 0) == 0)
     return -1;    /* out of memory */
        //create a VISA session and return a handle to it
     viOpenDefaultRM (&defaultRM);
        //create a VISA session to the serial port and return a handle to it
        viOpen (defaultRM, (ViRsrc)"TCPIP::localhost::INSTR", VI_NULL, VI_NULL,
&handle);
#INIT_CODE_END

#COMMAND_CODE_START
  write_command("%COMMAND");
#COMMAND_CODE_END

#NO_COMMAND_CODE_START
  //no SCPI command available for parameter %PARAMETER !
#NO_COMMAND_CODE_END

#EXIT_CODE_START
  viClose (handle);
        viClose (defaultRM);
        return 0;
}
#EXIT_CODE_END
```

12.17.3 Remote Control States

How to I recognize if there is an active remote connection to the instrument?

► Observe the indication on the taskbar.



A softkey in the taskbar indicates if and what kind of remote connections are currently set up.
See also Chapter 12.4.6, "Active Connections Settings", on page 364.

The following table shows the different remote control states and the associated commands or actions to return to manual control.

Table 12-3: Remote control status icons

GUI symbol	Transition to remote control state...	Transition to manual operation...(local state)
 	`&GTR` (controller) Remote control, but usable front panel keys. The parameters are in read-only mode.	• `&GTL` (controller) • Tap the "Remote" icon (display) • [Local] (front panel or key emulation) A currently performed setting is indicated by the green arrows. The setting must be completed (white arrows), otherwise the instrument remains in remote state.
	`&LLO` (controller) Remote control with locked front panel keys to prevent user interaction. The parameters are in read-only mode. You can unlock LLO, and thus return to manual operation only via remote control.	• `&LOCS` (controller) • `CALL IBLOC (generator%)` (controller) **Note:** The command `&REMS` returns to "Remote" state.

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, refer to:

- Chapter 12, "Network Operation and Remote Control", on page 346
- Chapter A.1, "Additional Basics on Remote Control", on page 710

13.1 Conventions used in SCPI Command Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S SMA100B 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 SMA100B. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the examples as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (for example comments) start with two // characters.

At the beginning of the most remote control program, an instrument (p)reset is recommended to set the R&S SMA100B to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

In all the examples we assume that:

- A remote PC is connected to the instrument
- The remote PC and the instrument are switched on
- A connection between them is established
- The security setting "System Config > Setup > Security > SCPI over LAN" is enabled.

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**

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,SMA100B,1419.8888K02/0,4.00.033`

Usage: Query only

Manual operation: See "IDN String" on page 364

***IST?**

Individual status query

Returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Return values:

<ISTflag>	0 | 1
Usage:	Query only

***OPC**

Operation complete

Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query writes a "1" into the output buffer when all preceding commands have been executed, which is useful for command synchronization.

***OPT?**

Option identification query

Queries the options included in the instrument. For a list of all available options and their description, refer to the data sheet.

Return values:

<Options>	The query returns a list of options. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.
Usage:	Query only
Manual operation:	See "OPT String" on page 364

***PRE** <Value>

Parallel poll register enable

Sets parallel poll enable register to the indicated value. The query returns the contents of the parallel poll enable register in decimal form.

Parameters:

<Value>	Range:	0 to 255

***PSC** <Action>

Power on status clear

Determines whether the contents of the `ENABle` registers are preserved or reset when the instrument is switched on. Thus a service request can be triggered when the instrument is switched on, if the status registers ESE and SRE are suitably configured. The query reads out the contents of the "power-on-status-clear" flag.

Parameters:

<Action> 0 | 1

0
The contents of the status registers are preserved.

1
Resets the status registers.

***RCL** <Number>

Recall

Loads the instrument settings from an intermediate memory identified by the specified number. The instrument settings can be stored to this memory using the command `*SAV` with the associated number.

It also activates the instrument settings which are stored in a file and loaded using the `MMEMory:LOAD <number>, <file_name.extension>` command.

Manual operation: See "Recall Immediate x" on page 294

***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 287

***SAV** <Number>

Save

Stores the current instrument settings under the specified number in an intermediate memory. The settings can be recalled using the command `*RCL` with the associated number.

To transfer the stored instrument settings in a file, use the command `:MMEMory:STORe:STATe`.

Manual operation: See "Save Immediate x" on page 293

***SRE** <Contents>

Service request enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:

<Contents> Contents of the service request enable register in decimal form. Bit 6 (MSS mask bit) is always 0.

Range: 0 to 255

***STB?**

Status byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**

Trigger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal. This common command complements the commands of the `TRIGger` subsystem.

Usage: Event

***TST?**

Self-test query

Initiates self-tests of the instrument and returns an error code.

Return values:

<ErrorCode> **integer > 0 (in decimal format)**
An error occurred.
(For details, see the Service Manual supplied with the instrument).

0
No errors occurred.

Usage: Query only

***WAI**

Wait to continue

Prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also command synchronization and *OPC).

Usage: Event

13.4 Preset Commands

The preset commands are not bundled in one subsystem. Therefore, they are listed separately in this section.

Four presetting actions are available:

- Activating the default state of all internal instrument functions (*RST on page 409). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. GPIB address or reference oscillator source settings.
- Activating the preset state of the parameters related to the selected signal path (:SOURce<hw>:PRESet on page 411)
- Activating the preset state of all parameters that are not related to the signal path (:DEVice:PRESet on page 411)
- Activating the original state of delivery (factory reset, :SYSTem:FPReset on page 412). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

:DEVice:PRESet

Presets all parameters which are not related to the signal path, including the LF generator.

Example: DEV:PRES
Presets all instruments settings that are not related to the signal path.

Usage: Event

:SOURce<hw>:PRESet

Presets all parameters which are related to the selected signal path.

Example: SOUR:PRES
Presets all settings that are related to signal path

Usage: Event

:SYSTem:PRESet

Triggers an instrument reset. It has the same effect as:

- The [Preset] key
- The `*RST` command

For an overview of the settings affected by the preset function, see Table 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 287

13.5 MMEMory Subsystem

The `MMEMory` subsystem (Mass MEMory) contains the commands for managing files and directories as well as for loading and storing complete instrument settings in files.

Mass storage location

Without any additional measures, the R&S SMA100B stores user files on the internal memory, the removable 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**.

If option R&S SMAB-B85 is installed, the R&S SMA100B maps the user directory to the removable memory. If a memory is mounted, user data is saved there. Otherwise user data is redirected to the volatile memory.

Default storage location

The R&S SMA100B stores user data in the user directory.

Depending on the installed options, the user directory is physically located on the internal memory or on the removable memory.

In the file system, user directory is always indicated as **/var/user/**.

In manual control, you access this directory via the "File Manager", see Chapter 10.8, "Using the File Manager", on page 298. 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 SMA100B distinguishes the files according to their extensions; each type of file is assigned a specific file content and hence a specific file extension. Refer to Chapter C, "Extensions for User Files", on page 739 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 Accessing Files in the Default or in a Specified Directory

For better overview and easy file handling, you may not save all user files in the user directory `/var/user` but rater organize them into subdirectories.

The command syntax defines two general ways to access files with user data in a *specific* directory:

- **Change the current default directory** for mass memory storage and then directly access the files in this default directory, like stored list files, files with user data or save/recall files.
  The subsequent commands for file handling (select, delete, read out files in the directory, etc.) require only specification of the filename. File extension can be omitted; after syntax evaluation of the used command, the R&S SMA100B filters out the relevant files.
- Define the **absolute file path**, including the user directory `/var/user`, created subdirectories and filename (see Example "Load file with user data from a specific directory" on page 414).
  As a rule, whenever an absolute file path is determined, it overwrites a previously specified default directory.

The following example explains this rule as a principle. Exceptions of this general rule are stated in the description of the corresponding command. The Chapter 13.5.3, "Programming Examples", on page 415 explains the general working principle with the commands for mass memory storage.

The same rule applies to the `/var/volatile` directory, see Example "Working with files in the volatile memory" on page 416.

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: Storing and loading current settings

This example shows two ways of how to store the current instrument setting in the file `settings.savrcltxt` in the directory `/var/user/savrcl`.

Before the instrument settings can be stored in a file, they have to be stored in an intermediate memory using common command `*SAV <number>`. The specified number is then used in the `:MMEMory:STORe:STATe` command.

Also, after loading a file with instrument settings with command `:MMEMory:LOAD:STATe`, these settings have to be activated with the common command `*RCL <number>`.

```
// Store the current settings in an intermediate memory with number 4
*SAV 4

// store the settings in a file in a specific directory;
// the complete path has to be specyfied
MMEMory:STORe:STATe 4,"/var/user/savrcl/settings.savrcltxt"

// store the settings in a file in the default directory;
// set the default directory; specify only the file name
MMEMory:CDIRectory  "/var/user/savrcl"
*SAV 4
MMEMory:STORe:STATe 4,"settings.savrcltxt"

// Load the stored settings in the intermediate memory 4 and activate them
MMEMory:LOAD:STATe 4,"/var/user/settings.savrcltxt"
*RCL 4
```

Example: Working with files and directories

This example shows how to list files in a directory, list the subdirectories, query the number of files in a directory, create directory, rename and delete files.

```
// Query the current default directory for mass storage,
// change the directory to the default user directory "/var/user"
// and read out the files in it
MMEMory:CDIRectory?
// "/var/user/temp"
MMEMory:CDIRectory
MMEMory:CDIRectory?
// "/var/user/"
MMEMory:CATalog?
// 1282630,8102817792,".,DIR,4096","..,DIR,4096","Log,DIR,4096",
// "settings.savrcltxt,BIN,16949","temp,DIR,4096","test,DIR,4096",
// "list.lsw,BIN,1245201"
// the directory "/var/user" contains the predefined directory "Log",
```

```
// the subdirectories "test" and "temp"
// as well as the files "settings.savrcltxt" and "list.lsw"

// query only the subdirectories of the current or specified directory
MMEMory:DCATalog? "/var/user"
// ".","..","Log","temp","test"

// query only number of subdirectories in the current or specified directory
MMEMory:DCATalog:LENGth? "/var/user"
// 5

// query number of files in the current or specified directory
MMEMory:CATalog:LENGth? "/var/user"
// 7

// Create a new directory for mass memory storage in the specified directory
MMEMory:MDIRectory "/var/user/new"

// Copy the file "settings.savrcltxt" into the new directory
MMEMory:COPY "/var/user/settings.savrcltxt","/var/user/new/settings.savrcltxt"

// Rename the file "settings.savrcltxt" into the new directory
// and read out the files in this specific directory
MMEMory:CDIRectory  "/var/user/new"
MMEMory:MOVE "settings.savrcltxt","settings_new.savrcltxt"
MMEMory:CATalog? "/var/user/new"
// 25141,8102789120,".,DIR,4096","..,DIR,4096","settings_new.savrcltxt,BIN,16949"

// Delete the "test" directory
MMEMory:RDIRectory "/var/user/test"
```

Example: Working with files in the volatile memory

This example shows how to work with files in the `/var/volatile` directory.

```
// Change the default directory for mass storage,
// read out the files, load and play a file with the ARB
MMEMory:CDIRectory "/var/volatile"
MMEMory:CDIRectory?
// "/var/volatile"
MMEMory:CATalog?
//13928,525352960,".,DIR,60","..,DIR,4096","list.lst,BIN,9772"

:SOURce1:LIST:SELect "/var/volatile/list"
:SOURce1:FREQuency:MODE LIST
:OUTPut1:STATe 1
```

13.5.4 Remote Control Commands

:MMEMory:CATalog? <path>

Returns the content of a particular directory.

Query parameters:

<path> string

String parameter to specify the directory.
If you leave out the path, the command returns the contents of the directory selected with `:MMEMory:CDIRectory`.
The path may be relative or absolute.

Return values:

<UsedDiskSpace> Byte size of all files in the directory.

<FreeDiskSpace> Remaining disk space in bytes.

<FileInfo> <NameFileN>,<SuffixFileN>,<SizeFileN>

List of files, separated by commas

<NameFileN>
Name of the file.

<SuffixFileN>
Type of the file. Possible suffixes are: ASCii, BINary, DIRectory

<SizeFileN>
Size of the file in bytes.

Usage: Query only

Manual operation: See "Directory, File List and Filename" on page 292

:MMEMory:CATalog:LENGth? <Path>

Returns the number of files in the current or in the specified directory.

Query parameters:

<Path> string

String parameter to specify the directory. If the directory is omitted, the command queries the content of the current directory, queried with `:MMEMory:CDIRectory` command.

Return values:

<FileCount> integer

Number of files.

Usage: Query only

:MMEMory:CDIRectory <Directory>

Changes the default directory for mass memory storage. The directory is used for all subsequent `MMEM` commands if no path is specified with them.

Parameters:

<Directory> <directory_name>

String containing the path to another directory. The path can be relative or absolute.
To change to a higher directory, use two dots '..' .

Usage: SCPI confirmed

Manual operation: See "Directory, File List and Filename" on page 292

:MMEMory:COPY <SourceFile>[,<DestinationFile>]

Copies an existing file to a new file. Instead of just a file, this command can also be used to copy a complete directory together with all its files.

Setting parameters:

<SourceFile> string

String containing the path and file name of the source file

<DestinationFile> string

String containing the path and name of the target file. The path can be relative or absolute.
If `<DestinationFile>` is not specified, the `<SourceFile>` is copied to the current directory, queried with the `:MMEMory:CDIRectory` command.
Note: Existing files with the same name in the destination directory are overwritten without an error message.

Usage: Setting only
SCPI confirmed

Manual operation: See "Cut, Copy&Paste and Delete" on page 300

:MMEMory:DATA <Filename>, <BinaryBlock>
:MMEMory:DATA? <Filename>

The setting command writes the block data `<BinaryBlock>` to the file identified by `<Filename>`.

Tip: Use this command to read/transfer stored instrument settings or waveforms directly from/to the instrument.

Parameters:

<BinaryBlock> #<number><length_entry><data>

`#`: Hash sign; always comes first in the binary block
`<number>`: the first digit indicates how many digits the subsequent length entry has
`<length_entry>`: indicates the number of subsequent bytes
`<data>`: binary block data for the specified length.
For files with a size with more than nine digits (gigabytes), the instrument allows the syntax `#(<Length>)`, where `<Length>` is the file size in decimal format.

Parameters for setting and query:

<Filename> string

String parameter to specify the name of the file.

Example: `MMEMory:DATA '/var/user/test.txt',#15hallo`
Writes the block data to the file `test.txt`.
The digit `1` indicates a length entry of one digit; the digit `5` indicate a length of the binary data (`hallo`) in bytes.
`MMEMory:DATA? '/var/user/test.txt'`
Sends the data of the file `test.txt` from the instrument to the controller in the form of a binary block.
`Response: #15hallo`

Usage: SCPI confirmed

:MMEMory:DCATalog? <path>

Returns the subdirectories of a particular directory.

Query parameters:

<path> String parameter to specify the directory. If the directory is omitted, the command queries the content of the current directory, queried with `:MMEMory:CDIRectory` command.

Return values:

<Catalog> <file_entry>

Names of the subdirectories separated by colons. The first two strings are related to the parent directory.

Usage: Query only

:MMEMory:DCATalog:LENGth? [<Path>]

Returns the number of subdirectories in the current or specified directory.

Query parameters:

<Path> String parameter to specify the directory. If the directory is 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: Event

SCPI confirmed

Manual operation: See "Cut, Copy&Paste and Delete" on page 300

: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 294

: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: Event

Manual operation: See "Create New Directory" on page 300

:MMEMory:MOVE <SourceFile>, <DestinationFile>

Moves an existing file to a new location or, if no path is specified, renames an existing file.

Setting parameters:

<SourceFile> string

String parameter to specify the name of the file to be moved.

<DestinationFile> string

String parameters to specify the name of the new file.

Usage: Event
SCPI confirmed

Manual operation: See "Rename " on page 300

:MMEMory:MSIS <Msis>

Defines the drive or network resource (in the case of networks) for instruments with windows operating system, using `msis` (MSIS = Mass Storage Identification String).

Note: Instruments with Linux operating system ignore this command, since Linux does not use drive letter assignment.

Usage: SCPI confirmed

:MMEMory:RDIRectory <Directory>

Removes an existing directory from the mass memory storage system. If no directory is specified, the subdirectory with the specified name is deleted in the default directory.

Setting parameters:

<Directory> string

String parameter to specify the directory to be deleted.

Usage: Event

:MMEMory:STORe:STATe <savrcl_state_nr>, <file_name>

Stores the current instrument setting in the specified file.

The instrument setting must first be stored in an internal memory with the same number using the common command `*SAV`.

Setting parameters:

<savrcl_state_nr> Corresponds to the specific `<number>` defined with the `*SAV` command, e.g. `*SAV 4`.

<file_name> String parameter to specify the file name with extension `*.savrcltxt`.

Usage: Event

Manual operation: See "Save" on page 293

: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.

Suffix <hw>

Suffix	Value range	Description
`CALibration<hw>`	[1]	Optional suffix

Understanding the query response

- `0`: error-free execution of the adjustments
- `1`: indicates that an error occurred; the process has been canceled

---

:CALibration:ALL[:MEASure]? [<Force>]

Starts all internal adjustments that do not need external measuring equipment.

NOTICE: Risk of DUT damage

During level adjustments, the instrument temporarily applies high power at the RF output. This high power can destroy a connected DUT.

Do not start level adjustments if DUT is connected. Disconnect the DUT and replace it by a terminating resistor with adequate power rating. We recommend that you use a 50 Ohm, 10 W or larger terminating resistor.

Query parameters:

<Force> string

Return values:

<Measure> 0 | 1 | OFF | ON

Example: `CAL:ALL:MEAS?`
0
Executes the adjustments of all instrument functions. When completed, it indicates that the adjustment has been performed successfully.

Usage: Query only

Manual operation: See "Adjust All" on page 695

:CALibration<hw>:ALL:DATE?

Queries the date of the most recently executed full adjustment.

Suffix:

<hw> [1]
Optional suffix

Return values:

<Date> string

Example: `CAL:ALL:DATE?`
`// "2016-01-01"`

Usage: Query only

Manual operation: See "Last Full Adjustment" on page 696

:CALibration<hw>:ALL:INFormation?

Queries the current state of the internal adjustment.

Return values:
<CalInfoText> string

Example: `CAL:ALL:INF?`
"Instrument is calibrated, no adjustment required."
"UNCAL, instrument is warming up."
"UNCAL, Please perform full adjustment after warming up."
"UNCAL, Please perform full adjustment."

Usage: Query only

Manual operation: See "Information" on page 696

:CALibration<hw>:ALL:TEMP?

Queries the temperature deviation compared to the calibration temperature.

Suffix:
<hw> [1]
Optional suffix

Return values:
<Temperature> string

Example:
```
CALibration:ALL:TEMP?
// "+39.00 K"
```

Usage: Query only

Manual operation: See "Temperature Offset Since Last Full Adjustment" on page 696

:CALibration<hw>:ALL:TIME?

Queries the time elapsed since the last full adjustment.

Return values:
<Time> string

Example:
```
CAL:ALL:TIME?
// "22 days"
```

Usage: Query only

Manual operation: See "Time Since Last Full Adjustment" on page 696

:CALibration:DATA:FACTory:DATE?

Queries the date of the last factory calibration.

Return values:
<Date> string

Example:
```
CAL:DATA:FACT:DATE?
// "2016-01-01"
```

Usage: Query only

Manual operation: See "Last Factory Calibration" on page 699

:CALibration<hw>:CONTinueonerror <State>

Continues the calibration even though an error was detected. By default adjustments are aborted on error.

Suffix:

<hw> [1]
Optional suffix

Parameters:

<State> 0 | 1 | OFF | ON
*RST: n.a. (factory preset: 0)

Example:

```
CAL:CONT ON
// Continues calibration after an error
```

13.7 CSYNthesis Subsystem

This subsystem contains the commands used to define the frequency settings for the separate clock source (clock synthesis).

Option: see "Required options" on page 278.

Example:

```
CSYNthesis:OTYPe DSIN
CSYNthesis:FREQuency 10000000
CSYNthesis:POWer -15
CSYNthesis:OFFSet:STATe 1
CSYNthesis:OFFSet 0.1
CSYNthesis:PHASe 180
CSYNthesis:PHASe:REFerence
CSYNthesis:PHASe?
// 0
CSYNthesis:FREQuency:STEP:MODE DEC
CSYNthesis:POWer:STEP:MODE DEC
// CSYNthesis:FREQuency:STEP:MODE USER
// CSYNthesis:FREQuency:STEP 1000
// CSYNthesis:FREQuency UP
// 10001000
// CSYNthesis:POWer:STEP:MODE USER
// CSYNthesis:POWer:STEP:INCRement 0.5
CSYNthesis:STATe 1
```

:CSYNthesis:STATe <State>

Activates the clock synthesis.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See " State " on page 279

:CSYNthesis:OTYPe <Mode>

Defines the shape of the generated clock signal.

Parameters:

<Mode> SESine | DSQuare | CMOS | DSINe

`SESine` = single-ended sine
`DSINe` = differential sine
`DSQuare` = differential square
`CMOS` = CMOS

*RST: SESine

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See "Output Type" on page 279

:CSYNthesis:FREQuency <Frequency>

Sets the frequency of the generated clock signal.

Parameters:

<Frequency> float

Numerical value
Sets the frequency

UP|DOWN
Varies the frequency step by step.
The frequency is increased or decreased by the value set with the command `:CSYNthesis:FREQuency:STEP`.

Range: 100E3 to 1.5E9
Increment: 0.001
*RST: 10E6

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See " Frequency " on page 280

:CSYNthesis:POWer <Power>

Sets the power level of the generated clock signal.

Parameters:

<Power> float

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 `:CSYNthesis:POWer:STEP[:INCRement]`.

Range: -24 to 10
Increment: 0.01
*RST: -20

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See " Level " on page 280

:CSYNthesis:OFFSet:STATe <State>

Activates a DC offset.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See " DC Offset State " on page 280

:CSYNthesis:OFFSet <Offset>

Sets the value of the DC offset.

Parameters:

<Offset> float

Range: -5 to 5
Increment: 0.001
*RST: 0

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See " DC Offset " on page 281

:CSYNthesis:VOLTage <Voltage>

Sets the voltage for the CMOS signal.

Parameters:

<Voltage> float

Range: 0.8 to 2.7
Increment: 0.001
*RST: 1.8

Example:

```
CSYNthesis:OTYPe CMOS
CSYNthesis:VOLTage 1.8
CSYNthesis:FREQuency 100000000
CSYNthesis:STATe 1
```

Manual operation: See "Voltage" on page 281

:CSYNthesis:PHASe <Phase>

Shifts the phase of the generated clock signal.

Parameters:

<Phase> float

Range: -36000 to 36000
Increment: 0.1
*RST: 0

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See "Delta Phase" on page 281

:CSYNthesis:PHASe:REFerence

Resets the delta phase value.

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Usage: Event

:CSYNthesis:POWer:STEP:MODE <Mode>
:CSYNthesis:FREQuency:STEP:MODE <Mode>

Defines the type of step size to vary the frequency and level at discrete steps.

Parameters:

<Mode> DECimal | USER

DECimal
Increases or decreases the level in steps of 10.

USER
Increases or decreases the value in increments, set with the command:
`:CSYNthesis:FREQuency:STEP`
`:CSYNthesis:POWer:STEP[:INCRement]`

*RST: DECimal

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See "Variation Active" on page 281

:CSYNthesis:POWer:STEP[:INCRement] <Increment>

Sets the step width of the rotary knob and, in user-defined step mode, increases or decreases the level.

Parameters:

<Increment> float

Range: 0 to 35
Increment: 0.01
*RST: 1

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See "Variation Step" on page 281

:CSYNthesis:FREQuency:STEP <Step>

Sets the step width of the rotary knob and, in user-defined step mode, increases or decreases the frequency.

Parameters:

<Step> float

Range: 0 to 14999E5
Increment: 0.001
*RST: 1E6

Example: See Chapter 13.7, "CSYNthesis Subsystem", on page 425.

Manual operation: See "Variation Step" on page 281

13.8 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 SMA100B Service Manual.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
DIAGnostic<hw>	[1]	Optional suffix

Example: Programming example

The example lists the commands required to query assemblies and test points for diagnosis purposes.

```
// Query the modules available in the instrument
// and variant and revision state of a certain assembly
DIAGnostic1:BGINfo:CATalog?
// FRONT_AF,PSU300,IFB.BV,MB2_AF,...
DIAGnostic1:BGINfo? "PSU300"
// PSU300 2118.2067.02 01.00 100000

// Query the test points available in the instrument
// and trigger the measurement in a selected test point
DIAGnostic1:POINt:CATalog?
// ATT6HP_AF_DET_N,ATT6HP_AF_DET_P,ATT6HP_AF_DET_TEMP...
DIAGnostic1:MEASure:POINt? "ATT6HP_AF_DET_N"
//  0.000000V
```


:DIAGnostic<hw>:BGINfo:CATalog?

Queries the names of the assemblies available in the instrument.

Return values:

<Catalog> string

List of all assemblies; the values are separated by commas
The length of the list is variable and depends on the instrument equipment configuration.

Example: See Example "Programming example" on page 430.

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 430.

Usage: Query only

Manual operation: See "Assembly" on page 699

:DIAGnostic<hw>:POINt:CATalog?

Queries the test points available in the instrument.

For more information, see R&S SMA100B Service Manual.

Return values:

<Catalog> string

List of comma-separated values, each representing a test point

Example: See Example "Programming example" on page 430.

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 SMA100B Service Manual.

Query parameters:

<Name> <test point identifier>

Test point name, as queried with the command `:DIAGnostic<hw>:POINt:CATalog?`

Return values:

<Value> <value><unit>

Example: See Example "Programming example" on page 430.

Usage: Query only

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 ON
// :DISPlay:ANNotation:FREQuency ON
// :DISPlay:ANNotation:AMPLitude ON

// Enable automatic update of the display at defined time intervals
:DISPlay:UPDate ON
```

Example: Querying the dialog IDs, opening and closing dialogs

Use the following commands to query the dialog IDs of all currently open dialogs. The dialog ID is a prerequisite for opening and closing dialogs via the remote control.

The dialog ID is also required to define user key actions.
See Chapter 11.2.3, "Assigning Actions to the [★ (User)] Key", on page 326.

```
// Query the dialog IDs of all open dialogs
:DISPlay:DIALog:ID?
// CEUtraDLGenSetDlg,_,$A DlgKeyRf_Rosc

// Open and close dialogs via remote control
:DISPlay:DIALog:OPEN "CEUtraDLGenSetDlg,_,$A"
:DISPlay:DIALog:OPEN "DlgKeyRf_Rosc"
:DISPlay:DIALog:CLOSe "DlgKeyRf_Rosc"
:DISPlay:DIALog:CLOSe:ALL
```


:DISPlay:PSAVe:HOLDoff <HoldoffTimeMin>

Sets the wait time for the screen saver mode of the display.

Parameters:

<HoldoffTimeMin> integer

Range: 1 to 60
*RST: n.a. (factory preset: 10)
Default unit: minute

Example: see Example "Activating screen saver mode and display update" on page 432

Manual operation: See "Wait Time" on page 319

:DISPlay:PSAVe[:STATe] <State>

Activates the screen saver mode of the display.

We recommend that you use this mode to protect the display, if you operate the instrument in remote control.

To define the wait time, use the command `:DISPlay:PSAVe:HOLDoff`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: See Example "Activating screen saver mode and display update" on page 432

Manual operation: See "Screen Saver" on page 319

: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 319

: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 319

:DISPlay:UPDate <Update>

Activates the refresh mode of the display.

Parameters:

<Update> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 432

Manual operation: See "Display Update is" on page 320

:DISPlay:ANNotation:AMPLitude <State>

Indicates asterisks instead of the level values in the status bar.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 432

Manual operation: See "Annotation Amplitude" on page 337

:DISPlay:ANNotation:FREQuency <State>

Indicates asterisks instead of the frequency values in the status bar.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 432

Manual operation: See "Annotation Frequency" on page 337

:DISPlay:ANNotation[:ALL] <State>

Displays asterisks instead of the level and frequency values in the status bar of the instrument.

We recommend that you use this mode if you operate the instrument in remote control.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Activating screen saver mode and display update" on page 432

: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 436

`:DISPlay:DIALog:CLOSe` on page 436

<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 432

Usage: Query only

Manual operation: See "SCPI" on page 326

: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 432

Usage: Setting only

Manual operation: See "SCPI" on page 326

: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 432

Usage: Setting only

:DISPlay:DIALog:CLOSe:ALL

Closes all open dialogs.

Example: See Example "Querying the dialog IDs, opening and closing dialogs" on page 432

Usage: Event

13.10 FORMat Subsystem

The commands in the `FORMat` subsystem determine the format of data returned by the R&S SMA100B to the controller. This affects all query commands that return a list of numerical data or block data, noted in the descriptions of the commands. The set data format applies to both paths.

:FORMat:BORDer <Border>

Determines the sequence of bytes within a binary block. This only affects blocks which use the IEEE754 format internally.

Parameters:

<Border> NORMal | SWAPped

NORMal
Expects/sends the *least* significant byte of each IEEE754 floating-point number first and the *most* significant byte last.

SWAPped
Expects/sends the *most* significant byte of each IEEE754 floating-point number first and the *least* significant byte last.

*RST: NORMal

Example: `FORM:BORD SWAP`
transfers the data with the most significant bit first.

:FORMat:SREGister <Format>

Determines the numeric format for responses of the status register.

Parameters:

<Format> ASCii | BINary | HEXadecimal | OCTal

ASCii
Returns the register content as a decimal number.

BINary|HEXadecimal|OCTal
Returns the register content either as a binary, hexadecimal or octal number. According to the selected format, the number starts with #B (binary), #H (hexadecimal) or #O (octal).

*RST: ASCii

Example: `FORM:SREG HEX`
returns the register content as a hexadecimal number.

:FORMat[:DATA] <Data>

Determines the data format the instrument uses to return data via the IEC/IEEE bus.

The instrument automatically detects the data format used by the controller, and assigns it accordingly. Data format determined by this SCPI command is in this case irrelevant.

Parameters:

<Data> ASCii | PACKed

ASCii
Transfers numerical data as plain text separated by commas.

PACKed
Transfers numerical data as binary block data.
The format within the binary data depends on the command.
The various binary data formats are explained in the description of the parameter types.

*RST: ASCii

Example: `FORM ASC`
transfers the data as ASCII data.

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?

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 438

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 438

Manual operation: See "Format" on page 312

: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 438

Manual operation: See "Region" on page 313

:HCOPy:FILE[:NAME] <Name>

Determines the file name and path to save the hard copy, provided automatic naming is disabled.

Note: If you have enabled automatic naming, the instrument automatically generates the file name and directory, see Chapter 13.11.2, "Automatic Naming", on page 441.

Parameters:

<Name> string

Example: See Example "Store a hard copy of the display" on page 438

Manual operation: See "File..." on page 312

: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 438

Usage: Event

Manual operation: See "Save" on page 312

13.11.2 Automatic Naming

Use the following commands to automatically assign a file name.

:HCOPy:FILE[:NAME]:AUTO?

Queries path and file name of the hardcopy file, if you have enabled *Automatic Naming*.

Return values:
<Auto> string

Example: See Example "Store a hard copy of the display" on page 438

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 438

Manual operation: See "Path..." on page 314

: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 438

Usage: Event

Manual operation: See "Clear Path" on page 314

: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 438.

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO:STATe <State>

Activates automatic naming of the hard copy files.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Store a hard copy of the display" on page 438

Manual operation: See "Automatic Naming" on page 313

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

Uses the date parameters (year, month or day) for the automatic naming. You can activate each of the date parameters separately.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Store a hard copy of the display" on page 438

Manual operation: See "Prefix, Year, Month, Day" on page 314

: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 SMA100B 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 438

Usage: Query only

Manual operation: See "Current Auto Number" on page 314

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

Uses the prefix for the automatic generation of the file name, provided `PREF:STAT` is activated.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Store a hard copy of the display" on page 438

Manual operation: See "Prefix, Year, Month, Day" on page 314

13.12 KBOard Subsystem

The `KBOard` subsystem contains the commands to set a connected keyboard.

:KBOard:LAYout <Layout>

Selects the language for an external keyboard and assigns the keys acccordingly.

Parameters:

<Layout> CHINese | DANish | DUTCh | DUTBe | ENGLish | ENGUK | FINNish | FRENch | FREBe | FRECa | GERMan | ITALian | JAPanese | KORean | NORWegian | PORTuguese | RUSSian | SPANish | SWEDish | ENGUS

*RST: n.a. (factory preset: ENGLish)

Example:
```
:KBOard:LAYout US
// activates American keyboard
```

Manual operation: See "USB Keyboard > Layout" on page 319

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 Chapter 13.16.6, "SOURce:LFOutput Subsystem", on page 599 system.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`OUTPut<hw>`	[1]	Optional suffix

:OUTPut:ALL[:STATe] <State>

Activates the RF output signal of the instrument.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: `OUTPut:ALL:STATe 0`

:OUTPut<hw>[:STATe] <State>

Activates the RF output signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `OUTP ON`

Activates the RF output.

Manual operation: See "RF State/RF ON" on page 62

:OUTPut<hw>[:STATe]:PON <Pon>

Defines the state of the RF output signal when the instrument is switched on.

Parameters:

<Pon> OFF | UNCHanged

*RST: n.a. (factory preset: UNCHanged)

Example: `OUTP:PON OFF`

The RF output is deactivated when the instrument is switched on.

Manual operation: See " Power-On State " on page 320

:OUTPut<hw>:AMODe <AMode>

Sets the step attenuator mode at the RF output.

Parameters:

<AMode> AUTO | FIXed

AUTO
The step attenuator adjusts the level settings automatically, within the full variation range.

FIXed
The step attenuator and amplifier stages are fixed at the current position, providing level settings settings with constant output VSWR. The resulting variation range is calculated according to the position.

*RST: AUTO

Example:

```
SOURce:POWer:ALC:STATe 1
OUTPut:AMODe FIXed
```

Manual operation: See " Mode " on page 195

:OUTPut<hw>:FILTer:MODE <Mode>

Activates low harmonic filter or enables its automatic switching.

Parameters:

<Mode> ON | AUTO | 1

ON|1
Ensures best low harmonics performance but decreases the level range

AUTO
Applies an automatically selected harmonic filter that fits to the current level setting.

*RST: AUTO

Example: `OUTPut:FILTer:MODE AUTO`

Manual operation: See " Harmonic Filter " on page 70

:OUTPut<hw>:IMPedance?

Queries the impedance of the RF outputs.

Return values:

<Impedance> G1K | G50 | G10K

*RST: G50

Example: `OUTP:IMP?`
queries the impedance of RF output.
`Response: 50`
the impedance is 50 ohms

Usage: Query only

Manual operation: See "RF output impedance" on page 62

:OUTPut:FPRoportional:SCALe <OutpSelScale>

Selects the mode the voltage is supplied depending on the frequency.

The R&S SMA100B supplies the signal at the V/GHz X-Axis connector.

Parameters:

<OutpSelScale> S0V25 | S0V5 | S1V0 | XAXis

S0V25|S0V5|S1V0
Supplies the voltage proportional to the set frequency, derived from the selected setting.

XAXis
Supplies a voltage range from 0 V to 10 V proportional to the frequency sweep range, set with `[:SOURce<hw>]:FREQuency:STARt` and `[:SOURce<hw>]:FREQuency:STOP`.

*RST: S0V25

Options: R&S SMAB-B28

Manual operation: See " V/GHz / X-Axis " on page 179

:OUTPut:USER:MARKer <SelUserMarker>

Selects the signal for output at the Marker User1 connector.

Parameters:

<SelUserMarker> MARK | USER

MARK
Assigns a marker signal to the output.

USER
Intended for future use.

*RST: MARK

Options: R&S SMAB-B28

Manual operation: See " Marker / User " on page 180

: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 445

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 196

:OUTPut<hw>:PROTection:CLEar

Resets the protective circuit after it has been tripped.

To define the output state, use the command `:OUTPut<hw>[:STATe]`.

Example: `OUTP:PROT:CLE`
Resets the protective circuit of the RF output.

Usage: Event

Manual operation: See "Overload" on page 196

:OUTPut<hw>:PROTection:TRIPped?

Queries the state of the protective circuit.

Return values:
<Tripped> 0 | 1 | OFF | ON
*RST: 0

Example: `OUTP:PROT:TRIP`
queries the state of the protective circuit of the RF output.
`Response: 0`
the protective circuit has not tripped.

Usage: Query only

Manual operation: See "Overload" on page 196

13.14 Power Sensor Measurement Subsystems

The power sensor measurement uses several subsystems:

- The `CALCulate` subsystem is used to configure the time gated measurements in power analysis.
- The `DISPlay` subsystem is used to configure the diagram appearance.
- The `INITiate` command switches the local state of the continuous power measurement on and off.
- The `READ` system is used to start and to retrieve the measurement result of the power viewer measurement.
- The `SENSe` subsystem contains the commands for configuring the power viewer and power analysis measurements with power sensors connected to the generator. Up to four sensors can be connected to the signal generator.
- The `TRACe` subsystem is used to configure the traces in power analysis and to retrieve the measurement results.

Power Viewer

The power viewer measurement is started with the `READ` command, this command also retrieves the measurement results.

The sensors are distinguished by the suffix under `SENSe`:

- Power sensor connected to the SENSOR port = `SENSe[1]`
- First Power sensor connected to the USB interface = `SENSe2`
- Second Power sensor connected to the USB interface = `SENSe3`
- Third Power sensor connected to the USB interface = `SENSe4`

Power and Pulse Data Analysis, Gated Measurements (option R&S SMA100B-K28)

The power analysis measurement commands are subsumed under the `SENSe[:POWer]:SWEep:...` commands. Three measurement modes are available: Frequency, Power and Time.

The power analysis measurement is started with the `SENSe[:POWer]:SWEep:INITiate` command and the measurement result retrieved with the `TRACe[:POWer]:SWEep:...` commands.

The four sensors are distinguished by the suffix at the second key word `SENSe`.

The time gate settings are performed using the `CALCulate[:POWer]:SWEep:...` commands.

The measurement diagram and results can be stored in a hardcopy with the `SENSe[:POWer]:SWEep:HCOPy:...` commands.

General parameter and measurement settings are valid for all connected sensors, therefore, no suffix is used in these commands.

13.14.1 CALCulate Subsystem

:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:STATe <State>

Activates the trace mathematics mode for "Frequency" measurement. This feature enables you to calculate the difference between the measurement values of two traces. For further calculation, a math result can also be assigned to a trace.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: `CALC:POW:SWE:FREQ:MATH2:STATe`
Switches on math mode in trace 2.

Options: R&S SMAB-K28

Manual operation: See " Mathematics - Trace Power Analysis " on page 228

:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:SUBTract <Subtract>

Subtracts the operands 1 and 2 and assigns the result to the selected trace in "Frequency" measurement mode.

Parameters:

<Subtract> T1T1 | T1T2 | T1T3 | T1T4 | T1REf | T2T1 | T2T2 | T2T3 | T2T4 | T2REf | T3T1 | T3T2 | T3T3 | T3T4 | T3REf | T4T1 | T4T2 | T4T3 | T4T4 | T4REf

Example: `CALC:POW:SWE:FREQ:MATH4:SUBT T2REF`

Subtracts the Reference and Trace 2, and assigns the result to Trace 4. The resulting curve is shown in the diagram.

Options: R&S SMAB-K28

Manual operation: See " Mathematics - Trace Power Analysis " on page 228

:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:STATe <State>

Activates the trace mathematics mode for "Power" measurement. This feature enables you to calculate the difference between the measurement values of two traces. For further calculation, a math result can also be assigned to a trace.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CALC:POW:SWE:POW:MATH2:STATe`

Switches on math mode in trace 2.

Options: R&S SMAB-K28

Manual operation: See " Mathematics - Trace Power Analysis " on page 228

:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:SUBTract <Subtract>

Subtracts the operands 1 and 2 and assigns the result to the selected trace in "Power" measurement mode.

Parameters:

<Subtract> T1T1 | T1T2 | T1T3 | T1T4 | T1REf | T2T1 | T2T2 | T2T3 | T2T4 | T2REf | T3T1 | T3T2 | T3T3 | T3T4 | T3REf | T4T1 | T4T2 | T4T3 | T4T4 | T4REf

Example: `CALC:POW:SWE:POW:MATH4:SUBT T2REF`

Subtracts the Reference and Trace 2, and assigns the result to Trace 4. The resulting curve is shown in the diagram.

Options: R&S SMAB-K28

Manual operation: See " Mathematics - Trace Power Analysis " on page 228

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:AVERage?

Queries the average power value of the time gated measurement.

Return values:

<Average> float

Range: -1000 to 1000
Increment: 1E-12
*RST: 0

Example: `SENS:SWE:MODE TIME`
Activates time mode for power analysis.
`CALC:SWE:TIME:GATE:STAT ON`
Activates time gated measurement.
`SENS:SWE:INIT`
Activates a single power analysis measurement.
`CALC:SWE:TIME:GATE2:AVER?`
Queries the average power in time gate 2 for trace 1 (=default).

Usage: Query only

Options: Option R&S SMAB-K28

Manual operation: See " State - Gate " on page 238

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:FEED <Feed>

Selects the trace for time gated measurement. Both gates are assigned to the same trace.

Parameters:

<Feed> TRAC1 | TRAC2 | TRAC3 | TRACe1 | TRACe2 | TRACe3 | TRAC4 | TRACe4

*RST: TRAC1

Example: `CALC:SWE:TIME:GATE:FEED TRAC2`
Assigns the gates to trace 2.

Options: Option R&S SMAB-K28

Manual operation: See " Trace - Gate " on page 237

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:MAXimum?

Queries the average power value of the time gated measurement.

Return values:

<Maximum> float

Range: -1000 to 1000
Increment: 1E-12
*RST: 0

Example: `SENS:SWE:MODE TIME`
Activates time mode for power analysis.
`CALC:SWE:TIME:GATE:STAT ON`
Activates time gated measurement.
`SENS:SWE:INIT`
Activates a single power analysis measurement.
`CALC:SWE:TIME:GATE2:MAX?`
Queries the peak power in time gate 2 for trace 1 (=default).

Usage: Query only

Options: Option R&S SMAB-K28

Manual operation: See " State - Gate " on page 238

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STARt <Start>
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STOP <Stop>

Sets the start time of the selected gate. Insert value and unit.

Parameters:

<Stop> float

Increment: 1E-12
*RST: Start/Stop: 5/15 (Gate1), 25/35 (Gate2)

Example: `CALC:SWE:TIME:GATE2:STAR 20us`
Sets a start time of 20 us for gate 2.
`CALC:SWE:TIME:GATE2:STOP 30us`
Sets a stop time of 30us for gate 2.

Options: Option R&S SMAB-K28

Manual operation: See " Start / Stop - Gate " on page 238

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STATe <State>

Activates the gate settings for the selected trace. The measurement is started with command `SENS:POW:INIT`. Both gates are active at one time.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CALC:SWE:TIME:GATE:STAT ON`
Enables time gated measurement.

Options: Option R&S SMAB-K28

Manual operation: See " State - Gate " on page 238

:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:STATe <State>

Activates the trace mathematics mode for "Time" measurement. This feature enables you to calculate the difference between the measurement values of two traces. For further calculation, a math result can also be assigned to a trace.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CALC:POW:SWE:TIME:MATH1:STATe`

Switches on math mode.

Options: R&S SMAB-K28

Manual operation: See " Mathematics - Trace Power Analysis " on page 228

:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:SUBTract <Subtract>

Subtracts the operands 1 and 2 and assigns the result to the selected trace in "Time" measurement mode.

Parameters:

<Subtract> T1T1 | T1T2 | T1T3 | T1T4 | T1REf | T2T1 | T2T2 | T2T3 | T2T4 | T2REf | T3T1 | T3T2 | T3T3 | T3T4 | T3REf | T4T1 | T4T2 | T4T3 | T4T4 | T4REf

Example: `CALC:POW:SWE:TIME:MATH4:SUBT T2REF`

Subtracts the Reference and Trace 2, and assigns the result to Trace 4. The resulting curve is shown in the diagram.

Options: R&S SMAB-K28

Manual operation: See " Mathematics - Trace Power Analysis " on page 228

13.14.2 DISPlay Subsystem

:DISPlay[:WINDow][:POWer]:SWEep:BACKground:COLor <Color>

Defines the background color of the measurement diagram. The selected color applies also to the hardcopy of the diagram.

Parameters:

<Color> BLACk | WHITe

*RST: BLACk

Example: `DISP:SWE:BACK:COL WHIT`

The measurement is indicated with a white background.

Manual operation: See " Background Color - Power Analysis " on page 236

:DISPlay[:WINDow][:POWer]:SWEep:GRID:STATe <State>

Indicates a grid in the diagram.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `DISP:SWE:GRID:STAT OFF`

Deactivates the indication of a grid in the diagram area.

Manual operation: See " Show Grid - Power Analysis " on page 236

13.14.3 INITiate Command

:INITiate<hw>[:POWer]:CONTinuous <Continuous>

The command switches the local state of the continuous power measurement by the R&S NRP-Zxx power sensors on and off. Switching off the local state enhances the measurement performance during remote control

The remote measurement is triggered by the READ query (command `:READ<ch>[:POWer]?` on page 454) which also provides the measurement results. The local state is not influenced by this command, measurements results can be retrieved with local state on or off.

Parameters:

<Continuous> 0 | 1 | OFF | ON

*RST: OFF

Example: `INIT:CONT ON`

switches local state of continuous power measurement on.

13.14.4 READ Subsystem

:READ<ch>[:POWer]?

The command triggers the measurement with power sensors and provides the power measurement result of the selected power sensor. The value is provided with the unit set with command `SENSe:UNIT[:POWer]`.

For certain power sensors, e.g. R&S NRP-Z81, two values are returned, first the value for the average level and - separated by a comma - the peak level

Note: The local state is not influenced by this command, measurements results can be retrieved with local state on or off. For long measurement times it is recommended to use a SRQ (MAV bit) for command synchronization.

Suffix:

<ch> 1..3

Return values:

<Power> string

Example:

`SENS:UNIT DBM`

selects unit dBm for presentation of measurement result.

`READ1?`

queries the measurement result of the sensor connected to the SENSOR interface.

`Response: -45.6246576745440230`

-45.6 dBm were measured at the given frequency.

or e.g. for R&S NRP-Z81

`Response:`

`-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

13.14.5 SENSe Subsystem

:SENSe<ch>[:POWer]:ZERO on page 465

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet <Offset>

Defines the level offset at the sensor input in dB. Activate the offset with the command `:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet:STATe` on page 457.

Parameters:

<Offset> float

Range: -100 to 100
Increment: 0.01
*RST: 0

Example: `SENS2:SWE:FREQ:OFFS -3dB`
Defines a level offset of -3 dB.
`SENS2:SWE:FREQ:OFFS:STAT ON`
Activates the specified level offset.

Options: Option R&S SMAB-K28

Manual operation: See " Level Offset - Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet:STATe <State>

Activates a level offset at the sensor input. Define the appropriate value with the command `:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet` on page 457.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS2:SWE:FREQ:OFFS:STAT ON`
Activates the specified level offset.

Options: Option R&S SMAB-K28

Manual operation: See " Level Offset State- Power Analysis " on page 239

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt <Start>

Sets the start frequency for the frequency power analysis with separate frequencies.

Parameters:

<Start> integer

Range: 0 to 1E12
*RST: 1E6

Example: `SENS2:SWE:FREQ:SENS:SRAN:STAT ON`
Activates use of a separate frequency range for frequency versus power measurement for sensor 2.
`SENS2:SWE:FREQ:SENS:STAR 2.0GHZ`
Sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.

Manual operation: See " Min Frequency - Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP <Stop>

Sets the stop frequency for the frequency power analysis with separate frequencies.

Parameters:

<Stop> integer

Range: 0 to 1E12
*RST: 10E6

Example: `SENS:SWE:FREQ:SENS2:SRAN:STAT ON`
Activates use of a separate frequency range for frequency versus power measurement.
`SENS:SWE:FREQ:SENS2:STAR 2.0GHZ`
Sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.
`SENS:SWE:FREQ:SENS2:STOP 2.9GHZ`
Sets a sweep stop at 2.9 GHz irrespective of the current signal generator frequency settings.

Manual operation: See " Max Frequency - Power Analysis " on page 241

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge[:STATe] <State>

Activates the use of a frequency range for the power measurement that is different to the set signal generator frequency range. The separate frequency range is entered with commands `:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt` on page 458 and `:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP` on page 458.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example:
```
SENS2:SWE:FREQ:SENS:SRAN ON
```
Activates use of a separate frequency range for frequency versus power measurement for sensor 2.
```
SENS2:SWE:FREQ:SENS:STAR 2.0GHZ
```
Sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.
```
SENS2:SWE:FREQ:SENS:STOP 2.9GHZ
```
Sets a sweep stop at 2.9 GHz irrespective of the current signal generator frequency settings.

Manual operation: See " Use Separate Frequency- Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet <Offset>

Defines the level offset at the sensor input in dB. Activate the offset with the command `:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet:STATe` on page 459.

Parameters:

<Offset> float

Range: -100 to 100
Increment: 0.01
*RST: 0

Example:
```
SENS2:SWE:POW:OFFS -5dB
```
Defines a level offset of -5 dB.
```
SENS2:SWE:POW:OFFS:STAT ON
```
Activates that the specified level offset is considered.

Options: Option R&S SMAB-K28

Manual operation: See " Level Offset - Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet:STATe <State>

Activates a level offset at the sensor input. Define the appropriate value with the command `:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet` on page 459.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example:
```
SENS2:SWE:POW:OFFS:STAT ON
```
Activates the specified level offset.

Options: Option R&S SMAB-K28

:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency <SFRequency>

Defines the separate frequency used for power vs. power measurement.

Parameters:

<SFRequency> float

Range: 0 to 1E12
Increment: 1
*RST: 1E6

Example: `SENS1:SWE:POW:SENS:SFR 2GHz`
The measurement is performed at 2 GHz

Manual operation: See " Use Separate Frequency- Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency:STATe <State>

Activates the use of a different frequency for the power measurement.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS1:SWE:POW:SENS:SFR:STAT ON`
Activates the use of a separate frequency than the generator frequency for power analysis

Manual operation: See " Use Separate Frequency- Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet <Offset>

Defines the level offset at the sensor input in dB. Activate the offset with the command `:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet:STATe` on page 461.

Parameters:

<Offset> float

Range: -100 to 100
Increment: 0.01
*RST: 0

Example: `SENS2:SWE:TIME:OFFS -7dB`
Defines a level offset of -7 dB.
`SENS2:SWE:TIME:OFFS:STAT ON`
The specified level offset is considered.

Options: Option R&S SMAB-K28

Manual operation: See " Level Offset - Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet:STATe <State>

Activates a level offset at the sensor input. Define the appropriate value with the command `:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet` on page 460.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0
Example:	`SENS2:SWE:POW:TIME:STAT ON` Activates the specified level offset.
Options:	Option R&S SMAB-K28
Manual operation:	See " Level Offset State- Power Analysis " on page 239

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:STATe <State>

Enables pulse data analysis. The measurement is started with command INITiate.

Note: The command is only available in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0
Example:	`SENS1:SWE:TIM:PULS:STAT ON` Enables pulse data analysis.
Options:	Option R&S SMAB-K28
Manual operation:	See " State - Pulse Data Analysis " on page 243

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:BASE <Base>

Selects how the threshold parameters for pulse analysis are calculated.

Note: The command is only available in time measurement mode and with R&S NRPZ81 power sensors.

Parameters:

<Base>	VOLTage | POWer *RST: VOLTage
Example:	`SENS1:SWE:TIME:PULS:THR:BASE POW` Activates threshold calculation related to power.
Options:	Option R&S SMAB-K28
Manual operation:	See " Base - Pulse Data Analysis " on page 243

**:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:
HREFerence** <HReference>

Sets the upper reference level in terms of percentage of the overall pulse level (power or voltage). The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Note: The command is only available in time measurement mode and with R&S NRPZ81 power sensors.

Parameters:

<HReference> float

Range: 0 to 100
Increment: 0.01
*RST: 90

Options: Option R&S SMAB-K28

Manual operation: See " Distal - Pulse Data Analysis " on page 244

**:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:
LREFerence** <LReference>

Sets the lower reference level in terms of percentage of the overall pulse level. The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Note: This parameter is only available in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<LReference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 10.0

Example: `SENS:SWE:TIM:PULS:THR:LREF 10`
Sets the lower reference level to 10%.

Options: Option R&S SMAB-K28

Manual operation: See " Proximal - Pulse Data Analysis " on page 244

**:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:
REFerence** <Reference>

Sets the medial reference level in terms of percentage of the overall pulse level (power or voltage related). This level is used to define pulse width and pulse period.

Note: The command is only available in time measurement mode and with R&S NRPZ81 power sensors.

Parameters:
<Reference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 50.0

Example: `SENS1:SWE:TIM:PULS:THR:REF 40`
Sets the medial reference level to 40% of the overall pulse level.

Options: Option R&S SMAB-K28

Manual operation: See " Mesial - Pulse Data Analysis " on page 244

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency <SFrequency>

Defines the separate frequency used for power vs. time measurement.

Parameters:
<SFrequency> float

Range: 0 to 1E12
Increment: 1
*RST: 1E6

Example: `SENS1:SWE:TIME:SENS:SFR 2GHz`
The measurement is performed at 2 GHz

Manual operation: See " Use Separate Frequency- Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency:STATe <State>

Activates the use of a different frequency for the power measurement.

Parameters:
<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS1:SWE:TIME:SENS:SFR:STAT ON`
Activates the use of a separate frequency than the generator frequency for power analysis

Manual operation: See " Use Separate Frequency- Power Analysis " on page 240

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:AUTO <Auto>

Sets the trigger level, the hysteresis and the dropout time to default values.

Parameters:
<Auto> ONCE

*RST: ---

Example: `SENS1:SWE:TIME:SENS:TRIG:AUTO ONCE`
The trigger level is automatically determined

Manual operation: See " Auto Set - Power Analysis " on page 250

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:DTIMe <DTime>

Determines the minimum time for which the signal must be below (above) the power level defined by level and hysteresis before triggering can occur again.

Parameters:

<DTime> float

Range: 0 to 10

*RST: 200E-9

Example: `SENS1:SWE:TIME:SENS:TRIG:DTIM 10 us`

The drop out time is 10 us

Manual operation: See " Drop out Time - Power Analysis " on page 250

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:HYSTeresis <Hysteresis>

Sets the hysteresis of the internal trigger threshold. Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again.

Parameters:

<Hysteresis> float

Range: 0 to 10

Increment: 0.001

*RST: 0.5

Example: `SENS1:SWE:TIME:SENS:TRIG:HYST 0.5 dB`

The hysteresis is 0.5 dB

Manual operation: See " Hysteresis - Power Analysis " on page 249

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:LEVel <Level>

Sets the trigger threshold.

Parameters:

<Level> float

Range: -200 to 100

Increment: 0.001

*RST: 1

Example: `SENS1:SWE:TIME:SENS:TRIG:LEV -20 dBm`

Sets the trigger level to -20 dBm.

Manual operation: See " Level - Power Analysis " on page 249

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SLOPe <TriggerSlope>

Sets the polarity of the active slope for the trigger signals.

Parameters:

<TriggerSlope> POSitive | NEGative

*RST: POSitive

Example: `SENS1:SWE:TIME:TRIG:SLOP POS`

The positive edge of a trigger signal is active.

Options: Option R&S SMAB-K28

Manual operation: See " Slope - Power Analysis " on page 249

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SOURce <Source>

Selects if the measurement is free running (FREE) or starts only after a trigger event. The trigger can be applied internally or externally.

Parameters:

<Source> FREE | AUTO | INTernal | EXTernal

*RST: AUTO

Example: `SENS1:SWE:TIME:SENS:TRIG:SOUR FREE`

The power versus time measurement is performed free running

Manual operation: See " Mode - Power Analysis " on page 249

:SENSe<ch>[:POWer]:ZERO

The command activates the autozero function. Zeroing is required in regular interval (at least once a day) and if the temperature has varied more than about 5 °C, if the sensor has been replaced or if measurements of signals with very low power are to be performed. The RF power source must be switched off or disconnected from the sensor before starting the autozero function.

Example: `SENS:ZERO`

activates autozero function.

Usage: Event

:SENSe[:POWer]:SWEep:ABORt

Aborts the power analysis with NRP power sensors.

Example: `SENS:SWE:ABOR;*OPC?`

Aborts the current power measurement.

Usage: Setting only

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:COPY

Generates a reference curve for "Frequency" measurement.

Example: `SENS:POW:SWE:FREQ:REF:DATA:COPY`

Generates a reference curve in frequency mode.

Usage: Event

Manual operation: See "Save To Ref" on page 228

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:POINts?

Queries the number of points from the reference curve in "Frequency" measurement.

Return values:

<Points> integer

Range: 10 to 1000

Example: `SENS:POW:SWE:FREQ:REF:DATA:POIN?`

Queries the number of points from the reference curve in frequency mode.

Usage: Query only

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:XVALues <XValues>

Sets or queries the x values of the two reference points, i.e. "Frequency X (Point A)" and "Frequency X (Point B)" in "Frequency" measurement.

Parameters:

<XValues> string

Example: `SENSe:POW:SWE:FREQ:REF:DATA:XVAL 100MHZ,22GHZ`

Sets the x value of reference "Point A" to 10 MHz, and the value of "Point B" to 10 GHz.

Manual operation: See "Freq (X) / Pow (Y)" on page 228

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:YVALues <YValues>

Sets or queries the y values of the two reference points, i.e."Pow Y (Point A)" and "Power Y (Point B)" in "Frequency" measurement.

Parameters:

<YValues> string

Example: `SENSe:POW:SWE:FREQ:REF:DATA:YVAL -10,25`

Sets the y value of reference "Point A" to -10 dBm, and the value of "Point B" to -25 dBm.

Manual operation: See "Freq (X) / Pow (Y)" on page 228

:SENSe[:POWer]:SWEep:FREQuency:RMODe <RMode>

Selects single or continuous mode for measurement mode frequency in power analysis.

Parameters:

<RMode>	SINGle | CONTinuous	
	*RST:	CONTinuous

Example: `SENS:SWE:FREQ:RMOD SING`
Selects single measurement

Manual operation: See " Execution - Power Analysis " on page 234

:SENSe[:POWer]:SWEep:FREQuency:SPACing[:MODE] <Mode>

Selects the spacing for the frequency power analysis.

Parameters:

<Mode>	LINear | LOGarithmic	
	*RST:	LINear

Example: `SENS:SWE:FREQ:SPAC:MODE LIN`
Sets linear spacing of the sweep

Manual operation: See " Spacing - Power Analysis " on page 233

:SENSe[:POWer]:SWEep:FREQuency:STARt <Start>

Sets the start frequency for the frequency mode.

Parameters:

<Start>	float	
	Range:	0 to 1E12
	*RST:	1E6

Example: `SENS:SWE:FREQ:STAR 2.0GHZ`
Sets a sweep start at 2 GHz.

Manual operation: See "Min - Power Analysis" on page 231

:SENSe[:POWer]:SWEep:FREQuency:STEPs <Steps>

Sets the number of measurement steps for the frequency mode.

Parameters:

<Steps>	integer	
	Range:	10 to 1000
	*RST:	200

Example: `SENS:SWE:FREQ:STEP 500`
Sets 500 steps

Manual operation: See " Steps - Power Analysis " on page 232

:SENSe[:POWer]:SWEep:FREQuency:STOP <Stop>

Sets the stop frequency for the frequency mode.

Parameters:

<Stop> float

Range: 0 to 1E12

*RST: 22GHZ

Example: `SENS:SWE:FREQ:STOP 20.0GHZ`

Sets the sweep stop to 20 GHz

Manual operation: See "Max - Power Analysis" on page 232

:SENSe[:POWer]:SWEep:FREQuency:TIMing[:MODE] <Mode>

Selects the mode in terms of speed and precision of the response of a measurement.

Parameters:

<Mode> FAST | NORMal | HPRecision

FAST

Selection FAST leads to a fast measurement with a short integration time for each measurement step.

NORMal

NORMal leads to a longer but more precise measurement due to a higher integration time for each step.

*RST: FAST

Example: `SENS:SWE:FREQ:TIM:MODE FAST`

The fast measurement mode is selected.

Manual operation: See " Timing - Power Analysis " on page 233

:SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO <Auto>

Activates autoscaling of the Y axis of the diagram.

Parameters:

<Auto> OFF | CEXPanding | FEXPanding | CFLoating | FFLoating

OFF

Auto scaling is deactivated. If switching from activated to deactivated Auto scaling, the scaling is maintained.

CEXPanding | FEXPanding

Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: CEXPanding

Example: `SENS:SWE:FREQ:YSC:AUTO OFF`
Deactivates auto scale

Manual operation: See " Auto Scale - Power Analysis " on page 235

:SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO:RESet

Resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high-power values. The reset function resets the diagram in such a way that it matches smaller power values again.

Example: `SENS:SWE:FREQ:YSC:AUTO:RES`
Resets auto scale

Usage: Event

Manual operation: See " Reset Auto Scale - Power Analysis " on page 236

:SENSe[:POWer]:SWEep:FREQuency:YSCale:MAXimum <Maximum>

Sets the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum> float

Range: -200 to 100
Increment: 0.01
*RST: 40

Example: `SENS:SWE:FREQ:YSC:MAX 10DBM`
Sets 10 dBm as the upper limit of the measurement diagram.

Manual operation: See " Min - Max Level - Power Analysis " on page 235

:SENSe[:POWer]:SWEep:FREQuency:YSCale:MINimum <Minimum>

Sets the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum> float

Range: -200 to 100
Increment: 0.01
*RST: -40

Example: `SENS:SWE:FREQ:YSC:MIN -10DB`
Sets -10 dBm as the lower limit of the measurement diagram.

Manual operation: See " Min - Max Level - Power Analysis " on page 235

:SENSe[:POWer]:SWEep:HCOPy:DATA?

Queries the measurement data directly. The data is transferred to the remote client as data stream.

Readable ASCII data is available for hardcopy language CSV. The representation of the values depends on the selected orientation for the CSV format.

Return values:

<Data> block data

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
selects output format *.csv.
`SENS:SWE:HCOP:DEV:LANG:CSV:ORI HOR`
selects horizontal orientation
`SENS:SWE:HCOP:DEV:LANG:CSV:SEP SEM`
selects ";" as the separator between the values
`SENS:SWE:HCOP:DEV:LANG:CSV:DPO DOT`
selects "." as decimal point
`SENS:SWE:HCOP:DATA?`
queries the measurement data of the current traces
`Response:`
#2651009500000;1019000000;1028500000;1038000000
-9.5;-9.7;-6.3;-2.5
The hash symbol # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example, the 2 following digit indicates the length to be 65 characters.
Because horizontal representation is selected, a row with all the x-values of the active trace (frequency) follows. The second row contains all the y-values of the active trace (power). The rows end with a new line (each counts as one character).
Note: if more than one trace is active, the third row contains the x values of the second active trace, and so on.

Example: `SENS:SWE:HCOP:DEV:LANG:CSV:ORI VERT`
selects horizontal orientation
`SENS:SWE:HCOP:DATA?`
queries the measurement data of the current traces
`Response:`
#2681009500000;-9.5; 1019000000;-9.7; 1028500000;-6.3; 1038000000;-2.5;
for vertical representation the length of the data block is 68
the first power value, the second row contains the second frequency value of the active trace followed by the second power value, and so on. The rows end with a new line (each counts as one character).
Note: if more than one trace is active, the first row also contains the value pairs of the second active trace, and so on.

Usage: Query only

:SENSe[:POWer]:SWEep:HCOPy:DEVice <Device>

Defines the output device. The setting is fixed to FILE, i.e. the hardcopy is stored in a file.

Parameters:

<Device> FILE | PRINter

*RST: FILE

Example: `SENS:SWE:HCOP:DEV FIL`
Selects output device file.

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage <Language>

Selects the bitmap graphic format for the screenshot of the power analysis trace.

In addition, ASCII file format `*.csv` is offered. If file format `*.csv` is selected, the trace data is saved as an ASCII file with comma separated values. It is also possible to directly retrieve the data using command `:SENSe[:POWer]:SWEep:HCOPy:DATA?` on page 470

Parameters:

<Language> BMP | JPG | XPM | PNG | CSV

*RST: BMP

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
Selects output format `*.bmp`.

Manual operation: See " Format - Power Analysis " on page 255

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:DPOint <DPoint>

Defines which character is used as the decimal point of the values, either dot or comma.

Parameters:

<DPoint> DOT | COMMa

*RST: DOT

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
Selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:DPO DOT`
Selects character dot for being used as decimal point.

Manual operation: See "Decimal Point" on page 259

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:HEADer <Header>

Defines whether each row (or column depending on the orientation) should be preceded by a header containing information about the trace (see also `:SENSe[:POWer]:SWEep:HCOPy:DATA?` on page 470).

Parameters:

<Header> OFF | STANdard

*RST: OFF

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
Selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:HEAD STAN`
Selects the standard header for the `*.csv` file.

Manual operation: See "Row Header" on page 259

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:ORIentation <Orientation>

Defines the orientation of the X/Y value pairs.

Parameters:

<Orientation> HORizontal | VERTical

*RST: VERTical

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
Selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:ORI VERT`
Selects vertical orientation, the value pairs are written in a column like structure (separated by the selected separator, e.g. tab)

Manual operation: See "Orientation" on page 258

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV[:COLumn]:SEParator <Separator>

Defines which character is to separate the values, either tabulator, semicolon, comma or blank.

Parameters:

<Separator> TABulator | SEMicolon | COMMa | BLANk

*RST: COMMa

Example:

`SENS:SWE:HCOP:DEV:LANG CSV`

Selects output format `*.csv`.

`SENS:SWE:HCOP:DEV:LANG:CSV:SEP TAB`

A tab separates the values.

Manual operation: See "Separator" on page 259

:SENSe[:POWer]:SWEep:HCOPy:DEVice:SIZE <Size>

Sets the size of the hardcopy in number of pixels. The first value of the size setting defines the width, the second value the height of the image.

Parameters:

<Size> 320,240 | 640,480 | 800,600 | 1024,768

*RST: 320,240

Example:

`SENS:SWE:HCOP:DEV:LANG BMP`

Selects output format `*.bmp`.

`SENS:SWE:HCOP:DEV:SIZE 320,240`

The size of the bitmap is 320 pixels by 240 pixels.

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME] <Name>

Creates of selects a file for storing the hardcopy after the `:SENSe[:POWer]:SWEep:HCOPy[:EXECute]` on page 478 command is sent. The directory is either defined with the command `MMEMory:CDIR` or the path is specified together with the file name. Access to the file via remote control is possible using the commands of the MMEM-Subsystem. In contrast, command `:SENSe[:POWer]:SWEep:HCOPy:DATA?` on page 470 transfers the hardcopy contents directly to the remote client where they can be further processed.

Parameters:

<Name> string

Example:

`SENS:SWE:HCOP:DEV:LANG BMP`

Selects output format `*,bmp`.

`SENS:SWE:HCOP:FILE:AUTO:STAT OFF`

Switches off automatic naming.

`SENS:SWE:HCOP:FILE 'var/trace/nrp_trace1'`

creates the file `nrp_trace1.bmp` in the trace directory.

`SENS:SWE:HCOP:EXEC`

Triggers the generation of a hardcopy of the current trace. The hardcopy is stored in the file `nrp_trace1.bmp`.

Manual operation: See " File name - Power Analysis " on page 254

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory <Directory>

Defines the directory into which the hardcopy files are stored if auto naming is activated (`SENS:SWE:HCOP:FILE:AUTO:STAT ON`).

Parameters:

<Directory> string

Example: `SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
Hardcopy file are stored in directory `var/nrp` if automatic naming is activated.

Manual operation: See "Path" on page 256

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar

Deletes all files with extensions `bmp , img, png, xpm` and `csv` in the directory set for automatic naming.

Example: `SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
Hardcopy filse are stored in directory `var/nrp` if automatic naming is activated.
`SENS:SWE:HCOP:FILEAUTO:DIR:CLE`
Deletes all hardcopy file that are stored in the directory `var/nrp`.

Usage: Event

Manual operation: See "Clear Parth" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE?

Queries the file name generated with the automatic naming settings.

Note: As default the automatically generated file name is composed of: `>PAth>/<Prefix><YYYY><MM><DD><Number>.<Format>`. Each component can be deactivated/ activated separately to individually design the file name.

Return values:

<File> string

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
Selects output format `*.bmp`.
`SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
Hardcopy files are stored in directory `var/nrp` if automatic naming is activated.
`SENS:SWE:HCOP:FILE:AUTO:PREF 'sens1'`
The file name starts with the prefix sens1. The usage of automatic naming with prefix and date in the file name is preset (...`:STAT ON`).
`SENS:SWE:HCOP`
Triggers the generation of a hardcopy of the current trace.
`SENS:SWE:HCOP:FILE:AUTO:FILE?`
Queries the file name

Usage: Query only

Manual operation: See " File name - Power Analysis " on page 254

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe <State>

Activates/deactivates automatic naming of the hardcopy files.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:STAT OFF`
Deactivates automatic naming of the hardcopy files. The file name and directory is now defined with command.
`SENS:SWE:HCOP:FILE:NAME <psth>`

Manual operation: See " File name - Power Analysis " on page 254

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?

Queries the day of the date part in the automatic file name.

Return values:

<Day> integer

Range: 1 to 31
*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:DAY?`
Queries the day of the date part in the automatic file name.

Usage: Query only

Manual operation: See "Prefix, Year, Month, Day, Instrument Name" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>

Activates the usage of the day in the automatic file name.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:DAY:STAT OFF`
Deactivates the usage of the day in the automatic file name.

Manual operation: See "Prefix, Year, Month, Day, Instrument Name" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?

Queries the day of the date part in the automatic file name.

Return values:

<Month> integer

Range: 1 to 12
*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:MONT?`
Queries the month of the date part in the automatic file name.

Usage: Query only

Manual operation: See "Prefix, Year, Month, Day, Instrument Name" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>

Activates the usage of the month in the automatic file name.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:MONT:STAT OFF`
Deactivates the usage of the month in the automatic file name.

Manual operation: See "Prefix, Year, Month, Day, Instrument Name" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?

Queries the generated number in the automatic file name.

Return values:

<Number> integer

Range: 0 to 999999
*RST: 0

Example: `SENS:SWE:HCOP:FILE:AUTO:NUMB?`
Queries the number in the automatic file name.

Usage: Query only

Manual operation: See "Current Auto Number" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>

Sets the prefix part in the automatic file name.

Parameters:

<Prefix> string

Example: `SENS:SWE:HCOP:FILE:AUTO:PREF 'sensor'`
The prefix sensor is used in the automatically generated file name of the hardcopy file.

Manual operation: See "Prefix, Year, Month, Day, Instrument Name" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

Activates the usage of the prefix in the automatic file name.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:PREF:STAT OFF`
Deactivates the usage of the prefix in the automatic file name.

Manual operation: See "Prefix, Year, Month, Day, Instrument Name" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?

Queries the year of the date part in the automatic file name.

Return values:

<Year> integer
Range: 1784 to 8000
*RST: 0

Example: `SENS:SWE:HCOP:FILE:AUTO:YEAR?`
Queries the year of the date part in the automatic file name.

Usage: Query only

Manual operation: See "Prefix, Year, Month, Day, Instrument Name" on page 257

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

Activates the usage of the year in the automatic file name.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:YEAR:STAT OFF`
Deactivates the usage of the year in the automatic file name.

Manual operation: See "Prefix, Year, Month, Day, Instrument Name" on page 257

:SENSe[:POWer]:SWEep:HCOPy[:EXECute]

Triggers the generation of a hardcopy of the current measurement diagram. The data is written into the file selected/created with the `:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]` on page 473 command.

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
Selects output format `*.bmp`.
`SENS:SWE:HCOP:FILE:AUTO:STAT OFF`
Switches off automatic file naming.
`SENS:SWE:HCOP:FILE 'var/nrp_trace1'`
Creates the file `nrp_trace1.bmp` in the set path.
`SENS:SWE:HCOP`
Triggers the generation of a hardcopy of the current measurement diagram. The hardcopy is stored in the file `nrp_trace1.bmp`.

Usage: Event

Manual operation: See " File name - Power Analysis " on page 254

:SENSe[:POWer]:SWEep:INITiate

Starts the power analysis with NRP power sensor.

Example: `SENS:SWE:INIT`
Start the power measurement.

Usage: Setting only

:SENSe[:POWer]:SWEep:MODE <Mode>

Selects power versus frequency measurement (frequency response), power vs power measurement (power sweep, AM/AM) or power vs. time measurement.

Parameters:

<Mode> FREQuency | POWer | TIME
*RST: FREQuency

Example: `SENS:SWE:MODE FREQ`
Selects frequency mode.

Manual operation: See " Mode - Power Analysis " on page 231

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:COPY

Generates a reference curve for "Power" measurement.

Example: `SENS:POW:SWE:POW:REF:DATA:COPY`
Generates a reference curve in power mode.

Usage: Event

Manual operation: See "Save To Ref" on page 228

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:POINts?

Queries the number of points from the reference curve in "Power" measurement.

Return values:

<Points> integer

Range: 10 to 1000

Example: `SENS:POW:SWE:POW:REF:DATA:POIN?`
Queries the number of points from the reference curve in power mode.

Usage: Query only

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:XVALues <XValues>

Sets or queries the x values of the two reference points, i.e. "Power X (Point A)" and "Power X (Point B)" in "Power" measurement.

Parameters:

<XValues> string

Example: `SENSe:POW:SWE:POW:REF:DATA:XVAL -15DBM,20DBM`
Sets the x value of reference "Point A" to -15 dBm, and the value of "Point B" to 20 dBm.

Manual operation: See "Pow (X) / Pow (Y)" on page 228

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:YVALues <YValues>

Sets or queries the y values of the two reference points, i.e. "Power Y (Point A)" and "Power Y (Point B)" in "Power" measurement.

Parameters:

<YValues> string

Example: `SENSe:POW:SWE:TIME:REF:DATA:YVAL -30,10`
Sets the y value of reference "Point A" to -30 dBm, and the value of "Point B" to 10 dBm.

Manual operation: See "Pow (X) / Pow (Y)" on page 228

:SENSe[:POWer]:SWEep:POWer:RMODe <RMode>

Selects single or continuous mode for measurement mode power in power analysis.

Parameters:

<RMode> SINGle | CONTinuous

*RST: CONTinuous

Example: `SENS:SWE:POW:RMOD SING`
Selects single measurement.

Manual operation: See " Execution - Power Analysis " on page 234

:SENSe[:POWer]:SWEep:POWer:SPACing[:MODE] <Mode>

Selects the spacing for the frequency power analysis.

Parameters:

<Mode> LINear

*RST: LINear

Example: `SENS:SWE:FREQ:SPAC:MODE LIN`
Sets linear spacing of the sweep.

Manual operation: See " Spacing - Power Analysis " on page 233

:SENSe[:POWer]:SWEep:POWer:STARt <Start>

Sets the start level for the power versus power measurement.

Parameters:

<Start> float

Range: -145 to 20
Increment: 0.01
*RST: 1MHZ

Example: `SENS:SWE:POW:STAR -20DBM`
Sets the start level to -20 dBm

Manual operation: See "Min - Power Analysis" on page 231

:SENSe[:POWer]:SWEep:POWer:STEPs <Steps>

Sets the number of measurement steps for the power versus power measurement.

Parameters:

<Steps> integer

Range: 10 to 1000
*RST: 500

Example: `SENS:SWE:POW:STEP 500`
Sets the 500 measurement steps.

Manual operation: See " Steps - Power Analysis " on page 232

:SENSe[:POWer]:SWEep:POWer:STOP <Stop>

Sets the stop level for the power versus power measurement.

Parameters:

<Stop> float

Range: -145 to 20
Increment: 0.01
*RST: 40

Example: `SENS:SWE:POW:STOP 20.0DBM`
Sets the stop level to 20 dBm.

:SENSe[:POWer]:SWEep:POWer:TIMing[:MODE] <Mode>

Selects the timing mode of the measurement.

Parameters:

<Mode> FAST | NORMal | HPRecision

FAST
Selection FAST leads to a fast measurement with a short integration times for each measurement step.

NORMal
NORMal leads to a longer but more precise measurement due to a higher integration time for each step.

*RST: NORMal

Example: `SENS:SWE:POW:TIM:MODE FAST`
Selects fast mode.

Manual operation: See " Timing - Power Analysis " on page 233

:SENSe[:POWer]:SWEep:POWer:YSCale:AUTO <Auto>

Activates autoscaling of the Y axis of the diagram.

Parameters:

<Auto> OFF | CEXPanding | FEXPanding | CFLoating | FFLoating

OFF
Auto scaling is deactivated. When switching from activated to deactivated Auto scaling, the scaling is maintained. When switching from deactivated to activated Auto scaling, the scaling is reset to min = max = 0.

CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: CEXPanding

Example: `SENS:SWE:POW:YSC:AUTO OFF`
Deactivates auto scale.

Manual operation: See " Auto Scale - Power Analysis " on page 235

:SENSe[:POWer]:SWEep:POWer:YSCale:AUTO:RESet

Resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function allows resetting the diagram to match smaller power values again.

Example: `SENS:SWE:POW:YSC:AUTO:RES`
Resets auto scale.

Usage: Event

Manual operation: See " Reset Auto Scale - Power Analysis " on page 236

:SENSe[:POWer]:SWEep:POWer:YSCale:MAXimum <Maximum>

Sets the maximum value for the y axis of the measurement diagram.

Parameters:
<Maximum> float

Range: -200 to 100
Increment: 0.01
*RST: 30

Example: `SENS:SWE:POW:YSC:MAX 10DBM`
Sets 10 dBm as the upper limit of the measurement diagram.

Manual operation: See " Min - Max Level - Power Analysis " on page 235

:SENSe[:POWer]:SWEep:POWer:YSCale:MINimum <Minimum>

Sets the minimum value for the y axis of the measurement diagram.

Parameters:
<Minimum> float

Range: -200 to 100
Increment: 0.01
*RST: -40

Example: `SENS:SWE:POW:YSC:MIN -10DBM`
Sets -10 dBm as the lower limit of the measurement diagram.

Manual operation: See " Min - Max Level - Power Analysis " on page 235

:SENSe[:POWer]:SWEep:RMODe <RMode>

Selects single or continuous mode for power analysis (all measurement modes).

Parameters:
<RMode> SINGle | CONTinuous

*RST: SINGle

Example: `SENS:SWE:RMOD SING`
Selects single measurement.

Manual operation: See " Execution - Power Analysis " on page 234

:SENSe[:POWer]:SWEep:TIME:AVERage[:COUNt] <Count>

Selects the averaging factor in time mode. The count number determines how many measurement cycles are used to form a measurement result. Higher averaging counts reduce noise but increase the measurement time. Averaging requires a stable trigger event so that the measurement cycles have the same timing.

Parameters:
<Count> 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024

*RST: 1

Example: `SENS:SWE:MODE TIME`
Selects time mode.
`SENS:SWE:TIME:AVER 128`
Selects averaging factor 128.

Options: Option R&S SMAB-K28

Manual operation: See " Average - Power Analysis " on page 233

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY

Generates a reference curve for "Time" measurement.

Example: `SENS:POW:SWE:TIME:REF:DATA:COPY`
Generates a reference curve in time mode.

Usage: Event

Manual operation: See "Save To Ref" on page 228

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:POINts?

Queries the number of points from the reference curve in "Time" measurement.

Return values:

<Points> integer

Range: 10 to 1000
*RST: 0

Example: `SENS:POW:SWE:TIME:REF:DATA:POIN?`
Queries the number of points from the reference curve in time mode.

Usage: Query only

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:XVALues <XValues>

Sets or queries the x values of the two reference points, i.e. "Time X (Point A)" and "Time X (Point B) "in "Time" measurement.

Parameters:

<XValues> string

Example: `SENSe:POW:SWE:TIME:REF:DATA:XVAL 5,45`
Sets the x value of reference "Point A" to 5 µs, and the value of "Point B" to 45 µs.

Manual operation: See "Time (X) / Pow (Y)" on page 228

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:YVALues <YValues>

Sets or queries the y values of the two reference points, i.e. "Power Y (Point A)" and "Power Y (Point B)" in "Time" measurement.

Parameters:

<YValues> string

Example: `SENSe:POW:SWE:TIME:REF:DATA:YVAL -30,10`
sets the y value of reference "Point A" to -30 dBm, and the value of "Point B" to 10 dBm.

Manual operation: See "Time (X) / Pow (Y)" on page 228

:SENSe[:POWer]:SWEep:TIME:RMODe <RMode>

Selects single or continuous mode for measurement mode time in power analysis.

Parameters:

<RMode> SINGle | CONTinuous

*RST: CONTinuous

Example: `SENS:SWE:TIME:RMOD SING`
Selects single measurement.

Manual operation: See " Execution - Power Analysis " on page 234

:SENSe[:POWer]:SWEep:TIME:SPACing[:MODE] <Mode>

Queries the sweep spacing for the power versus time measurement. The spacing is fixed to linear.

Parameters:

<Mode> LINear

*RST: LINear

Example: `SENS:SWE:TIME:SPAC?`
Queries the sweep spacing.

Manual operation: See " Spacing - Power Analysis " on page 233

:SENSe[:POWer]:SWEep:TIME:STARt <Start>

Sets the start time for the power versus time measurement. Value 0 defines the trigger point. By choosing a negative time value, the trace can be shifted in the diagram. It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, an error message is output.

Parameters:

<Start> float

Range: -1 to 1
Increment: 1E-12
*RST: -5E-6

Example: `SENS:SWE:TIME:STAR 0s`
Sets the start time to 0 s.

Manual operation: See "Min - Power Analysis" on page 231

:SENSe[:POWer]:SWEep:TIME:STEPs <Steps>

Sets the number of measurement steps for the power versus time measurement. Value 0 defines the trigger point.

Parameters:

<Steps> integer

Range: 10 to 1000
*RST: 500

Example: `SENS:SWE:TIME:STEP 500`
Sets the 500 measurement steps.

Manual operation: See " Steps - Power Analysis " on page 232

:SENSe[:POWer]:SWEep:TIME:STOP <Stop>

Sets the stop time for the power versus time measurement.

Parameters:

<Stop> float

Range: 0 to 2
Increment: 1E-12
*RST: 1E-3

Example: `SENS:SWE:TIME:STOP 1ms`
Sets the stop time to 1 ms.

Manual operation: See "Max - Power Analysis" on page 232

:SENSe[:POWer]:SWEep:TIME:TEVents <TriggerTEvents>

Determines, whether the measurement data processing starts with a trigger event in one of the sensors (Logical OR), or whether all channels have to be triggered (logical AND). Each sensor evaluates a trigger event according to its setting independently. This function supports the internal or external trigger modes with multi-channel time measurements.

Parameters:

<TriggerTEvents> AND | OR

*RST: AND

Example: `SENS:POW:SWE:TIME:TEV AND`
The measurement data processing starts when all channels are triggered.

Options: Option R&S SMAB-K28

Manual operation: See " All Trigger Events - Power Analysis " on page 234

:SENSe[:POWer]:SWEep:TIME:YSCale:AUTO <Auto>

Activates autoscaling of the Y axis in the diagram.

Parameters:

<Auto> OFF | CEXPanding | FEXPanding | CFLoating | FFLoating

OFF
Auto scaling is deactivated. When switching from activated to deactivated Auto scaling, the scaling is maintained. When switching from deactivated to activated Auto scaling, the scaling is reset to min = max = 0.

CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: CEXPanding

Example: `SENS:SWE:TIME:YSC:AUTO OFF`
Deactivates auto scale

Manual operation: See " Auto Scale - Power Analysis " on page 235

:SENSe[:POWer]:SWEep:TIME:YSCale:AUTO:RESet

Resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function allows resetting the diagram to match smaller power values again.

Example: `SENS:SWE:TIME:YSC:AUTO:RES`
Resets auto scale.

Usage: Event

Manual operation: See " Reset Auto Scale - Power Analysis " on page 236

:SENSe[:POWer]:SWEep:TIME:YSCale:MAXimum <Maximum>

Sets the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum> float

Range: -200 to 100
Increment: 0.01
*RST: 30.0
Default unit: dBm

Example: `SENS:SWE:TIME:YSC:MAX 10DBM`
Sets 10 dBm as the upper limit of the measurement diagram.

Manual operation: See " Min - Max Level - Power Analysis " on page 235

:SENSe[:POWer]:SWEep:TIME:YSCale:MINimum <Minimum>

Sets the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum> float

Range: -200 to 100
Increment: 0.01
*RST: dBm

Example:
```
SENS:SWE:TIME:YSC:MIN -10DBM
```
Sets -10 dBm as the lower limit of the measurement diagram.

Manual operation: See " Min - Max Level - Power Analysis " on page 235

13.14.6 TRACe Subsystem

:TRACe<ch>[:POWer]:SWEep:COLor <Color>

Defines the color of a trace.

Parameters:

<Color> INVers | GRAY | YELLow | BLUE | GREen | RED | MAGenta

*RST: trace 1 = YELLow, trace 2 = GREen, trace 3 = RED.

Example: `TRAC2:SWE:COL GRAY`

Trace2 is indicated in gray color.

Manual operation: See " Color - Trace Power Analysis " on page 227

:TRACe<ch>[:POWer]:SWEep:COPY <Copy>

Stores the selected trace data as reference trace.

Setting parameters:

<Copy> REFerence

Example: `TRAC2:SWE:COPY REF`
Stores the current trace2 as reference trace'
`TRAC1:SWE:FEED REF`
Assigns the reference trace to trace 1.

Usage: Setting only

Manual operation: See " Indication - Power Analysis " on page 227

:TRACe<ch>[:POWer]:SWEep:DATA:POINts?

Queries the number of measurement points of the selected trace of the current power analysis.

Return values:

<Points> integer

Range: 10 to 1000
*RST: 0

Example: `TRAC1:SWE:DATA:POIN?`
Response: `624`
Measurement trace 1 contains 624 measurement points

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:DATA:XVALues?

Queries the x-axis values - frequency, power or time values - of the selected trace of the current power analysis.

Return values:

<XValues> string

Example: `SENS:SWE:MODE FREQ`
Sets measurement mode frequency versus power.
`SENS:SWE:RMOD SING`
Selects single measurement.
`SENS:SWE:INIT`
Starts the measurement.
`*OPC?`
Waits until measurement is performed.
`TRAC1:SWE:DATA:XVAL?`
Queries the x-axis values of trace 1.
`TRAC1:SWE:DATA:YVAL?`
Queries the y-axis values of trace 1

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:DATA:YSValue? <XValue>

For a given x-axis value, queries the measurement (y-axis) value of the selected trace of the current power analysis.

Query parameters:

<XValue> float

Return values:

<YSValue> float

Increment: 1E-9

Example: `TRACe1:SWE:DATA:YSValue? 2.3`

Example: Queries the y-axis values of trace 1 at x-axis value of 2.3.
See `:TRACe<ch>[:POWer]:SWEep:DATA:XVALues?` on page 490.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:DATA:YVALues?

Queries the measurement (y-axis) values of the selected trace of the current power analysis.

Return values:

<YValues> string

Example: `SENS:SWE:TRAC2:DATA:YVAL?`
Queries the power values of trace 2.
See `:TRACe<ch>[:POWer]:SWEep:DATA:XVALues?` on page 490.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:FEED <Feed>

Selects the source for the trace data.

Parameters:

<Feed> SENS1 | SENS2 | SENS3 | REFerence | NONE | SENSor1 | SENSor2 | SENSor3 | SENS4 | SENSor4

*RST: The preset value for each trace is evaluated during runtime as follows: If a sensor is plugged into the generator whose number corresponds to the trace number, this sensor is used to feed the trace and the state of the trace is ON; If no sensor is found with number corresponding to the trace number, the preset value of the trace is "Off".

Example:

`TRAC2:SWE:COPY REF`
Stores trace2 as reference trace.
`TRAC1:SWE:FEED REF`
Assigns the reference trace to trace 1.
`TRAC1:SWE:STAT ON`
Assigns the reference trace to trace 1.
`SENS:SWE:RMOD SING`
Selects single measurement
`SENS:SWE:INIT`
Starts the measurement

Manual operation: See " Indication - Power Analysis " on page 227

:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:STATe?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot?

The above listed commands query the measured pulse parameter values.

Note: These commands are only available in time measurement mode and with R&S NRP-Z81 power sensors.

Return values:

<Overshoot> float

Range: 0 to 100
Increment: 0.01
*RST: 0

Example:

`TRAC1:SWE:MEAS:POW:HREF?`
Queries the measured mesial threshold level of trace 1.
`TRAC3:SWE:MEAS:POW:MAX?`
Queries the measured peak power of trace 3.

Usage: Query only

Options: Option R&S SMAB-K28

Manual operation: See "Overshoot (Rising Edge / Falling Edge)" on page 247

:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot:DISPlay:ANNotation[:STATe] <State>

The above listed commands select the pulse parameters which are indicated in the display and hardcopy file. Only six parameters can be indicated at a time.

Note: These commands are only available in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `TRAC:SWE:MEAS:TRAC2:PULS:PER:DISP:ANN ON`
Selects the pulse period to be indicated in the display.
`TRAC:SWE:MEAS:PULS:DISP:ANN ON`
Activates indication of the selected pulse data in the display.

Options: Option R&S SMAB-K28

Manual operation: See "Overshoot (Rising Edge / Falling Edge)" on page 247

:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:ALL:DISPlay:ANNotation[:STATe] <State>

This command deactivates the indication of all pulse data of the selected trace. The parameters to be indicated can be selected with the `TRAC:SWE:MEAS:….` commands. Only six parameters are indicated at one time.

Note: This command is only available in time measurement mode and with R&S NRPZ81 power sensors.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: `TRAC:SWE:MEAS:PULS:ALL:DISP:ANN OFF`
Switches the indication of all pulse data off.

Options: Option R&S SMAB-K28

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:BASE?

Queries how the threshold parameters are calculated.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Base> VOLTage | POWer
*RST: VOLTage

Example: `TRAC1:SWE:PULS:THR:BAS?`
Queries the threshold base of pulse data calculation.

Usage: Query only

Manual operation: See " Base - Pulse Data Analysis " on page 243

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:HREFerence <HReference>

Queries the upper threshold level of the overall pulse level. The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<HReference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 90.0

Example: `TRAC2:SWE:PULS:THR:POW:HREF?`
Queries the upper reference level of trace 2.

Manual operation: See " Distal - Pulse Data Analysis " on page 244

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:LREFerence <LReference>

Queries the lower medial threshold level of the overall pulse level. The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<LReference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 10.0

Example: `TRAC:SWE:PULS:THR:POW:LREF?`
Queries the medial threshold level of trace 1.

Manual operation: See " Proximal - Pulse Data Analysis " on page 244

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:REFerence <Reference>

Queries the medial threshold level of the overall pulse level. This level is used to define the pulse width and pulse period.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<Reference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 50.0

Example: `TRAC3:SWE:PULS:THR:POW:REF?`
Queries the medial threshold level of trace 3.

Manual operation: See " Mesial - Pulse Data Analysis " on page 244

:TRACe<ch>[:POWer]:SWEep:STATe <State>

Activates the selected trace.

Parameters:

<State> OFF | ON | HOLD

*RST: The preset value for each trace is evaluated during runtime as follows: If a sensor is plugged into the generator whose number corresponds to the trace number, this sensor is used to feed the trace and the state of the trace is ON; If no sensor is found with a number corresponding to the trace number, the preset value of the trace is "Off".

Example:
`TRAC2:SWE:COPY REF`
Stores trace2 as reference trace.
`TRAC1:SWE:FEED REF`
Assigns the reference trace to trace 1.
`TRAC1:SWE:STAT ON`
Assigns the reference trace to trace 1.
`SENS:SWE:RMOD SING`
Selects single measurement.
`SENS:SWE:INIT`
Starts the measurement.

Manual operation: See " Indication - Power Analysis " on page 227

:TRACe[:POWer]:SWEep:MEASurement:FULLscreen:DISPlay:ANNotation[:STATe] <State>

Selects fullscreen display of the measurement diagram on the display and in the hard-copy file.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example:
`TRAC:SWE:MEAS:FULL:DISP:ANN ON`
The display only shows the diagram.

Options: Option R&S SMAB-K28

Manual operation: See "Full Screen" on page 253

:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] <State>

Activates th eindication of the time gate borders and values in the measurement diagram and in the hardcopy file. The gate settings are performed with the `CALC:POW:SWE:TIME:GATE:...` commands.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `TRAC:SWE:MEAS:GATE:DISP:ANN ON`
The diagram also shows the gate information.

Options: Option R&S SMAB-K28

Manual operation: See " State - Gate " on page 238

:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe] <State>

Activates the indication of the markers and the marker list in the measurement diagram and in the hardcopy file.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 1

Example: `TRAC:SWE:MEAS:MARK:DISP:ANN ON`
The diagram also shows the marker information.

Options: Option R&S SMAB-K28

Manual operation: See "Marker View" on page 252

:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe] <State>

Activates the indication of the pulse data below the measurement diagram and storing the data in the hardcopy file. The parameters to be indicated can be selected with the following `TRAC:SWE:MEAS:….` commands. Only six parameters are indicated at one time.

Note: This command is only avalaible in time measurement mode and with R&S NRPZ81 power sensors.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 1

Example: `TRAC:SWE:MEAS:PULS:DISP:ANN ON`
Activates indication of the selected pulse data.

Options: Option R&S SMAB-K28

Manual operation: See "Pulse Data View" on page 252

:TRACe[:POWer]:SWEep:MEASurement:STANdard:DISPlay:ANNotation[:STATe] <State>

Selects the standard view, i.e. diagram and buttons but no lists are displayed and also stored in the hardcopy file.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 1

Example: `TRAC:SWE:MEAS:STAN:DISP:ANN ON`
Activates indication of the selected pulse data.

Options: Option R&S SMAB-K28

Manual operation: See "Standard View" on page 251

13.15 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 SMA100B.

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 Sensor mapping: • `SENSe[1]` - default mapping for sensors connected to the [Sensor] connector • `SENSe2` - sensor connected to a [USB] connector • `SENSe3|4` - further connected sensors to [USB] connectors, in the connection order Use the `:SLISt` commands to change the sensor mapping
`READ<ch>`	[1] to 4	Sensor assignment
`INIate<hw>`	[1] to 4	Sensor assignment
`ELEMent<ch>`	[1] to 25	Sensor mapping list

Programming examples

Example: Detecting and assigning a power sensor

```
SLISt:LIST?
// Response: "NRP33SN-V-900007-USB Legacy","NRP-Z211-900001-USB Legacy"
// list of automatically detected sensors

SLISt:SCAN:STATe 1
// searches for sensors connected in the LAN or via the USBTMC protocol

SLISt:LIST?
// Response:
// "NRP33SN-V-900007-USB Legacy","NRP-Z211-900001-USB Legacy",
// "NRP33SN-V-900005-USBTMC","NRP33SN-V-900011-LAN"
// list of automatically detected sensors
// the list can contain more entries

SLISt:ELEMent3:MAPPing SENS1
// maps the third sensor from the list to the first sensor channel

SLISt:SENSor:MAP "NRPS18S-100654-USB Legacy", SENS3
// maps the sensor directly to channel 3
```

Example: Performing a simple power measurement

Prerequisite: The sensor is connected to the instrument and mapped to the first sensor channel.

```
:INITiate1:CONTinuous ON
//Switches the continous power measurement on

:READ1?
// Triggers the measurement and displays the results
```

Example: Performing a power measurement with a fixed filter

Prerequisite: The sensor is connected to the instrument and mapped to the first sensor channel.

```
SENSe1:SOURce RF
//Sensor measures the power of the RF signal

SENSe1:FILTer:TYPE NSRatio
//Selects fixed noise filter mode

SENSe1:FILTer:NSRatio 0.02 DB
//Sets the maximum noise component in the result to 0.02 DB

SENSe1:FILTer:NSRatio:MTIMe 10
//Limits the settling time to 10 seconds.

:SENSe1:APERture:DEFault:STATe 0
// Deactivates the default aperture time of the sensor

:SENSe1:APERture:TIMe 10e-6
// Sets the aperture time to 10 us

SENSe1:UNIT DBM
//Selects unit dBm for the measured value

:INITiate:CONTinuous ON
//Switches the continous power measurement on

:READ?
//Triggers the measurement and displays the results
```

:SLISt[:LIST]?

Returns a list of all detected sensors in a comma-separated string.

Return values:

<SensorList>	String of comma-separated entries Each entry contains information on the sensor type, serial number and interface. The order of the entries does not correspond to the order the sensors are displayed in the "NRP Sensor Mapping" dialog.
Example:	See Example "Detecting and assigning a power sensor" on page 499.
Usage:	Query only
Manual operation:	See " Sensor Mapping List " on page 213

:SLISt:SCAN[:STATe] <State>

Starts the search for R&S NRP power sensors, connected in the LAN or via the USBTMC protocol.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0
Example:	See Example "Detecting and assigning a power sensor" on page 499.
Manual operation:	See " Scan " on page 214

: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 499.

Manual operation: See " Sensor Mapping List " on page 213

: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 499.

Usage: Setting only

Manual operation: See " Sensor Mapping List " on page 213

:INITiate<hw>[:POWer]:CONTinuous <Continuous>

Switches the local state of the continuous power measurement by R&S NRP power sensors on and off. Switching off local state enhances the measurement performance during remote control.

The remote measurement is triggered with `:READ<ch>[:POWer]?`). This command also returns the measurement results. The local state is not affected, measurement results can be retrieved with local state on or off.

Parameters:

<Continuous> 0 | 1 | OFF | ON

*RST: 0

Example: `INIT1:CONT ON`

Switches local state of continuous power measurement on.

Manual operation: See " State " on page 218

: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
```

Usage: Query only

Manual operation: See " Level (Peak) / Level (Average) " on page 218

:SENSe<ch>:UNIT[:POWer] <Power>

Selects the unit (Watt, dBm or dBµV) of measurement result display, queried with `:READ<ch>[:POWer]?`.

Parameters:

<Power> DBM | DBUV | WATT

*RST: DBM

Example: `SENS2:UNIT DBM`

Selects dBm as unit for the measured value returned by command `READ`.

`READ2?`

`Response: 7.34`

7.34 dBm are measured by sensor 2.

Manual operation: See " Level (Peak) / Level (Average) " on page 218

: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 504.

Parameters:

<UseDefAp> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Performing a power measurement with a fixed filter" on page 500.

Manual operation: See "Default Aperture Time" on page 221

: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 500.

Manual operation: See "Aperture Time" on page 221

: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 221

:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe <State>

Activates the use of the S-parameter correction data.

Note: If you use power sensors with attenuator, the instrument automatically activates the use of S-parameter data.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENSe1:POWer:CORRection:SPDevice:STATe 1`

Activates the use of the S-parameters correction data.

Manual operation: See " S-Parameter " on page 221

: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 221

: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`
The permanent viewer is switched on.
`SENS1:DISP:PERM:PRI AVER`
The measured average power is indicated.

Manual operation: See " Display " on page 219

:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe <State>

Activates the permanent display of the measured power level results. The instrument also indicates the sensor type, the connection, the measurement source and the offset if set.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: `SENS1:POW:DISP:PERM:STAT ON`
The permanent viewer is switched on.

Manual operation: See " Permanent " on page 218

:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?

Queries the current filter length in filter mode `AUTO` (`:SENSe<ch>[:POWer]:FILTer:TYPE`)

Return values:

<Auto> float
Range: 1 to 65536

Example: `SENS1:FILT:TYPE AUTO`
Selects auto filter.
`SENS1:FILT:LENG:AUTO?`
Queries the automatically set filter length.
`Response: 1024`

Usage: Query only

Manual operation: See "Filter Length" on page 220

: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 214).

The R&S NRP power sensors provide different resolutions for setting the filter length, depending on the used sensor type:

- Resolution = 1 for R&S NRPxx power sensors
- Resolution = 2^n for sensors of the R&S NRP-Zxx family, with n = 1 to 16

Parameters:

<User> float

Range: 1 to 65536
*RST: 1

Example: `SENS1:FILT:TYPE USER`
Selects user filter mode.
`SENS1:FILT:LENG 16`
Sets a filter length of 16. E.g. using a sensor with 20 ms time window, the resulting measurement time is 640 ms (2x16x20 ms)

Manual operation: See "Filter Length" on page 220

: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 500.

Manual operation: See "Noise/Signal Ratio" on page 220

:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe <MTime>

Sets an upper limit for the settling time of the auto-averaging filter in the `NSRatio` mode and thus limits the length of the filter. The filter type is set with command `:SENSe<ch>[:POWer]:FILTer:TYPE`.

Parameters:

<MTime> float

Range: 1 to 999.99

Increment: 0.01

*RST: 4

Example: See Example "Performing a power measurement with a fixed filter" on page 500.

Manual operation: See "Timeout" on page 220

: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 220

:SENSe<ch>[:POWer]:FILTer:TYPE <Type>

Selects the filter mode. The filter length is the multiplier for the time window and thus directly affects the measurement time.

Parameters:

<Type> AUTO | USER | NSRatio

AUTO

Automatically selects the filter length, depending on the measured value. The higher the power, the shorter the filter length, and vice versa.

USER

Allows you to set the filter length manually. As the filter-length takes effect as a multiplier of the measurement time, you can achieve constant measurement times.

NSRatio
Selects the filter length (averaging factor) according to the criterion that the intrinsic noise of the sensor (2 standard deviations) does not exceed the specified noise content. You can define the noise content with command `:SENSe<ch>[:POWer]:FILTer:NSRatio`.
Note: To avoid long settling times when the power is low, you can limit the averaging factor limited with the "timeout" parameter (`:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe`).
*RST: AUTO

Example: See Example "Performing a power measurement with a fixed filter" on page 500.

Manual operation: See " Filter" on page 219

:SENSe<ch>[:POWer]:FREQuency <Frequency>

Sets the RF frequency of the signal, if signal source "USER" is selected (`:SENSe<ch>[:POWer]:SOURce`).

Parameters:
<Frequency> float
*RST: 1 GHz

Example:
`SENS1:SOUR USER`
Selects user-defined source.
`SENS1:FREQ 2.44GHz`
Sets the RF frequency of the source which is 2.44 GHz.

Manual operation: See " Frequency " on page 219

:SENSe<ch>[:POWer]:LOGGing:STATe <State>

Activates the recording of the power values, measured by a connected R&S NRP power sensor.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example:
`SENS:LOGG:STAT ON`
Activates recording of the power measurement of the first sensor.

Manual operation: See "Enable Logging" on page 221

: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 219

:SENSe<ch>[:POWer]:OFFSet:STATe <State>

Activates the addition of the level offset to the measured value. The level offset value is set with command `:SENSe<ch>[:POWer]:OFFSet`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS1:POW:OFFS 0.4dB`
Sets a level offset of 0.4 dB
`SENS1:POW:OFFS:STAT ON`
A level offset of 0.4 dB is added to the measured value.

Manual operation: See " Level Offset State,Level Offset" on page 219

: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 218

: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 500.

Manual operation: See " Use Frequency Of" on page 219

:SENSe<ch>[:POWer]:STATus[:DEVice]?

Queries if a sensor is connected to the instrument.

Return values:

<Status> 0 | 1 | OFF | ON

*RST: 0

Example:
```
SENS1:STAT?
Response: 1
```
A sensor is connected.

Usage: Query only

Manual operation: See " State " on page 218

: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 218

: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 218

13.16 SOURce Subsystem

The `SOURce` subsystem contains the commands for configuring the digital and analog signals.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`SOURce<hw>`	[1]	• SOURce[1] = RF output (optional keyword) • LF output = `SOURce:LFOutput` (`SOURce` is optional keyword)

13.16.1 Analog Modulation Subsystems

Option: see Chapter 4.1, "Required Options", on page 73.

The subsystems in this section describe all commands for analog modulation of the RF signal. Divided in separate sections, you can configure amplitude modulation (AM), frequency modulation (FM) , phase modulation (PhiM) and pulse modulation (PULM).

You can perform each of the modulations either with an internally generated modulation signal or with an externally applied signal.

To configure the internal signal, use the commands listed in Chapter 13.16.6, "SOURce:LFOutput Subsystem", on page 599.

For more information:

See Chapter 4, "Analog Modulations", on page 73.

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> 0 | 1 | OFF | ON

*RST: 0

Example:

```
SOURce1:AM1:DEPTh 30
SOURce1:AM1:SOURce LF1
SOURce1:AM1:STATe 1
SOURce1:FM1:DEViation 1000
SOURce1:FM1:STATe 1
// disable both modulation
SOURce1:MODulation:ALL:STATe 0
SOURce1:AM1:STATe?
// 0
SOURce1:FM1:STATe?
// 0
// enable both modulation
SOURce1:MODulation:ALL:STATe 1
SOURce1:AM1:STATe?
// 1
SOURce1:FM1:STATe?
// 1
```

Manual operation: See "[Mod on/off]" on page 75

13.16.1.2 SOURce:AM Subsystem

Option: R&S SMAB-K720

The AM subsystem contains the commands for setting the amplitude modulation and also the broadband amplitude modulation.

The following examples show some variants for generating AM signals.

Example: Creating an amplitude modulated RF signal

Using the internal LF generator, the following command sequence configures an amplitude modulated signal.

```
// Reset the instrument to start from a defined state
*RST

// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the modulation signal
SOURce1:LFOutput1:SHAPe SINE
SOURce1:LFOutput1:FREQuency 20000

// Configure the amplitude modulation settings and switch AM on
SOURce1:AM1:SOURce LF1
SOURce1:AM1:DEPTh 30
SOURce1:AM:RATio 40
SOURce1:AM1:DEViation:MODe UNC
SOURce1:AM1:STATe 1
```

Example: Using combined LF signals

Using the internal LF generators of both paths, the following command sequences configure an amplitude modulated signal with determined deviations depths.

```
// Configure the AM modulation settings with combined LF signal sources
SOURce1:AM1:SOURce LF1
SOURce1:AM1:DEPTh:LINear 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:LINear?
// Response:  28

// Combine the signals of both paths with fixed ratio
SOURce1:AM1:DEViation:MODe RAT
```

```
SOURce1:AM1:RATio 100
SOURce1:AM2:DEPTh:LINear 25

// Query the deviation depth of modulation signal in the first path
SOURce1:AM1:DEPTh:LINear?
// Response:  25

SOURce1:AM1:STATe 1
SOURce1:AM2:STATe 1
```

Example: Using an external signal source

Using an external signal source, you can additionally determine whether you want to use only the AC component of the external modulation signal.

```
// Reset the instrument to start from a defined state
*RST

// Set frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25


// Configure the amplitude modulation settings and turn on AM
SOURce1:AM1:SOURce EXT1
SOURce1:AM1:DEPTh 40

// Query the input sensitivity at the external modulation input
SOURce1:AM1:SENSitivity?
// Response:  40
// Since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 50%/V.
// This value is assigned to the voltage value for full
// modulation of the input.

// Select the coupling mode AC for external amplitude modulation
SOURce1:INPut:MODext:COUPling1 AC

// For external AM signal input, adjust the sensitivity
SOURce1:AM1:TYPE EXP
SOURce1:AM1:SOURce EXT1
SOURce1:AM1:SENSitivity 25
SOURce1:AM1:SENSitivity?
Response: 25

// Alternatively use the scan mode for the level behavior of rotating antennas
// SCAN automatically sets the modulation type to exponential
SOURce1:AM1:MODE SCAN
SOURce1:AM1:SOURce EXT2
SOURce1:AM1:DEPTh:EXPonential 12
SOURce1:AM1:DEPTh:EXPonential?
Response: 12
```

```
// Activating the external exponential AM changes the coupling
// in this example for EXT2
INPut:MODext:COUPling2 DC

// Configure the modulation settings

// Switch on AM and RF signal output
SOURce1:AM1:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:AM<ch>:STATe <State>

Activates amplitude modulation.

Suffix:

<ch> 1 to 2
Modulation signal channel

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: See Example "Creating an amplitude modulated RF signal" on page 513.

Manual operation: See "State" on page 79

[:SOURce<hw>]:AM<ch>:SOURce <Source>

Selects the modulation source for amplitude modulation.

Suffix:

<ch> 1 to 2
Modulation signal channel

Parameters:

<Source> LF1 | LF2 | NOISe | EXT1 | EXT2 | EXTernal | INTernal

LF1|LF2
Uses an internally generated LF signal.

EXT1|EXT2
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).

*RST: LF1 <AM1>; LF2 <AM2>

Example: See Example "Creating an amplitude modulated RF signal" on page 513.

Manual operation: See "Source" on page 79

[:SOURce<hw>]:AM<ch>[:DEPTh] <Depth>

Sets the depth of the amplitude modulation in percent.

Suffix:

<ch> 1...2
Modulation signal channel

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.01
*RST: 30

Example: See Example "Creating an amplitude modulated RF signal" on page 513.

[:SOURce<hw>]:AM<ch>:DEPTh:LINear <DepthLin>

Sets the depth of the linear amplitude modulation in percent / volt.

Parameters:

<DepthLin> float

Range: 0 to 100
Increment: 0.01
*RST: 30

Example: See Example "Creating an amplitude modulated RF signal" on page 513. Similar to `DEPTh`.

Manual operation: See "Depth" on page 83

[:SOURce<hw>]:AM<ch>:DEPTh:EXPonential <DepthExp>

Sets the depth of the exponential amplitude modulation in dB/volt.

Parameters:

<DepthExp> float

Range: 0 to 100
Increment: 0.01
*RST: 10

Example: See Example "Creating an amplitude modulated RF signal" on page 513. Similar to `DEPTh`.

Manual operation: See "Depth" on page 83

[:SOURce<hw>]:AM:MODE <AmMode>

Selects the mode of the amplitude modulation.

`[:SOURce<hw>]:AM:MODE > SCAN` sets `[:SOURce<hw>]:AM:TYPE > EXPonential`.

For active external exponential AM, automatically sets `[:SOURce<hw>]:INPut:MODext:COUPling<ch> > DC`.

Parameters:

<AmMode> SCAN | NORMal

*RST: NORMal

Example: See Example "Using an external signal source" on page 514.

Options: R&S SMAB-K721

Manual operation: See "Mode" on page 82

[:SOURce<hw>]:AM:DEPTh:SUM <AmDepthSum>

Sets the total depth of the LF signal when using combined signal sources in amplitude modulation.

Parameters:

<AmDepthSum> float

Range: 0 to 100
Increment: 0.01
*RST: 30

Example: See Example "Using combined LF signals" on page 513.

Manual operation: See "Total Depth" on page 84

[: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 513.

Manual operation: See "Deviation Mode" on page 83

[:SOURce<hw>]:AM:RATio <Ratio>

Sets the deviation ratio (path#2 to path#1) in percent.

Parameters:

<Ratio> float

Range: 0 to 100
Increment: 0.01
*RST: 100

Example: See Example "Creating an amplitude modulated RF signal" on page 513.

Manual operation: See "Ratio Path2/Path1" on page 84

[:SOURce<hw>]:AM<ch>:SENSitivity:EXPonential <Sensitivity>

For `[:SOURce<hw>]:AM:TYPEEXP`, sets the sensitivity of the external signal source for amplitude modulation.

Parameters:

<Sensitivity> float

Range: 0 to 100
Increment: 0.01
*RST: 10

Example: See Example "Using an external signal source" on page 514.

Manual operation: See "Sensitivity" on page 83

[:SOURce<hw>]:AM<ch>:SENSitivity[:LINear] <Sensitivity>

For `[:SOURce<hw>]:AM:TYPE` `LIN`, sets the sensitivity of the external signal source for amplitude modulation.

Parameters:

<Sensitivity> float

Range: 0 to 100
Increment: 0.1
*RST: 30

Example: See Example "Using an external signal source" on page 514.

Manual operation: See "Sensitivity" on page 83

[:SOURce<hw>]:AM:TYPE <AmType>

Selects the type of amplitude modulation.

For `[:SOURce<hw>]:AM:MODE` `SCAN`, only `EXPonential` is available.

For active external exponential AM, automatically sets `[:SOURce<hw>]:INPut:MODext:COUPling<ch>` `DC`.

Parameters:

<AmType> LINear | EXPonential

*RST: LINear

Example: See Example "Using an external signal source" on page 514.

Options: R&S SMAB-K721

Manual operation: See "Type" on page 83

13.16.1.3 SOURce:FM Subsystem

Option: R&S SMAB-K720

The FM subsystem contains the commands for setting the frequency modulation.

Example: Creating a frequency modulated RF signal

Using the internal LF generator, the following command sequence configures a frequency modulated signal.

```
// Reset the instrument to start from a defined state
*RST

// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the modulation signal
SOURce1:LFOutput1:SHAPe SINE
```

```
SOURce1:LFOutput1:FREQuency 20000

// Configure the frequency modulation settings and switch FM on
SOURce1:FM1:SOURce LF1
SOURce1:FM1:DEViation 1000
SOURce1:FM:RATio 40
SOURce1:FM:MODe LNOise
SOURce1:FM1:STATe 1

// Switch on LF and RF signal output
SOURce1:LFOutput1:STATe 1
OUTPut1:STATe 1
```

Example: Using combined LF signals

Using the internal LF generators of both paths, the following command sequences configure a frequency modulated signal with determined deviations.

```
// Configure the FM modulation settings with combined LF signal sources
SOURce1:FM1:SOURce LF1
SOURce1:FM1:DEViation 1000
// Select the modulation signal source for the second path
SOURce1:FM2:SOURce LF2
// Combine the signals of both paths with fixed total deviation depth
SOURce1:FM1:DEViation:MODe TOT
SOURce1:FM1:DEViation:SUM 5000

// Query the deviation depth of modulation signal in the second path
SOURce1:FM2:DEViation?
// Response:  4000

// Combine the signals of both paths with fixed ratio
SOURce1:FM1:DEViation:MODe RAT
SOURce1:FM1:RATio 100
SOURce1:FM2:DEVIation 10000

// Query the deviation depth of modulation signal in the first path
SOURce1:AM1:DEViation?
// Response:  1000

SOURce1:FM1:STATe 1
SOURce1:FM2:STATe 1
```

Example: Using an external signal source

Alternatively configure the frequency modulation settings with an external modulation signal.

```
// Reset the instrument to start from a defined state
*RST
```

```
// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the frequency modulation settings and switch FM on
SOURce1:FM1:SOURce EXT1
SOURce1:FM1:DEViation 5000

// Query the input sensitivity at the external modulation input
:SOURCe1:FM1:SENSitivity?
// Response:  1000
// since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 5000 Hz/V.

// Switch on FM and RF signal output
SOURce1:FM1:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:FM<ch>:STATe <State>

Activates frequency modulation.

Suffix:

FM<ch> 1..2
determines the modulation signal channel.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: See Example "Creating a frequency modulated RF signal" on page 519.

Manual operation: See "State" on page 79

[:SOURce<hw>]:FM<ch>[:DEViation] <Deviation>

Sets the modulation deviation of the frequency modulation in Hz.

Suffix:

FM<ch> 1|2
Modulation signal channel

Parameters:

<Deviation>	float The maximum deviation depends on the RF frequency and the selected modulation mode (see data sheet). Range: 0 to max Increment: 0.01 *RST: 1E3
Example:	See Example "Creating a frequency modulated RF signal" on page 519.
Manual operation:	See "Deviation" on page 79

[:SOURce<hw>]:FM<ch>:SOURce <Source>

Selects the modulation source for frequency modulation.

Suffix:

FM<ch>	1|2 Modulation signal channel.

Parameters:

<Source>	LF1 | LF2 | NOISe | EXT1 | INTernal | EXTernal | EXT2 **LF1|LF2** Uses an internally generated LF signal. **INTernal = LF1** Works like `LF1` **EXTernal** Works like `EXT1` **EXT1|EXT2** Uses an externally supplied LF signal. **NOISe** Uses the internally generated noise signal. *RST: LF1 <FM1>; LF2 <FM2>
Example:	See Example "Creating a frequency modulated RF signal" on page 519.
Manual operation:	See "Source" on page 79

[: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 520.

Manual operation: See "Deviation Mode" on page 80

[: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 520.

Manual operation: See "Total Deviation" on page 80

[:SOURce<hw>]:FM:RATio <Ratio>

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

Parameters:

<Ratio> float

Range: 0 to 100
Increment: 0.01
*RST: 100

Example: See Example "Creating a frequency modulated RF signal" on page 519.

Manual operation: See "Ratio Path2/Path1" on page 80

[: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 519.

Manual operation: See "Mode" on page 80

[: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 520.

Usage: Query only

13.16.1.4 SOURce:PM Subsystem

Option: R&S SMAB-K720

The PM subsystem contains the commands for setting the phase modulation. You can configure the internal modulation source (LF generator) with the commands listed in Chapter 13.16.6, "SOURce:LFOutput Subsystem", on page 599 .

Example: Performing phase modulation

The following example shows a command sequence to perform phase modulation.

```
// Reset the instrument to start from an initial state
*RST; *CLS

// Set the RF signal frequency and level
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the phase modulation settings
SOURce1:LFOutput1:SHAPe SINE
SOURce1:LFOutput1:FREQuency 1000

// Select the LF signal generated by the internal modulation generator
// or the internally generated noise signal
SOURce1:PM1:DEViation 1
SOURce1:PM1:SOURce LF1
// SOURce1:PM1:SOURce INTernal
// SOURce1:PM1:SOURce NOISe
```

```
SOURce1:PM1:RATio 40
SOURce1:PM1:MODE HBAN

// Alternatively configure the phase modulation settings for an
// external modulation source and query the input sensitivity.
SOURce1:PM1:SOURce EXT1
// SOURce1:PM1:SOURce EXTernal
SOURce1:PM1:DEViation 1
SOURce1:PM1:SENSitivity?
// Response: 1
// since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 1RAD/V.

// Activate the signal output
SOURce1:PM1:STATe 1
OUTPut1:STATe 1
```

Example: Using combined LF signals

Using the internal LF generators of both paths, the following command sequences configure an phase modulated signal with determined deviations.

```
// Configure the Phase modulation settings with combined LF signal sources
SOURce1:PM1:SOURce LF1
SOURce1:PM1:DEViation 1.5
// Select the modulation signal source for the second path
SOURce1:PM2:SOURce LF2
// Combine the signals of both paths with fixed total deviation depth
SOURce1:PM1:DEViation:MODe TOT
SOURce1:PM1:DEViation:SUM 2

// Query the deviation depth of the modulation signal in the second path
SOURce1:PM2:DEViation?
// Response:  0.5

// Combine the signals of both paths with fixed ratio
SOURce1:PM1:DEViation:MODe RAT
SOURce1:PM1:RATio 80
SOURce1:PM2:DEViation?
// Response:  1.2

// Query the deviation depth of modulation signal in the first path
SOURce1:PM1:DEViation?
// Response:  1.5

SOURce1:FM1:STATe 1
SOURce1:FM2:STATe 1
```

The following commands are available:

[:SOURce<hw>]:PM<ch>:STATe <State>

Activates phase modulation.

Activation of phase modulation deactivates frequency modulation.

Suffix:

PM<ch> 1|2
Sets the modulation signal channel.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: See Example "Performing phase modulation" on page 524.

Manual operation: See "State" on page 79

[: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> LF1 | LF2 | NOISe | EXT1 | EXT2 | INTernal | EXTernal

LF1|LF2
Uses an internally generated LF signal.

EXT1|EXT2
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).

*RST: LF1 <PM1>; LF2 <PM2>

Example: See Example "Performing phase modulation" on page 524.

Manual operation: See "Source" on page 79

[: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 524.

Manual operation: See "Mode" on page 82

[: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 525

Manual operation: See "Deviation Mode" on page 81

[:SOURce<hw>]:PM:DEViation:SUM <PmDevSum>

Sets the total deviation of the LF signal when using combined signal sources in phase modulation.

Parameters:

<PmDevSum> float

Range: 0 to 20
Increment: 1E-6
*RST: 1

Example: See Example "Using combined LF signals" on page 525

Manual operation: See "Total Deviation" on page 81

[: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 524.

Manual operation: See "Ratio Path2/Path1" on page 81

[: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 524.

Usage: Query only

[:SOURce]:PM<ch>[:DEViation] <Deviation>

Sets the modulation deviation of the phase modulation in RAD.

Parameters:

<Deviation> float

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

Range: 0 to max
Increment: 1
*RST: 1
Default unit: RAD

Example: See Example "Performing phase modulation" on page 524.

Manual operation: See "Deviation" on page 81

13.16.1.5 SOURce:PULM Subsystem

Option: see Chapter 4.1, "Required Options", on page 73.

The `PULM` subsystem contains the commands for setting the pulse modulation.

Pulse Modulation Settings

With the commands described in this section, you can configure the settings for pulse modulation, select the trigger mode and determine delay times for the pulse modulation signal.

Example: Perform pulse modulation

The example shows a command sequence to perform pulse modulation.

```
// Reset the instrument to start from an initial state
*RST; *CLS

// Set the RF signal frequency and level
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the pulse modulation settings
// Select the internal modulation generator,
// set trigger mode, select pulse mode, transition type
// and select the polarity of the internally generated pulse video output
// Trigger a single pulse
SOURce:PULM:SOURce INT
SOURce:PULM:TRIGger:MODE SING
SOURce:PULM:MODE DOUB
SOURce:PULM:TTYPe SMO
SOURce:PULM:OUTPut:VIDeo:POLarity INVerted
SOURce:PULM:TRIG:IMM
// Alternatively configure the pulse modulation settings for
// external modulation source
// Select the source, set the polarity of the external signal,
// select the impedance for the external pulse modulation input/
// for the external pulse modulation trigger input
SOURce:PULM:SOURce EXT
SOURce:PULM:POLarity NORMal
SOURce:PULM:IMPedance G1K
// Configure the pulse generator settings
// Set pulse period, width, and delay
SOURce:PULM:PERiod 10 us
SOURce:PULM:WIDth 8 us
SOURce:PULM:DOUBle:WIDTh 0.0000012
SOURce:PULM:DOUBle:DELay 0.0000045

// Activate the signal output
SOURce:PGENerator:OUTPut:STATe 1
```

```
SOURce:PULM:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:PULM:MODE <Mode>

Selects the mode for the pulse modulation.

Parameters:

<Mode> SINGle | DOUBle | PTRain

SINGle
Generates a single pulse.

DOUBle
Generates two pulses within one pulse period.

PTRain
Generates a user-defined pulse train.
Specify the pulse sequence with the commands:
`[:SOURce<hw>]:PULM:TRAin:ONTime`
`[:SOURce<hw>]:PULM:TRAin:OFFTime`
`[:SOURce<hw>]:PULM:TRAin:REPetition`

*RST: SINGle

Example: See Example "Perform pulse modulation" on page 529.

Options: PTRain requires R&S SMAB-K27

Manual operation: See "Pulse Mode" on page 86

[: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 529.

Manual operation: See "Trigger Mode" on page 86

[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate

If `[:SOURce<hw>]:PULM:TRIGger:MODE SINGle`, triggers the pulse generator.

Example: See Example "Perform pulse modulation" on page 529.

Manual operation: See "Execute Single Trigger" on page 89

[: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 SMAB-K22 or R&S SMAB-K23

Range:	20E-9 to 100
Increment:	5E-9
*RST:	10E-6

Example: See Example "Perform pulse modulation" on page 529.

Manual operation: See "Pulse Period" on page 88

[:SOURce<hw>]:PULM:WIDTh <Width>

Sets the width of the generated pulse, that means the pulse length. It must be at least 20ns less than the set pulse period.

Parameters:

<Width> float

Range:	20E-9 to 100
Increment:	10E-9
*RST:	2E-6

Example: See Example "Perform pulse modulation" on page 529.

Manual operation: See "Pulse Width" on page 88

[:SOURce<hw>]:PULM:DELay <Delay>

Sets the pulse delay.

Parameters:

<Delay> float

*RST: 1ms

Example: See Example "Perform pulse modulation" on page 529.

Manual operation: See "Pulse Delay" on page 89

[: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 529.

Manual operation: See "Double Pulse Delay" on page 89

[: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 529.

Manual operation: See "Double Pulse Width" on page 89

[:SOURce<hw>]:PULM:DOUBle:STATe <State>

Provided for backward compatibility with former Rohde & Schwarz signal generators.

Works like the command `[:SOURce<hw>]:PULM:MODE DOUBle`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

[:SOURce<hw>]:PULM:STATe <State>

Activates pulse modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Perform pulse modulation" on page 529.

Manual operation: See "State" on page 76

[: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 529.

Manual operation: See "Source" on page 77

[: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 529.

Manual operation: See "Transition Type" on page 77

[:SOURce<hw>]:PULM:OUTPut:VIDeo:POLarity <Polarity>

Sets the polarity of the pulse video (modulating) signal, related to the RF (modulated) signal.

Parameters:

<Polarity> NORMal | INVerted

NORMal
the video signal follows the RF signal, that means it is high wihen RF signal is high and vice versa.

INVerted
the video signal follows in inverted mode.

*RST: NORMal

Example: See Example "Perform pulse modulation" on page 529.

Manual operation: See "Video Polarity" on page 77

[: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 529.

Manual operation: See "Polarity" on page 97

[:SOURce<hw>]:PULM:IMPedance <Impedance>

Sets the impedance for the external pulse trigger and pulse modulation input.

Parameters:

<Impedance> G50 | G10K

*RST: G50

Example: See Example "Perform pulse modulation" on page 529.

Manual operation: See "Impedance" on page 97

[:SOURce<hw>]:PULM:THReshold <Threshold>

Sets the threshold for the input signal at the [Pulse Ext] connector.

Parameters:

<Threshold> float

Range: 0 to 2
Increment: 0.1
*RST: 1
Default unit: V

Example: `SOURce:PULM:THReshold 1`

Manual operation: See "Threshold" on page 97

Pulse Train Settings

Option: R&S SMAB-K27

This section describes the commands for the pulse train modulation and the associated file handling. For background information, see Chapter 4.4.3.2, "Pulse Generator > Pulse Train Settings", on page 89.

Example: Generating a pulse train signal

The following settings are required to perform pulse train modulation.

Always create and select pulse train data list first before you activate the pulse train mode.

Otherwise, an error is displayed

```
*RST; *CLS

// Set the RF signal frequency and level
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// Create a pulse train data list
// Select the directory
MMEM:CDIR '/var/user/'
SOURce1:PULM:TRAin:CATalog?
// my_pt
// Create and7or select the pulse train data file
SOURce1:PULM:TRAin:SELect "/var/user/pt"
// Enter the pulse train data
SOURCe:PULM:TRAin:ONTime 0.0001,0.00025,0.0001
SOURCe:PULM:TRAin:OFFTime 500us,500us,300us
SOURCe:PULM:TRAin:REPetition 2,0,3
// the second pulse is ignored

// Select pulse train mode
// Select the internal modulation generator and the pulse mode
SOURce1:PULM:SOURce INT
SOURce1:PULM:MODE PTR
SOURce1:PULM:TRIGger:MODE EXT
SOURce1:PGENerator:OUTPut:STATe 1
SOURce1:PGENerator:OUTPut:POLarity NORM
SOURce:PGENerator:OUTPut:STATe 1
SOURce:PULM:STATe 1
OUTPut1:STATe 1

// SOURce1:PULM:TRAin:CATalog?
// my_pt, pt
// SOURce1:PULM:TRAin:DEL "/var/user/my_pt"
```

The following commands are available:

[:SOURce<hw>]:PULM:TRAin:CATalog?

Queries the available pulse train files in the specified directory.

Return values:

<Catalog> string

List of list filenames, separated by commas

Example: See Example "Generating a pulse train signal" on page 535.

Usage: Query only

Manual operation: See "Pulse Train Data" on page 91

[: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 535.

Usage: Setting only

Manual operation: See "Pulse Train Data" on page 91

[:SOURce<hw>]:PULM:TRAin:ONTime <OnTime>
[:SOURce<hw>]:PULM:TRAin:OFFTime <OffTime>

Enters the pulse on/off times values in the selected list.

Parameters:

<OffTime> Offtime#1{, Offtime#2, ...} | binary block data

List of comma-separated numeric values or binary block data, where:
The list of numbers can be of any length.
In binary block format, 8 (4) bytes are always interpreted as a floating-point number with double accuracy.
See `:FORMat[:DATA]` on page 438 for details.
The maximum length is 2047 values.

Range: 0 ns to 5 ms

Example: See Example "Generating a pulse train signal" on page 535.

Manual operation: See "Edit Pulse Train Data" on page 91

[:SOURce<hw>]:PULM:TRAin:REPetition:POINts?
[:SOURce<hw>]:PULM:TRAin:ONTime:POINts?
[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts?

Queries the number of on and off time entries and repetitions in the selected list.

Return values:

<Points> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Generating a pulse train signal" on page 535.

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 535.

Manual operation: See "Edit Pulse Train Data" on page 91

[:SOURce<hw>]:PULM:TRAin:SELect <Filename>

Selects or creates a data list in pulse train mode.

If the list with the selected name does not exist, a new list is created.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted.

Example: See Example "Generating a pulse train signal" on page 535.

Manual operation: See "Pulse Train Data" on page 91

Pulse Train Data Exchange

Option: R&S SMAB-K27

With the following commands, you can configure pulse trains in ASCII format and export or import them accordingly.

```
SOURce1:PULM:SOURce INT
SOURce1:PULM:MODE PTR
SOURce1:PULM:TRAin:SELect "/var/user/pt"
```

```
SOURce1:PULM:STATe 1

SOURce1:PULM:TRAin:DEXChange:MODE EXP
SOURce1:PULM:TRAin:DEXChange:AFILe:EXTension TXT
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal DOT
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn SEM
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn COMM
SOURce1:PULM:TRAin:DEXChange:SELect "/var/user/pt.pulstrn"
SOURce1:PULM:TRAin:DEXChange:AFILe:SELect "/var/user/pt_script.txt"
SOURce1:PULM:TRAin:DEXChange:EXECute
```

The following commands are available:

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE <Mode>

Determines the import or export of a list.

Specify the source or destination file with the command `[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect`.

Parameters:

<Mode> IMPort | EXPort

*RST: IMPort

Example: See "Pulse Train Data Exchange" on page 537.

Manual operation: See " Mode " on page 94

[: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 537.

Manual operation: See "ASCII File Settings" on page 94

[: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 537.

Manual operation: See "ASCII File Settings" on page 94

[: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 537.

Manual operation: See "ASCII File Settings" on page 94

[: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 537.

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 94

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect <Filename>

Selects the ASCII file to be imported or exported.

Parameters:

<Filename> string
Filename or complete file path; file extension can be omitted.

Example: See "Pulse Train Data Exchange" on page 537.

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 94

[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect <Filename>

Selects the ASCII file for import or export, containing a pulse train list.

Parameters:

<Filename>	string Filename or complete file path; file extension can be omitted.
Example:	See "Pulse Train Data Exchange" on page 537.
Manual operation:	See "Select Source/Select ASCII Destination" on page 95

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute

Usage:	Event
Manual operation:	See "Import / Export" on page 95

Executes the import or export of the selected list file, according to the transfer direction set with command `[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE`.

13.16.2 Avionic Standards Subsystems

Option: see Chapter 5.1, "Required Options", on page 110.

The following subsections describe all commands for avionic standard modulation of the RF signal. Divided into separate avionic subsystem command sections, you can configure ADF, ILS and VOR modulation.

Programming examples are given for general configuration and avionic standard-specific configuration tasks.

Placeholder <Subsystem>

To simplify the description of the remote control commands, the placeholder `<Subsystem>` is introduced. Depending on the avionic standard used as an entry standard, replace this placeholder `<Subsystem>` with for example `SOURce:ADF` for ADF.

The replacement of the place holder `<Subsystem>` is mandatory, i.e. remote control commands containing this placeholder are not recognized and accepted by the instrument.

Example:

SCPI command `<subsystem>:SETTing:STATe`:

- Entry Standard = ADF
  `SOURce:ADF:STATe`
- Entry Standard = ILS
  `SOURce:ILS:STATe`
- Entry Standard = VOR
  `SOURce:VOR:STATe`
- Invalid command
  `<Subsystem>:STAT`

Contents

13.16.2.1 Programming Examples

Example: Save/Recall a configuration

This example shows how to query and load settings files, stored with the save/recall function for the ADF standard.

For other avionic standards, replace `ADF` by `ILS` or `VOR`.

```
SOURce1:ADF:PRESet
// Go to the "settings" directory.
MMEM:CDIR "/var/user/settings"
// List all files in the directory with extension *.adf.
SOURce1:ADF:SETTing:CATalog?
// adf_general, adf_comid

// Store the ADF configuration in the file "adf_general_latest.adf".
SOURce1:ADF:SETTing:STORe "/var/user/settings/adf_general_latest"
// Delete the file "adf_general.adf".
SOURce1:ADF:SETTing:DELete "/var/user/settings/adf_general"
SOURce1:ADF:SETTing:CATalog?
// adf_general_latest, adf_comid

// Load the file "adf_general_latest.adf".
SOURce1:ADF:SETTing:LOAD "/var/user/settings/adf_general_latest"

SOURce1:ADF:STATe 1
```

Example: Configure and generate a ADF signal

```
SOURce1:ADF:PRESet

// Configure ADF COM/ID settings.
SOURce1:ADF:COMid:PERiod 9
SOURce1:ADF:COMid:FREQuency 1020
SOURce1:ADF:COMid:DEPTh 11
SOURce1:ADF:COMid:TSCHema USER
SOURce1:ADF:COMid:DOT 0.11
SOURce1:ADF:COMid:DASH 0.29
SOURce1:ADF:COMid:SYMBol 0.11
SOURce1:ADF:COMid:LETTer 0.29
SOURce1:ADF:COMid:STATe 1

SOURce1:ADF:STATe 1
```

Example: Configure and generate an ILS glide slope signal

```
SOURce1:BB:ILS:PRESet

// Configure ILS localizer general settings.
SOURce1:ILS:TYPE GS
SOURce1:ILS:GS:FREQuency:MODE USER
SOURce1:ILS:GS:FREQuency 334700000
SOURce1:ILS:GS:FREQuency:MODE ICAO
SOURce1:ILS:GS:ICAO:CHANnel?
// CH18X
SOURce1:ILS:GS:FREQuency:SYNChronize 1
SOURce1:ILS:LOCalizer:ICAO:CHANnel?
// CH18X
SOURce1:ILS:LOCalizer:FREQuency?
// 108100000
SOURce1:ILS:GSLope:SOURce?
// INT

// Configure ILS glide slope signal settings.
SOURce1:ILS:GS:MODE NORM
SOURce1:ILS:GS:DDM:POLarity P90_150
SOURce1:ILS:GS:ULOBe:FREQuency 90
SOURce1:ILS:GS:LLOBe:FREQuency 150
SOURce1:ILS:GS:PHASe 0

// Configure ILS glide slope amplitude settings.
SOURce1:ILS:GS:DDM:DIRection UP
SOURce1:ILS:GS:SDM 80
SOURce1:ILS:GS:DDM:COUPling FIX
SOURce1:ILS:GS:DDM:STEP DEC
SOURce1:ILS:GS:DDM:CURRent 0
SOURce1:ILS:GS:DDM:DEPTh 0
SOURce1:ILS:GS:DDM:LOGarithmic 0
SOURce1:ILS:GS:DDM:PCT 0
```

```
SOURce1:ILS:STATe 1
```

Example: Configure and generate an ILS localizer signal

```
SOURce1:ILS:PRESet

// Configure ILS localizer general settings.
SOURce1:ILS:TYPE LOC
SOURce1:ILS:LOCalizer:FREQuency:MODE USER
SOURce1:ILS:LOCalizer:FREQuency 108100000
SOURce1:ILS:LOCalizer:FREQuency:SYNChronize 1
SOURce1:ILS:GS:FREQuency?
// 108100000
SOURce1:ILS:LOCalizer:FREQuency:MODE ICAO
SOURce1:ILS:LOCalizer:ICAO:CHANnel CH26Y
SOURce1:ILS:GS:ICAO:CHANnel?
// CH26Y
SOURce1:ILS:GS:FREQuency?
// 108950000
SOURce1:ILS:LOCalizer:SOURce?
// INT

// Configure ILS localizer signal settings.
SOURce1:ILS:LOCalizer:MODE NORM
SOURce1:ILS:LOCalizer:DDM:POLarity P90_150
SOURce1:ILS:LOCalizer:LLOBe:FREQuency 90
SOURce1:ILS:LOCalizer:RLOBe:FREQuency 150
SOURce1:ILS:LOCalizer:PHASe 0

// Configure ILS localizer amplitude settings.
SOURce1:ILS:LOCalizer:DDM:DIRection LEFT
SOURce1:ILS:LOCalizer:SDM 40
SOURce1:ILS:LOCalizer:DDM:COUPling FIX
SOURce1:ILS:LOCalizer:DDM:STEP DEC
SOURce1:ILS:LOCalizer:DDM:CURRent 0
SOURce1:ILS:LOCalizer:DDM:DEPTh 0
SOURce1:ILS:LOCalizer:DDM:LOGarithmic 0
SOURce1:ILS:LOCalizer:DDM:PCT 0

// Configure ILS localizer COM/ID settings.
SOURce1:ILS:LOCalizer:COMid:CODE "MUC"
SOURce1:ILS:LOCalizer:COMid:PERiod 9
SOURce1:ILS:LOCalizer:COMid:FREQuency 1020
SOURce1:ILS:LOCalizer:COMid:DEPTh 10
SOURce1:ILS:LOCalizer:COMid:TSCHema USER
SOURce1:ILS:LOCalizer:COMid:DOT 0.11
SOURce1:ILS:LOCalizer:COMid:DASH 0.29
SOURce1:ILS:LOCalizer:COMid:SYMBol 0.11
SOURce1:ILS:LOCalizer:COMid:LETTer 0.29
SOURce1:ILS:LOCalizer:COMid:STATe 1
```

```
SOURce1:ILS:STATe 1
```

Example: Configure and generate an ILS marker beacons signal

```
SOURce:ILS:PRESet

// Configure ILS marker beacons general settings.
SOURce1:ILS:TYPE MBE
SOURce1:ILS:MBEacon:FREQuency:MODE USER
SOURce1:ILS:MBEacon:FREQuency 75000000
SOURce1:ILS:MBEacon:MARKer:FREQuency 400
SOURce1:ILS:MBEacon:MARKer:DEPTh 95
SOURce1:ILS:MBEacon:MARKer:PULSed?
// 0

// Configure ILS marker beacons COM/ID settings.
SOURce1:ILS:MBEacon:COMid:CODE "MUC"
SOURce1:ILS:MBEacon:COMid:PERiod 9
SOURce1:ILS:MBEacon:COMid:FREQuency 1020
SOURce1:ILS:MBEacon:COMid:DEPTh 5
SOURce1:ILS:MBEacon:COMid:TSCHema USER
SOURce1:ILS:MBEacon:COMid:DOT 0.11
SOURce1:ILS:MBEacon:COMid:DASH 0.29
SOURce1:ILS:MBEacon:COMid:SYMBol 0.11
SOURce1:ILS:MBEacon:COMid:LETTer 0.29
SOURce1:ILS:MBEacon:COMid:STATe 1

SOURce1:BB:ILS:STATe 1
```

Example: Configure and generate a VOR signal

```
SOURce1:VOR:PRESet

// Configure VOR general settings.
SOURce1:VOR:FREQuency:MODE USER
SOURce1:VOR:FREQuency 108000000
SOURce1:VOR:FREQuency:MODE ICAO
SOURce1:VOR:ICAO:CHANnel?
// CH17X
SOURce1:VOR:SOURce?
// INT

// Configure VOR signal settings.
SOURce1:VOR:MODE NORM
SOURce1:VOR:VAR:FREQuency 30
SOURce1:VOR:VAR:DEPTh 30
SOURce1:VOR:SUBCarrier:FREQuency 9960
SOURce1:VOR:SUBCarrier:DEPTh 30
SOURce1:VOR:REFerence:DEViation 480
```

```
// Configure VOR position settings.
SOURce1:VOR:BANGle 1
SOURce1:VOR:BANGle:DIRection FROM

// Configure VOR COM/ID settings.
SOURce1:VOR:COMid:PERiod 9
SOURce1:VOR:COMid:FREQuency 1020
SOURce1:VOR:COMid:DEPTh 11
SOURce1:VOR:COMid:TSCHema USER
SOURce1:VOR:COMid:DOT 0.11
SOURce1:VOR:COMid:DASH 0.29
SOURce1:VOR:COMid:SYMBol 0.11
SOURce1:VOR:COMid:LETTer 0.29
SOURce1:VOR:COMid:STATe 1

SOURce1:VOR:STATe 1
```

13.16.2.2 General Commands

<subsystem>:PRESet
[:SOURce<hw>]:ADF:PRESet
[:SOURce<hw>]:ILS:PRESet
[:SOURce<hw>]:VOR:PRESet

Sets the parameters of the digital standard to their default values (`*RST` values specified for the commands).

Not affected is the state set with the command `SOURce<hw>:VOR:STATe`.

Example: See Example "Save/Recall a configuration" on page 541.

<subsystem>:SETTing:CATalog
[:SOURce<hw>]:ADF:SETTing:CATalog
[:SOURce<hw>]:ILS:SETTing:CATalog?
[:SOURce<hw>]:VOR:SETTing:CATalog?

Queries the files with settings in the default directory. Listed are files with the file extension `*.adf/*.ils/*.vor`.

Return values:

<FileNames> <filename1>,<filename2>,...
Returns a string of filenames separated by commas.

Example: See Example "Save/Recall a configuration" on page 541.

Usage: Query only

<subsystem>:SETTing:DELete
[:SOURce<hw>]:ADF:SETTing:DELete <Filename>
[:SOURce<hw>]:ILS:SETTing:DELete <Filename>
[:SOURce<hw>]:VOR:SETTing:DELete <Filename>

Deletes the selected file from the default or the specified directory. Deleted are files with extension `*.adf/*.ils/*.vor`.

Setting parameters:

<Filename> "<filename>"
Filename or complete file path; file extension can be omitted

Example: See Example "Save/Recall a configuration" on page 541.

Usage: Setting only

<subsystem>:SETTing:LOAD
[:SOURce<hw>]:ADF:SETTing:LOAD <Filename>
[:SOURce<hw>]:ILS:SETTing:LOAD <Filename>
[:SOURce<hw>]:VOR:SETTing:LOAD <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.adf/*.ils/*.vor`.

Parameters:

<Filename> "<filename>"

Filename or complete file path; file extension can be omitted

Example: See Example "Save/Recall a configuration" on page 541.

Usage: Setting only

<subsystem>:SETTing:STATe
[:SOURce<hw>]:ADF:STATe <State>
[:SOURce<hw>]:ILS:STATe <State>
[:SOURce<hw>]:VOR:STATe <State>

Activates/deactivates the VOR modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Save/Recall a configuration" on page 541.

<subsystem>:SETTing:STORe
[:SOURce<hw>]:ADF:SETTing:STORe <Filename>
[:SOURce<hw>]:ILS:SETTing:STORe <Filename>
[:SOURce<hw>]:VOR:SETTing:STORe <Filename>

Saves the current settings into the selected file; the file extension (`*.adf/*.ils/*.vor`) is assigned automatically.

Parameters:

<Filename> "<filename>"

Filename or complete file path

Example: See Example "Save/Recall a configuration" on page 541.

Usage: Setting only

<subsystem>:SETTing:SOURce
[:SOURce<hw>]:ILS[:GS|GSLope]:SOURce <IlsGsSource>
[:SOURce<hw>]:ILS:LOCalizer:SOURce <IlsLocSource>
[:SOURce<hw>]:VOR:SOURce <VorSourceSel>

Sets the modulation source for the avionic standard modulation.

If external modulation source is set, the external signal is added to the internal signal. Switching off the internal modulation source is not possible.

Parameters:

<VorSourceSel> INT | INT,EXT | EXT

INT
Internal modulation source is used.

EXT|INT,EXT
An external modulation source is used, additional to the internal modulation source.
The external signal is input at the Ext connector.

Example: See Example "Configure and generate a VOR signal" on page 544.

<subsystem>:SETTing:FREQuency:SYNChronize:STATe
[:SOURce<hw>]:ILS[:GS|GSLope]:FREQuency:SYNChronize[:STATe] <Mode>
[:SOURce<hw>]:ILS:LOCalizer:FREQuency:SYNChronize[:STATe] <Mode>

Activates synchronization of the ILS localizer ICAO channel with the ILS glide slope ICAO channel.

The ILS glide slope/localizer frequency of the ICAO channel (Table 5-2) is set automatically.

Parameters:
<Mode> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

13.16.2.3 SOURce:ADF Subsystem

Option: R&S SMAB-K25

The `SOURce:ADF` subsystem contains all commands for configuring the ADF signal.

Characteristics which are valid for all modulations and the LF output are configured in the SOURce:LFOutput subsystem. The signal is output at the LF connector.

Commands

[:SOURce<hw>]:ADF:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter D, "Morse Code Settings", on page 740.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Parameters:

<Code> string

Example: See Example "Configure and generate a ADF signal" on page 542.

Manual operation: See "Code" on page 151

[:SOURce<hw>]:ADF:COMid:DASH <Dash>

Sets the length of a Morse code dash.

Parameters:

<Dash> float

Range: 50E-3 to 1
Increment: 1E-4
*RST: 300E-3

Example: See Example "Configure and generate a ADF signal" on page 542.

Manual operation: See " Dash Length " on page 152

[:SOURce<hw>]:ADF:COMid:DEPTh <Depth>

Sets the AM modulation depth of the COM/ID signal.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 95

Example: See Example "Configure and generate a ADF signal" on page 542.

Manual operation: See "Depth" on page 152

[:SOURce<hw>]:ADF:COMid:DOT <Dot>

Sets the length of a Morse code dot.

Parameters:

<Dot> float

Range: 50E-3 to 1
Increment: 1E-4
*RST: 100E-3

Example: See Example "Configure and generate a ADF signal" on page 542.

Manual operation: See "Dot Length" on page 152

[:SOURce<hw>]:ADF:COMid:FREQuency <Frequency>

Sets the frequency of the COM/ID signal.

Parameters:

<Frequency> float

Range: 0.1 to 20E3
Increment: 0.01
*RST: 1020

Example: See Example "Configure and generate a ADF signal" on page 542.

Manual operation: See "Frequency" on page 152

[:SOURce<hw>]:ADF:COMid:LETTer <Letter>

Sets the length of a Morse code letter space.

Parameters:

<Letter> float

Range: 50E-3 to 1
Increment: 1E-4
*RST: 300E-3

Example: See Example "Configure and generate a ADF signal" on page 542.

Manual operation: See " Letter Space " on page 153

[:SOURce<hw>]:ADF:COMid:PERiod <Period>

Sets the period of the COM/ID signal.

Parameters:

<Period> float

Range: 0 to 120
Increment: 1E-3
*RST: 9

Example: See Example "Configure and generate a ADF signal" on page 542.

Manual operation: See "Period" on page 152

[:SOURce<hw>]:ADF:COMid:SYMBol <Symbol>

Sets the length of the Morse code symbol space.

Parameters:

<Symbol>	float Range: 50E-3 to 1 Increment: 1E-4 *RST: 100E-3
Example:	See Example "Configure and generate a ADF signal" on page 542.
Manual operation:	See " Symbol Space " on page 152

[:SOURce<hw>]:ADF:COMid:TSCHema <TSCHema>

Sets the time schema of the Morse code for the COM/ID signal.

Parameters:

<TSCHema>	STD | USER *RST: STD
Example:	See Example "Configure and generate a ADF signal" on page 542.
Manual operation:	See "Time Schema" on page 152

[:SOURce<hw>]:ADF:COMid[:STATe] <State>

Enables/disables the COM/ID signal.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0
Example:	See Example "Configure and generate a ADF signal" on page 542.
Manual operation:	See "COM/ID State" on page 151

13.16.2.4 SOURce:ILS Subsystem

Option: R&S SMAB-K25

The `SOURce:BB:ILS` subsystem contains all commands for configuring the ILS signal.

Characteristics which are valid for all modulations and the LF output are configured in the SOURce:LFOutput subsystem. The signal is output at the LF connector.

Commands

[:SOURce<hw>]:ILS:TYPE <Type>

Selects the ILS modulation type.

Parameters:

<Type> GS | LOCalize | GSLope | MBEacon

*RST: GS

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "ILS Component" on page 126

[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:COUPling <Coupling>

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see `[:SOURce<hw>]:ILS[:GS|GSLope]:SDM` on page 559).

Parameters:

<Coupling> FIXed | SDM

*RST: FIXed

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "DDM - SDM Coupling" on page 134

[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:CURRent <Current>

Sets the DDM value alternatively as a current by means of the ILS indicating instrument. The instrument current is calculated according to:

DDM Current µA = DDM Depth [%] × 857,125 µA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Parameters:

<Current> float

Range: -8.57125E-4 to 8.57125E-4
Increment: 1E-7
*RST: 0

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "DDM Current" on page 133

[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:DIRection <Direction>

Sets the simulation mode for the ILS glide slope modulation signal. A change of the setting automatically changes the sign of the DDM value.

Parameters:

<Direction> UP | DOWN

UP
The 150-Hz modulation signal is predominant, the DDM value is negative (the airplane is too low, it must climb).

DOWN
The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too high, it must descend).

*RST: UP

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "FlyMode" on page 132

[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:LOGarithmic <Logarithmic>

Sets the depth of modulation value for ILS glide slope modulation in dB.

See also `[:SOURce<hw>]:ILS[:GS|GSLope]:DDM[:DEPTh]` on page 556.

Parameters:

<Logarithmic> float

Range: -999.9 to 999.9
Increment: 1E-4
*RST: 0

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "DDM Logarithmic" on page 133

[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:PCT <Pct>

Sets the difference in depth of modulation between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone.

See also `[:SOURce<hw>]:ILS[:GS|GSLope]:DDM[:DEPTh]` on page 556.

Parameters:

<Pct> float

Range: -80.0 to 80.0
Increment: 0.01
*RST: 0

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "DDM Percent" on page 133

[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:POLarity <Polarity>

Sets the polarity for DDM calculation (see `[:SOURce<hw>]:ILS[:GS|GSLope]:DDM[:DEPTh]` on page 556).

The DDM depth calculation depends on the selected polarity:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)] / 100%
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)] / 100%

Parameters:

<Polarity> P90_150 | P150_90

*RST: P90_150

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "DDM Polarity" on page 131

[:SOURce<hw>]:ILS[:GS|GSLope]:DDM:STEP <DdmStep>

Sets the variation of the difference in depth of modulation via the rotary knob.

Parameters:

<DdmStep> DECimal | PREDefined

*RST: DECimal

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "DDM Step" on page 133

[:SOURce<hw>]:ILS[:GS|GSLope]:DDM[:DEPTh] <Depth>

Sets the difference in depth of modulation between the signal of the upper/left lobe (90 Hz) and the lower/right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone. The following is true:

```
ILS:GS|GSL:DDM:DEPTh = (AM(90Hz) - AM(150Hz))/100%
```

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Parameters:

<Depth> float

Range: -0.8 to 0.8
Increment: 1E-4
*RST: 0

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "DDM Depth" on page 133

[:SOURce<hw>]:ILS[:GS|GSLope]:FREQuency <CarrierFreq>

Sets the carrier frequency of the signal.

Parameters:

<CarrierFreq> float

Range: 100E3 to 6E9
Increment: 0.01
*RST: 334.7E6

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "Carrier Frequency" on page 128

[:SOURce<hw>]:ILS[:GS|GSLope]:FREQuency:MODE <Mode>

Sets the mode for the carrier frequency of the signal.

Parameters:

<Mode> USER | ICAO

*RST: USER

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "Carrier Frequency Mode" on page 128

[:SOURce<hw>]:ILS[:GS|GSLope]:FREQuency:SYNChronize[:STATe] <Mode>

Activates synchronization of the ILS glide slope ICAO channel with the ILS localizer ICAO channel.

The ILS glide slope/localizer frequency of the ICAO channel (Table 5-2) is set automatically.

Parameters:

<Mode> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

[:SOURce<hw>]:ILS[:GS|GSLope]:ICAO:CHANnel <Channel>

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

The ICAO channel settings for ILS glide slope/localizer components are coupled. For an overview of the ILS ICAO channel frequencies, see Table 5-2.

Parameters:

<Channel> CH18X | CH18Y | CH20X | CH20Y | CH22X | CH22Y | CH24X | CH24Y | CH26X | CH26Y | CH28X | CH28Y | CH30X | CH30Y | CH32X | CH32Y | CH34X | CH34Y | CH36X | CH36Y | CH38X | CH38Y | CH40X | CH40Y | CH42X | CH42Y | CH44X | CH44Y | CH46X | CH46Y | CH48X | CH48Y | CH50X | CH50Y | CH52X | CH52Y | CH54X | CH54Y | CH56X | CH56Y

*RST: CH18X

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "ICAO Channel" on page 129

[:SOURce<hw>]:ILS[:GS|GSLope]:LLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the bottom viewed from the air plane for the ILS glide slope modulation signal.

Parameters:

<Frequency> float

Range: 100 to 200
Increment: 0.05
*RST: 150

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "Down Frequency" on page 131

[:SOURce<hw>]:ILS[:GS|GSLope]:MODE <Mode>

Sets the operating mode for the ILS glide slope modulation signal.

Parameters:

<Mode> NORM | ULOBe | LLOBe

NORM
ILS glide slope modulation is active.

ULOBe
Amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the ILS glide slope signal is active.

LLOBe
Amplitude modulation of the output signal with the lower lobe (150Hz) signal component of the ILS glide slope signal is active.

*RST: NORM

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "Operating Mode" on page 130

[:SOURce<hw>]:ILS[:GS|GSLope]:PHASe <Phase>

Sets the phase between the modulation signals of the upper and lower antenna lobe of the ILS glide slope signal.

Zero crossing of the lower lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the right antenna lobe.

Parameters:

<Phase> float

Range: -60 to 120
Increment: 0.01
*RST: 0.0

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "Up/Down Phase" on page 131

[:SOURce<hw>]:ILS:GS|GSLope:PRESet

Sets the parameters of the ILS glide slope component to their default values (`*RST` values specified for the commands).

For other ILS preset commands, see `[:SOURce<hw>]:ILS:PRESet` on page 546.

Example: `SOURce1:ILS:GS:PRESet`

Usage: Event

[:SOURce<hw>]:ILS[:GS|GSLope]:SDM <Sdm>

Sets the arithmetic sum of the modulation depths of the upper lobe (90 Hz) and lower lobe (150 Hz) for the ILS glide slope signal contents.

The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

Parameters:

<Sdm> float

Range: 0 to 100
Increment: 0.1
*RST: 80

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "Sum of Depth" on page 132

[:SOURce<hw>]:ILS[:GS|GSLope]:SOURce <IlsGsSource>

Sets the modulation source for the avionic standard modulation.

If external modulation source is set, the external signal is added to the internal signal. Switching off the internal modulation source is not possible.

Parameters:

<IlsGsSource> INT | INT,EXT | EXT

INT
Internal modulation source is used.

EXT|INT,EXT
An external modulation source is used, additional to the internal modulation source.
The external signal is input at the Ext connector.

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "EXT AM" on page 127

[:SOURce<hw>]:ILS[:GS|GSLope]:ULOBe[:FREQuency] <Frequency>

Parameters:

<Frequency> float

Range: 60 to 120
Increment: 0.03
*RST: 90

Example: See Example "Configure and generate an ILS glide slope signal" on page 542.

Manual operation: See "Up Frequency" on page 131

[:SOURce<hw>]:ILS:LOCalizer:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter D, "Morse Code Settings", on page 740.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Parameters:

<Code> string

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Code" on page 142

[:SOURce<hw>]:ILS:LOCalizer:COMid:DASH <Dash>

Sets the length of a Morse code dash.

Parameters:

<Dash> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See " Dash Length " on page 143

[:SOURce<hw>]:ILS:LOCalizer:COMid:DEPTh <Depth>

Sets the AM modulation depth of the COM/ID signal.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 10

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Depth" on page 142

[:SOURce<hw>]:ILS:LOCalizer:COMid:DOT <Dot>

Sets the length of a Morse code dot.

Parameters:

<Dot> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Dot Length" on page 143

[:SOURce<hw>]:ILS:LOCalizer:COMid:FREQuency <Frequency>

Sets the frequency of the COM/ID signal.

Parameters:

<Frequency> float

Range: 0.1 to 20E3
Increment: 0.01
*RST: 1020

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Frequency" on page 142

[:SOURce<hw>]:ILS:LOCalizer:COMid:LETTer <Letter>

Sets the length of a Morse code letter space.

Parameters:

<Letter> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See " Letter Space " on page 143

[:SOURce<hw>]:ILS:LOCalizer:COMid:PERiod <Period>

Sets the period of the COM/ID signal.

Parameters:

<Period> float

Range: 0 to 120
Increment: 1E-3
*RST: 9

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Period" on page 142

[:SOURce<hw>]:ILS:LOCalizer:COMid:SYMBol <Symbol>

Sets the length of the Morse code symbol space.

Parameters:

<Symbol> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See " Symbol Space " on page 143

[:SOURce<hw>]:ILS:LOCalizer:COMid:TSCHema <TSchema>

Sets the time schema of the Morse code for the COM/ID signal.

Parameters:

<TSchema> STD | USER

STD
Activates the standard time schema of the Morse code.
The set `dot length` determines the `dash length`, which is 3 times the dot length.

USER
Activates the user-defined time schema of the Morse code.
Dot and dash length, as well as `symbol` and `letter space` can be set separately.

*RST: STD

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Time Schema" on page 143

[:SOURce<hw>]:ILS:LOCalizer:COMid[:STATe] <State>

Enables/disables the COM/ID signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "COM/ID State" on page 142

[:SOURce<hw>]:ILS:LOCalizer:DDM:COUPling <Coupling>

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see `[:SOURce<hw>]:ILS:LOCalizer:SDM` on page 568).

Parameters:

<Coupling> FIXed | SDM

*RST: FIXed

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "DDM - SDM Coupling" on page 140

[:SOURce<hw>]:ILS:LOCalizer:DDM:CURRent <Current>

Sets the DDM value alternatively as a current by means of the ILS indicating instrument. The instrument current is calculated according to:

DDM µA = DDM × 857,1 µA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Parameters:

<Current> float

Range: -9.6775E-4 to 9.6775E-4
Increment: 1E-7
*RST: 0

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "DDM Current" on page 140

[:SOURce<hw>]:ILS:LOCalizer:DDM:DIRection <Direction>

Sets the simulation mode for the ILS-LOC modulation signal. A change of the setting automatically changes the sign of the DDM value.

Parameters:

<Direction> LEFT | RIGHt

LEFT
The 150 Hz modulation signal is predominant, the DDM value is negative (the airplane is too far to the right, it must turn to the left).

RIGHT
The 90 Hz modulation signal is predominant, the DDM value is positive (the airplane is too far to the left, it must turn to the right).

*RST: LEFT

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "FlyMode" on page 139

[:SOURce<hw>]:ILS:LOCalizer:DDM:LOGarithmic <Logarithmic>

Sets the modulation depth in dB for ILS localizer modulation.

See also [:SOURce<hw>]:ILS:LOCalizer:DDM[:DEPTh] on page 565.

Parameters:

<Logarithmic> float

Range: -999.9 to 999.9
Increment: 1E-4
*RST: 0

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "DDM Logarithmic" on page 141

[:SOURce<hw>]:ILS:LOCalizer:DDM:PCT <Pct>

Sets the difference in depth of modulation between the signal of the left lobe (90 Hz) and the right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone.

See also [:SOURce<hw>]:ILS:LOCalizer:DDM[:DEPTh] on page 565.

Parameters:

<Pct> float

Range: -80.0 to 80.0
Increment: 0.01
*RST: 0

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "DDM Percent" on page 141

[:SOURce<hw>]:ILS:LOCalizer:DDM:POLarity <Polarity>

Sets the polarity for DDM calculation (see [:SOURce<hw>]:ILS:LOCalizer:DDM[:DEPTh]).

The DDM depth calculation depends on the selected polarity:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM (90 Hz) - AM (150 Hz)] / 100%
- Polarity 150 Hz - 90 Hz:

DDM = [AM (150 Hz) - AM (90 Hz)] / 100%

Parameters:

<Polarity> P90_150 | P150_90

*RST: P90_150

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "DDM polarity" on page 138

[:SOURce<hw>]:ILS:LOCalizer:DDM:STEP <DdmStep>

Sets the variation step of the DDM values.

Parameters:

<DdmStep> DECimal | PREDefined

*RST: DECimal

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "DDM Step" on page 140

[:SOURce<hw>]:ILS:LOCalizer:DDM[:DEPTh] <Depth>

Sets the difference in depth of modulation between the signal of the upper/left lobe (90 Hz) and the lower/right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone.The following is true:

```
ILS:LOC:DDM:DEPTh = (AM(90Hz) - AM(150Hz))/100%
```

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Parameters:

<Depth> float

Range: -0.4 to 0.4
Increment: 1E-4
*RST: 0

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "DDM Depth" on page 140

[:SOURce<hw>]:ILS:LOCalizer:FREQuency <CarrierFreq>

Sets the carrier frequency of the signal.

Parameters:

<CarrierFreq> float

Range: 100E3 to 6E9
Increment: 0.01
*RST: 108.1E6

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Carrier Frequency" on page 135

[:SOURce<hw>]:ILS:LOCalizer:FREQuency:MODE <IlsLocFreqMode>

Sets the mode for the carrier frequency of the signal.

Parameters:

<IlsLocFreqMode> DECimal | USER | ICAO

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Carrier Frequency Mode" on page 135

[:SOURce<hw>]:ILS:LOCalizer:FREQuency:SYNChronize[:STATe] <Mode>

Activates synchronization of the ILS localizer ICAO channel with the ILS glide slope ICAO channel.

The ILS glide slope/localizer frequency of the ICAO channel (Table 5-2) is set automatically.

Parameters:

<Mode> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

[:SOURce<hw>]:ILS:LOCalizer:ICAO:CHANnel <SelIcaoChan>

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

The ICAO channel settings for ILS glide slope/localizer components are coupled. For an overview of the ILS ICAO channel frequencies, see Table 5-2.

Parameters:

<SelIcaoChan> CH18X | CH18Y | CH20X | CH20Y | CH22X | CH22Y | CH24X | CH24Y | CH26X | CH26Y | CH28X | CH28Y | CH30X | CH30Y | CH32X | CH32Y | CH34X | CH34Y | CH36X | CH36Y | CH38X | CH38Y | CH40X | CH40Y | CH42X | CH42Y | CH44X | CH44Y | CH46X | CH46Y | CH48X | CH48Y | CH50X | CH50Y | CH52X | CH52Y | CH54X | CH54Y | CH56X | CH56Y

*RST: CH18X

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "ICAO Channel" on page 136

[:SOURce<hw>]:ILS:LOCalizer:LLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the bottom viewed from the air plane for the ILS localizer modulation signal.

Parameters:

<Frequency> float

Range: 60 to 120
Increment: 0.03
*RST: 90

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Left Frequency" on page 138

[:SOURce<hw>]:ILS:LOCalizer:MODE <Mode>

Sets the operating mode for the ILS localizer modulation signal.

Parameters:

<Mode> NORM | LLOBe | RLOBe

NORM
ILS localizer modulation is active.

LLOBe
Amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS localizer signal is active.

RLOBe
Amplitude modulation of the output signal with the right lobe (150Hz) signal component of the ILS localizer signal is active.

*RST: NORM

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Operating Mode" on page 137

[:SOURce<hw>]:ILS:LOCalizer:PHASe <Phase>

Sets the phase between the modulation signals of the left and right antenna lobe of the ILS localizer signal.

The zero crossing of the right lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the right antenna lobe.

Parameters:

<Phase> float

Range: -60 to 120
Increment: 0.01
*RST: 0

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Left/Right Phase" on page 138

[:SOURce<hw>]:ILS:LOCalizer:PRESet

Sets the parameters of the ILS localizer component to their default values (`*RST` values specified for the commands).

For other ILS preset commands, see `[:SOURce<hw>]:ILS:PRESet` on page 546.

Example: `SOURce1:ILS:LOCalizer:PRESet`

Usage: Event

[:SOURce<hw>]:ILS:LOCalizer:RLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the right viewed from the air plane.

Parameters:

<Frequency> float

Range: 100 to 200
Increment: 0.05
*RST: 150

Example: See Example "Configure and generate an ILS localizer signal" on page 543.

Manual operation: See "Right Frequency" on page 138

[:SOURce<hw>]:ILS:LOCalizer:SDM <Sdm>

Sets the arithmetic sum of the modulation depths of the left lobe (90 Hz) and right lobe (150 Hz) for the ILS localizer signal contents.

The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

Parameters:

<Sdm>	float Range: 0 to 100 Increment: 0.1 *RST: 40
Example:	See Example "Configure and generate an ILS localizer signal" on page 543.
Manual operation:	See "Sum of Depth" on page 139

[:SOURce<hw>]:ILS:LOCalizer:SOURce <IlsLocSource>

Sets the modulation source for the avionic standard modulation.

If external modulation source is set, the external signal is added to the internal signal. Switching off the internal modulation source is not possible.

Parameters:

<IlsLocSource>	INT | INT,EXT | EXT **INT** Internal modulation source is used. **EXT|INT,EXT** An external modulation source is used, additional to the internal modulation source. The external signal is input at the Ext connector.
Example:	See Example "Configure and generate an ILS localizer signal" on page 543.
Manual operation:	See "EXT AM" on page 127

[:SOURce<hw>][:ILS]:MBEacon:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter D, "Morse Code Settings", on page 740.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Parameters:

<Code>	string
Example:	See Example "Configure and generate an ILS marker beacons signal" on page 544.
Manual operation:	See "Code" on page 147

[:SOURce<hw>][:ILS]:MBEacon:COMid:DASH <Dash>

Sets the length of a Morse code dash.

Parameters:

<Dash>	float Range: 0.05 to 1 Increment: 1E-4 *RST: 0.3

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Dash Length" on page 148

[:SOURce<hw>][:ILS]:MBEacon:COMid:DEPTh <Depth>

Sets the AM modulation depth of the COM/ID signal.

Parameters:

<Depth>	float Range: 0 to 100 Increment: 0.1 *RST: 5

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Depth" on page 147

[:SOURce<hw>][:ILS]:MBEacon:COMid:DOT <Dot>

Sets the length of a Morse code dot.

Parameters:

<Dot>	float Range: 0.05 to 1 Increment: 1E-4 *RST: 0.1

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Dot Length" on page 148

[:SOURce<hw>][:ILS]:MBEacon:COMid:FREQuency <Frequency>

Sets the frequency of the COM/ID signal.

Parameters:

<Frequency>	float Range: 0.1 to 20E3 Increment: 0.01 *RST: 1020

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Frequency" on page 147

[:SOURce<hw>][:ILS]:MBEacon:COMid:LETTer <Letter>

Sets the length of a Morse code letter space.

Parameters:

<Letter> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See " Letter Space " on page 148

[:SOURce<hw>][:ILS]:MBEacon:COMid:PERiod <Period>

Sets the period of the COM/ID signal.

Parameters:

<Period> float

Range: 0 to 120
Increment: 1E-3
*RST: 9

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Period" on page 147

[:SOURce<hw>][:ILS]:MBEacon:COMid:SYMBol <Symbol>

Sets the length of the Morse code symbol space.

Parameters:

<Symbol> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See " Symbol Space " on page 148

[:SOURce<hw>][:ILS]:MBEacon:COMid:TSCHema <Tschema>

Sets the time schema of the Morse code for the COM/ID signal.

Parameters:

<Tschema> STD | USER

STD
Activates the standard time schema of the Morse code.
The set `dot length` determines the `dash length`, which is 3 times the dot length.

USER
Activates the user-defined time schema of the Morse code.
Dot and dash length, as well as `symbol` and `letter space` can be set separately.

*RST: STD

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Time Schema" on page 147

[:SOURce<hw>][:ILS]:MBEacon:COMid[:STATe] <State>

Enables/disables the COM/ID signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "COM/ID State" on page 147

[:SOURce<hw>][:ILS]:MBEacon:FREQuency <CarrierFreq>

Sets the carrier frequency for the ILS marker beacon signal.

Parameters:

<CarrierFreq> float

Range: 100E3 to 6E9
Increment: 0.01
*RST: 75E6

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Carrier Frequency" on page 144

[:SOURce<hw>][:ILS]:MBEacon:FREQuency:MODE <Mode>

Sets the carrier frequency mode of the ILS marker beacon signal.

Parameters:

<Mode>	USER | PREDefined	
	*RST:	USER

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Carrier Frequency Mode" on page 144

[:SOURce<hw>][:ILS]:MBEacon:MARKer:FREQuency <Frequency>

Sets the modulation frequency of the marker signal for the ILS marker beacon modulation signal.

Parameters:

<Frequency>	400 | 1300 | 3000	
	*RST:	400
	Default unit:	Hz

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Marker Frequency" on page 145

[:SOURce<hw>][:ILS]:MBEacon[:MARKer]:DEPTh <Depth>

Sets the modulation depth of the marker signal for the ILS marker beacon signal.

Parameters:

<Depth>	float	
	Range:	0 to 100
	Increment:	0.1
	*RST:	95

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Marker Depth" on page 145

[:SOURce<hw>][:ILS]:MBEacon:PRESet

Sets the parameters of the ILS marker beacons component to their default values (`*RST` values specified for the commands).

For other ILS preset commands, see `[:SOURce<hw>]:ILS:PRESet` on page 546.

Example: `SOURce1:ILS:MBEacon:PRESet`

Usage: Event

[:SOURce<hw>][:ILS]:MBEacon[:MARKer]:PULSed <Pulsed>

Activates the modulation of a pulsed marker signal (morse coding).

Parameters:

<Pulsed> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configure and generate an ILS marker beacons signal" on page 544.

Manual operation: See "Pulsed Marker" on page 145

13.16.2.5 SOURce:VOR Subsystem

Option: R&S SMAB-K25

The `SOURce:VOR` subsystem contains all commands for configuring the VOR signal.

Characteristics which are valid for all modulations and the LF output are configured in the SOURce:LFOutput subsystem. The signal is output at the LF connector.

Commands

[:SOURce<hw>]:VOR:SOURce <VorSourceSel>

Sets the modulation source for the avionic standard modulation.

If external modulation source is set, the external signal is added to the internal signal. Switching off the internal modulation source is not possible.

Parameters:

<VorSourceSel> INT | INT,EXT | EXT

INT
Internal modulation source is used.

EXT|INT,EXT
An external modulation source is used, additional to the internal modulation source.
The external signal is input at the Ext connector.

Example: See Example "Configure and generate a VOR signal" on page 544.

[:SOURce<hw>]:VOR[:BANGle] <BAngle>

Sets the bearing angle between the VAR signal and the reference signal.

The orientation of the angle can be set with `[:SOURce<hw>]:VOR[:BANGle]:DIRection`.

Parameters:

<BAngle> float

Range: 0 to 360
Increment: 0.01
*RST: 0

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Bearing Angle" on page 121

[:SOURce<hw>]:VOR[:BANGle]:DIRection <Direction>

Sets the reference position of the phase information.

Parameters:

<Direction> FROM | TO

FROM
The bearing angle is measured between the geographic north and the connection line from beacon to airplane.

TO
The bearing angle is measured between the geographic north and the connection line from airplane to beacon.

*RST: FROM

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Direction" on page 121

[:SOURce<hw>]:VOR:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter D, "Morse Code Settings", on page 740.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Parameters:
<Code> string

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Code" on page 122

[:SOURce<hw>]:VOR:COMid:DASH <Dash>

Sets the length of a Morse code dash.

Parameters:
<Dash> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Dash Length" on page 123

[:SOURce<hw>]:VOR:COMid:DEPTh <Depth>

Sets the AM modulation depth of the COM/ID signal.

Parameters:
<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 10

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Depth" on page 123

[:SOURce<hw>]:VOR:COMid:DOT <Dot>

Sets the length of a Morse code dot.

If the `time schema` is set to standard, the dash length (= 3 times dot length), symbol space (= dot length) and letter space (= 3 times dot length) is also determined by this entry.

Parameters:

<Dot>	float	
	Range:	0.05 to 1
	Increment:	1E-4
	*RST:	0.1

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Dot Length" on page 123

[:SOURce<hw>]:VOR:COMid:FREQuency <Frequency>

Sets the frequency of the COM/ID signal.

Parameters:

<Frequency>	float	
	Range:	0.1 to 20E3
	Increment:	0.01
	*RST:	1020

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Frequency" on page 123

[:SOURce<hw>]:VOR:COMid:LETTer <Letter>

Sets the length of a Morse code letter space.

Parameters:

<Letter>	float	
	Range:	0.05 to 1
	Increment:	1E-4
	*RST:	0.3
	Default unit:	s

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See " Letter Space " on page 124

[:SOURce<hw>]:VOR:COMid:PERiod <Period>

Sets the period of the COM/ID signal.

Parameters:

<Period>	float	
	Range:	0 to 120
	Increment:	1E-3
	*RST:	9

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Period" on page 123

[:SOURce<hw>]:VOR:COMid:SYMBol <Symbol>

Sets the length of the Morse code symbol space.

Parameters:

<Symbol> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See " Symbol Space " on page 124

[:SOURce<hw>]:VOR:COMid:TSCHema <Tschema>

Sets the time schema of the Morse code for the COM/ID signal.

Parameters:

<Tschema> STD | USER

STD
Activates the standard time schema of the Morse code.
The set `dot length` determines the `dash length`, which is 3 times the dot length.

USER
Activates the user-defined time schema of the Morse code.
Dot and dash length, as well as `symbol` and `letter space` can be set separately.

*RST: STD

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Time Schema" on page 123

[:SOURce<hw>]:VOR:COMid[:STATe] <State>

Enables/disables the COM/ID signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "COM/ID State" on page 122

[:SOURce<hw>]:VOR:FREQuency <CarrierFreq>

Sets the carrier frequency of the signal.

Parameters:

<CarrierFreq> float

Range: 100E3 to 6E9
Increment: 0.01
*RST: 108E6

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Carrier Frequency" on page 118

[:SOURce<hw>]:VOR:FREQuency:MODE <Mode>

Sets the mode for the carrier frequency of the signal.

Parameters:

<Mode> USER | ICAO

*RST: USER

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Carrier Frequency Mode" on page 118

[:SOURce<hw>]:VOR:ICAO:CHANnel <Channel>

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

The carrier frequency is set automatically to the value of the ICAO channel. For an overview of the VOR ICAO channel frequencies, see Table 5-1.

Parameters:

<Channel> CH17X | CH17Y | CH19X | CH19Y | CH21X | CH21Y | CH23X | CH23Y | CH25X | CH25Y | CH27X | CH27Y | CH29X | CH29Y | CH31X | CH31Y | CH33X | CH33Y | CH35X | CH35Y | CH37X | CH37Y | CH39X | CH39Y | CH41X | CH41Y | CH43X | CH43Y | CH45X | CH45Y | CH47X | CH47Y | CH49X | CH49Y | CH51X | CH51Y | CH53X | CH53Y | CH55X | CH55Y | CH57X | CH57Y | CH58X | CH58Y | CH59X | CH59Y | CH70X | CH70Y | CH71X | CH71Y | CH72X | CH72Y | CH73X | CH73Y | CH74X | CH74Y | CH75X | CH75Y | CH76X | CH76Y | CH77X | CH77Y | CH78X | CH78Y | CH79X | CH79Y | CH80X | CH80Y | CH81X | CH81Y | CH82X | CH82Y | CH83X | CH83Y | CH84X | CH84Y | CH85X | CH85Y | CH86X | CH86Y | CH87X | CH87Y | CH88X | CH88Y | CH89X | CH89Y | CH90X | CH90Y | CH91X | CH91Y | CH92X | CH92Y | CH93X | CH93Y | CH94X | CH94Y | CH95X | CH95Y | CH96X | CH96Y | CH97X | CH97Y | CH98X | CH98Y | CH99X | CH99Y | CH100X | CH100Y | CH101X | CH101Y | CH102X | CH102Y | CH103X | CH103Y | CH104X | CH104Y | CH105X | CH105Y | CH106X | CH106Y | CH107X | CH107Y | CH108X | CH108Y | CH109X | CH109Y | CH110X | CH110Y | CH111X | CH111Y | CH112X | CH112Y | CH113X | CH113Y | CH114X | CH114Y | CH115X | CH115Y | CH116X | CH116Y | CH117X | CH117Y | CH118X | CH118Y | CH119X | CH119Y | CH120X | CH120Y | CH121X | CH121Y | CH122X | CH122Y | CH123X | CH123Y | CH124X | CH124Y | CH125X | CH125Y | CH126X | CH126Y

*RST: CH17X

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "ICAO Channel" on page 118

[:SOURce<hw>]:VOR:MODE <Mode>

Sets the operating mode for the VOR modulation signal.

Parameters:

<Mode> NORM | VAR | SUBCarrier | FMSubcarrier

NORM
VOR modulation is active.

VAR
Amplitude modulation of the output signal with the variable signal component (30Hz signal content) of the VOR signal.
The modulation depth of the 30 Hz signal can be set with `[:SOURce<hw>]:VOR:VAR[:DEPTh]`.

SUBCarrier
Amplitude modulation of the output signal with the unmodulated FM carrier (9960Hz) of the VOR signal.
The modulation depth of the 30 Hz signal can be set with `[:SOURce<hw>]:VOR:SUBCarrier:DEPTh`.

FMSubcarrier
Amplitude modulation of the output signal with the frequency modulated FM carrier (9960Hz) of the VOR signal.
The modulation depth of the 30 Hz signal can be set with `[:SOURce<hw>]:VOR:SUBCarrier:DEPTh`.
The frequency deviation can be set with `[:SOURce<hw>]:VOR:REFerence[:DEViation]`.

*RST: NORM

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Mode" on page 119

[:SOURce<hw>]:VOR:REFerence[:DEViation] <Deviation>

Sets the frequency deviation of the reference signal on the FM carrier.

Parameters:
<Deviation> integer

Range: 0 to 960
*RST: 480

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "REF Deviation" on page 120

[:SOURce<hw>]:VOR:SUBCarrier:DEPTh <Depth>

Sets the AM modulation depth of the FM carrier.

Parameters:
<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 30

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See " Subcarrier Depth " on page 120

[:SOURce<hw>]:VOR:SUBCarrier[:FREQuency] <Frequency>

Sets the frequency of the FM carrier.

Parameters:

<Frequency>	float Range: 5E3 to 15E3 Increment: 0.01 *RST: 9.96E3

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "Subcarrier Frequency" on page 120

[:SOURce<hw>]:VOR:VAR:FREQuency <Frequency>

Sets the frequency of the variable and the reference signal. As the two signals must have the same frequency, the setting is valid for both signals.

Parameters:

<Frequency>	float Range: 10 to 60 Increment: 0.01 *RST: 30

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "VAR/REF Frequency" on page 120

[:SOURce<hw>]:VOR:VAR[:DEPTh] <Depth>

Sets the AM modulation depth of the 30Hz variable signal.

Parameters:

<Depth>	float Range: 0 to 100 Increment: 0.1 *RST: 30

Example: See Example "Configure and generate a VOR signal" on page 544.

Manual operation: See "VAR Depth" on page 120

13.16.3 SOURce:CORRection Subsystem

The `SOURce:CORRection` subsystem contains the commands for defining correction values for external test assemblies.

You can acquire the correction values any time, regardless of the modulation settings of the generator. The correction is performed by adding the correction values to the output level of the respective RF frequency.

Determine the correction values in one of the following ways:

- Measure the RF output level at several frequency points and enter the value pairs manually in a table
- Connect an R&S NRP to the generator output signal and send the command `[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` to fill the table automatically.

Correction values can be stored in files with the predefined file extension `*.uco`.

Refer to Chapter 13.5.2, "Accessing Files in the Default or in a Specified Directory", on page 414 for general information on file handling in the default and in a specific directory.

Programming example

The examples in this section assume that:

- The files are stored in the default directory.
- `*RST` does not affect data lists.

Example: Create a table with user-defined correction values for the RF level

The following example shows a command sequence to create and activate a list for assigning level correction values to arbitrary RF frequencies. Further hardware settings are not considered.

```
// Reset the instrument to start from an initial state
// Query the available user correction list files in the default directory
// Select a file or create a new one
// ******************************************************************
*RST; *CLS
SOURce1:CORRection:CSET:CATalog?
// Response: shows the name of available user correction files (if applicable)
// Select a file
SOURce1:CORRection:CSET:SELect "/var/user/ucor1"
// Create a new file (if not existing)
SOURce1:CORRection:CSET:SELect "/var/user/ucor2"

// Enter the frequency/level value pairs in the table;
// existing data is overwritten
// Query the number of frequency/power entries in the selected list
SOURce1:CORRection:CSET:DATA:FREQuency 100MHz,110MHz,120MHz,130MHz,140MHz,150MHz
SOURce1:CORRection:CSET:DATA:POWer -10,-7.5,-5.0,-2.5,0,2.5
SOURce1:CORRection:CSET:DATA:FREQuency:POINts?
// 6
SOURce1:CORRection:CSET:DATA:POWer:POINTs?
// 6

// Enable user correction mode and RF output
SOURce1:CORRection:STATe 1
OUTPut1:STATe ON
```

```
// Query the currently used correction value
SOURce1:CORRection:VALue?
// -2.5

// Delete a user correction file
SOURce1:CORRection:CSET:DELEte "/var/user/ucor1.uco"
```

Example: Fill user correction data with sensor

The following example shows a command sequence to fill a user correction list automatically supported by a connected R&S NRP.

```
// Fill a user correction list with the level values
// measured by an R&S NRP,
// store the data in a file and enable user correction.

*RST; *CLS

SOURce1:CORRection:CSET:SELect "/var/user/Ucor1_AutoFill.uco"
SOURce1:CORRection:CSET:DATA:FREQuency 100MHz,110MHz,120MHz,130MHz,140MHz,150MHz
SOURce1:CORRection:ZERoing:STATe 1
SOURce1:CORRection:CSET:DATA:SENSor1:POWer:SONCe
// Query the number of automatically filled correction level values
SOURce1:CORRection:CSET:DATA:POWer:POINTs?
// 6
SOURce1:CORRection:STATe 1

// Query the correction value at a certain frequency
FREQ 120000000
SOURce1:CORRection:VALue?
// -52.13
```

Example: User correction data exchange

The following example shows a command sequence to export a user correction list (here the list created with the example before) into an ASCII file. Further hardware settings are not considered.

```
// Select a user correction file for exporting to file in ASCII format
// Set ASCII data parameters
// Set the ASCII file extension, the decimal separator
// and the column separator for the ASCII data
SOURce1:CORRection:DEXChange:AFILe:CATalog?
// my_ucor
SOURce1:CORRection:CSET:CATalog?
// ucor1,Ucor1_AutoFill
SOURce1:CORRection:CSET:SELect "/var/user/Ucor1_AutoFill.uco"
SOURce1:CORRection:DEXChange:AFILe:EXTension CSV
SOURce1:CORRection:DEXChange:AFILe:SEParator:DECimal DOT
SOURce1:CORRection:DEXChange:AFILe:SEParator:COLumn COMMa
```

```
// Select source and destination
SOURce1:CORRection:DEXChange:AFILe:SELect "/var/user/ucor2ASCII"

// Export the user correction data into the ASCII file
SOURce1:CORRection:DEXChange:MODE EXPort
SOURce1:CORRection:DEXChange:EXECute

// Query the available ASCII files with extension .csv
SOURce1:CORRection:DEXChange:AFILe:CATalog?
// ucor2ASCII,my_ucor

// Import a user correction ASCII file
SOURce1:CORRection:DEXChange:MODE IMPort
SOURce1:CORRection:DEXChange:AFILE:SELect "/var/user/my_ucor"
SOURce1:CORRection:DEXChange:EXECute
```


13.16.3.1 Correction Settings

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency <Frequency>

Enters the frequency value in the table selected with `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

Parameters:

<Frequency> Frequency#1[, Frequency#2, ...]

String of values with default unit Hz.

Example: See Example "Create a table with user-defined correction values for the RF level" on page 583 .

Manual operation: See "Edit List Mode Data" on page 190

[:SOURce<hw>]:CORRection:CSET:DATA:POWer <Power>

Enters the level values to the table selected with `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

Parameters:

<Power> Power#1[, Power#2, ...]

String of values with default unit dB.
*RST: 0

Example: See Example "Create a table with user-defined correction values for the RF level" on page 583 .

Manual operation: See "Edit List Mode Data" on page 190

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts?
[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts?

Queries the number of frequency/level values in the selected table.

Return values:

<Points> integer

Range: 0 to 10000
*RST: 0

Example: See Example "Create a table with user-defined correction values for the RF level" on page 583 .

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

Fills the selected user correction table with the level values measured by the power sensor for the given frequencies.

To select the used power sensor set the suffix in key word `SENSe`.

Example: See Example "Fill user correction data with sensor" on page 584.

Usage: Event

Manual operation: See " Fill User Correction Data with Sensor" on page 207

[:SOURce<hw>]:CORRection:CSET[:SELect] <Filename>

Selects or creates a file for the user correction data.

If the file with the selected name does not exist, a new file is created.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted.

Example: See Example "Create a table with user-defined correction values for the RF level" on page 583 .

Manual operation: See "UCOR Data" on page 203

[:SOURce<hw>]:CORRection:VALue?

Queries the current value for user correction.

Return values:

<Value> float

Range: -100 to 100
Increment: 0.01
*RST: 0

Example: See Example "Create a table with user-defined correction values for the RF level" on page 583 .

Usage: Query only

Manual operation: See "User Correction" on page 202

[:SOURce<hw>]:CORRection:ZERoing:STATe <State>

Activates the zeroing procedure before filling the user correction data acquired by a sensor.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Fill user correction data with sensor" on page 584.

Manual operation: See " Fill User Correction Data with Sensor" on page 207

[: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 "Fill user correction data with sensor" on page 584.

Usage: Event

[:SOURce<hw>]:CORRection[:STATe] <State>

Activates user correction with the currently selected table.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Create a table with user-defined correction values for the RF level" on page 583 .

Manual operation: See "State" on page 202

[:SOURce]:CORRection:CSET:CATalog?

Queries a list of available user correction tables.

Return values:

<Catalog> string

List of list filenames, separated by commas

Example: See Example "Create a table with user-defined correction values for the RF level" on page 583 .

Usage: Query only

Manual operation: See "UCOR Data" on page 203

[:SOURce]:CORRection:CSET:DELete <Filename>

Deletes the specified user correction list file.

Setting parameters:

<Filename> string

Filename or complete file path; file extension is optional.

Example: See Example "Create a table with user-defined correction values for the RF level" on page 583 .

Usage: Setting only

Manual operation: See "UCOR Data" on page 203

13.16.3.2 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 "Create a table with user-defined correction values for the RF level" on page 583 .

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 94

[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension <Extension>

Determines the extension of the ASCII files for file import or export, or to query existing files.

Parameters:

<Extension> TXT | CSV

*RST: TXT

Example: See Example "User correction data exchange" on page 584 .

Manual operation: See "ASCII File Settings" on page 94

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect <Filename>

Selects the ASCII file to be imported or exported.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted.

Example: See Example "User correction data exchange" on page 584 .

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 94

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn <Column>

Selects the separator between the frequency and level column of the ASCII table.

Parameters:

<Column> TABulator | SEMicolon | COMMa | SPACe

*RST: COMMa

Example: See Example "User correction data exchange" on page 584 .

Manual operation: See "ASCII File Settings" on page 94

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal <Decimal>

Sets the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Parameters:

<Decimal> DOT | COMMa

*RST: DOT

Example: See Example "User correction data exchange" on page 584 .

Manual operation: See "ASCII File Settings" on page 94

[:SOURce<hw>]:CORRection:DEXChange:EXECute

Executes the import or export of the selected correction list, according to the previously set transfer direction with command `[:SOURce<hw>]:CORRection:DEXChange:MODE`.

Example: See Example "User correction data exchange" on page 584 .

Usage: Event

Manual operation: See "Import / Export" on page 95

[:SOURce<hw>]:CORRection:DEXChange:MODE <Mode>

Determines import or export of a user correction list.

Specify the source or destination file with the command `[:SOURce<hw>]:CORRection:DEXChange:SELect`.

Parameters:

<Mode> IMPort | EXPort

*RST: IMPort

Example: See Example "User correction data exchange" on page 584 .

Manual operation: See " Mode " on page 94

[:SOURce<hw>]:CORRection:DEXChange:SELect <Filename>

Selects the ASCII file for import or export, containing a user correction list.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted.

Example: See Example "User correction data exchange" on page 584 .

Manual operation: See "Select Source/Select ASCII Destination" on page 95

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: Frequency configuration

```
SOURce1:FREQuency:MODE CW
SOURce1:FREQuency:CW 6000000000
SOURce1:FREQuency:OFFSet 2000000000
SOURce1:FREQuency:MULTiplier 1.5
SOURce1:FREQuency:CW?
// 11000000000

// SOURce1:FREQuency:STEP:MODE USER
// SOURce1:FREQuency:STEP:INCRement 1000000
// SOURce1:FREQuency:CW UP

SOURce1:PHASe 2
SOURce1:PHASe:REFerence
```

Example: Setting a phase continuous frequency range

```
SOURce1:FREQuency:CW 502000000
SOURce1:FREQuency:PHASE:MODE NARR
SOURce1:FREQuency:PHASe:CONTinuous:STATe 1
******************************************
// Query the frequency range
SOURce1:FREQuency:PHASe:CONTinuous:LOW?
// Response:  494062500
SOURce1:FREQuency:PHASe:CONTinuous:HIGh?
// Response:  503750000
******************************************
// Vary the frequency. Within the specified range the signal is phase continuous.
SOURce1:FREQuency:CW 49900000
SOURce1:FREQuency:CW 50000000
SOURce1:FREQuency:CW 501000000
SOURce1:FREQuency:CW 503000000
```

[:SOURce<hw>]:FREQuency:MODE <Mode>

Sets the frequency mode for generating the RF output signal. The selected mode determines the parameters to be used for further frequency settings.

Parameters:

<Mode> CW | FIXed | SWEep | LIST

CW|FIXed
Sets the fixed frequency mode. `CW` and `FIXed` are synonyms.
The instrument operates at a defined frequency, set with command `[:SOURce<hw>]:FREQuency[:CW|FIXed]`.

SWEep
Sets sweep mode.
The instrument processes frequency (and level) settings in defined sweep steps.
Set the range and current frequency with the commands:
`[:SOURce<hw>]:FREQuency:STARt` on page 595 and `[:SOURce<hw>]:FREQuency:STOP` on page 595,
`[:SOURce<hw>]:FREQuency:CENTer` on page 594,
`[:SOURce<hw>]:FREQuency:SPAN` on page 595,
`[:SOURce<hw>]:FREQuency:MANual` on page 593

LIST
Sets list mode.
The instrument processes frequency and level settings by means of values loaded from a list.
To configure list mode settings, use the commands of the Chapter 13.16.7, "SOURce:LIST Subsystem", on page 612.

*RST: CW

Example: See Example "Frequency configuration" on page 590

Example: See Example "Setup an RF frequency or power sweep" on page 643

Manual operation: See "State (RF frequency sweep)" on page 171

[:SOURce<hw>]:FREQuency[:CW|FIXed] <Fixed>

Sets the frequency of the RF output signal in the selected path.

The effect depends on the selected mode:

- In CW mode (`FREQ:MODE CW | FIXed`), the instrument operates at a fixed frequency.
- In sweep mode (`FREQ:MODE SWE`), the value applies to the sweep frequency. The instrument processes the frequency settings in defined sweep steps.
- In user mode (`FREQ:STEP:MODE USER`), you can vary the current frequency step by step.

Parameters:

<Fixed> float

The following settings influence the value range:
An offset set with the command `[:SOURce<hw>]:FREQuency:OFFSet`

Numerical value
Sets the frequency in CW and sweep mode

UP|DOWN
Varies the frequency step by step in user mode.
The frequency is increased or decreased by the value set with the command `[:SOURce<hw>]:FREQuency:STEP[:INCRement]`.

Range: (RFmin + OFFSet) to (RFmax + OFFSet)
*RST: 100 MHz

Example: See Example "Frequency configuration" on page 590

Example: See Example "Setup an RF frequency or power sweep" on page 643

Options: RFmax depends on the installed options, for example 3 GHz with R&S SMAB-B103

Manual operation: See "Frequency" on page 65

[: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 293

[:SOURce<hw>]:FREQuency:MANual <Manual>

Sets the frequency and triggers a sweep step manually if `SWEep:MODE MAN`.

Parameters:

<Manual> float

You can select any frequency within the setting range, where:
`STARt` is set with `[:SOURce<hw>]:FREQuency:STARt`
`STOP` is set with `[:SOURce<hw>]:FREQuency:STOP`
`OFFSet` is set with `[:SOURce<hw>]:FREQuency:OFFSet`

Range: (STARt + OFFSet) to (STOP + OFFSet)
Increment: 0.01Hz
*RST: 100 MHz
Default unit: Hz

Example: See Example "Setup an RF frequency or power sweep" on page 643

Manual operation: See " Current Frequency" on page 172

[: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 63.

Parameters:

<Multiplier> float

Range: 1 to dynamic
Increment: 0.001
*RST: 1

Example: See Example "Frequency configuration" on page 590

Manual operation: See "Multiplier" on page 65

[: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 63.

Note: The offset also affects RF frequency sweep.

Parameters:

<Offset> float

Increment: 0.01
*RST: 0

Example: See Example "Frequency configuration" on page 590

Manual operation: See "Offset" on page 65

[:SOURce<hw>]:FREQuency:CENTer <Center>

Sets the center frequency of the sweep.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Parameters:

<Center>	float Range: 300 kHz to RFmax Increment: 0.01 Hz *RST: 300E6 Default unit: Hz

Example: See Example "Setup an RF frequency or power sweep" on page 643

Manual operation: See " Center Frequency " on page 176

[:SOURce<hw>]:FREQuency:SPAN <Span>

Sets the sapn of the frequency sweep range.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Parameters:

<Span>	float Full freqeuncy range Increment: 0.01 *RST: 400E6

Example: See Example "Setup an RF frequency or power sweep" on page 643

Manual operation: See "Span" on page 176

[:SOURce<hw>]:FREQuency:STARt <Start>

Sets the start frequency for the RF sweep.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Parameters:

<Start>	float Range: 300kHz to RFmax Increment: 0.01Hz *RST: 100 MHz

Example: See Example "Setup an RF frequency or power sweep" on page 643

Manual operation: See " Start Frequency/Stop Frequency " on page 176

[:SOURce<hw>]:FREQuency:STOP <Stop>

Sets the stop frequency range for the RF sweep.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Parameters:

<Stop> float

Range: 300kHz to RFmax
Increment: 0.01Hz
*RST: 500 MHz
Default unit: Hz

Example: See Example "Setup an RF frequency or power sweep" on page 643

Manual operation: See " Start Frequency/Stop Frequency " on page 176

[:SOURce<hw>]:FREQuency:STEP:MODE <Mode>

Defines the type of step size to vary the RF frequency at discrete steps with the commands `FREQ UP or FREQ DOWN`.

Parameters:

<Mode> DECimal | USER

DECimal
Increases or decreases the level in steps of ten.

USER
Increases or decreases the level in increments, set with the command `FREQ:STEP[:INCR]`.

*RST: DECimal

Example:

```
// increasing the RF frequency with a step size of 50 KHz
SOURce1:FREQuency:STEP 50E3
SOURce1:FREQuency:STEP:MODE USER
SOURce1:FREQuency:CW UP
```

Manual operation: See "Variation Active" on page 66

[:SOURce<hw>]:FREQuency:STEP[:INCRement] <Increment>

Sets the step width.

You can use this value to vary the RF frequency with command `FREQ UP or FREQ DOWN`, if you have activated `FREQ:STEP:MODE USER`.

Note: This value also applies to the step width of the rotary knob on the instrument and, in user-defined step mode, increases or decreases the frequency.

Parameters:

<Increment> float

Range: 0 Hz to RFmax - 100 kHz
Increment: 0.01 Hz
*RST: 1E6

Example: See Example "Frequency configuration" on page 590

Manual operation: See "Variation Step" on page 66

[:SOURce<hw>]:FREQuency:PLL:MODE <Mode>

Selects the PLL (Phase Locked Loop) bandwidth of the main synthesizer.

Parameters:

<Mode> NORMal | NARRow

NORMal
Maximum modulation bandwidth and FM/PhiM deviation.

NARRow
Narrow PLL bandwidth

*RST: NORMal

Example: `SOURce:FREQuency:PLL:MODE NORMal`

Manual operation: See "Main PLL Bandwidth" on page 65

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:HIGH?
[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW?

Queries the minimum frequency of the frequency range for phase continuous settings.

The minimum frequency of the frequency range depends on the mode selected with the command `[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:MODE`.

Return values:

<Low> float

Range: 1E5 to 6E9
Increment: 0.01
*RST: 1E9
Default unit: Hz

Example:

```
SOURce:FREQuency:PHASe:CONTinuous:MODE NARR
SOURce:FREQuency:PHASe:CONTinuous:STATe 1
SOURce:FREQuency:PHASe:CONTinuous:LOW?
998 720 930.20
```

Usage: Query only

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:MODE <Mode>

Selects the mode that determines the frequency range for the phase continuity.

To query the frequency range, use the commands `[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:HIGH?` and `[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW?`

Parameters:

<Mode> NARRow | WIDE

NARRow
Small frequency range, asymmetrically around the RF frequency.

WIDE
Large frequency range, symmetrically around the RF frequency.

*RST: NARRow

Example: See [:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW? on page 597

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:STATe <State>

Activates phase continuity of the RF frequency.

The frequency range is limited and varies depending on the set RF frequency. You can query the range with the commands [:SOURce<hw>]:FREQuency:PHASe:CONTinuous:HIGH? on page 597 and [:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW? on page 597.

Note: Restricted structure of command line.

In phase continuous mode, the R&S SMA100B only processes the first command of a command line and ignores further commands if they are on the same line.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See [:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW? on page 597

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<ch> <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.
For active external exponential AM, automatically sets [:SOURce<hw>]:INPut:MODext:COUPling<ch>DC.

*RST: AC

Example: `INP:MOD:COUP AC`
Selects the coupling mode AC for an externally applied modulation signal.

Manual operation: See "Coupling (AC/DC)" on page 102

[: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<ch> on page 598.

Manual operation: See "Impedance" on page 102

[: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 175

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: Setup an LF sweep

The following example shows a command sequence to set up an LF sweep.

```
// Reset the instrument to start from an initial state
*RST; *CLS

// Set the trigger mode, the sweep mode and the sweep range
TRIGger1:LFFSweep:SOURce SINGle
```

```
SOURce1:LFOutput1:SWEep:FREQuency:MODE AUTO
SOURce1:LFOutput1:FREQuency:STARt 1 kHz
SOURce1:LFOutput1:FREQuency:STOP 7 kHz

// Select linear spacing
// Select the waveform shape for the frequency sweep cycle
// Set the step width and the dwell time.
SOURce1:LFOutput1:SWEep:FREQuency:SPACing LINear
SOURce1:LFOutput1:SWEep:FREQuency:SHAPe SAWtooth
SOURce1:LFOutput1:SWEep:FREQuency:STEP:LINear 100 Hz
SOURce1:LFOutput1:SWEep:FREQuency:DWELl 150 ms
// Alternatively to the step width set the number of steps
SOURce1:LFOutput1:SWEep:FREQuency:POINts 61

// Activate change to start frequency while waiting for next trigger
// Prerequisites: sweep mode single and sweep waveform sawtooth
SOURce1:LFOutput:SWEep:FREQuency:RETRace 1

// Activate the LF frequency sweep
SOURce1:LFOutput:FREQuency:MODE SWE

// Trigger the sweep(depending on the set mode) and query the status
// Perform a one-off LF sweep
SOURce1:LFOutput1:SWEep:FREQuency:EXECute
SOURce1:LFOutput1:SWEep:FREQuency:RUNNing?
// 1
// the sweep is running

// ***************************************************
// For manual step LF sweep use the following commands
*RST; *CLS
SOURce1:LFOutput:SWEep:FREQuency:MODE MANual
// Activate the LF frequency sweep
SOURce1:LFOutput:FREQuency:MODE SWEep
// Activate LF Output1.
SOURce1:LFOutput1:STATe 1
// Input the frequency manually for each step
SOURce1:LFOutput1:FREQuency:MANual 2 kHz
SOURce1:LFOutput1:FREQuency:MANual 2.1 kHz
// Alternatively use UP or DOWN parameter with set step width.
SOURce1:LFOutput1:SWEep:FREQuency:STEP:LINear 500 Hz
SOURce1:LFOutput1:FREQuency:MANual UP
```

Example: Configuring the LF generator

The following is a simple example on how to configure the LF generator and output the generated signal.

```
// configure the signal of the LF1 generator
SOURce1:LFOutput1:SHAPe SQU
SOURce1:LFOutput1:SHAPe:PULSe:PERiod 0.001
```

```
SOURce1:LFOutput1:SHAPe:PULSe:WIDTh 0.0005
SOURce1:LFOutput1:SHAPe:PULSe:DCYCle 0.5
// configure the signal of the LF1 generator
SOURce1:LFOutput2:SHAPe SINE
SOURce1:LFOutput2:FREQuency 1000000
SOURce1:LFOutput2:PERiod?
// 0.000001

// changing the LF signal shape
// SOURce1:LFOutput2:SHAPe TRAP
// SOURce1:LFOutput2:SHAPe:PULSe:PERiod 0.2
// SOURce1:LFOutput2:SHAPe:TRAPeze:RISE 0.0001
// SOURce1:LFOutput2:SHAPe:TRAPeze:FALL 0.001
// SOURce1:LFOutput2:SHAPe:TRAPeze:FALL 0.0001
// SOURce1:LFOutput2:SHAPe:TRAPeze:HIGH 0.0005
// SOURce1:LFOutput2:SHAPe TRI
// SOURce1:LFOutput2:SHAPe:PULSe:PERiod 0.1
// SOURce1:LFOutput2:SHAPe:TRIangle:RISE 0.0001

// activate the LF output and select the LF1 as signal source
// configure the LF output signal
SOURce1:LFOutput1:FREQuency:MODE CW
SOURce1:LFOutput1:STATe 1
SOURce1:LFOutput1:SOURce LF1
SOURce1:LFOutput1:INTernal:VOLTage 1
SOURce1:LFOutput1:OFFSet 0.001
```


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?

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 103

[:SOURce]:LFOutput<ch>:FREQuency <Frequency>

Sets the frequency of the LF signal in `[:SOURce<hw>]:LFOutput:FREQuency:MODE` `CW|FIXed` mode.

Note

- If signal source "Internal" is set, the instrument performs the analog modulations (AM/FM/PhiM/PM) with this frequency.
- In sweep mode (`[:SOURce<hw>]:LFOutput:FREQuency:MODE` `SWE`), the frequency is coupled with the sweep frequency.

Parameters:

<Frequency> float

Range: depends on the installed options
*RST: 1000
Default unit: Hz

Example:

```
SOURce1:LFOutput1:FREQuency 5 kHz
// sets the LF frequency
```

Manual operation: See "Frequency" on page 100

[: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 600.

Usage: Query only

[:SOURce<hw>]:LFOutput:FREQuency:MANual <Manual>

Sets the frequency of the subsequent sweep step if `LFO:SWE:MODE MAN`.

Use a separate command for each sweep step.

Parameters:

<Manual> float

You can select any value within the setting range, where:
`STARt` is set with `[:SOURce<hw>]:LFOutput:FREQuency:STARt`
`STOP` is set with `[:SOURce<hw>]:LFOutput:FREQuency:STOP`

Range: STARt to STOP
Increment: 0.1
*RST: 1000

Example: See Example "Setup an LF sweep" on page 599.

Manual operation: See " Current Frequency" on page 172

[:SOURce<hw>]:LFOutput:FREQuency:MODE <Mode>

Sets the mode for the output of the LF generator frequency, and determines the commands to be used for frequency settings.

Parameters:

<Mode> CW | FIXed | SWEep

CW|FIXed
Sets the fixed-frequency mode. `CW` and `FIXed` are synonyms.
To set the output frequency, use command `[:SOURce]:LFOutput<ch>:FREQuency`

SWEep
Sets sweep mode.
To set the frequency, use the commands:
`[:SOURce<hw>]:LFOutput:FREQuency:STARt` and `[:SOURce<hw>]:LFOutput:FREQuency:STOP`
Or `[:SOURce<hw>]:LFOutput:FREQuency:MANual`

*RST: CW

Example: See Example "Setup an LF sweep" on page 599.

Manual operation: See "State (LF frequency sweep)" on page 99

[:SOURce<hw>]:LFOutput:FREQuency:STOP <Stop>
[:SOURce<hw>]:LFOutput:FREQuency:STARt <Start>

Sets the start/stop frequency for `[:SOURce<hw>]:LFOutput:FREQuency:MODE SWEep`.

Parameters:

<Start> float

Range: 0.1 Hz to 1 MHz
Increment: 0.1
*RST: 1 KHz

<Stop> float

Range: 0.1 Hz to 1 MHz
Increment: 0.1 Hz
*RST: 100 KHz

Example: See Example "Setup an LF sweep" on page 599.

Manual operation: See " Start Frequency/Stop Frequency " on page 176

[:SOURce]:LFOutput<ch>[:STATe] <State>

Activates LF signal output.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configuring the LF generator" on page 600.

Manual operation: See "State" on page 104

[: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 600.

Manual operation: See "Output Voltage" on page 105

[: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 600.

Manual operation: See "DC-Offset" on page 105

[:SOURce]:LFOutput<ch>:SOURce <Source>

Determines the LF signal to be synchronized, when monitoring is enabled.

Parameters:

<Source> LF1 | LF2 | NOISe | AM | FMPM | EXT1 | | EXT2

LF1|LF2
Selects an internally generated LF signal.

NOISe
Selects an internally generated noise signal.

EXT1|EXT2
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 600.

Manual operation: See "Source" on page 105

[:SOURce]:LFOutput<ch>:SOURce:PATH <SourPath>

Determines the path of the LF output source.

Parameters:

<SourPath> A | B

*RST: A

Example: `LFO:SOUR:PATH?`
Queries the currently set path for the LF output signal source.

[:SOURce]:LFOutput:VOLTage <Voltage>

Sets the voltage of the LF output.

Parameters:

<Voltage> float

Range: dynamic (see data sheet)
Increment: 0.001
*RST: 1

Example: `SOURce:LFOutput:VOLTage 1.5`

[:SOURce<hw>]:LFOutput<ch>:SHAPe <Shape>

Selects the waveform shape of the LF signal.

Parameters:

<Shape> SINE | SQUare | TRIangle | TRAPeze

*RST: SINE

Example: See Example "Configuring the LF generator" on page 600.

Options: TRIangle|TRAPeze require R&S SMAB-K24

Manual operation: See "Shape" on page 99

[: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 600.

Manual operation: See "Pulse Duty Cycle" on page 101

[: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 600.

Manual operation: See "Period" on page 101

[: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 600.

Manual operation: See "Pulse Width" on page 101

[: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 600.

Manual operation: See "Trapezoid Rise / Fall" on page 101

[: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 600.

Manual operation: See "Trapezoid High" on page 101

[: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 600.

Manual operation: See "Period" on page 101

[: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 600.

Manual operation: See "Trapezoid Rise / Fall" on page 101

[: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 600.

Manual operation: See "Period" on page 101

[: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 600.

Manual operation: See "Triangle Rise" on page 101

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 <Dwell>

Sets the dwell time for each frequency step of the sweep.

Parameters:

<Dwell> float

Range: 5E-4 to 100
Increment: 100E-6
*RST: 10E-3
Default unit: s

Example: See Example "Setup an LF sweep" on page 599.

Manual operation: See " Dwell Time " on page 174

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute

Immediately starts an LF sweep.

`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE` determines which sweep is executed, e.g. `SOURce:LFOutput:SWEep:FREQuency:MODE STEP`.

Example: See Example "Setup an LF sweep" on page 599.

Usage: Event

Manual operation: See " Execute Single Sweep " on page 175

[: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 603.

STEP
Each trigger command triggers one sweep step only.
The frequency increases by the value set with the coammnds:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear]` (linear spacing)
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic`(logarithmic spacing)

*RST: AUTO

Example: See Example "Setup an LF sweep" on page 599.

Manual operation: See "Mode" on page 172

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:POINts <Points>

Sets the number of steps in an LF sweep.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164

Parameters:

<Points> integer

Range: 2 to POINts
*RST: 50

Example: See Example "Setup an LF sweep" on page 599.

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace <State>

Activates that the signal changes to the start frequency value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single".

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "Retrace" on page 173

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RUNNing?

Queries the current status of the LF frequency sweep mode.

Return values:

<State>	0 | 1 | OFF | ON
Example:	See Example "Setup an LF sweep" on page 599.
Usage:	Query only

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe <Shape>

Sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape>	SAWTooth | TRIangle *RST: SAWTooth
Example:	See Example "Setup an LF sweep" on page 599.
Manual operation:	See " Shape" on page 173

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing <Spacing>

Selects linear or logarithmic sweep spacing.

Parameters:

<Spacing>	LINear | LOGarithmic *RST: LINear
Example:	See Example "Setup an LF sweep" on page 599.
Manual operation:	See " Spacing" on page 174

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

Sets the step width factor for logarithmic sweeps to calculate the frequencies of the steps.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164

Parameters:

<Logarithmic>	float The unit is mandatory Range: 0.01 to 100 Increment: 0.01 *RST: 1 Default unit: PCT
Example:	See Example "Setup an LF sweep" on page 599.

Manual operation: See " Step Linear/Step Logarithmic " on page 177

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step width for the linear sweep.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164

Parameters:

<Linear> float

Range: 0.1 to STOP-STARt
Increment: 0.1
*RST: 1000

Example: See Example "Setup an LF sweep" on page 599.

Manual operation: See " Step Linear/Step Logarithmic " on page 177

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 Chapter 13.5.2, "Accessing Files in the Default or in a Specified Directory", on page 414 for general information on file handling in the default and in a specific directory.

- `*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
SOUR1:LIST:CAT?
// Response:- shows the name of available list files (if applicable)
SOUR1:LIST:SEL "/var/user/list1.lsw"

// Write the frequency/level/dwell time values in the selected list file
// existing data is overwritten
// Query the number of frequency/power/dwell time entries in the selected list
```

```
// Query the amount of free memory (in bytes) for list mode lists
SOUR1:LIST:FREQ 58 MHz, 61 MHz, 73 MHz, 86 MHz, 91 MHz, 92 MHz, 98 MHz
SOUR1:LIST:POW 13 dBm, 12 dBm, 5 dBm, 3 dBm, 0 dBm, 4 dBm, 6 dBm
SOUR1:LIST:DWEL:LIST 10000, 100000, 200000, 19000, 10000, 150000, 220000
SOUR1:LIST:FREQ:POIN?
// 7
SOUR1:LIST:POW:POINT?
// 7
SOUR1:LIST:DWEL:LIST:POIN?
// 7
SOUR1:LIST:FREE?
// 2147483647 (bytes of free memory)

// Use dwell times from list
// Configure the list mode parameters
// Enable RF output
SOUR1:LIST:MODE AUTO
SOUR1:LIST:TRIG:SOUR AUTO
SOUR1:LIST:DWEL:MODE "LIST"

OUTP1:STAT ON

// Use global dwell time
// Set only a part of the list (value pairs 3 to 5) to be processed
// Configure the list mode parameters using global dwell time
// Enable RF output
SOUR1:LIST:IND:START 2
SOUR1:LIST:IND:STOP 4
SOUR1:LIST:MODE AUTO
SOUR1:LIST:TRIG:SOUR AUTO
SOUR1:LIST:DWEL:LIST 500 ms
OUTP1:STAT ON

// Enable the list mode
// Trigger the list (depending on the mode, not needed with trigger
// mode AUTO); query the current index
// Reset the list to the starting point
SOUR1:FREQ:MODE LIST
SOUR1:LIST:TRIG:EXEC
SOUR1:LIST:RUNN?
SOUR1:LIST:IND?
// 3
// value changes when the value is queried again
SOUR1:LIST:RES

// For list mode STEP use the following commands
*RST; *CLS
// Change list mode to STEP
SOUR1:LIST:MODE STEP
// Activate RF Output1
OUTP1:STAT 1
```

```
// Activate the list mode
SOUR1:FREQ:MODE LIST
// For each step: select frequency/powerlevel pair as index from the list
SOUR1:LIST:IND 2
SOUR1:LIST:IND 3
SOUR1:LIST:IND 4

// Use the selected list for path B (with List Mode B default settings)
SOUR2:LIST:SEL "/var/user/list1.lsw"
OUTP2:STAT ON
SOUR2:FREQ:MODE LIST
SOUR2:LIST:IND?
// 2
// value canges when the value is queried again

// Deactivate the list mode
SOUR1:FREQ:MODE CW
```

Example: List mode data exchange

The following example shows a command sequence to export a list (here the RF list created with the example before) into an ASCII file. Further hardware settings are not considered.

```
*RST; *CLS
LIST:DEXC:MODE EXP

// Set ASCII data parameters
// Set the ASCII file extension, the decimal separator
// and the column separator for the ASCII data
SOUR1:LIST:DEXC:AFIL:EXT CSV
SOUR1:LIST:DEXC:AFIL:SEP:DEC DOT
SOUR1:LIST:DEXC:AFIL:SEP:COL COMM

// Select source and destination path/directory
// Query available listfiles in default directory "/var/user"
SOUR1:LIST:CAT?
// list1
SOUR1:LIST:DEXC:AFIL:SEL "/var/user/list1ASCII"
SOUR1:LIST:DEXC:SEL "/var/user/list1"

// Export the list file data into the ASCII file
SOUR1:LIST:DEXC:EXEC

// Query the available ASCII files with extension .csv
SOUR1:LIST:DEXC:AFIL:CAT?
// Response: "list1ASCII"

// Deactivate the list mode
SOUR1:FREQ:MODE CW
```

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 <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 612.

Manual operation: See "Global Dwell Time" on page 184

[: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 612.

Manual operation: See "Dwell Time Mode" on page 184

[: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 438 for more details.

Example: See Example "Create an RF list and activate the list mode" on page 612.

Manual operation: See "Edit List Mode Data" on page 190

[:SOURce<hw>]:LIST:DWELl:LIST:POINts?

Queries the number (points) of dwell time entries in the selected list.

Return values:

<Points> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 612.

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 612.

Manual operation: See "Edit List Mode Data" on page 190

[: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 612.

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 612.

Manual operation: See " Current Index " on page 183

[: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:

<Start>/<Stop> integer

Index range
Only values inside this range are processed in list mode

Range: 0 to list length
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 612.

Manual operation: See " List Range from/to " on page 186

[:SOURce<hw>]:LIST:MODE <Mode>

Sets the list mode.

The instrument processes the list according to the selected mode and trigger source, see `LIST:TRIG:SOUR AUTO, SING or EXT`.

Parameters:

<Mode> AUTO | STEP

AUTO
Each trigger event triggers a complete list cycle.

STEP
Each trigger event triggers only one step in the list processing cycle. The list is processed in ascending order.
In this mode, you can select between `LIST:TRIG:SOUR SING or EXT`.

*RST: AUTO

Example: See Example "Create an RF list and activate the list mode" on page 612.

Manual operation: See "Mode" on page 184

[: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 612.

Manual operation: See "Edit List Mode Data" on page 190

[: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 612.

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 612.

Usage: Event

Manual operation: See " Execute Single" on page 185

[:SOURce<hw>]:LIST:TRIGger:SOURce <Source>

Selects the trigger source for processing lists.

The names of the parameters correspond to those in sweep mode. SCPI standard uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration. For an overview, see the following table:

Rohde & Schwarz name	SCPI name	Command in manual control
AUTO	IMMediate	`MODE AUTO`
SINGle	BUS	`MODE SINGLE` or `STEP`
EXTernal	EXTernal	`MODE EXT TRIG SINGLE` or `EXT TRIG STEP`

Parameters:

<Source> SINGle | BUS | AUTO | EXTernal | IMMediate

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. The selected list is restarted as soon as it is finished.

SINGle|BUS
The list is triggered by the command `[:SOURce<hw>]:LIST:TRIGger:EXECute`. The list is executed once.

EXTernal
The list is triggered externally and executed once.

*RST: AUTO

Example: See Example "Create an RF list and activate the list mode" on page 612.

Manual operation: See "Mode" on page 184

[:SOURce<hw>]:LIST:RUNNing?

Queries the current state of the list mode.

Return values:

<State> 0 | 1 | OFF | ON

1
Signal generation based on the list mode is active.

Example: See Example "Create an RF list and activate the list mode" on page 612.

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?

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 612.

Usage: Query only

Manual operation: See " List Mode Data " on page 185

[: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 621.

Usage: Setting only

Manual operation: See " List Mode Data " on page 185

[: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 185

[: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 612.

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 612.

Usage: Event

Manual operation: See " Reset " on page 185

[: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 612.

Manual operation: See " List Mode Data " on page 185

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?

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 614.

Usage: Query only

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 94

[:SOURce<hw>]:LIST:DEXChange:EXECute

Executes the import or export of the selected list file, according to the previously set transfer direction with command `[:SOURce<hw>]:LIST:DEXChange:MODE`

Example: See Example "List mode data exchange" on page 614.

Usage: Event

Manual operation: See "Import / Export" on page 95

[: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 614.

Manual operation: See "ASCII File Settings" on page 94

[: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 614.

Manual operation: See "Select (ASCII) Source/Select (ASCII) Destination" on page 94

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn <Column>

Selects the separator between the frequency and level column of the ASCII table.

Parameters:

<Column>	TABulator | SEMicolon | COMMa | SPACe *RST: COMMa
Example:	See Example "List mode data exchange" on page 614.
Manual operation:	See "ASCII File Settings" on page 94

[: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 614.
Manual operation:	See "ASCII File Settings" on page 94

[: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 614.
Manual operation:	See " Mode " on page 94

[: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 614.
Manual operation:	See "Select Source/Select ASCII Destination" on page 95

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: Configuring the noise generator

```
SOURce1:NOISe:DISTribution GAUSs
SOURce1:NOISe:BANDwidth 10000000
SOURce1:NOISe:BANDwidth:STATe 1

SOURce1:LFOutput1:SOURce NOIS
SOURce1:LFOutput1:STATe 1

SOURce1:NOISe:LEVel:RELative?
// -83.86
SOURce1:NOISe:LEVel:ABSolute?
// -13.86
```

[:SOURce<hw>]:NOISe:BANDwidth|BWIDth <BWidth>

Sets the noise level in the system bandwidth when bandwidth limitation is enabled.

Parameters:

<BWidth> float

Range:	100E3 to 10E6
Increment:	100E3
*RST:	100E3

Example: See Example "Configuring the noise generator" on page 625.

Manual operation: See "Bandwidth" on page 103

[:SOURce<hw>]:NOISe:BWIDth:STATe <State>

Activates noise bandwidth limitation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configuring the noise generator" on page 625.

Manual operation: See "Bandwidth" on page 103

[:SOURce<hw>]:NOISe:DISTribution <Distribution>

Sets the distribution of the noise power density.

Parameters:

<Distribution> GAUSs | EQUal

*RST: GAUSs

Example: See Example "Configuring the noise generator" on page 625.

Manual operation: See "Distribution" on page 103

[:SOURce<hw>]:NOISe:LEVel:RELative?

Queries the level of the noise signal per Hz in the total bandwidth.

Return values:

<Relative> float

Range: -149.18 to -52.67
Increment: 0.1
*RST: -69.84

Example: See Example "Configuring the noise generator" on page 625.

Usage: Query only

Manual operation: See "Noise Density" on page 105

[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?

Queries the level of the noise signal in the system bandwidth within the enabled bandwidth limitation.

Return values:

<Absolute> float

Noise level within the bandwidth limitation

*RST: 3.84 MHz

Example: See Example "Configuring the noise generator" on page 625.

Usage: Query only

Manual operation: See "Noise Level" on page 106

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 <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 627.

Manual operation: See "Pulse Output Polarity" on page 89

[:SOURce<hw>]:PGENerator:OUTPut[:STATe] <State>

Activates the output of the pulse modulation signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Using pulse generator as source for pulse modulation" on page 627.

Manual operation: See "Pulse Output State" on page 89

[:SOURce<hw>]:PGENerator:STATe <State>

Enables the output of the video/sync signal.

If the pulse generator is the current modulation source, activating the pulse modulation automatically activates the signal output and the pulse generator.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: See Example "Using pulse generator as source for pulse modulation" on page 627.

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 <Phase>

Specifies the phase variation relative to the current phase.

Parameters:

<Phase> float
Range: -36000 to 36000
Increment: 0.1
*RST: 0
Default unit: DEG

Example: See Example "Programming Example" on page 628.

Manual operation: See "Delta Phase" on page 72

[:SOURce<hw>]:PHASe:REFerence

Assigns the value set with command `[:SOURce<hw>]:PHASe` as the reference phase.

Example: See Example "Programming Example" on page 628.

Usage: Event

Manual operation: See "Reset Delta Phase Display" on page 72

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 on of the following:

- Enter the unit after the numerical value
  Example: `:POW 0.5V`
- Set the unit with the command `:UNIT:POWer`.

[:SOURce<hw>]:POWer:ALC[:STATe] <State>

Parameters:

<State> 0 | OFF | AUTO | 1 | ON | ONTable | PRESet | OFFTable

AUTO
Adjusts the output level to the operating conditions automatically.

1|ON
Activates internal level control permanently.

OFFTable
Controls the level using attenuation values of the internal ALC table.

0|OFF
Provided only for backward compatibility with other Rohde & Schwarz signal generators.
The R&S SMA100B accepts these values and maps them automatically as follows:
`0|OFF = OFFTable`

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 198

[:SOURce<hw>]:POWer:ALC:DSENsitivity <Sensitivity>

Sets the sensitivity of the ALC detector.

Parameters:

<Sensitivity> AUTO | FIXed

AUTO
Selects the optimum sensitivity automatically.

FIXed
Fixes the internal level detector.

*RST: AUTO

Example: `POW:ALC:DSEN FIX`

Manual operation: See "Detector Sensitivity" on page 198

[: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 71

[: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 196

[:SOURce<hw>]:POWer:EMF:STATe <State>

Displays the signal level as voltage of the EMF. The displayed value represents the voltage over a 50 Ohm load.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: `POW:EMF:STAT 1`
Activates voltage level display.

Manual operation: See " Display Level as Voltage of EMF " on page 320

[:SOURce<hw>]:POWer:LBEHaviour <Behaviour>

Parameters:

<Behaviour> AUTO | UNINterrupted | MONotone | CVSWr | HDUN

UNINterrupted|MONotone
Uninterrupted level settings and strictly monotone modes.

CVSWr
Constant VSWR

HDUN
High dynamic uninterrupted level settings.

*RST: AUTO

Example: `SOURce1:POWer:LBEHaviour AUTO`

Options: R&S SMAB-K724

Manual operation: See " Setting Characteristics " on page 69

[: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 69

[:SOURce<hw>]:POWer:LMODe <LevMode>

Sets the RF level mode.

Parameters:

<LevMode> NORMal | LOWNoise | LOWDistortion

NORMal
Supplies the RF signal with the standard power level of the instrument.

LOWNoise
Supplies a very low noise sinewave signal.

LOWDistortion
Supplies a very pure sinewave signal.

*RST: NORMal

Example: `SOURce1:POWer:LMODe LOWD`
Sets low distortion mode. The instrument reduces distortions of the RF signal to a minimum.

Manual operation: See " Mode " on page 70

[:SOURce<hw>]:POWer:MANual <Manual>

Sets the level for the subsequent sweep step if `SWE:POW:MODE MAN`.

Use a separate command for each sweep step.

Parameters:

<Manual> float

You can select any level within the setting range, where:
`STARt` is set with `[:SOURce<hw>]:POWer:STARt`
`STOP` is set with `[:SOURce<hw>]:POWer:STOP`
`OFFSet` is set with `[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet`

Range: (STARt + OFFSet) to (STOP + OFFSet)
Increment: 0.01
Default unit: dBm

Example: See Example "Setup an RF frequency or power sweep" on page 643

Manual operation: See " Current Level" on page 172

[:SOURce<hw>]:POWer:MODE <Mode>

Selects the operating mode of the instrument to set the output level.

Parameters:

<Mode> CW | FIXed | SWEep

CW|FIXed
Operates at a constant level.
`CW` and `FIXed` are synonyms.
To set the output level value, use the command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]`.

SWEep
Sets sweep mode.
Set the range and current level with the commands:
`[:SOURce<hw>]:POWer:STARt` and `[:SOURce<hw>]:POWer:STOP`,
`[:SOURce<hw>]:POWer:MANual`.

*RST: CW

Example: See Example "Setup an RF frequency or power sweep" on page 643

Manual operation: See "State (RF level sweep)" on page 171

[: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 63.

Parameters:

<Power> float

Level at the RF output, without level offset

Range: See data sheet
Increment: 0.01
Default unit: dBm

Example: `SOURce1:POWer:POWer 15`
Sets the level at RF output

Manual operation: See "Amplitude" on page 68

[: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 "Setup an RF frequency or power sweep" on page 643

Manual operation: See " Start Level / Stop Level " on page 178

[:SOURce<hw>]:POWer:STEP:MODE <Mode>

Defines the type of step width to vary the RF output power step-by-step with the commands `POW UP or POW DOWN`.

Parameters:

<Mode> DECimal | USER

DECimal
Increases or decreases the level in steps of ten.

USER
Increases or decreases the level in increments, determined with the command `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

*RST: DECimal

Example:
```
SOURce1:POWer:STEP:INCRement 2
SOURce1:POWer:STEP:MODE USER
SOURce1:POWer:LEVel:IMMediate:AMPLitude UP
```
Increasing the RF level with a step size of 2 dB

Manual operation: See "Variation Active" on page 66

[:SOURce<hw>]:POWer:STEP[:INCRement] <Increment>

Specifies the step width in the appropriate path for `POW:STEP:MODE USER`.

To adjust the level step-by-step with this increment value, use the command `POW UP, or POW DOWN`.

Note: The command also sets "Variation Step" in the manual control, that means the user-defined step width for setting the level with the rotary knob or the [Up/Down] arrow keys.

Parameters:

<Increment> float

Range: 0 to 200
Increment: 0.01
*RST: 1
Default unit: dB

Example: See [:SOURce<hw>]:POWer:STEP:MODE on page 634.

Manual operation: See "Variation Step" on page 66

[: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 63.

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 69

[: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 294

[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

Sets the RF level applied to the DUT.

To activate the RF output use command :OUTPut<hw>[:STATe] ("RF On"/"RF Off").

The following applies `POWer = RF output level + OFFSet`, where:

- `POWer` is the values set with [:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]
- RF output level is set with [:SOURce<hw>]:POWer:POWer
- `OFFSet` is set with [:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet

Parameters:

<Amplitude> float

The following settings influence the value range:
`OFFSet` set with the command [:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet

Numerical value
Sets the level

UP|DOWN
Varies the level step by step.
The level is increased or decreased by the value set with the command [:SOURce<hw>]:POWer:STEP[:INCRement].

Range: (Level_min + OFFSet) to (Level_max + OFFStet)
*RST: -30
Default unit: dBm

Example: `POWer -30`
Sets the RF level

Example: See also [:SOURce<hw>]:POWer:STEP:MODE on page 634.

Manual operation: See "Amplitude" on page 68

[: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 70

[:SOURce]:POWer:WIGNore <State>

Ignores level range warnings.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example:

```
SOURce:POWer:WIGNore 1
```

13.16.12 SOURce:ROSCillator Subsystem

The `SOURce:ROSCillator` subsystem contains the commands for setting the external and internal reference frequency.

The commands of this subsystem are not affected by an instrument reset (*RST on page 409).

Example: Configuring the reference oscillator

```
// Using 100 MHz external reference source
SOURce:ROSCillator:PRESet
SOURce:ROSCillator:SOURce EXT
SOURce:ROSCillator:EXTernal:RFOFf:STATe 1
SOURce:ROSCillator:EXTernal:FREQuency 100MHZ
SOURce:ROSCillator:EXTernal:SBANdwidth WIDE
// 100 MHz (loop thought) and 1 GHz output
SOURce:ROSCillator:OUTPut:FREQuency:MODE LOOP
SOURce:ROSCillator:OUTPut:ALTernate:FREQuency:MODE DER1G
SOURce:ROSCillator:INTernal:ADJust:STATe 0

// Variable external reference frequency
// SOURce:ROSCillator:EXTernal:FREQuency VAR
// SOURce:ROSCillator:EXTernal:FREQuency:VARiable 100000000

// Using the internal reference frequency
SOURce:ROSCillator:SOURce INT
SOURce:ROSCillator:INTernal:TUNing:STATe 1
SOURce:ROSCillator:INTernal:TUNing:SLOPe LOW
// 10 MHz and 1 GHz output
SOURce:ROSCillator:OUTPut:FREQuency:MODE DER10M
SOURce:ROSCillator:OUTPut:ALTernate:FREQuency:MODE DER1G

// Query calibration value
CALibration:ROSCillator?
// 32767
// Set an internal source
// Activate user-defined adjustment value of 1000
SOURce:ROSCillator:SOURce INT
SOURce:ROSCillator:INTernal:ADJust:STATe 1
SOURce:ROSCillator:INTernal:ADJust:VALue 1000

// to resume calibrated state
SOURce:ROSCillator:INTernal:ADJust:VALue 0
SOURce:ROSCillator:INTernal:ADJust:STATe 0
// or
// SYSTem:FPRest
```

[:SOURce]:ROSCillator:PRESet

Resets the reference oscillator settings.

Example: See Example "Configuring the reference oscillator" on page 638.

Usage: Event

Manual operation: See "Set to Default" on page 273

[: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 638.

Manual operation: See "Source" on page 273

[:SOURce]:ROSCillator:INTernal:TUNing[:STATe] <State>

Activates the EFC (external frequency control).

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 1)

Example: See Example "Configuring the reference oscillator" on page 638.

Manual operation: See "External Tuning Active" on page 274

[:SOURce]:ROSCillator:INTernal:TUNing:SLOPe <State>

Sets the sensitivity of the external tuning volatge.

Parameters:

<State> LOW | HIGH

*RST: n.a. (factory preset: LOW)

Example: See Example "Configuring the reference oscillator" on page 638.

Manual operation: See "External Tuning Slope" on page 275

[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] <State>

Determines that the RF output is turned off when the external reference signal is selected, but missing.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: See Example "Configuring the reference oscillator" on page 638.

Manual operation: See "Deactivate RF Output (if external reference is missing)" on page 273

[: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 638.

Options: VARiable requires R&S SMAB-K704
100MHZ|1GHZ require R&S SMAB-K703

Manual operation: See "External Reference Frequency" on page 273

[: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 638.

Options: R&S SMAB-K704

Manual operation: See "Variable Reference Frequency" on page 274

[:SOURce]:ROSCillator:EXTernal:SBANdwidth <SBandwidth>

Selects the synchronization bandwidth for the external reference signal.

For more information, see data sheet.

Parameters:

<SBandwidth> WIDE | NARRow

NARRow
The synchronization bandwidth is a few Hz.
Suitable for external reference sources with phase noise worse than the R&S SMA100B.

WIDE
Uses the widest possible synchronization bandwidth.
For more information, see data sheet.

*RST: n.a. (factory preset)

Example: See Example "Configuring the reference oscillator" on page 638.

Manual operation: See "Synchronization Bandwidth" on page 274

[:SOURce]:ROSCillator:EXTernal:MLRange?

Queries the minimum locking range for the selected external reference frequency.

Return values:

<MinLockRange> string

Example: `SOUR:ROSC:EXT:MLR?`

Usage: Query only

Manual operation: See "Minimum Locking Range" on page 274

[: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 274

[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE <OutpFreqMode>

Sets the output reference frequency.

Parameters:

<OutpFreqMode> DER10M | DER100M | OFF | LOOPthrough

OFF
Disables the output.

DER10M|DER100M
Sets the output reference frequency to 10 MHz or 100 MHz.
The reference frequency is derived from the internal reference frequency.

LOOPthrough
This option is unavailable for `ROSCillator:EXTernal:FREQuency 1GHZ`. Forwards the input reference frequency to the reference frequency output.

*RST: n.a. (factory preset: DER10M)

Example: See Example "Configuring the reference oscillator" on page 638.

Manual operation: See "Reference Output/1GHz Reference Output" on page 275

[: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:FREQuency1GHZ`, 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 638.

Manual operation: See "Reference Output/1GHz Reference Output" on page 275

[: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 643

Manual operation: See "Adjustment Value" on page 276

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] <State>

Determines whether the calibrated (off) or a user-defined (on) **adjustment value** is used for fine adjustment of the frequency.

Parameters:

<State> 0 | 1 | OFF | ON

0
Fine adjustment with the calibrated frequency value

1
User-defined adjustment value.
The instrument is no longer in the calibrated state.
The calibration value is, however, not changed. The instrument resumes the calibrated state if you send
`SOURce:ROSCillator:INTernal:ADJust:STATe 0`.

*RST: n.a. (factory preset: 0)

Example: see Example "Configuring the reference oscillator" on page 638.

Manual operation: See "Adjustment Active" on page 276

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))
- All sweeps, including the LF sweep, can be set independently of each other.

For detailed information on the sweep modes and the triggering, see Chapter 6.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 156.

Example: Setup an RF frequency or power sweep

The following example shows a command sequence to set up an RF frequency sweep, triggered by the execute command. For an RF power sweep, replace `FREQuency` in the `SWEep` commands with `POWer`.

Exceptions are the power spacing (defined with `LINear` only) and the power step width (defined with `LOGarithmic` only).

```
// Reset the instrument to start from an initial state
// Switch off display update to improve performance
```

```
// (especially with short dwell times)
// Set the sweep mode (first two commands) and the sweep range
// Select linear spacing
// Select the waveform shape for the frequency sweep
*RST; *CLS
SYSTem:DISPlay:UPDate OFF
TRIGger1:FSWeep:SOURce SINGle
SOURce1:SWEep:FREQuency:MODE AUTO
SOURce1:FREQuency:SPAN 300 MHz
SOURce1:FREQuency:CENTer 200 MHz
// Alternatively use
// SOURce1:FREQuency:STARt 50 MHz
// SOURce1:FREQuency:STOP 350 MHz
SOURce1:SWEep:FREQuency:SPACing LINear
SOURce1:SWEep:FREQuency:SHAPe SAWTooth

// Activate change to start frequency while waiting for next trigger
// Prerequisites: sweep mode single and sweep waveform sawtooth
SOURce1:SWEep:FREQuency:RETRace 1
// Alternatively reset all sweeps to their initial value
SOURce1:SWEep:RESet:ALL

// Set the step width and dwell time
SOURce1:SWEep:FREQuency:STEP:LINear 1 MHz
// Alternatively set the number of steps, then the sweep step width is
// set automatically
SOURce1:SWEep:FREQuency:POINts 301
SOURce1:SWEep:FREQuency:DWELl 500 ms
// With logarithmic spacing select the step width as follows
// (steps of 10 percent of the previous frequency in each instance)
SOURce1:SWEep:FREQuency:SPACing LOG
SOURce1:SWEep:FREQuency:STEP:LOGarithmic 10PCT

// Activate the sweep
// Trigger the sweep (depending on the set mode) and query the status
SOURce1:FREQuency:MODE SWEep
// Perform a one-off RF frequency sweep
SOURce1:SWEep:FREQuency:EXECute
SOURce1:SWEep:FREQuency:RUNNing?
// 1
// the frequency sweep is running

// For manual step RF sweep use the following commands
*RST; *CLS
// Activate manual step RF sweep
SOURce1:SWEep:FREQuency:MODE MANual
// Activate the RF frequency sweep.
SOURce1:FREQuency:MODE SWEep
// Activate RF Output1.
Output1:STATe 1
```

```
// Input the frequency manually for each step
SOURce1:FREQuency:MANual 200 MHz
SOURce1:FREQuency:MANual 201 MHz
// Alternatively use the UP or DOWN commands with the set step width.
SOURce1:SWEep:FREQuency:STEP:LINear 1 MHz
SOURce1:FREQuency:MANual UP
```

:SWEep:TYPE <SweepType>

Provided for compatibility between SCPI and Rohde & Schwarz commands.

Parameters:

<SweepType>	ADVanced | STANdard	
	*RST:	n.a. (factory preset: STANdard)

[:SOURce<hw>]:SWEep:POWer:DWELl <Dwell>

Sets the dwell time for a level sweep step.

Parameters:

<Dwell> float

Range: 3E-3 to 100
Increment: 100E-6
*RST: 10E-3
Default unit: s

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See " Dwell Time " on page 174

[:SOURce<hw>]:SWEep:GENeration <SweepType>

Selects frequency sweep type.

Parameters:

<SweepType> STEPped | ANALog

STEPped
Performs a frequency sweep.

ANALog
Performs a continuous analog frequency sweep (ramp), synchronized with the sweep time `[:SOURce<hw>]:SWEep[:FREQuency]:TIME`.

*RST: STEPped

Manual operation: See " Sweep Type " on page 171

[:SOURce<hw>]:SWEep:POWer:MODE <Mode>

Sets the cycle mode for the level sweep.

Parameters:

<Mode> AUTO | MANual | STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. You can trigger every step individually with the command `[:SOURce<hw>]:POWer:MANual`.
The level value increases at each step by the value that you define with `[:SOURce<hw>]:POWer:STEP[:INCRement]`.
Values directly entered with the command `[:SOURce<hw>]:POWer:MANual` are not taken into account.

STEP
Each trigger triggers one sweep step only. The level increases by the value entered with `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

*RST: AUTO

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See "Mode" on page 172

[:SOURce<hw>]:SWEep:POWer:POINts <Points>

Sets the number of steps within the RF level sweep range.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Parameters:

<Points> integer

Range: 2 to Max

Example: See Example "Setup an RF frequency or power sweep" on page 643.

[:SOURce<hw>]:SWEep:POWer:SPACing:MODE?

Queries the level sweep spacing. The sweep spacing for level sweeps is always linear.

Return values:

<Mode> LINear

*RST: LINear

Example: `SWE:POW:SPAC:MODE?`
queries the sweep spacing for a level sweep at RF output.
Result: "`LIN`"
linear spacing

Usage: Query only

[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic] <Logarithmic>

Sets a logarithmically determined step size for the RF level sweep. The level is increased by a logarithmically calculated fraction of the current level.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Parameters:

<Logarithmic> float

The unit `dB` is mandatory.

Range: 0.01 to 139 dB
Increment: 0.01
*RST: 1
Default unit: dB

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See " Step " on page 178

[:SOURce<hw>]:SWEep[:FREQuency]:DWELl <Dwell>

Sets the dwell time for a frequency sweep step.

Parameters:

float

Range: 3E-3 (R&S SMAB-B709/-B710/-B710N), 5E-3 (R&S SMAB-B711/-B711N) to 100
Increment: 100E-6
*RST: 10E-3
Default unit: s
Note: The minimum dwell time varies, depending on the phase noise options the instrument is equipped with (see the data sheet for the specifications).

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See " Dwell Time " on page 174

[:SOURce<hw>]:SWEep[:FREQuency]:MODE <Mode>

Sets the cycle mode for the frequency sweep.

Parameters:

<Mode> AUTO | MANual | STEP

AUTO
Each trigger event triggers exactly one complete sweep.

MANual
The trigger system is not active. You can trigger every step individually by input of the frequencies with the command `[:SOURce<hw>]:FREQuency:MANual`.

STEP
Each trigger event triggers one sweep step. The frequency increases by the value entered with `[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]` (linear spacing) or `[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic` (logarithmic spacing).

*RST: AUTO

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See "Mode" on page 172

[:SOURce<hw>]:SWEep[:FREQuency]:POINts <Points>

Sets the number of steps within the RF frequency sweep range.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Two separate `POINts` values are used for linear or logarithmic sweep spacing (`[:SOURce<hw>]:SWEep[:FREQuency]:SPACing LIN | LOG`). The command always affects the currently set sweep spacing.

Parameters:

<Points> integer

Range: 2 to Max

Example: See Example "Setup an RF frequency or power sweep" on page 643.

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing <Spacing>

Selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

The keyword `[:FREQuency]` can be omitted; then the command is SCPI-compliant.

Parameters:

<Spacing> LINear | LOGarithmic

LINear
Sets a fixed frequency value as step width and adds it to the current frequency.
The linear step width is entered in Hz, see `[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]`.

LOGarithmic
Sets a constant fraction of the current frequency as step width and adds it to the current frequency.
The logarithmic step width is entered in %, see `[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic`.

*RST: LINear

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See " Spacing" on page 174

[:SOURce<hw>]:SWEep:POWer:SHAPe <Shape>
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe <Shape>

Determines the waveform shape for a frequency sweep sequence.

Parameters:

<Shape> SAWTooth | TRIangle

*RST: SAWTooth

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See " Shape" on page 173

[:SOURce<hw>]:SWEep:POWer:EXECute
[:SOURce<hw>]:SWEep[:FREQuency]:EXECute

Executes an RF frequency sweep.

The command performs a single sweep and is therefore only effective in manual sweep mode.

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Usage: Event

Manual operation: See " Execute Single Sweep " on page 175

[:SOURce<hw>]:SWEep:POWer:RETRace <State>
[:SOURce<hw>]:SWEep[:FREQuency]:RETRace <State>

Activates that the signal changes to the start frequency value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single".

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See "Retrace" on page 173

[:SOURce<hw>]:SWEep:POWer:RUNNing?
[:SOURce<hw>]:SWEep[:FREQuency]:RUNNing?

Queries the current sweep state.

Return values:

<State> 0 | 1 | OFF | ON

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Usage: Query only

[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

Sets a logarithmically determined step width for the RF frequency sweep. The value is added at each sweep step to the current frequency.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Parameters:

<Logarithmic> float

The unit is mandatory.

Range: 0.01 to 100
Increment: 1E-3
*RST: 1
Default unit: PCT

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See " Step Linear/Step Logarithmic " on page 177

[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step width for linear sweeps.

See Chapter 6.2.1, "Correlating Parameters in Sweep Mode", on page 164.

Omit the optional keywords so that the command is SCPI-compliant.

Parameters:

<Linear> float

Range: 0.001 Hz to (STOP - STARt)
Increment: 0.01

Example: See Example "Setup an RF frequency or power sweep" on page 643.

Manual operation: See " Step Linear/Step Logarithmic " on page 177

[:SOURce<hw>]:SWEep:RESet[:ALL]

Resets all active sweeps to the starting point.

Usage: Event

Manual operation: See " Reset Sweep " on page 175

[:SOURce<hw>]:SWEep[:FREQuency]:TIME <Time>

Sets the duration of a frequency ramp sweep step.

Parameters:

<Time> float

Range: 0.01 to 100
Increment: 1E-4
*RST: 0.015
Default unit: s

Example:

```
SOURce1:SWEep:FREQuency:SPACing RAMP
SOURce1:SWEep:FREQuency:TIME 0.020
```

Options: R&S SMAB-B28

Manual operation: See " Sweep Time " on page 174

[:SOURce<hw>]:SWEep:MARKer:OUTPut:POLarity <Polarity>

Selects the polarity of the marker signal.

Parameters:

<Polarity> NORMal | INVerted

NORMal
Marker level is high when after reaching the mark.

INVerted
Marker level is low after reaching the mark.

*RST: NORMal

Example: See [:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FREQuency on page 652.

Options: R&S SMAB-B28

Manual operation: See "Marker Polarity" on page 182

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer:ACTive <Active>

Defines the marker signal to be output with a higher voltage than all other markers.

Parameters:

<Active> NONE | M01 | M02 | M03 | M04 | M05 | M06 | M07 | M08 | M09 | M10

*RST: NONE

Example: See [:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FREQuency on page 652.

Options: R&S SMAB-B28

Manual operation: See " Active Marker " on page 182

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FREQuency <Frequency>

Sets the frequency of the selected marker.

Suffix:

<ch> 1 to 10
Marker

Parameters:

<Frequency> float

Increment: 0.01
RST: 100 + n 100

Example:
```
SOURce1:SWEep:MARKer:OUTPut:POLarity NORMal
```
three markers at 1 GHz, 2 GHz and 3 GHz
```
SOURce1:SWEep:FREQuency:MARKer1:FREQuency
1000000000
SOURce1:SWEep:FREQuency:MARKer2:FREQuency
2000000000
SOURce1:SWEep:FREQuency:MARKer3:FREQuency
3000000000
SOURce1:SWEep:FREQuency:MARKer1:FSTate 1
SOURce1:SWEep:FREQuency:MARKer2:FSTate 1
SOURce1:SWEep:FREQuency:MARKer3:FSTate 1
SOURce1:SWEep:FREQuency:MARKer:ACTive M03
```

Options: R&S SMAB-B28

Manual operation: See " Frequency x " on page 181

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FSTate <FState>

Activates the selected marker.

Suffix:

<ch> 1 to 10
Marker

Parameters:

<FState> 0 | 1 | OFF | ON
*RST: 0

Example: See `[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FREQuency` on page 652.

Options: R&S SMAB-B28

Manual operation: See " State " on page 181

13.17 SYSTem Subsystem

The `SYSTem` subsystem contains a series of commands for general functions which do not directly affect signal generation.

Example: Retrieving information on network-related settings

```
SYSTem:COMMunicate:NETWork:STATus?
// 1
SYSTem:PROTection1:STATe 0,123456

SYSTem:COMMunicate:NETWork:IPADdress:MODE STAT
SYSTem:COMMunicate:NETWork:IPADdress "10.113.0.104"
SYSTem:COMMunicate:NETWork:IPADdress:DNS "10.0.2.166"
SYSTem:COMMunicate:NETWork:COMMon:HOSTname?
// "SMA100B-102030"
SYSTem:COMMunicate:NETWork:COMMon:WORKgroup "instrument"
SYSTem:COMMunicate:NETWork:COMMon:DOMain "rsint.net"
SYSTem:COMMunicate:NETWork:IPADdress:GATeway "10.113.0.1"
SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK "255.255.252.0"
SYSTem:COMMunicate:NETWork:MACaddress "08 00 27 a3 a1 70"
SYSTem:PROTection1:STATe 1
```

Example: Finding out the used VISA ressource strings

```
SYSTem:COMMunicate:NETWork:RESource?
// "TCPIP::10.113.0.104::inst0::INSTR"

SYSTem:COMMunicate:HISLip:RESource?
// "TCPIP::10.113.0.104::hislip0::INSTR"

SYSTem:COMMunicate:GPIB:RESource?
// "GPIB::28::INSTR"
SYSTem:COMMunicate:GPIB:SELF:ADDRess?
// 28
SYSTem:COMMunicate:GPIB:LTERminator?
// STAN

SYSTem:COMMunicate:SERial:RESource?
// "ASRL1::INSTR"
SYSTem:COMMunicate:SERial:SBITs?
// 1
SYSTem:COMMunicate:SERial:BAUD?
// 115200
SYSTem:COMMunicate:SERial:PARity?
// NONE

SYSTem:COMMunicate:SOCKet:RESource?
// "TCPIP::10.113.0.104::5025::SOCKET"
SYSTem:COMMunicate:USB:RESource?
// "USB::0x0AAD::0x01DD::100001::INSTR"
```

Example: Querying the error queue

```
SYSTem:ERRor:STATic?
// -221,"Settings conflict", 153,"Input voltage out of range", ...
// returns all static errors that are collected in the error queue

SYSTem:ERRor:HISTory:ClEar
// deletes the history entries
```

:SYSTem:ERRor:ALL?

Queries the error/event queue for all unread items and removes them from the queue.

Return values:

<All> string

Error/event_number,"Error/event_description>[;Device-dependent info]"
A comma separated list of error number and a short description of the error in FIFO order.
If the queue is empty, the response is `0,"No error"`
Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.
Volatile errors are reported once, at the time they appear. Identical errors are reported repeatedly only if the original error has already been retrieved from (and hence not any more present in) the error queue.

Example: `SYST:ERR:ALL?`
Queries all entries in the error queue.
`Response: 0, 'no error'`
No errors have occurred since the error queue was last read out.

Usage: Query only

Manual operation: See "Clear History" on page 706

:SYSTem:ERRor:CODE:ALL?

Queries the error numbers of all entries in the error queue and then deletes them.

Return values:

<All> string

Returns the error numbers. To retrieve the entire error text, send the command `:SYSTem:ERRor:ALL?`.

0
"No error", i.e. the error queue is empty

Positive value
Positive error numbers denote device-specific errors

Negative value
Negative error numbers denote error messages defined by SCPI.

Example: `SYST:ERR:CODE:ALL`
Queries all entries in the error queue.
`Response: 0`
No errors have occurred since the error queue was last read out.

Usage: Query only

:SYSTem:ERRor:CODE[:NEXT]?

Queries the error number of the oldest entry in the error queue and then deletes it.

Return values:

<Next> string

Returns the error number. To retrieve the entire error text, send the command `:SYSTem:ERRor:ALL?`.

0
"No error", i.e. the error queue is empty

Positive value
Positive error numbers denote device-specific errors

Negative value
Negative error numbers denote error messages defined by SCPI.

Example: `SYST:ERR:CODE`
Queries the oldest entry in the error queue.
`Response: 0`
No errors have occurred since the error queue was last read out.

Usage: Query only

:SYSTem:ERRor:COUNt?

Queries the number of entries in the error queue.

Return values:
<Count> integer

0
The error queue is empty.

Example: `SYST:ERR:COUN`
Queries the number of entries in the error queue.
`Response: 1`
One error has occurred since the error queue was last read out.

Usage: Query only

:SYSTem:ERRor[:NEXT]?

Queries the error/event queue for the oldest item and removes it from the queue.

Return values:
<Next> string

Error/event_number,"Error/event_description>[;Device-dependent info]"
Error number and a short description of the error.
If the queue is empty, the response is `0,"No error"`
Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.
Volatile errors are reported once, at the time they appear. Identical errors are reported repeatedly only if the original error has already been retrieved from (and hence not any more present in) the error queue.

Example: `SYST:ERR?`
Queries the oldest entry in the error queue.
`Response: 0, 'no error'`
No errors have occurred since the error queue was last read out.

Usage: Query only

Manual operation: See "Static Errors/Error History" on page 706

:SYSTem:ERRor:GNEXt?

Similar to `:SYSTem:ERRor[:NEXT]?`, but queries the next entry from the global persistant error/event queue.

Return values:

<NextGlobalError> string

Error/event number, "Error/event description> [;Device dependent info]"
An error number and a short description of the error.
Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Example: `SYST:ERR:GNEX?`
Returns the next error message from the global error queue.

Usage: Query only

:SYSTem:ERRor:HISTory:CLEar

Clears the error history.

Example: See Example "Querying the error queue" on page 655

Usage: Event

Manual operation: See "Clear History" on page 706

:SYSTem:ERRor:STATic?

Returns a list of all errors existing at the time when the query is started. This list corresponds to the display on the info page under manual control.

Return values:

<StaticErrors> string

Example: See Example "Querying the error queue" on page 655

Usage: Query only

Manual operation: See "Static Errors/Error History" on page 706

:SYSTem:ULOCk <Mode>

Locks or unlocks the user interface of the instrument.

Parameters:

<Mode> ENABled | DONLy | DISabled | TOFF | VNConly

ENABled
Unlocks the display, the touchscreen and all controls for the manual operation.

DONLy
Locks the touchscreen and controls for the manual operation of the instrument. The display shows the current settings.

VNConly
Locks the touchscreen and controls for the manual operation, and enables remote operation over VNC. The display shows the current settings.

TOFF
Locks the touchscreen for the manual operation of the instrument. The display shows the current settings.

DISabled
Locks the display, the touchscreen and all controls for the manual operation.

*RST: n.a. (factory preset: ENABled)

Example: `:SYST:ULOC DIS`
Activates the user interface lock, including display and controls.

Manual operation: See "User Interface" on page 338

:SYSTem:DLOCk <DispLockStat>

Disables the manual operation via the display, including the front panel keyboard of the instrument and the Local key.

Parameters:
<DispLockStat> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: `SYST:DLOC ON`
Activates the display lock. The instrument cannot be operated via the display until it has been enabled with `SYST:DLOC OFF`.

Manual operation: See "User Interface" on page 338

:SYSTem:KLOCk <State>

Disables the front panel keyboard of the instrument including the Local key.

Parameters:
<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: `SYST:KLOC ON`
Locks the front panel and external controls.
To enable the controls, send `SYST:KLOC OFF`.

Manual operation: See "User Interface" on page 338

:SYSTem:SAV <Pathname>

Saves the current instrument settings to a file with defined filename.

Setting parameters:

<Pathname> string

Example: `SYSTem:SAV "/var/user/Instrument_settings.svrcltxt"`

Usage: Setting only

:SYSTem:RCL <Pathname>

Loads a file with previously saved instrument settings.

Setting parameters:

<Pathname> string

Example: `SYSTem:RCL "/var/user/Instrument_settings.svrcltxt"`

Usage: Setting only

:SYSTem:PROTect<ch>[:STATe] <State>[, <Key>]

Activates and deactivates the specified protection level.

Suffix:

<ch> Indicates the protection level.
See also "Protection" on page 332

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 1)

Setting parameters:

<Key> integer

The respective functions are disabled when the protection level is activated. No password is required for activation of a level.
A password must be entered to deactivate the protection level.
The default password for the first level is 123456.
This protection level is required to unlock internal adjustments for example.

Example: To activate protection level:
`SYSTem:PROTect1:STATe 1`
Internal adjustments or hostname cannot be changed.
To unlock protection level 1:
`SYSTem:PROTect1:STATe 0,123456`
Internal adjustments are accessible.

Manual operation: See "Protection Level/Password" on page 333

: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 336

: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 "Finding out the used VISA ressource strings" on page 654.

:SYSTem:COMMunicate:GPIB:RESource?

Queries the visa resource string for remote control via the GPIB interface.

To change the GPIB address, use the command `:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess`.

Return values:

<Resource> string

Example: See Example "Finding out the used VISA ressource strings" on page 654.

Usage: Query only

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

Sets the GPIB address.

Parameters:

<Address> integer

Range: 0 to 30
*RST: 28

Example: See Example "Finding out the used VISA ressource strings" on page 654.

:SYSTem:COMMunicate:HISLip:RESource?

Queries the VISA resource string . This string is used for remote control of the instrument with HiSLIP protocol.

Return values:

<Resource> string

Example: See Example "Finding out the used VISA ressource strings" on page 654.

Usage: Query only

:SYSTem:COMMunicate:NETWork:IPADdress <IpAddress>

Sets the IP address.

Parameters:

<IpAddress> string

Range: 0.0.0.0. to ff.ff.ff.ff

Example: See Example "Retrieving information on network-related settings" on page 654.

Manual operation: See "IP Address" on page 360

:SYSTem:COMMunicate:NETWork:IPADdress:MODE <Mode>

Selects manual or automatic setting of the IP address.

Parameters:

<Mode> AUTO | STATic

*RST: n.a. (factory preset: AUTO)

Example: See Example "Retrieving information on network-related settings" on page 654.

Example:
```
SYSTem:COMMunicate:NETWork:IPADdress:MODE
STATic
SYSTem:COMMunicate:NETWork:IPADdress
"10.113.0.105"
```

Manual operation: See "Address Mode" on page 359

:SYSTem:COMMunicate:NETWork:MACaddress <MacAddress>

Queries the MAC address of the network adapter.

This is a password-protected function. Unlock the protection level 1 to access it, see `:SYSTem:PROTect<ch>[:STATe]`.

Parameters:

<MacAddress> string

Example: See Example "Retrieving information on network-related settings" on page 654.

Manual operation: See "MAC Address" on page 361

:SYSTem:COMMunicate:NETWork:RESource?

Queries the visa resource string for Ethernet instruments.

Return values:

<Resource> string

Example: See Example "Finding out the used VISA ressource strings" on page 654.

Usage: Query only

:SYSTem:COMMunicate:NETWork:RESTart

Restarts the network.

Example:
```
SYSTem:COMMunicate:NETWork:RESTart
// Terminates the network connection and sets it up again
```

Usage: Event

Manual operation: See "Restart Network" on page 359

:SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

Return values:

<State> 0 | 1 | OFF | ON

Example: See Example "Retrieving information on network-related settings" on page 654.

Usage: Query only

Manual operation: See "Network Status" on page 358

:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain <Domain>

Determines the primary suffix of the network domain.

Parameters:

<Domain> string

Example: See Example "Retrieving information on network-related settings" on page 654.

Manual operation: See "DNS Suffix" on page 360

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

Sets an individual hostname for the Signal Generator.

Note: We recommend that you do not change the hostname to avoid problems with the network connection. If you change the hostname, be sure to use a unique name.

This is a password-protected function. Unlock the protection level 1 to access it, see `:SYSTem:PROTect<ch>[:STATe]`.

Parameters:

<Hostname> string

Example: See Example "Retrieving information on network-related settings" on page 654.

Manual operation: See "Hostname" on page 359

:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup <Workgroup>

Sets an individual workgroup name for the instrument.

Parameters:

<Workgroup> string

Example: See Example "Retrieving information on network-related settings" on page 654.

Manual operation: See "Workgroup" on page 359

:SYSTem:COMMunicate:NETWork[:IPADdress]:DNS <DNS>

Determines or queries the network DNS server to resolve the name.

Parameters:

<DNS> string

Example: See Example "Retrieving information on network-related settings" on page 654.

Manual operation: See "DNS Server" on page 360

:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway <Gateway>

Sets the IP address of the default gateway.

Parameters:

<Gateway> string

Range: 0.0.0.0 to ff.ff.ff.ff

Example: See Example "Retrieving information on network-related settings" on page 654.

Manual operation: See "Default Gateway" on page 360

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK <Mask>

Sets the subnet mask.

Parameters:

<Mask> string

Example: See Example "Retrieving information on network-related settings" on page 654.

Manual operation: See "Subnet Mask" on page 360

:SYSTem:COMMunicate:SERial:BAUD <Baud>

Defines the baudrate for the serial remote control interface.

Parameters:

<Baud> 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200

*RST: n.a. (factory preset: 115200)

Example: See Example "Finding out the used VISA ressource strings" on page 654.

Manual operation: See "Baud Rate" on page 362

:SYSTem:COMMunicate:SERial:PARity <Parity>

Enters the parity for the serial remote control interface.

Parameters:

<Parity> NONE | ODD | EVEN

*RST: n.a. (factory preset: NONE)

Example: See Example "Finding out the used VISA ressource strings" on page 654.

Manual operation: See "Parity" on page 362

:SYSTem:COMMunicate:SERial:RESource?

Queries the visa resource string for the serial remote control interface. This string is used for remote control of the instrument.

Return values:

<Resource>	string
Example:	See Example "Finding out the used VISA ressource strings" on page 654.
Usage:	Query only

:SYSTem:COMMunicate:SERial:SBITs <SBits>

Defines the number of stop bits for the serial remote control interface.

Parameters:

<SBits>	1 | 2 *RST: n.a. (factory preset: 1)
Example:	See Example "Finding out the used VISA ressource strings" on page 654.
Manual operation:	See "Stop Bits" on page 363

:SYSTem:COMMunicate:SOCKet:RESource?

Queries the visa resource string for remote control via LAN interface, using TCP/IP socket protocol.

Return values:

<Resource>	string
Example:	See Example "Finding out the used VISA ressource strings" on page 654.
Usage:	Query only

:SYSTem:COMMunicate:USB:RESource?

Queries the visa resource string for remote control via the USB interface.

Return values:

<Resource>	string
Example:	See Example "Finding out the used VISA ressource strings" on page 654.
Usage:	Query only

:SYSTem:HELP:EXPort

Saves the online help as zip archive in the user directory.

Example:
```
:SYSTem:HELP:EXPort
MMEM:CDIR?
// "/var/user"
MMEM:CAT?
// ..,"Log,DIR,4096","help.tgz,BIN,69836600"
// confirms that help zip archive is saved.
```

Usage: Event

Manual operation:: "Setup > Help > Export Help to User Path"

:SYSTem:IDENtification <Identification>

Selects the mode to determine the "IDN String" and the "OPT String" for the instrument, selected with command `:SYSTem:LANGuage`.

Note: While working in an emulation mode, the R&S SMA100B specific command set is disabled, that is, the SCPI command `SYST:IDEN` is discarded.

Parameters:

<Identification> AUTO | USER

AUTO
Automatically determines the strings.

USER
User-defined strings can be selected.

*RST: n.a. (factory preset: AUTO)

Example: `SYST:IDEN AUTO`
Automatically assigns the OPT and IDN strings according to the selected instrument language.

Manual operation: See "Mode" on page 363

:SYSTem:IDENtification:PRESet

Sets the `*IDN` and `*OPT` strings in user defined mode to default values.

Example:
```
SYST:IDEN USER
SYST:IDEN:PRES
```

Usage: Event

Manual operation: See "Set to Default" on page 364

: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 364

: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 364

:SYSTem:LANGuage <Language>

Sets the remote control command set.

Parameters:

<Language> string

Example:

```
SYSTem:LANGuage "SCPI"
// selects SCPI command set
```

Manual operation: See "Language" on page 363

:SYSTem:INFormation:SCPI <InfoString>

Inserts system information in recorded SCPI command lists, for example information on a missing command.

Parameters:

<InfoString> string

Example:

```
SYST:INF:SCPI "missing command"
```

enters the information into a recorded SCPI command list.

:SYSTem:SECurity: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 336

:SYSTem:SECurity:SUPolicy <SecPassWord>, <Update Policy>

Configures the automatic signature verification for firmware installation.

Parameters:

<Update Policy> STRict | CONFirm | IGNore

*RST: n.a. (factory preset: CONFirm)

Setting parameters:

<SecPassWord> string

Manual operation: See "Secure Update Policy" on page 335

:SYSTem:SPECification? <Id>

Retrieves data sheet information for a specific parameter.

Setting parameters:

<Id> string

Identifies the name of the entry in the data sheet, as quieried with the command `:SYSTem:SPECification:IDENtification:CATalog?` on page 671

Return values:

<ValList> float

Comma-separated list with the specified and, if available, the typical value of the parameter, as specified in the data sheet. See also "Data Sheet" on page 372.

Example:	Retrieving instruments specification
	Note: The following values are merely an example.
	Query the data sheet versions stored in the instrument:
	`:SYSTem:SPECification:VERSion:CATalog?`
	`"04.03,04.02,04.01,04.00,03.04,03.03,03.02,`
	`03.01,03.00,02.96,02.95,02.94,02.02,02.01,`
	`02.00,01.03,01.02,01.01,01.00"`
	Query the data sheet version with that the instrument was delivered:
	`:SYSTem:SPECification:VERSion:FACTory?`
	`"04.00"`
	Select a data sheet version:
	`:SYSTem:SPECification:VERSion?`
	`"04.00"`
	`:SYSTem:SPECification:VERSion "04.01"`
	Selects one particular data sheet version.
	Queries regarding data sheet parameters (IDs) and their values Rrefer to this particular data sheet
	Query the IDs of all parameters listed in the **selected** data sheet version:
	`:SYSTem:SPECification:IDENtification:CATalog?`
	`"ID_RF_FREQ_SETTING_TIME_ALC_ON_MS,`
	`ID_RF_FREQ_SETTING_TIME_MS,..."`
	Query the data sheet information on a specific parameter, defined by its ID
	`:SYSTem:SPECification?`
	`"ID_RF_FREQ_SETTING_TIME_ALC_ON_MS"`
	Rreturned is the specified and, if available, the typical value of the parameter

Usage:	Query only

:SYSTem:SPECification:VERSion <Version>

Selects a data sheet version from the data sheets saved on the instrument.

Further queries regarding the data sheet parameters (`<Id>`) and their values refer to the selected data sheet.

To query the list of data sheet versions, use the command `:SYSTem:SPECification:VERSion:CATalog?` on page 672.

Parameters:

<Version>	string
Example:	See `:SYSTem:SPECification?` on page 670.

: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 670.

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 670.

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 670.

Usage: Query only

Manual operation: See "Versions" on page 701

:SYSTem:SRData?

Queris the SCPI recording data from the internal file.

This feature enables you to transfer an instrument configuration to other test environments, as e.g. laboratory virtual instruments.

Return values:

<FileData> block data

Example:

```
SYSTem:SRData?
// #3118:SOURce1:ROSCillator:SOURce EXT
// :SOURce1:FREQuency:CW 4000000000
// :SOURce1:FREQuency:OFFSet 1000000
// :SOURce1:AM1:STATe 1
// :OUTPut1:STATe 1
```

Usage: Query only

:SYSTem:STARtup:COMPlete?

Queries if the startup of the instrument is completed.

Return values:

<Complete> 0 | 1 | OFF | ON
*RST: 0

Example: `SYST:STAR:COMP?`
Response: `1`
the startup of the instrument is completed.

Usage: Query only

:SYSTem:DATE <Year>, <Month>, <Day>

Queries or sets the date for the instrument-internal calendar.

This is a password-protected function. Unlock the protection level 1 to access it, see `:SYSTem:PROTect<ch>[:STATe]`.

Parameters:

<Year> integer

<Month> integer
Range: 1 to 12

<Day> integer
Range: 1 to 31

Example:

```
:SYSTem:DATE?
// 2016,05,01
```

Manual operation: See "Date" on page 690

: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 691

:SYSTem:NTP:STATe <UseNtpState>

Activates clock synchronization via NTP.

Parameters:

<UseNtpState> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example:

```
SYSTem:NTP:STATe 1
```

Manual operation: See "Use Time from NTP Server" on page 691

: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, see :SYSTem:PROTect<ch>[:STATe].

Parameters:

<Hour> integer

Range: 0 to 23

<Minute> integer

Range: 0 to 59

<Second> integer

Range: 0 to 59

Example:

```
SYSTem:TIME?
// 10,27,14
```

Manual operation: See "Time" on page 690

:SYSTem:TIME:ZONE <TimeZone>

Sets the timezone. You can query the list of the available timezones with `:SYSTem:TIME:ZONE:CATalog?`.

Parameters:

<TimeZone> string

Manual operation: See "Timezone" on page 691

:SYSTem:TIME:ZONE:CATalog?

Querys the list of available timezones.

Return values:

<Catalog>

Usage: Query only

Manual operation: See "Timezone" on page 691

:SYSTem:UPTime?

Queries the up time of the operating system.

Return values:

<UpTime> "<ddd.hh:mm:ss>"

Example: `SYSTem:UPTime?`
Response: `"0.08:11:00"`

Usage: Query only

:SYSTem:BIOS:VERSion?

Queries the BIOS version of the instrument.

Return values:

<Version> string

Example: `SYST:BIOS:VERS?`
queries the BIOS version.
`Response: 123456`

Usage: Query only

:SYSTem:VERSion?

Queries the SCPI version the instrument's command set complies with.

Return values:

<Version> string

Example: `SYST:VERS`
queries the SCPI version.
Response: `"1996"`
The instrument complies with the SCPI version from 1996.

Usage: Query only

:SYSTem:OSYStem?

Queries the operating system of the instrument.

Return values:
<OperSystem> string

Example: `SYSTem:OSYStem?`
Response: `"Linux"`

Usage: Query only

:SYSTem:MMEMory:PATH:USER?

Queries the user directory, that means the directory the R&S SMA100B stores user files on.

Return values:
<PathUser> string

Example: `SYSTem:MMEMory:PATH:USER?`
Response: "'/var/user/"

Usage: Query only

:SYSTem:DFPR?

Queries the device footprint of the instrument. The retrieved information is in machine-readable form suitable for automatic further processing.

Return values:
<DeviceFootprint> string
Information on the instrument type, device identification and details on the installed FW version, hardware and software options.

Example: `:SYSTem:DFPR?`

Usage: Query only

:SYSTem:REBoot

Reboots the instrument including the operating system.

Usage: Event

:SYSTem:RESTart

Restarts the instrument without restarting the operating system.

Usage: Event

:SYSTem:SHUTdown

Shuts down the instrument.

Usage: Event

Manual operation: See "Shut down" on page 697

:SYSTem:WAIT <TimeMs>

Delays the execution of the subsequent remote command by the specified time.

This function is useful, for example to execute an SCPI sequence automatically but with a defined time delay between some commands.

See Chapter 11.2.3, "Assigning Actions to the [★ (User)] Key", on page 326.

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 or, if installed, from the SD card slot.

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 Chapter A.1.5, "Status Reporting System", on page 722 for detailed information.

`*RST` on page 409 has no effect on the status registers.

Value ranges

- Queries return the current value of the respective register, which permits a check of the device status.
  Return values: A decimal value in the range 0 to 32767 (=2^{15}-1)
- The configuration commands set the respective register thus determining which status changes of the R&S SMA100B cause the status registers to be changed.
  Setting values: A decimal value in the range 0 to 32767 (=2^{15}-1)

:STATus:OPERation:CONDition?

Quieries the content of the CONDition part of the STATus:OPERation register.

This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out because it indicates the current hardware status.

Return values:

<Condition> string

Example: `:STATus:OPERation:CONDition?`

Usage: Query only

:STATus:OPERation:ENABle <Enable>

Sets the bits of the ENABle part of the STATus:OPERation register. This setting determines which events of the Status-Event part are forwarded to the sum bit in the status byte. These events can be used for a service request.

Parameters:

<Enable> string

Example: `:STAT:OPER:ENAB 32767`
all events are forwarded to the sum bit of the status byte.

:STATus:OPERation[:EVENt] <Event>

Queries the content of the EVENt part of the STATus:OPERation register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Parameters:

<Event> string

Example: `:STAT:OPER:EVEN?`
queries the STATus:OPERation:EVENt register.

:STATus:OPERation:NTRansition <Ntransition>

Sets the bits of the NTRansition part of the STATus:OPERation register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register. The disappearance of an event in the hardware is thus registered, for example the end of an adjustment.

Parameters:

<Ntransition> string

Example: `:STAT:OPER:NTR 0`
a transition from 1 to 0 in the condition part of the Status:Operation register does not cause an entry to be made in the EVENt part.

:STATus:OPERation:PTRansition <Ptransition>

Sets the bits of the PTRansition part of the STATus:OPERation register. If a bit is set, a transition from 0 to 1 in the condition part causes an entry to be made in the EVENt part of the register. A new event in the hardware is thus registered, for example the start of an adjustment.

Parameters:

<Ptransition> string

Example: `:STAT:OPER:PTR 32767`
all transitions from 0 to 1 in the condition part of the Status:Operation register cause an entry to be made in the EVENt part.

:STATus:PRESet <Preset>

Resets the status registers. All PTRansition parts are set to FFFFh (32767), i.e. all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e. a transition from 1 to 0 in a CONDition bit is not detected. The ENABle parts of STATus:OPERation and STATus:QUEStionable are set to 0, i.e. all events in these registers are not passed on.

Parameters:

<Preset> string

Example: `STAT:PRES`
resets the status registers.

:STATus:QUEStionable:CONDition <Condition>

Queries the content of the CONDition part of the STATus:QUEStionable register. This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out since it indicates the current hardware status.

Parameters:
<Condition> string

Example: `:STATus:QUEStionable:CONDition?`
queries the Status:Questionable:Condition register.

:STATus:QUEStionable:ENABle <Enable>

Sets the bits of the ENABle part of the STATus:QUEStionable register. The enable part determines which events of the STATus:EVENt part are enabled for the summary bit in the status byte. These events can be used for a service request.

If a bit in the ENABle part is 1, and the 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] <Event>

Queries the content of the EVENt part of the `STATus:QUEStionable` register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Parameters:
<Event> string

Example: `STAT:QUES:EVEN?`
queries the Status:Questionable:Event register.

:STATus:QUEStionable:NTRansition <Ntransition>

Sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register.

Parameters:
<Ntransition> string

Example: `STAT:QUES:NTR 0`
a transition from 1 to 0 in the condition part of the 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 658.

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.

:TEST<hw>:ALL:STARt

Usage: Event

Starts the selftest. Use the command `:TEST<hw>:ALL:RESult?` to query the result.

:TEST<hw>:ALL:RESult?

Queries the result of the performed selftest. Start the selftest with `:TEST<hw>:ALL:STARt`.

Return values:

<Result> 0 | 1 | RUNning | STOPped

*RST: STOPped

Usage: Query only

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 SMA100B 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.
EXTernal	EXTernal	"Ext Single" and "Ext Step" mode. Use command `LFO:SWEep:MODE` to select between the two sweep modes.
EAUTo	-	"Ext Start/Stop" mode.

:TRIGger<hw>:FSWeep:SOURce <Source>
:TRIGger<hw>:LFFSweep:SOURce <Source>
:TRIGger<hw>:PSWeep:SOURce <Source>
:TRIGger<hw>[:SWEep]:SOURce <Source>

Selects the trigger source for the corresponding sweeps:

- `FSWeep` - RF frequency
- `LFFSweep` - LF frequency
- `PSWeep` - RF level
- `SWEep` - all sweeps

The source names of the parameters correspond to the values provided in manual control of the instrument. They differ from the SCPI-compliant names, but the instrument accepts both variants.

Use the SCPI name, if compatibility is an important issue. Find the corresponding SCPI-compliant commands in Cross-reference between the manual and remote control .

Setting parameters:

<Source> AUTO | IMMediate | SINGle | BUS | EXTernal | EAUTo

AUTO [IMMediate]
Executes a sweep automatically.
In this free-running mode, the trigger condition is met continuously. I.e. when a sweep is completed, the next one starts immediately.

SINGle [BUS]
Executes one complete sweep cycle.
The following commands initiate a trigger event:
`*TRG` on page 410
`[:SOURce<hw>]:SWEep:POWer:EXECute`
`[:SOURce<hw>]:SWEep[:FREQuency]:EXECute`
`:TRIGger<hw>[:SWEep][:IMMediate]`, `:TRIGger<hw>:PSWeep[:IMMediate]` and `:TRIGger<hw>:FSWeep[:IMMediate]`.
Set the sweep mode with the commands:
`[:SOURce<hw>]:SWEep:POWer:MODE AUTO|STEP`
`[:SOURce<hw>]:SWEep[:FREQuency]:MODE AUTO|STEP`
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE AUTO|STEP`
In step mode (`STEP`), the instrument executes only one step.

EXTernal
An external signal triggers the sweep.

EAUTo
An external signal triggers the sweep. When one sweep is finished, the next sweep starts.
A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: AUTO

Example: See Example "Setup an LF sweep" on page 599

Usage: Setting only

Manual operation: See "Mode" on page 172

:TRIGger<hw>:FSWeep[:IMMediate]
:TRIGger<hw>:PSWeep[:IMMediate]
:TRIGger<hw>:LFFSweep:IMMediate
:TRIGger<hw>[:SWEep][:IMMediate]

Performs a single sweep and immediately starts the activated, corresponding sweep:

- `FSWeep` - RF frequency
- `PSWeep` - RF level
- `LFFSweep` - LF frequency
- `SWEep` - all sweeps

Effective in the following configuration:

- `TRIG:FSW|LFFS|PSW|[:SWE]:SOUR` **`SING`**
- `SOUR:SWE:FREQ|POW:MODE` **`AUTO`** or `SOUR:LFO:SWE:[FREQ:]MODE` **`AUTO`**

Alternatively, you can use the `IMMediate` command instead of the respective `SWEep:[FREQ:]|POW:EXECute` command.

Example: `TRIG`
Starts all active sweeps.

Usage: Event

Manual operation: See " Execute Single Sweep " on page 175

: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 <Angle>

Sets the default unit for phase modulation angle. The command affects no other parameters, such as RF phase, or the manual control or display.

Parameters:

<Angle>	DEGree | DEGRee | RADian
	*RST: RADian

:UNIT:POWer <Power>

Sets the default unit for all power parameters. This setting affects the GUI, as well as all remote control commands that determine power values.

Parameters:

<Power>	V | DBUV | DBM
	*RST: DBM

14 Maintenance

The instrument does not need periodic maintenance. Only the cleaning of the instrument is essential.

Follow the instructions in the service manual and the safety instructions when exchanging modules or ordering spares. The order no. for spare parts is included in the service manual. The service manual includes further information particularly on troubleshooting, repair, exchange of modules and alignment.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

NOTICE

Risk of damage during shipment

Insufficient protection against mechanical and electrostatic effects during shipment can damage the instrument.

- When shipping an instrument, use the original packaging. If you do not have the original packaging, use sufficient padding to prevent the instrument from moving around inside the box.
- Pack the instrument in antistatic wrap to protect it from electrostatic charging.
- Secure the instrument to prevent any movement and other mechanical effects during transportation.

14.1 Cleaning

WARNING

Risk of electric shock

If moisture enters the casing, for example if you clean the instrument using a moist cloth, contact with the instrument can lead to electric shock. Before cleaning the instrument other than with a dry cloth, make sure that the instrument is switched off and disconnected from all power supplies.

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances such as solvents (thinners, acetone, etc.), acids, bases, or other substances. Solvents can damage the front panel labeling, plastic parts, or screens, for example.

Never use cleaning agents to clean the outside of the instrument. Use a soft, dry, lint-free dust cloth instead.

NOTICE

Risk of instrument damage due to obstructed fans

If the instrument is operated in dusty areas, the fans become obstructed by dust or other particles over time. Check and clean the fans regularly to ensure that they always operate properly. If the instrument is run with obstructed fans for a longer period, the instrument overheats, which can disturb the operation and even cause damage.

1. Clean the outside of the instrument using a soft, dry, lint-free dust cloth.
2. Check and clean the fans regularly to ensure that they always operate properly.
3. Clean the touchscreen as follows:
   a) Apply a small amount of standard screen cleaner to a soft cloth.
   b) Wipe the screen gently with the moist, but not wet, cloth.
   c) If necessary, remove any excess moisture with a dry, soft cloth.

14.2 Storing and Packing

The storage temperature range of the instrument is given in the data sheet. If the instrument is to be stored for a longer period of time, it must be protected against dust.

Repack the instrument as it was originally packed when transporting or shipping. The two protective foam plastic parts prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.

If you do not use the original packaging, use a sturdy cardboard box of suitable size and provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

14.3 Performing Maintenance Tasks

The R&S SMA100B is accurate due to integrated adjustment procedures, which you can execute directly on the instrument.

Internal Adjustments

NOTICE

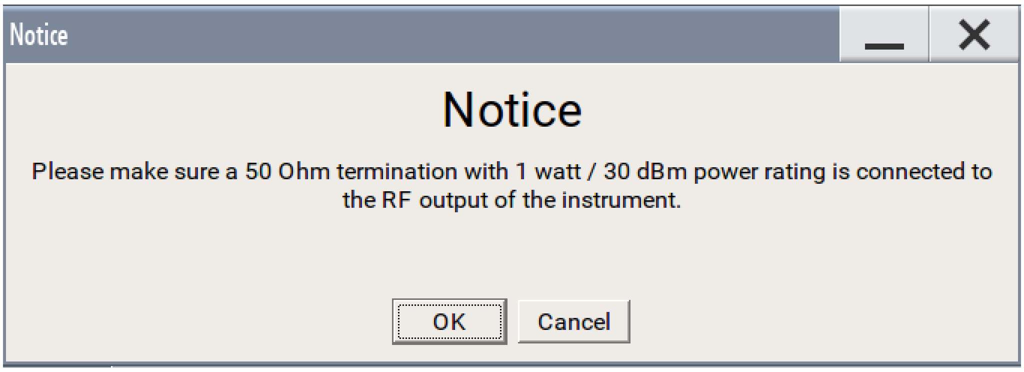
Risk of DUT damage

During internal adjustments, the instrument temporarily applies high power at the RF output. This high power can destroy a connected DUT (device under test).

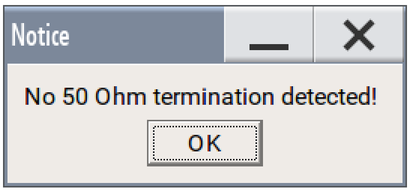
Do not start internal adjustments if the DUT is connected.

Disconnect the DUT and replace it by a terminating resistor with adequate power rating.

Note: Before the internal adjustment starts, a warning message prompts you to make sure that you have terminated the RF output as specified in the message. The required power of the resistor varies depending on whether the instrument is equipped with a high power option.



If the termination resistor is missing, a second warning message appears.



NOTICE

Risk of invalid adjustment

Wait until the instrument has reached its operating temperature before you start the adjustment procedure. The warm-up time is 30 minutes.

Self-calibration routines that require additional (external) equipment are performed at an authorized Rohde & Schwarz service center.

See also "Protection levels" on page 332.

When to perform adjustments?

We recommend that you perform internal adjustments in the following cases:

- Before starting any application, that requires a maximum of level and frequency accuracy
- When a long period of time has passed since the last adjustments
- If the ambient temperature of the instrument significantly differs from the one of the last adjustments

Additional Information to the Adjustments

During adjustments, a progress indicator shows the status of the process. If any error occurs, the process aborts and an error message appears in the info line.

The extent of the adjustments depends on the installed options.

14.3.1 Date and Time Settings

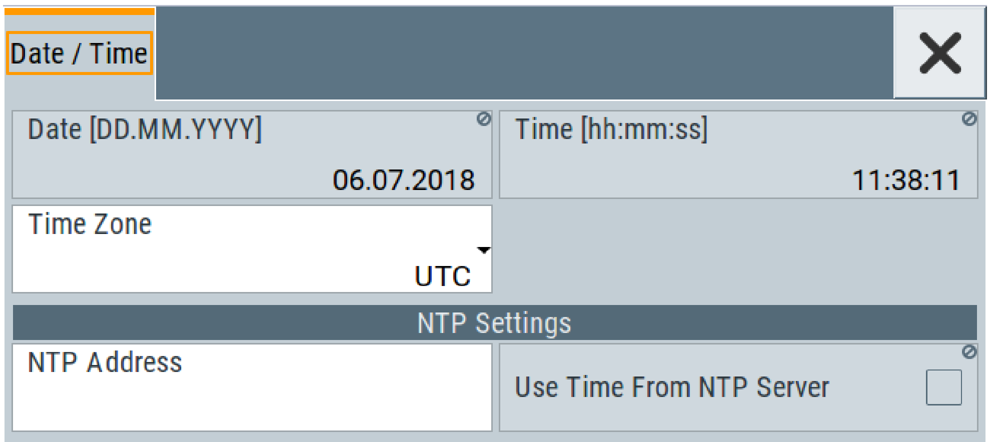
The R&S SMA100B uses an internal real-time clock to determine the date and time. It adjusts the time and date to the timezone of your location automatically, by providing a selection list of continents and cities.

The instrument records the time whenever you create or modify files on your instrument or you use timed licenses. By default, the instrument is set to the UTC timezone, but you can select the timezone according to your location.

Moreover, the instrument supports NTP protocol for synchronizing all connected instruments and computer systems to minimize time delays in the network.

Access:

► Select "System Config > Setup > Maintenance > Date / Time".



The "Date / Time" dialog contains the time and data settings of the operating system.
This function is password-protected. Unlock the protection level 1 to access it.

The required remote commands are described in Chapter 13.17, "SYSTem Subsystem", on page 653.

To select the timezone

1. Press the [Setup] key.
2. Select "Maintenance > Date /Time > Timezone".
3. Select continent and city of your location.
   Tip: By typing the first letter, you can quickly navigate through the lists to find the desired destination.
4. Close the dialogs.

   The instrument adjusts the time according to the selected location.

To set the date and time

1. Press the [Setup] key.
2. Select "Security > Protection".
3. Enable the "Protection Level 1".
   The default password is *123456*.
4. Select "Setup > Maintenance > Date / Time".
5. Adjust the settings.
6. Close the dialogs.

   The instrument adopts the new date and time.

Settings:

Date

Displays the date set in the operating system in the format [dd.mm.yyyy].

Remote command:
`:SYSTem:DATE` on page 673

Time

Displays the time set in the operating system in the format [hh.mm.ss].

The time setting corresponds to the selected Use Time from NTP Server.

Remote command:
`:SYSTem:TIME` on page 674

Timezone
Selects the timezone.

You can select the timezone according to the major cities on the respective continents.

Note: By typing the first letter, you can quickly navigate through the lists to find the desired destination.

Remote command:
`:SYSTem:TIME:ZONE` on page 675
`:SYSTem:TIME:ZONE:CATalog?` on page 675

NTP Address
Sets the IP address or host name of the NTP server.

NTP is a network time protocol used for synchronizing all participating devices in a data network.

You can select a high-precision time server to reduce the impact of varying network delays.

Remote command:
`:SYSTem:NTP:HOSTname` on page 674

Use Time from NTP Server
Activates clock synchronization of the network via the NTP protocol.

Remote command:
`:SYSTem:NTP:STATe` on page 674

14.3.2 Check Front Panel

Within this dialog, you can verify the functionality of the control keys.

For Instructions on how to perform the tests and the expected results, see Chapter 14.3.2.2, "How to Test the Front Panel", on page 692

In case of malfunctions:

Contact the Rohde & Schwarz customer support, see Chapter 15.6, "Collecting Information for Technical Support", on page 707.

Accessing the online help in the check front panel dialog or exiting via [Esc]
During the test, the actual functions of all keys are disabled, including the [Help] and the [Esc] keys.

14.3.2.1 Check Front Panel Settings

Access:

► Select "System Config > Setup > Maintenance > Check Front Panel".

Reflecting the front panel, the "Check Front Panel" dialog contains all functions to test the operating elements of the instrument.

14.3.2.2 How to Test the Front Panel

How to perform the key panel test

To perform the key panel test, you operate the keys at the front panel, and check the response of the instrument in the "Check Front Panel" dialog. To perform this test 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, see Press the ESC key a third time.

5. Continue with the next key on the front panel and repeat step 3 to step 5 until all keys are tested.

   The test is completed, when each key is verified successfully, confirmed by a "Test passed" message.

► Press the [Esc] key a third time.
Exits the "Check Front Panel" dialog.

Expected responses:

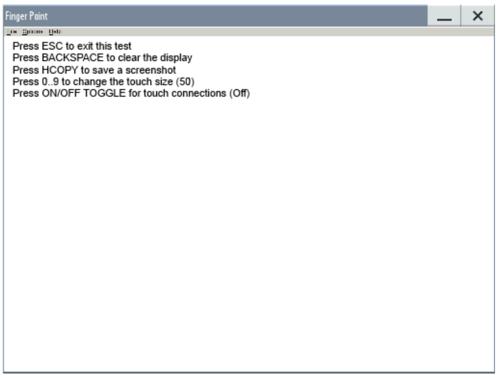
- Pressing a key once (green), pressing twice (red)
- Pressing the [Esc] key a third time exits the dialog.

If you detect a malfunction, for example, you press the front panel key the first time, and the color of the button in the dialog turns red (instead of green), the front panel key may be stuck.

Contact the Rohde & Schwarz customer support, see Chapter 15.6, "Collecting Information for Technical Support", on page 707.

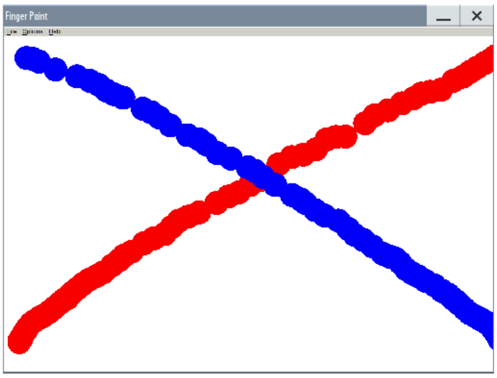
How to perform the touchscreen test

1. Press the [Setup] key.
2. Select "Maintenance > Check Touch Panel"
   The "Finger Paint" test window opens.

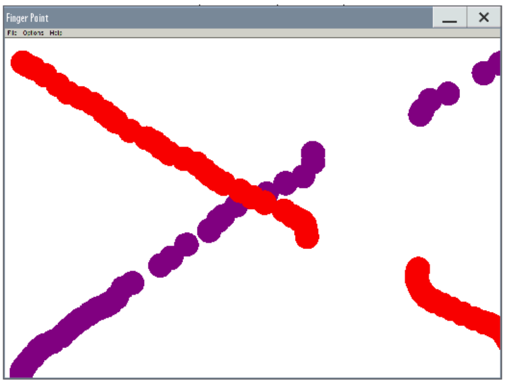


3. Drag with your finger one or more lines, for example diagonally across the screen.
   The test traces the movements of your finger on the screen.

   The following results are expected:
   - If the lines are uninterrupted, the touchscreen works properly.



- If there are any gaps, the touch-sensitive functionality is damaged.



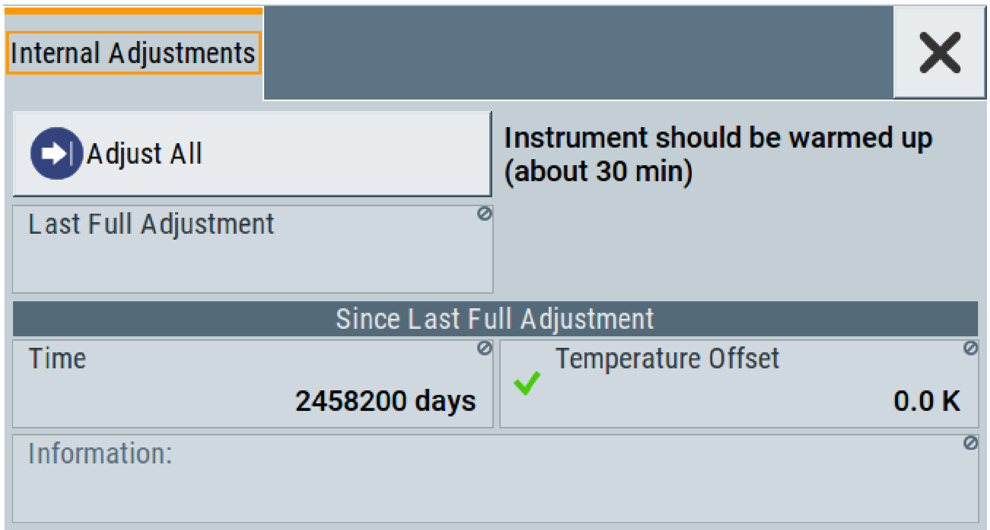
- To return to the "Check Front Panel" dialog, press [Esc].

If there are malfunctions:
Contact the Rohde & Schwarz customer support, see Chapter 15.6, "Collecting Information for Technical Support", on page 707.

14.3.3 Internal Adjustment Settings

Access:

► Select "System Config > Setup > General > Internal Adjustments".



In this dialog, you can perform internal calibration routines and get information on the last performed calibration.

The remote commands required to define these settings are described in Chapter 13.6, "CALibration Subsystem", on page 422.

The background color of "Temperature Offset" depends on the deviation of the temperature at the beginning of the adjustment, compared to the last adjustment. We recommend that you perform internal adjustments if the instrument is warmed up, but depending on instrument usage, less than 30 minutes are sufficient.

Further functions and individually targeted calibration routines are also available but password-protected.

- Calibration routines
  Self-calibration routines that require additional (external) equipment are performed in the Rohde & Schwarz service center.
  These functions are password-protected and require higher-level protection password, see "Protection levels" on page 332

For more information, see R&S SMA100B Service Manual.

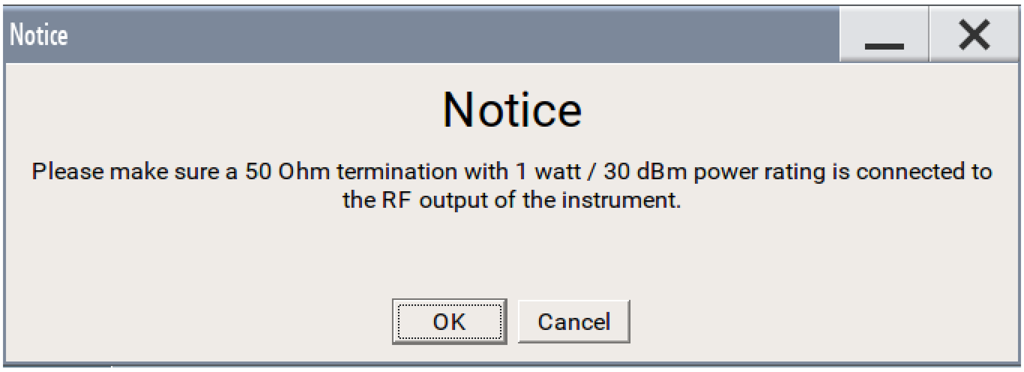
Adjust All

Performs all available internal calibration routines of the instrument.

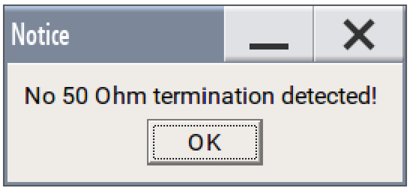
NOTICE! Risk of DUT damage. During internal adjustments, the instrument temporarily applies high power at the RF output. This high power can destroy a connected DUT (device under test).
Do not start internal adjustments if the DUT is connected.

Disconnect the DUT and replace it by a terminating resistor with adequate power rating.

Note: Before the internal adjustment starts, a warning message prompts you to make sure that you have terminated the RF output as specified in the message. The required power of the resistor varies depending on whether the instrument is equipped with a high power option.



If the termination resistor is missing, a second warning message appears.



Remote command:
`:CALibration:ALL[:MEASure]?` on page 423

Last Full Adjustment
Displays the date of the last fully performed adjustment.

Remote command:
`:CALibration<hw>:ALL:DATE?` on page 423

Time Since Last Full Adjustment
Displays the elapsed time since the last full adjustment.

Remote command:
`:CALibration<hw>:ALL:TIME?` on page 424

Temperature Offset Since Last Full Adjustment
Displays the temperature difference, comparing the temperature at the beginning of the last adjustment to the temperature at the beginning of the present adjustment.

If the temperature deviates more than ± 5 K, the background of the parameter turns yellow.

Remote command:
`:CALibration<hw>:ALL:TEMP?` on page 424

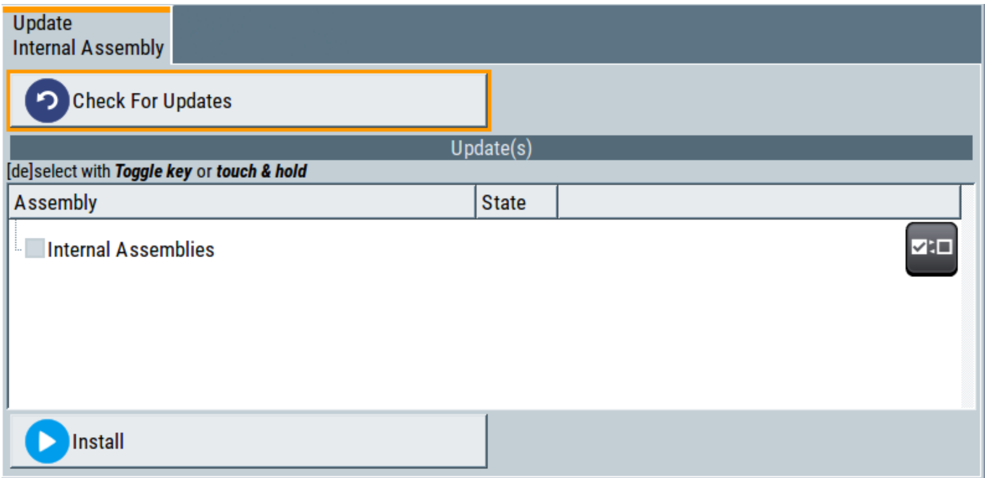
Information
Displays information to the current adjustment state.

Remote command:
`:CALibration<hw>:ALL:INFormation?` on page 423

14.3.4 FPGA/uC Update Settings

Access:

► Select "System Config > Setup > Maintenance > FPGA/µC Update".



This dialog enables you to check for and install internal assembly updates.

Settings:

Check For Updates

Check for updates of the FPGA/µC.

Remote command:
n.a.

Assembly

The table shows the installed assemblies and their states.

"Assembly"	Assembly designation.
"State"	Indicates the current state of installed assemblies.

Install

Install all available updates for the FPGA/µC.

Remote command:
n.a.

Shut down

For at least one assembly "State = Done" and no pending assemblies, shuts the instrument down to applies installed updates.

Remote command:

:SYSTem:SHUTdown on page 677

14.3.5 Requesting Instrument Configuration and Specifications

The R&S SMA100B is equipped with various hardware and software components. To get an overview of what your instrument is equipped with, you can request the assemblies, hardware and software options, and the firmware version. The components are structured according to the hardware configuration, software options, including the license management, and externally used Rohde & Schwarz equipment, like R&S NRP power sensors.

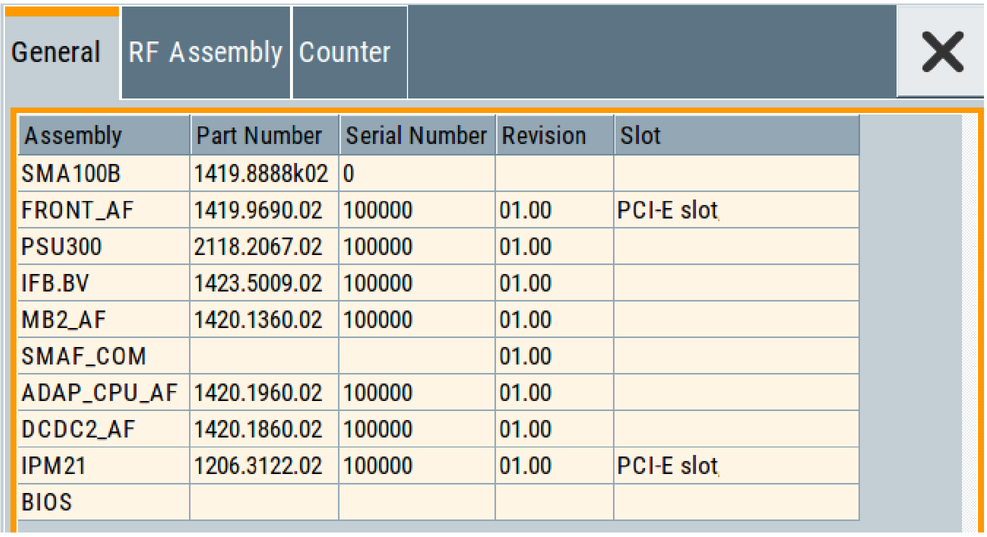
Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. How to install options is described in chapter 4 of the R&S SMA100B service manual.

The installation of hardware options purchased at a later stage is also described in chapter 4 of the service manual. Most of the hardware options have to be installed at an authorized Rohde & Schwarz service center.

14.3.5.1 Hardware Configuration Settings

Access:

► Select "System Config > Setup > Instrument Assembly > Hardware Config".



Assembly	Part Number	Serial Number	Revision	Slot
SMA100B	1419.8888k02	0		
FRONT_AF	1419.9690.02	100000	01.00	PCI-E slot
PSU300	2118.2067.02	100000	01.00	
IFB.BV	1423.5009.02	100000	01.00	
MB2_AF	1420.1360.02	100000	01.00	
SMAF_COM			01.00	
ADAP_CPU_AF	1420.1960.02	100000	01.00	
DCDC2_AF	1420.1860.02	100000	01.00	
IPM21	1206.3122.02	100000	01.00	PCI-E slot
BIOS				

The "Hardware Config" dialog lists all installed assemblies and externally connected instruments with information on their part and serial numbers, and revision states. The BIOS version is also listed; firmware updates do not update the BIOS version.

The dialog is divided in tabs, according to the hardware components of the signal domains. The "Counter" tab provides information on the operation time and number of times the instrument was powered on.

The remote commands required to query the hardware configuration are described in Chapter 13.8, "DIAGnostic Subsystem", on page 430.

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 431

Counter
Displays information on the operation times of the R&S SMA100B.

Operation Time / h ← Counter
Displays the operation time in hours.

Remote command:
n.a.

Power On Count ← Counter
Displays the number of power-on.

Remote command:
n.a.

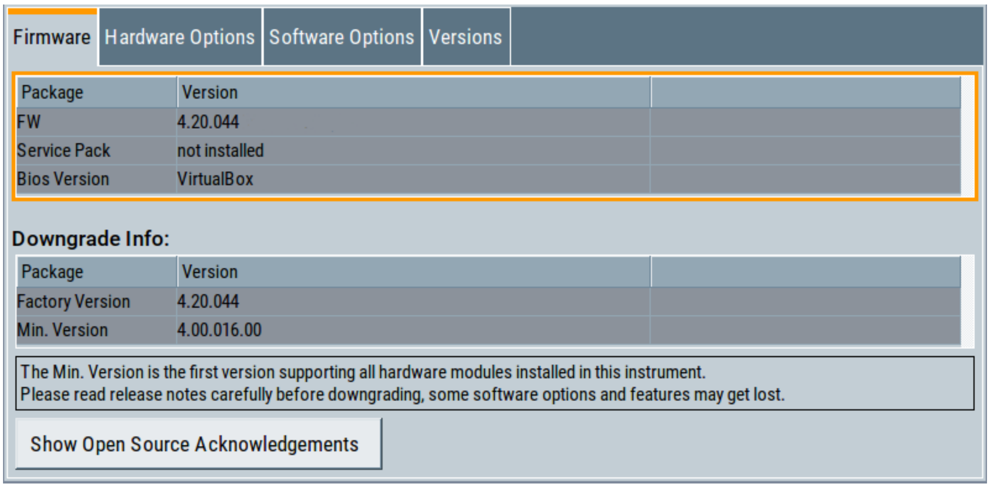
Last Factory Calibration ← Counter
Displays the date of the last factory calibration.

Remote command:
`:CALibration:DATA:FACTory:DATE?` on page 424

14.3.5.2 Versions/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 Chapter 13.8, "DIAGnostic Subsystem", on page 430.

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/sma100b

Remote command:
n.a.

Downgrade Info
Shows downgrade information, like factory firmware version and minimum firmware version to that the instrument can be downgraded.

Remote command:
n.a.

Show Open Source Acknowledgments
Accesses the list of the used open source software packages and the corresponding verbatim license texts.

Hardware Options/Software Options
The tables in the "Hardware" and "Software" tabs list the installed hardware and software options.

"Option"	Short name of option
"Designation"	Name of option

"Expiration Date"
For regular options, "Permanent" is indicated in this column. Some options are available as trial versions. This column shows their expiration date. After this date, the option is no longer available on the instrument.

Remote command:
*OPT? on page 408
*IDN? on page 407

Versions

The "Versions" tab shows the versions of the technical specification of the R&S SMA100B and of the software components that comprise the firmware.

"Package" Name of the component.

"Version" Current issue of the component.
E.g. the data sheet covers the technical data of the hardware components of the factory settings.
See also "Data Sheet" on page 372.

Remote command:
:SYSTem:SPECification:VERSion:FACTory? on page 672

14.3.5.3 Requesting the Data Sheet

You can access data sheet realted inforamtion vie the LXI web browser, see "Data Sheet" on page 372.

15 Troubleshooting and Error Messages

The R&S SMA100B distinguishes between various messages such as status messages, error messages, warnings, or information that are displayed in the "Info" line on the screen, and also entered in the error/event queue of the status reporting system.

This section describes the types of error messages and warnings. The status reporting system is described in detail in Chapter A.1.5, "Status Reporting System", on page 722.

You can also access an Info window with detailed information about all messages in a history list. For details, see Chapter 15.4, "Querying Error Messages", on page 704

15.1 Error Messages

Error messages indicate errors in the instrument. They are displayed in different colors depending on their importance and display duration. Errors (e.g. no calibration data) are displayed in red, information (e.g. file not found) and warnings in black. Warnings indicate less significant errors (e.g. the instrument operates outside specified data).

Some error messages require that the error must be eliminated before correct instrument operation can be ensured. To access the "Info" dialog with a list of current messages and a detailed description of each message, select "Info".

In the remote control mode, error messages are entered in the error/event queue of the status reporting system and can be queried with the command `SYSTem:ERRor?`. If the error queue is empty, 0 ("No error") is returned.

15.1.1 Volatile Messages

Volatile messages report automatic settings in the instrument (e.g. switching off incompatible types of modulation) or on illegal entries that are not accepted by the instrument (e.g. range violations). They are displayed in the info line on a yellow background. They are displayed on top of status information or permanent messages.

Volatile messages do not normally demand user actions and disappear automatically after a brief period of time. They are stored in the history, however.

Remote command:

`:SYSTem:ERRor:ALL?` or

`:SYSTem:ERRor:CODE[:NEXT]?`

15.1.2 Permanent Messages

Permanent messages are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signaled by a permanent message must be eliminated before correct instrument operation can be continued.

The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

Remote command:

`:SYSTem:ERRor:STATic?`

15.2 SCPI-Error Messages

The SCPI error messages are the same in all SCPI instruments. Detailed information and an overview of all error messages as defined in SCPI standard can be found in the corresponding documentation.

The errors are assigned negative numbers. The error text being entered into the error/ event queue or being displayed is printed in bold face on the left together with the error code. Below the error text, there is an explanation as to the respective error.

15.3 Device-Specific Error Messages

The following table contains all error messages specific for the instrument in alphabetical order, as well as an explanation of the error situation. The positive error codes mark the errors specific to the instrument.

The device-specific error messages set bit 3 in the ESR register.

The index provides a list of the error messages sorted according to their error codes.

Error Code	Error	Description	Remedy
50	Extern reference out of range or disconnected	External reference is selected but no external signal is applied or the signal is out of range.	• Check the selected reference signal source (internal or external) in the "Setup > Reference Oscillator" dialog. • Change setting to 'internal' if no appropriate external source is available.
140	This modulation forces other modulations off	A modulation has been switched on which cannot be used at the same time as an already active modulation. The previous modulation has been switched off.	
180	Adjustment failed	Adjustment could not be executed	Generate the adjustment data and load it into the device
182	Adjustment data missing	Adjustment data is missing.	Generate the adjustment data and load it into the device

Error Code	Error	Description	Remedy
183	Adjustment data invalid	Adjustment data is invalid and must be restored.	Generate the adjustment data and load it into the device
200	Cannot access hardware	The data transmission to a module was unsuccessful.	The module is not installed, not properly installed or missing.
201	Hardware revision out of date	A later version of certain parts of the instrument is necessary to execute the function selected.	The driver does not support the installed version of a module.
202	Cannot access the EEPROM	An error occurs when writing or reading a EEPROM.	The EEPROM is possibly defect. Replace it.
203	Invalid EEPROM data	Reading a EEPROM is possible, however the data are inconsistent.	
204	Driver initialization failed	Initialization of a driver fails when booting the instrument firmware.	The driver is not compatible with the hardware or software configuration of the instrument.
241	No current list	There is no list selected. To execute the required operation, a list has to be selected in the related dialog. If no list is available, a new list must be created.	
242	Unknown list type specified	The list type selected is not valid for the required operation.	Check the selected list type.
460	Cannot open the file	The selected file cannot be opened.	Check the path and file name.
461	Cannot write file	The file cannot be written.	Check if the file is read-only.
462	Cannot read file	The file cannot be read.	Check if the file contents are compatible with the file type.
463	Filename missing	The required operation cannot be executed because the file name is not specified.	Enter file name when creating list.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extension.
465	File contains invalid data	The selected file contains data that is not valid for the file type. The file extension determines the data that is valid for this file type. If the file extension is changed, the lists are no longer recognized and the data is therefore invalid.	Check the file extension.

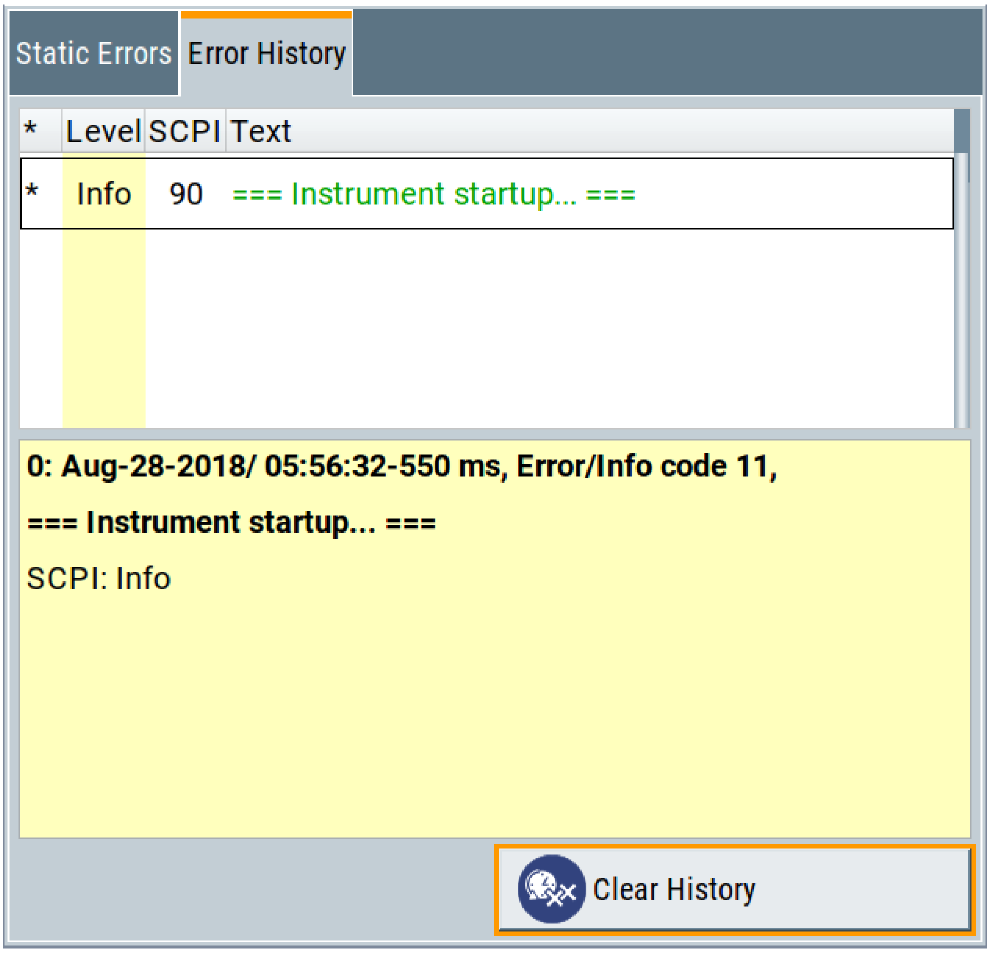
15.4 Querying Error Messages

The R&S SMA100B monitors the functions performed and automatically detects errors and irregularities. The instrument displays the messages in the "Info" line and records them in the background with a detailed description.

Find details to the system messages in Chapter 15, "Troubleshooting and Error Messages", on page 702.

To display information on static errors and error history

1. In the taskbar, select the "Info" icon.
2. For some messages, the information line appears briefly on the home screen.
   To open the dialog, in the "Info" line select the "Info" button.



- The "Static Errors" dialog lists the last monitored messages chronologically and displays additional information on the highlighted message.
- The "Error History" dialog lists the accumulated messages with a short description.
  Volatile errors are reported once, at the time they appear. If identical errors occur subsequently, they are not reported repeatedly.
  In the "Info" line, identical errors are displayed repeatedly only if the original error has already disappeared from the display. If queried by SCPI command, identical errors are only reported if the original error has already been retrieved from (and hence not any more present in) the error queue.

Indication and handling of permanent messages

If any critical error occurs, the R&S SMA100B automatically shows the icon in the taskbar. Select the icon to obtain information on the error and the number of occurrences.

The icon is assigned to permanent messages. The message and icon are displayed until the error is eliminated.

Static Errors/Error History

Toggles between "Static" and "History" view of the info dialog.

Remote command:

`:SYSTem:ERRor[:NEXT]?` on page 658

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 659

Queries the list of all errors.

Clear History

Clears all messages in the "History" view.

Remote command:

`:SYSTem:ERRor:ALL?` on page 656

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 659

Clears the messages in the "History" view.

15.5 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 SMA100B and certain switches or routers available on the market
- An invalid IP address assigned to the instrument

Possible solutions

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

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

Errors can affect the entire network.

- Check the network infrastructure. Exchange connecting cables if obvious damage is visible.
- Observe the link status LED on the R&S SMA100B or the connected network device. The link status LED is located next to the LAN connector.
  If a link failure is detected, connect the instrument to a different device port or to a different network device.
- Check whether the LAN interface and the required LAN services are enabled.
  See Chapter 11.4.3, "Configuring LAN Services", on page 340.
- Check whether the IP address of the instrument is within the network's address range.
  (See also "IP Address" on page 360).
  Check whether IP addresses that were set manually or obtained via the Zeroconf (APIPA) protocol are valid.

15.6 Collecting Information for Technical Support

If you encounter problems that you cannot solve yourself, contact your Rohde & Schwarz support center as listed at http://www.customersupport.rohde-schwarz.com. Our support center staff is optimally trained to assist you in solving problems.

The support center finds solutions more quickly and efficiently if you provide them with information on the instrument and an error description.

- The following dialog boxes in the "Setup > Instrument Assembly" menu provide useful information:
  – **Hardware Configuration:** hardware assemblies
  – **Software and Options:** the status of all software and hardware options installed on your instrument
- **System Messages:** displayed in the "Info" line and provide information on any errors that have occurred
- **Support file:** a special file (`*.tar.gz` file) with important support information that can be created automatically.

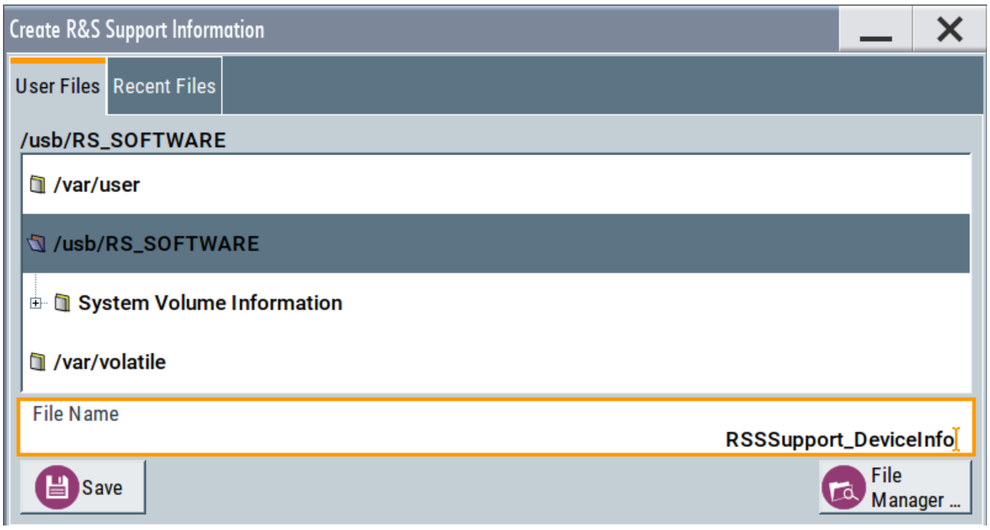
The support *.tar.gz file has a user definable name and contains the following files and information:

- SgErrors.txt: chronological record of errors
- SystemRestaurationSMAB.savrcltxt: instrument settings at the last correct shutdown of the instrument
- UndoHistSuppInfo.xml: list of the last user interactions
- DeviceFootprint_<SerialNumber>_<Date>_<Time>.xml: service-related information on the instrument's configuration.
- crashlog.txt, coredump: Postmortem debug info
- Several files with information on the last performed adjustment and self-test.

See also the description of error messages Chapter 15.1, "Error Messages", on page 702.

To collect error information in a support file

1. Connect a USB device to the R&S SMA100B.
2. Select "System Config > Setup > Maintenance > Create R&S Support Information".
3. In the "Create R&S Support Information" dialog, navigate to the /usb directory.
   Enter the support filename, for example RSSupport_DeviceInfo.



The error information and further required data is collected automatically.
The support file RSSupport_DeviceInfo.tar.gz is created and stored in the /usb directory.
Collect the error information and attach it to an email in which you describe the problem. Send the email to the customer support address for your region as listed on the Internet (http://www.customersupport.rohde-schwarz.com).

To remove sensitive data

► For information on how to handle or remove the sensitive data from your instrument, refer to the description "Resolving Security Issues when working with R&S SMA100B".

Packing and transporting the instrument

► If the instrument has to be transported or shipped, observe the notes described in Chapter 2.1.1.2, "Unpacking and Checking the Instrument", on page 22.

Annex

A Reference Information for Remote Control

A.1 Additional Basics on Remote Control

This section provides basic information using the remote control.

A.1.1 Messages

The messages transferred on the data lines are divided into the following categories:

- Interface messages
  Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They are used to communicate between the controller and the instrument. Interface messages can only be sent by instruments that have GPIB bus functionality. For details see the sections for the required interface.
- Instrument messages
  Instrument messages are employed in the same way for all interfaces, if not indicated otherwise in the description. Structure and syntax of the instrument messages are described in Chapter A.1.3, "SCPI Command Structure", on page 711. A detailed description of all messages available for the instrument is provided in the chapter "Remote Control Commands".
  There are different types of instrument messages, depending on the direction they are sent:
  – Commands
  – Instrument responses

Commands

Commands (program messages) are messages the controller sends to the instrument. They operate the instrument functions and request information. The commands are subdivided according to two criteria:

- According to the effect they have on the instrument:
  – **Setting commands** cause instrument settings such as a reset of the instrument or setting the frequency.
  – **Queries** cause data to be provided for remote control, e.g. for identification of the instrument or polling a parameter value. Queries are formed by directly appending a question mark to the command header.
- According to their definition in standards:
  – **Common commands**: their function and syntax are precisely defined in standard IEEE 488.2. They are employed identically on all instruments (if implemented). They refer to functions such as management of the standardized status registers, reset and self-test.

– **Instrument control commands** refer to functions depending on the features of the instrument such as frequency settings. Many of these commands have also been standardized by the SCPI committee. These commands are marked as "SCPI confirmed" in the command reference chapters. Commands without this SCPI label are device-specific; however, their syntax follows SCPI rules as permitted by the standard.

Instrument responses

Instrument responses (response messages and service requests) are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status.

A.1.2 LAN Interface Messages

In the LAN connection, the interface messages are called low–level control messages. These messages can be used to emulate interface messages of the GPIB bus.

Command	Long term	Effect on the instrument
&ABO	Abort	Aborts processing of the commands just received.
&DCL	Device Clear	Aborts processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
&GTL	Go to Local	Transition to the "local" state (manual control). (The instrument automatically returns to remote state when a remote command is sent UNLESS `&NREN` was sent before.)
&GTR	Go to Remote	Enables automatic transition from local state to remote state by a subsequent remote command (after `&NREN` was sent).
&GET	Group Execute Trigger	Triggers a previously active instrument function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
&LLO	Local Lockout	Disables transition from remote control to manual control by means of the front panel keys.
&NREN	Not Remote Enable	Disables automatic transition from local state to remote state by a subsequent remote command. (To re-activate automatic transition use `&GTR`.)
&POL	Serial Poll	Starts a serial poll.

A.1.3 SCPI Command Structure

SCPI commands consist of a header and, in most cases, one or more parameters. The header and the parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several mnemonics (keywords). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common commands). Common and device-specific commands differ in their syntax.

A.1.3.1 Syntax for Common Commands

Common (= device-independent) commands consist of a header preceded by an asterisk (*), and possibly one or more parameters.

Table A-1: Examples of common commands

*RST	RESET	Resets the instrument.
*ESE	EVENT STATUS ENABLE	Sets the bits of the event status enable registers.
*ESR?	EVENT STATUS QUERY	Queries the contents of the event status register.
*IDN?	IDENTIFICATION QUERY	Queries the instrument identification string.

A.1.3.2 Syntax for Device-Specific Commands

Not all commands used in the following examples are necessarily implemented in the instrument. For demonstration purposes only, assume the existence of the following commands for this section:

- DISPlay[:WINDow<1...4>]:MAXimize <Boolean>
- FORMat:READings:DATA <type>[,<length>]
- HCOPy:DEVice:COLor <Boolean>
- HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>
- HCOPy[:IMMediate]
- HCOPy:ITEM:ALL
- HCOPy:ITEM:LABel <string>
- HCOPy:PAGE:DIMensions:QUADrant[<N>]
- HCOPy:PAGE:ORIentation LANDscape | PORTrait
- HCOPy:PAGE:SCALe <numeric value>
- MMEMory:COPY <file_source>,<file_destination>
- SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>
- SENSe:FREQuency:STOP <numeric value>
- SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

`HCOPy:DEVice:COLor ON` is equivalent to `HCOP:DEV:COL ON`.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric Suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:

Definition: `HCOPy:PAGE:DIMensions:QUADrant[<N>]`

Command: `HCOP:PAGE:DIM:QUAD2`

This command refers to the quadrant 2.

Different numbering in remote control

For remote control, the suffix may differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. If the numbering differs in manual operation and remote control, it is indicated for the corresponding command.

Optional Mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: `HCOPy[:IMMediate]`

Command: `HCOP:IMM` is equivalent to `HCOP`

Optional mnemonics with numeric suffixes

Do not omit an optional mnemonic if it includes a numeric suffix that is relevant for the effect of the command.

Example:

Definition:`DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`

Command: `DISP:MAX ON` refers to window 1.

In order to refer to a window other than 1, you must include the optional `WINDow` parameter with the suffix for the required window.

`DISP:WIND2:MAX ON` refers to window 2.

A.1.3.3 SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank).

The parameters required for each command and the allowed range of values are specified in the command description.

Allowed parameters are:

Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed.

Example:

`SENS:FREQ:STOP 1500000` = `SENS:FREQ:STOP 1.5E6`

Units

For physical quantities, the unit can be entered. If the unit is missing, the basic unit is used. Allowed unit prefixes are:

- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)

- N (nano)

Example:

`SENSe:FREQ:STOP 1.5GHz` = `SENSe:FREQ:STOP 1.5E9`

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the `PCT` string.

Example:

`HCOP:PAGE:SCAL 90PCT`

Special Numeric Values

The following mnemonics are special numeric values. In the response to a query, the numeric value is provided.

- **MIN and MAX**: denote the minimum and maximum value.
- **DEF**: denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command.
- **UP and DOWN**: increases or reduces the numeric value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP and DOWN.
- **INF and NINF**: INFinity and negative INFinity (NINF) represent the numeric values 9.9E37 or -9.9E37, respectively. INF and NINF are only sent as instrument responses.
- **NAN**: Not A Number (NAN) represents the value 9.91E37. NAN is only sent as a instrument response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Example:

Setting command: `SENSe:LIST:FREQ MAXimum`

Query: `SENS:LIST:FREQ?`

Response: `3.5E9`

Queries for special numeric values

The numeric values associated to `MAXimum/MINimum/DEFault` can be queried by adding the corresponding mnemonic after the quotation mark.

Example: `SENSe:LIST:FREQ? MAXimum`

Returns the maximum numeric value as a result.

Boolean Parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The numeric values are provided as the response for a query.

Example:

Setting command: `HCOPy:DEV:COL ON`

Query: `HCOPy:DEV:COL?`

Response: `1`

Text Parameters

Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the response to a query, the short form of the text is provided.

Example:

Setting command: `HCOPy:PAGE:ORIentation LANDscape`

Query: `HCOP:PAGE:ORI?`

Response: `LAND`

Character Strings

Strings must always be entered in quotation marks (' or ").

Example:

`HCOP:ITEM:LABel "Test1"`

`HCOP:ITEM:LABel 'Test1'`

Block Data

Block data is a format which is suitable for the transmission of large amounts of data. For example, a command using a block data parameter has the following structure:

`FORMat:READings:DATA #45168xxxxxxxx`

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted.

#0 specifies a data block of indefinite length. The use of the indefinite format requires a `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

A.1.3.4 Overview of Syntax Elements

The following tables provide an overview of the syntax elements and special characters.

Table A-2: Syntax elements

:	The colon separates the mnemonics of a command.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk marks a common command.
' ' "	Quotation marks introduce a string and terminate it (both single and double quotation marks are possible).
#	The hash symbol introduces binary, octal, hexadecimal and block data. ● Binary: #B10110 ● Octal: #O7612 ● Hexa: #HF3A7 ● Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

Table A-3: Special characters

<table>
<tr><td>|</td><td>Parameters
A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.
Example:
Definition:HCOPy:PAGE:ORIentation LANDscape | PORTrait
Command HCOP:PAGE:ORI LAND specifies landscape orientation
Command HCOP:PAGE:ORI PORT specifies portrait orientation
Mnemonics
A selection of mnemonics with an identical effect exists for several commands. These mnemonics are indicated in the same line; they are separated by a vertical stroke. Only one of these mnemonics needs to be included in the header of the command. The effect of the command is independent of which of the mnemonics is used.
Example:
DefinitionSENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>
The two following commands with identical meaning can be created:
SENS:BAND:RES 1
SENS:BWID:RES 1</td></tr>
<tr><td>[ ]</td><td>Mnemonics in square brackets are optional and may be inserted into the header or omitted.
Example: HCOPy[:IMMediate]
HCOP:IMM is equivalent to HCOP</td></tr>
<tr><td>{ }</td><td>Parameters in curly brackets are optional and can be inserted once or several times, or omitted.
Example: SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}
The following are valid commands:
SENS:LIST:FREQ 10
SENS:LIST:FREQ 10,20
SENS:LIST:FREQ 10,20,30,40</td></tr>
</table>

A.1.3.5 Structure of a Command Line

A command line may consist of one or several commands. It is terminated by one of the following:

- <New Line>
- <New Line> with EOI
- EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";".

Example:

`MMEM:COPY "Test1","MeasurementXY";:HCOP:ITEM ALL`

This command line contains two commands. The first command belongs to the MMEM system, the second command belongs to the HCOP system. If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

`HCOP:ITEM ALL;:HCOP:IMM`

This command line contains two commands. Both commands are part of the `HCOP` command system, i.e. they have one level in common.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. When abbreviating the command line, the second command begins with the level below HCOP. The colon after the semicolon is omitted. The abbreviated form of the command line reads as follows:

`HCOP:ITEM ALL;IMM`

Example:

`HCOP:ITEM ALL`

`HCOP:IMM`

A new command line always begins with the complete path.

A.1.3.6 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

- The requested parameter is transmitted without a header.
  Example: `HCOP:PAGE:ORI?`, Response: `LAND`
- Maximum values, minimum values and all other quantities that are requested via a special text parameter are returned as numeric values.
  Example: `SENSe:FREQuency:STOP? MAX`, Response: `3.5E9`
- Numeric values are output without a unit. Physical quantities are referred to the basic units or to the units set using the `Unit` command. The response `3.5E9` in the previous example stands for 3.5 GHz.

- Truth values (Boolean values) are returned as `0` (for OFF) and `1` (for ON).
  Example:
  Setting command: `HCOPy:DEV:COL ON`
  Query: `HCOPy:DEV:COL?`
  Response: `1`
- Text (character data) is returned in a short form.
  Example:
  Setting command: `HCOPy:PAGE:ORIentation LANDscape`
  Query: `HCOP:PAGE:ORI?`
  Response: `LAND`
- Invalid numerical results
  In some cases, particularly when a result consists of multiple numeric values, invalid values are returned as 9.91E37 (not a number).

A.1.4 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command always completes executing before the next command starts. Commands that are processed quickly are defined as sequential commands. They are not implemented in the instrument. However, the execution time of most of the commands is so short that they act as sequential commands, if they are sent in separate command lines.
- An overlapping command is still running when the next command starts. Usually, an overlapping command takes a certain time to process its task, and thus allows the program to execute other tasks, while it is still running. If overlapping commands have to follow a specific order, for example to avoid incorrect measurement readings, they must be executed in sequence. This is called synchronization between the controller and the instrument.

Several setting commands within a command line are not necessarily processed in the order they are received. Even if they are implemented as sequential commands. To follow a particular sequence, send each command in a separate line.

As a rule, send commands and queries in different program messages.

A.1.4.1 Preventing Overlapping Execution

To prevent an overlapping execution of commands, one of the commands `*OPC`, `*OPC?` or `*WAI` can be used. All three commands cause a certain action only to be carried out after the hardware has been set. The controller can be forced to wait for the corresponding action to occur.

*Table A-4: Synchronization using *OPC, *OPC? and *WAI*

Command	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This occurs when all pending operations are completed.	Send *OPC? directly after the command whose processing must be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Send *WAI directly after the command whose processing must be terminated before other commands are executed.

Command synchronization using `*WAI` or `*OPC?` is a good choice if the overlapped command takes only little time to process. The two synchronization commands simply block overlapped execution of the command. Append the synchronization command to the overlapping command, for example:

```
SINGle; *OPC?
```

For time consuming overlapped commands, you can allow the controller or the instrument to do other useful work while waiting for command execution. Use one of the following methods:

*OPC with a service request

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
2. Set bit no. 5 in the SRE: `*SRE 32` to enable ESB service request.
3. Send the overlapped command with `*OPC` .
4. Wait for a service request.

   The service request indicates that the overlapped command has finished.

*OPC? with a service request

1. Set bit no. 4 in the SRE: `*SRE 16` to enable MAV service request.
2. Send the overlapped command with `*OPC?`.
3. Wait for a service request.

   The service request indicates that the overlapped command has finished.

Event status register (ESE)

1. Set the OPC mask bit (bit no. 0) in the ESE: `*ESE 1`
2. Send the overlapped command without `*OPC`, `*OPC?` or `*WAI`.

3. Poll the operation complete state periodically (with a timer) using the sequence: `*OPC; *ESR?`

   A return value (LSB) of 1 indicates that the overlapped command has finished.

A.1.4.2 Examples to Command Sequence and Synchronization

See the following examples to command sequences and synchronization. Some examples given illustrate possible constellations for overlapping tasks.

Example: Commands and queries in one message

The response to a query combined in a program message with commands that affect the queried value is not predictable.

The following commands always return the specified result:

`:FREQ:STAR 1GHZ;SPAN 100 :FREQ:STAR?`

Result:

`1000000000` (1 GHz)

Whereas the result for the following commands is not specified by SCPI:

`:FREQ:STAR 1GHz;STAR?;SPAN 1000000`

The result could be the value of `STARt` before the command was sent since the instrument might defer executing the individual commands until a program message terminator is received. The result could also be 1 GHz if the instrument executes commands as they are received.

Example: Overlapping command with *OPC

The instrument implements `*RST` as an overlapped command. Assuming that `*RST` takes longer to execute than `*OPC`, sending the following command sequence results in initiating a reset and, after some time, setting the `OPC` bit in the `ESR`:

`*RST; *OPC`

Sending the following commands still initiates a reset:

`*RST; *OPC; *CLS`

However, since the operation is still pending when the instrument executes `*CLS`, forcing it into the "Operation Complete Command Idle" State (OCIS), `*OPC` is effectively skipped. The `OPC` bit is not set until the instrument executes another `*OPC` command.

Example: Overlapped command followed by non-conflicting commands

Suppose that the instrument is switched on to provide a real time test signal that requires some calculation time. At the same time, some settings for the configuration of a different signal are made which do not interact with the generated signal (for example the signal may be used later on). The signal generation and the signal configuration are independent from each other, so there is no need to synchronize the following overlapped commands:

```
SOUR:BB:3GPP:STAT ON
SOUR:BB:GSM:FORM FSK2
```

Example: Overlapped command followed by conflicting commands

Suppose that the generator is switched on to provide a real time test signal that requires some calculation time. This signal is to be added to a waveform from the second baseband generator. In this case, the application program has to make sure that the real signal is available in the added signal before further action is started. This involves an appropriate synchronization technique for the first command (the following sequence assumes an appropriate routing):

`SOUR:BB:3GPP:STAT ON`

The instrument waits until command has finished.

`SOUR2:BB:GSM:STAT ON`

Depending on the selected synchronization techniques, non-conflicting commands can be executed while waiting until the synchronized overlapped command has finished.

Example: Polling the progress of the zeroing process

Suppose that you start the zeroing for a connected power sensor via the remote control command `SENS1:ZERO`. This process blocks the processing of further tasks during execution. The query for completeness is performed with the `*OPC?` command. It returns a `1` in the output buffer when the process is completed.

`SENS:ZERO;*OPC?`

Instead of waiting via `*OPC?`, you can perform alternative tasks while the zeroing is running, as for example updating the GUI or adjusting other instruments. Synchronize the commands by querying the progress of the zeroing process periodically via the event status register `*ESR?`:

`*SRE 32`

Sets the service request enable. The bit is set when an event in the event status register occurs.

`*ESE 1`

Configures the mask of the event status register to "Operation Complete".

`SENS:ZERO;*OPC`

Sets the evaluation via the status byte query. It uses `*OPC?` as the reference.

`*CLS`

Clears all status registers.

Even if the instrument is busy, you can perform this procedure, since the query is executed in a subchannel.

A.1.5 Status Reporting System

The status reporting system stores all information on the current operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue.

You can query both with the commands of the STATus Subsystem.

A.1.5.1 Hierarchy of the Status Registers

The Figure A-1 shows the hierarchical structure of information in the status registers (ascending from left to right).

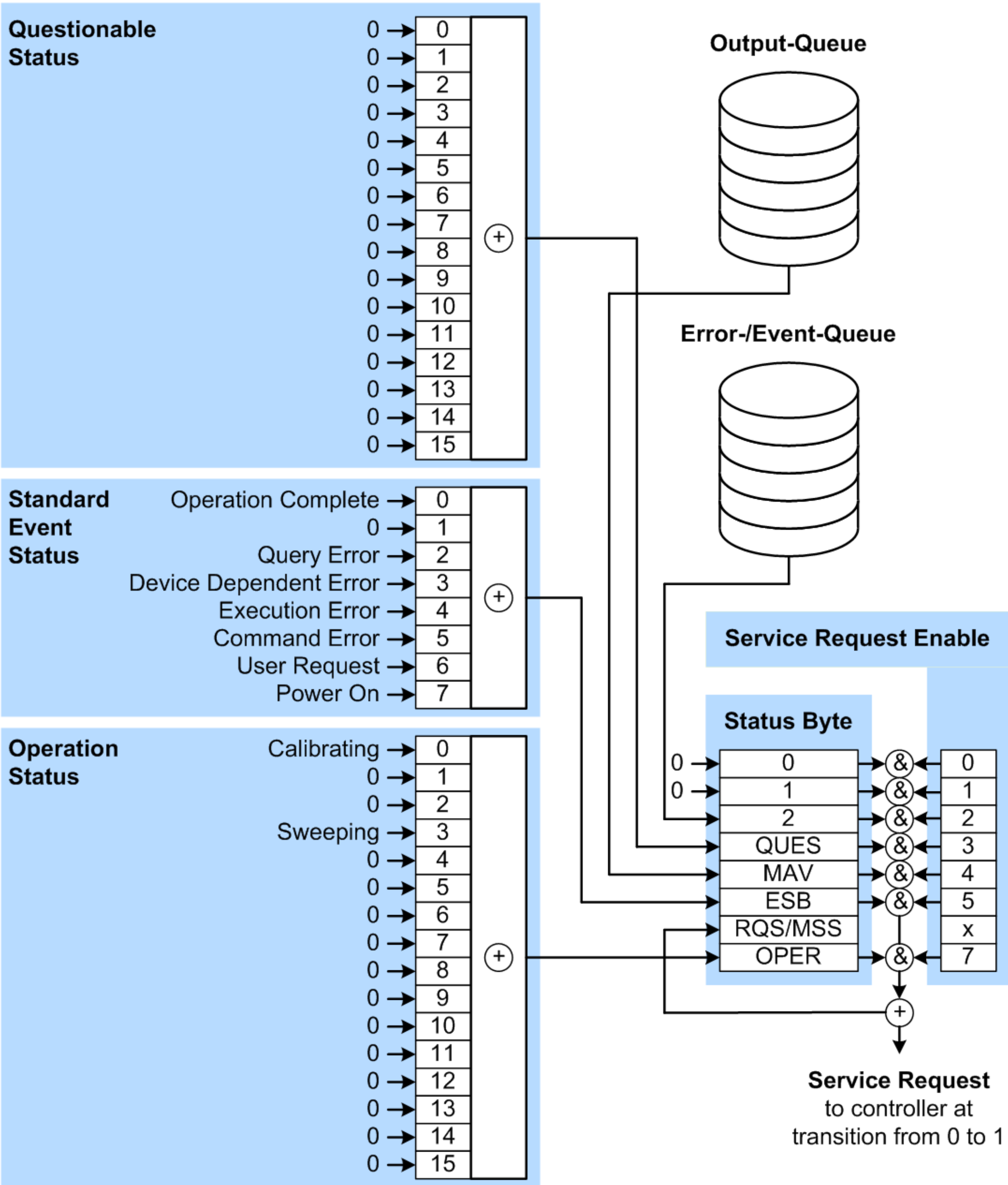


Figure A-1: Graphical overview of the status registers hierarchy

OPER = Operation Status Summary Bit
RQS/MSS = Service Request Generation
ESB = Standard Event Status Summary Bit
MAV = Message Available in Output Queue
QUES = Questionable Status Summary Bit
2 = Error- /Event-Queue
1, 0 = not used

Note: This legend explains the abbreviations to the Status Byte Register.

The R&S SMA100B uses the following status registers:

- **Status Byte** (STB) and **Service Request Enable** (SRE), see Chapter A.1.5.3, "Status Byte (STB) and Service Request Enable Register (SRE)", on page 726.
- **Standard Event Status**, i.e. the Event status Register (ESR) and the Event Status Enable (ESE), see Chapter A.1.5.4, "Event Status Register (ESR) and Event Status Enable Register (ESE)", on page 727.
- **Questionable Status** and **Operation Status**, the (SCPI status registers, see Chapter A.1.5.2, "Structure of a SCPI Status Register", on page 724, Chapter A.1.5.5, "Questionable Status Register (STATus:QUEStionable)", on page 728 and Chapter A.1.5.6, "Operation Status Register (STATus:OPERation)", on page 728.
- **Output-Queue**
  The output queue contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the `MAV` bit in the `STB` and thus is represented in the overview.
- **Error- /Event-Queue**
  The error-/event-queue contains all errors and events that have occurred in the past. When reading the queue, the instrument starts with the first occurred error/ event.

All status registers have the same internal structure.

SRE, ESE

The service request enable register `SRE` can be used as `ENABle` part of the `STB` if the `STB` is structured according to SCPI. By analogy, the `ESE` can be used as the `ENABle` part of the `ESR`.

A.1.5.2 Structure of a SCPI Status Register

Each standard SCPI register consists of 5 parts. Each part has a width of 16 bits and has different functions. The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integers.

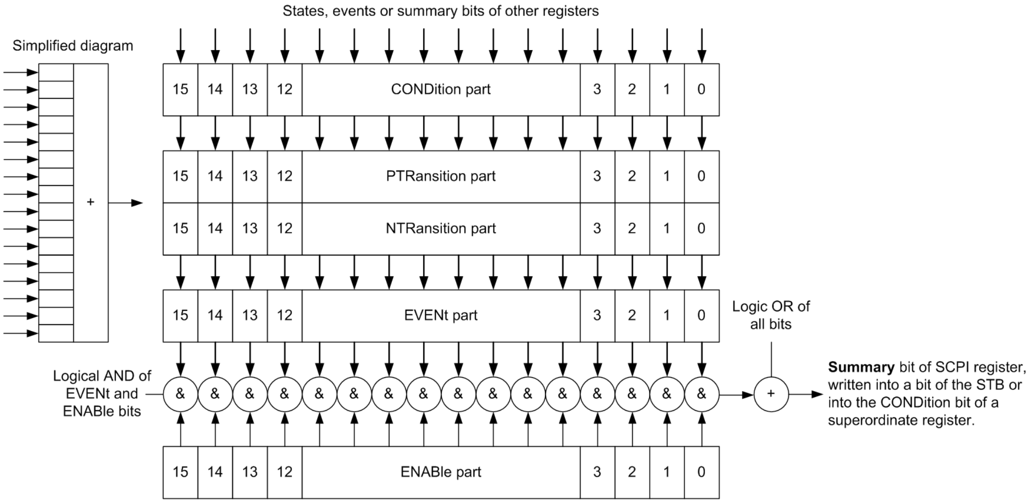


Figure A-2: The status-register model

Description of the five status register parts

The five parts of a SCPI register have different properties and functions:

- **CONDition**
  The `CONDition` part is written into directly by the hardware or the sum bit of the next lower register. Its contents reflect the current instrument status. This register part can only be read, but not written into or cleared. Its contents are not affected by reading.
- **PTRansition / NTRansition**
  The two transition register parts define which state transition of the `CONDition` part (none, 0 to 1, 1 to 0 or both) is stored in the `EVENt` part.
  The **Positive-TRansition** part acts as a transition filter. When a bit of the `CONDition` part is changed from 0 to 1, the associated `PTR` bit decides whether the `EVENt` bit is set to 1.
  - PTR bit =1: the `EVENt` bit is set.
  - PTR bit =0: the `EVENt` bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.
  The **Negative-TRansition** part also acts as a transition filter. When a bit of the `CONDition` part is changed from 1 to 0, the associated `NTR` bit decides whether the `EVENt` bit is set to 1.
  - NTR bit =1: the `EVENt` bit is set.
  - NTR bit =0: the `EVENt` bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.
- **EVENt**
  The `EVENt` part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be

read by the user. Reading the register clears it. This part is often equated with the entire register.

- **ENABle**
  The `ENABle` part determines whether the associated `EVENt` bit contributes to the sum bit (see below). Each bit of the `EVENt` part is "ANDed" with the associated `ENABle` bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an "OR" function (symbol '+').
  `ENABle` bit = 0: the associated `EVENt` bit does not contribute to the sum bit
  `ENABle` bit = 1: if the associated `EVENt` bit is "1", the sum bit is set to "1" as well.
  This part can be written into and read by the user as required. Its contents are not affected by reading.

Sum bit

The sum bit is obtained from the `EVENt` and `ENABle` part for each register. The result is then entered into a bit of the `CONDition` part of the higher-order register.

The instrument automatically generates the sum bit for each register. Thus an event can lead to a service request throughout all levels of the hierarchy.

A.1.5.3 Status Byte (STB) and Service Request Enable Register (SRE)

The `STatus Byte` (STB) is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STB is read using the command `*STB?` or a serial poll.

The `STatus Byte` (STB) is linked to the `Service Request Enable` (SRE) register. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) is generated. The SRE can be set using the command `*SRE` and read using the command `*SRE?`.

Table A-5: Meaning of the bits used in the status byte

Bit No.	Meaning
0...1	Not used
2	Error Queue not empty The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
3	QUEStionable status register summary bit The bit is set if an `EVENt` bit is set in the `QUEStionable` status register and the associated `ENABle` bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by querying the `STATus:QUEStionable` status register.

Bit No.	Meaning
4	MAV bit (message available) The bit is set if a message is available in the output queue which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
5	ESB bit Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	MSS bit (master status summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	`STATus:OPERation` status register summary bit The bit is set if an `EVENt` bit is set in the `OPERation` status register and the associated `ENABle` bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by querying the `STATus:OPERation` status register.

A.1.5.4 Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the `EVENt` part of a SCPI register. The event status register can be read out using command `*ESR?`.

The ESE corresponds to the `ENABle` part of a SCPI register. If a bit is set in the ESE and the associated bit in the ESR changes from 0 to 1, the ESB bit in the STB is set. The ESE register can be set using the command `*ESE` and read using the command `*ESE?`.

Table A-6: Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	Not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	Device-dependent Error This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.

Bit No.	Meaning
5	Command Error This bit is set if a command is received, which is undefined or syntactically incorrect. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue.
6	User Request This bit is set when the instrument is switched over to manual control.
7	Power On (supply voltage on) This bit is set on switching on the instrument.

A.1.5.5 Questionable Status Register (STATus:QUEStionable)

This register contains information on questionable instrument states. Such states may occur when the instrument is not operated in compliance with its specifications.

To read the register, use the query commands `STAT:QUEST:COND?` or `STAT:QUEST[:EVEN]?`.

Table A-7: Meaning of the bits used in the questionable status register

Bit No.	Meaning
0–15	Not used

A.1.5.6 Operation Status Register (STATus:OPERation)

This condition part contains information on the actions currently being performed by the instrument, while the event part contains information on the actions performed by the instrument since the last readout of the register.

To read the register, use the query commands `STAT:OPER:COND?` or `STAT:OPER[:EVEN]?`.

Table A-8: Meaning of the bits used in the operation status register

Bit No.	Meaning
0	Calibrating The bit is set during the calibration phase.
1–2	Not used
3	Sweeping This bit is set during a sweep in automatic or single mode.
4–15	Not used

A.1.5.7 Application of the Status Reporting System

The purpose of the status reporting system is to monitor the status of one or several devices in a measuring system. To do this and react appropriately, the controller must receive and evaluate the information of all devices. The following standard methods are used:

- **Service request** (SRQ) initiated by the instrument
- **Serial poll** of all devices in the bus system, initiated by the controller to find out who sent an SRQ and why
- Query of a **specific instrument status** by commands
- Query of the **error queue**

Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. An SRQ is always initiated if one or several of bits 2, 4 or 5 of the status byte are set and enabled in the SRE. Each of these bits combines the information of the error queue or the output buffer. To use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Example:

Use command `*OPC` to generate an SRQ .

`*ESE 1` - set bit 0 of ESE (Operation Complete)

`*SRE 32` - set bit 5 of SRE (ESB).

After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

Serial Poll

In a serial poll, just as with command `*STB`, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster.

The serial poll method is defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

Query of an instrument status

Each part of any status register can be read using queries. There are two types of commands:

- The common commands `*ESR?`, `*IDN?`, `*IST?`, `*STB?` query the higher-level registers.
- The commands of the `STATus` system query the SCPI registers (`STATus:QUEStionable`...)

The returned value is always a decimal number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain text error messages that can be looked up in the Error Log or queried via remote control using `SYSTem:ERRor[:NEXT]?`. Each call of `SYSTem:ERRor[:NEXT]?` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

A.1.5.8 Reset Values of the Status Reporting System

The following table contains the different commands and events causing the status reporting system to be reset. None of the commands, except of `*RST` and `SYSTem:PRESet` affect the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table A-9: Resetting the status reporting system

Event	**Switching on supply voltage** **Power-On-Status-Clear**		`DCL`, `SDC` **(Device Clear, Selected Device Clear)**	`*RST` **or** `SYSTem:PRESet`	`STATus:PRESet`	`*CLS`
Effect	**0**	**1**				
Clear STB, ESR	-	Yes	-	-	-	Yes
Clear SRE, ESE	-	Yes	-	-	-	-
Clear PPE	-	Yes	-	-	-	-
Clear error queue	Yes	Yes	-	-	-	Yes
Clear output buffer	Yes	Yes	Yes	1)	1)	1)
Clear command processing and input buffer	Yes	Yes	Yes	-	-	-
1) The first command in a command line that immediately follows a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.						

A.1.6 General Programming Recommendations

Initial instrument status before changing settings

Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the instrument status. Thus, when a command attempts to define incompatible settings, the command is ignored and the instrument status remains unchanged, i.e. other settings are not automatically adapted. Therefore, control programs should always define an initial instrument status (e.g. using the *RST command) and then implement the required settings.

Command sequence

As a general rule, send commands and queries in different program messages. Otherwise, the result of the query may vary depending on which operation is performed first (see also Preventing Overlapping Execution).

Reacting to malfunctions

The service request is the only possibility for the instrument to become active on its own. Each controller program should instruct the instrument to initiate a service request in case of malfunction. The program should react appropriately to the service request.

Error queues

The error queue should be queried after every service request in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

A.2 Telnet program examples

The following program example shows a simple `TcpClient` class that is intended to explain on how to get started with programming of sockets.

The example sets up a socket communication to R&S SMA100B 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;
}
```

B Hardware Interfaces

This section covers hardware-related topics, like pin assignment of the IEC 625/IEEE 488 interface.

The remote control interfaces are described in details in Chapter 12, "Network Operation and Remote Control", on page 346.

All other interfaces are described in Chapter 2.2, "Instrument Tour", on page 31.

For specifications, refer to the data sheet.

B.1 GPIB-Bus Interface

Option: R&S SMAB-B86.

Pin assignment

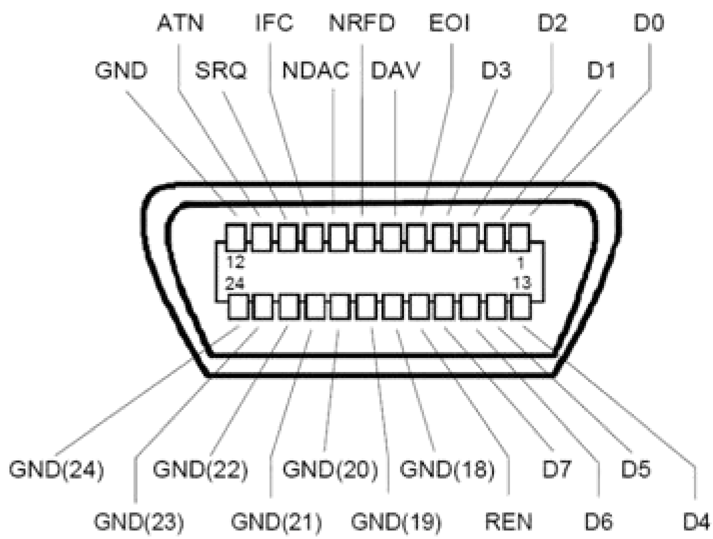


Figure B-1: Pin assignment of GPIB-bus (IEEE 488) interface

Bus lines

- Data bus with 8 lines D0 to D7:
  The transmission is bit-parallel and byte-serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.
- Control bus with five lines:
  IFC (Interface Clear): active LOW resets the interfaces of the instruments connected to the default setting.
  ATN (Attention): active LOW signals the transmission of interface messages, inactive HIGH signals the transmission of device messages.

SRQ (Service Request): active LOW enables the connected device to send a service request to the controller.
REN (Remote Enable): active LOW permits switchover to remote control.
EOI (End or Identify): has two functions in connection with ATN:

- ATN=HIGH active LOW marks the end of data transmission.
- ATN=LOW active LOW triggers a parallel poll.

- Handshake bus with three lines:
  DAV (Data Valid): active LOW signals a valid data byte on the data bus.
  NRFD (Not Ready For Data): active LOW signals that one of the connected devices is not ready for data transfer.
  NDAC (Not Data Accepted): active LOW signals that the instrument connected is accepting the data on the data bus.

Interface functions

Instruments which can be controlled via GPIB-bus interface can be equipped with different interface functions. Table B-1 lists the interface functions for the R&S SMA100B.

Table B-1: GPIB-bus interface functions

Control character	Interface function
SH1	Handshake source function (source handshake), full capability
AH1	Handshake sink function (acceptor handshake), full capability
L4	Listener function, full capability, de-addressed by MTA.
T6	Talker function, full capability, ability to respond to serial poll, deaddressed by MLA
SR1	Service request function (Service Request), full capability
PP1	Parallel poll function, full capability
RL1	Remote/Local switch over function, full capability
DC1	Reset function (Device Clear), full capability
DT1	Trigger function (Device Trigger), full capability

C Extensions for User Files

The Table C-1 lists all available file extensions for user files. The currently available files on the instrument depend on the installed options.

Table C-1: List of the automatically assigned file extensions in the instrument

Function	List type	Contents	File suffix
Instrument State	Settings	Instrument settings	`*.savrcltxt`
License Key		License Key	`*.xml`
"User Correction"	List	User-defined level correction values	`*.uco`
"List Mode"	List	User-defined frequency/level value pairs	`*.lsw`
	Settings	Response file	`*.txt`
"Pulse Train"	Settings	Pulse train data	`*.pulstrn`
"NRP Settings"	Settings	R&S NRP Settings	`*.nrp`, `*.rsu`
SCPI command list	List	Export file containing list of SCPIs	`*.iec`
R&S Support Info Archive	Support File	Automatically collected support information	`*.tar.gz`
Tutorials	Tutorial files	Lists containing SCPIs and explanations	`*.tut`

D Morse Code Settings

The COM/ID tone is sent according to the selected code (see Table D-1). The length of the Morse code can be varied. For selected standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selected user time scheme, all length parameters of the code can be set independently. If no coding is entered, the COM/ID tone is sent uncoded (key down).

The following values are default values:

- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

After each word, a word space is entered. The word repetition rate is 7 words per minute. Since the word length can vary between 900 ms and 4500 ms, the word space between the words varies accordingly.

Example:

ID code = MUC

The word length = (300+100+300)+300+(100+100+100+100+300)+300+(300+100+100+100+300+100+100) = 3100 ms

Table D-1: Morse code

Letter	Morse code	Letter	Morse code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Glossary: List of the Often Used Terms and Abbreviations

Symbols

1MA193: 1MA193_0e Application Note, "Aeronautical radio navigation measurement solutions"

A

Absolute file path: Complete file path

B

Base unit: This term describes a R&S SMA100B equipped with the option R&S SMAB-B103.

C

Clock: A mandatory internal or an external reference clock signal for generating the timing pulse in the instrument.

Complete file path: The complete file path specifies the root directory and all subdirectories that contain a file or folder.
See also Chapter 13.5.2, "Accessing Files in the Default or in a Specified Directory", on page 414.

Computer name: An unambiguous indication of the instrument a LAN that uses a DNS server.
The default computer name follows the syntax `SMAB100A-<serial number>`, e.g. *SMA100B-102030*.
Synonym: Hostname
See Serial number.

D

daisy chain: A connection scheme in which instruments are connected together in sequence, i.e. an output of the first one is the connected to an input of the second one, etc.

DHCP: Dynamic host configuration protocol

DNS: Domain name system server

E

e.g.: For example

External mass memory: External memory, connected to the instrument via USB connector (Type A female). It can hold stored files with user data.
See also System drive and SD card

F

File transfer: The transmission of files from or to the instrument by a remote client. The instrument supports the standard methods FTP and file sharing according to SAMBA/SMB.

FTP: File transfer protocol

Full file path: Complete file path

G

Glossary: List of the often used terms and abbreviations

GUI: Graphical user interface

H

HDD: Hard disk drive, see System drive

Hostname: Computer name

I

i.e.: That is

L

LF: Low frequency

LSB: Least significant bit

M

MIMO: Multiple input multiple output

MSB: Most significant bit

P

PC: Personal computer

Power: A term describing the signal level of the RF signal

product page: A designation of the R&S SMA100B product page http://www.rohde-schwarz.com/product/SMA100B.html

R

Remote access: Remote operation

Remote control: The operation of the R&S SMA100B 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 SMA100B in remote operation mode, see Remote operation.
Synonyms: External controller, client device

Remote operation: Allows you to operate the R&S SMA100B from a remote device via VNC.
Both the R&S SMA100B 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.
See also SD card

RF: Radio frequency

S

SAMBA/SMB: Server message protocol

SD card: Secure digital card is a type of removable memory storage, that can hold files with user data.
Support of this memory type is optional and requires option R&S SMAB-B85.
Throughout this description, the SD card is referred as a removable memory.
See also System drive.

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. `SMA100B-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 SD card and Removable memory

T

Trigger: Internally generated or externally supplied signal which starts signal generation at a particular point in time

Trigger event: A trigger event is caused by the received trigger signal or executed manual trigger.

U

UE: User equipment

USBTMC: (USB test & measurement class)
A protocol built on top of USB for communication with USB devices. Using VISA library, it supports service request, triggers, and other specific operations, similar to GPIB.

User directory: Describes the default file storage location for user data.
Depending on the installed options, the user directory is physically located on the System drive or on the Removable memory
In the file system, user directory is always indicated as **`/var/user`**

V

VISA: Virtual instrument software architecture

List of Commands

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