R&S®SGU100A SGMA Upconverter User Manual



1176772602



This document describes the R&S[®]SGU100A, stock no. 1418.2005.02 and its options.

- R&S[®]SGU-B26 (1418.3401.02)
- R&S[®]SGU-B120/120V (1418.2605.02/1418.2657.02)
- R&S[®]SGU-B140/140V (1418.2870.02/1418.2928.02)

This manual describes firmware version FW 4.30.046.xx and later of the R&S®SGU100A.

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1176.7726.02 | Version 09 | R&S®SGU100A

Throughout this manual, products from Rohde & Schwarz are indicated without the [®] symbol , e.g. R&S[®]SGU is indicated as R&S SGU.

Safety Instructions Instrucciones de seguridad Sicherheitshinweise Consignes de sécurité

A 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.

A 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.

A 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.

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1 Preface

The R&S SGU is an upconverter in the frequency range of 10 MHz to 40 GHz.

Optimized for use in automated test equipment (ATE), the instrument offers fast settling times in an exceptionally small form factor and low power consumption. The R&S SGU has LO connectors for coupling multiple generators to a common LO source and can be equipped with a mechanical step attenuator.

1.1 Key Features

The key features of the R&S SGU include the following:

- Compact size and low power consumption
- Remote connection via PCI Express, minimizing the setup time Alternatively, LAN or USB connections available
- Coherent LO input and output connectors, also usable as MIMO input/output and phase coherent I/Q demodulation
- Linux operating system
- Graphical user interface R&S SGMA-GUI to set up and control one or more R&S SGU instruments simultaneously from one remote computer, available for Windows and Linux systems

1.2 Documentation Overview

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

www.rohde-schwarz.com/manual/sgu100a

1.2.1 Getting Started Manual

Introduces the R&S SGU 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.

1.2.2 User Manual 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 SGU. 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.

1.2.3 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).

1.2.4 Instrument Security Procedures

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

1.2.5 Basic Safety Instructions

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

1.2.6 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S SGU. 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/sgu100a

1.2.7 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/sgu100a

1.2.8 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/sgu100a.

1.3 Typographical Conventions

The following text markers are used throughout this documentation:

| Convention | Description | | | |
|--|--|--|--|--|
| "Graphical user interface ele- ments" | All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks. | | | |
| [Keys] | Key and knob names are enclosed by square brackets. | | | |
| Filenames, commands, program code | Filenames, commands, coding samples and screen output are distin- guished by their font. | | | |
| Input | Input to be entered by the user is displayed in italics. | | | |
| Links | Links that you can click are displayed in blue font. | | | |
| "References" | References to other parts of the documentation are enclosed by quota- tion marks. | | | |

2 Preparing for Use

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Connecting an External PC and Devices......20

2.1 Putting into Operation

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

A WARNING

Risk of injury and instrument damage

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

- Do not open the instrument casing.
- Read and observe the "Basic Safety Instructions" delivered as a printed brochure with the instrument.

In addition, read and observe the safety instructions in the following sections. Notice that the data sheet may specify additional operating conditions.

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 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 and LAN cables.

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

2.1.2 Unpacking and Checking the Instrument

Unpack the R&S SGU 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 SGU 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.

2.1.3 Accessory List

The instrument comes with the following accessories:

- Power cable
- Getting started printed manual

2.1.4 Placing or Mounting the Instrument

The R&S SGU is designed for use under laboratory conditions, either on a bench top or in a rack using a rack adapter kit (order number see data sheet).

Bench top operation

If the R&S SGU is operated on a bench top, the surface should be flat. The instrument can be used in horizontal position, standing on its feet.

Risk of injury and instrument damage if stacking instruments

A stack of instruments may tilt over and cause injury. Furthermore, the instruments at the bottom of the stack may 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 with the same dimensions (width and length). 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.
- All instruments should 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.



Rack mounting

The R&S SGU 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.

2.1.5 Switching the Instrument On and Off

The R&S SGU is automatically adapted to the AC voltage supplied. 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 SGU to the AC power source using the AC power cable delivered with the instrument.

Note: The instrument is in compliance with safety class EN61010-1. Connect the instrument only to a socket with earthing contact.

To start up the instrument

1. Connect the instrument to the AC supply.



2. To turn on the power, press the main power switch to position I (On).

To switch between standby and ready state

Press the [POWER ON /STAND BY] key briefly to switch the instrument from the standby to ready state or vice versa.



In ready state, the button is green. The instrument is ready for operation. All modules are power-supplied and the R&S SGU initiates its startup procedure. In standby state, the button is orange. The standby power mode keeps the power switch circuits and the remote control system active.

Start-up and booting

The instrument boots the operating system and starts the instrument firmware. During the booting process, the green [POWER ON /STAND BY] key blinks. If the previous session was terminated regularly, the instrument uses the last setup with the relevant instrument settings.

Once the startup procedure has been terminated, the instrument is ready for operation.



In the R&S SGMA-GUI, select "Instrument > Preset" function to return the instrument to its defined reset/preset state, if the current setup is no longer relevant.

To customize the start settings, use the "SGMA-GUI > File > Save As/Open" function.

To shut down the instrument

To shut down the R&S SGU, proceed as described below.

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.

Always press the [POWER ON/STANDBY] key first to shut down the application properly.

1. Press the [POWER ON /STAND BY] key to save the current setup, shut down the operating system and set the instrument to standby state.

The [POWER ON /STAND BY] LED must be orange.

Tip: If the instrument is operated manually via the R&S SGMA-GUI, select "SGMA-GUI > Instrument Name > Setup > Standby".

2. To turn the power off, press the main power switch to position 0 (Off).

None of the front-panel LEDs should be on.

2.1.6 Function Check

The instrument automatically monitors the main functions when it is switched on and monitors them continuously during operation.

A detected fault is indicated by an "Error" message displayed in the info line of the R&S SGMA-GUI together with a brief error description. For an in-depth identification of the error, press the "SGMA-GUI > Info" button. In response, a description of the errors is displayed. For more information, refer to the "Error Messages" section in the user manual.

2.1.7 Default Settings

When the instrument is switched on, it is not the preset state that is active, but rather the instrument state that was set before the instrument was switched off. It is recommended that you use the "SGMA-GUI > Instrument > Preset" function to return the instrument to its defined preset state every time a new configuration is required or the current setup is no longer relevant.

The R&S SGU offers a two-stage preset concept:

- Preset the instrument to a predefined state
 The "SGMA-GUI > Instrument Name > Preset" function calls up a defined instrument setup. All parameters and switching states are preset (also these of inactive operating modes). The default instrument settings provide a reproducible initial basis for all other settings. However, functions that concern the integration of the instrument into a measurement setup are not changed.
- Preset the instrument to its factory settings

The instrument can also be forced to load its default factory settings. To access the corresponding dialog box, select the "SGMA-GUI > Instrument Name > Setup > Factory Preset" function.

For more information and an overview of the settings affected by the factory preset function, see Chapter 8.9, "Factory Preset", on page 101.



User-defined instrument states can be stored and called up using the functions "SGMA-GUI > File > Save As/Open".

2.2 Linux Operating System

The instrument uses an embedded Linux operating system, optimally adapted to the instrument.



Accessing the operating system

No access to the operating system is required for normal operation. All necessary system settings can be made in the "Setup" dialog.

2.3 Connecting an External PC and Devices

As a rule, the R&S SGU is operated exclusively via remote control on a connected PC. Another way to control the instrument is the manual operation via the R&S SGMA-GUI software on the connected PC.

Both the remote control and the manual operation of the instrument require an external controller. For the prerequisites and the instructions on how to configure an external controller for remote control, refer to the user manual. A brief introduction to the remote control capabilities is provided in Chapter 10, "Network and Remote Control Operation", on page 113.

This section gives an introduction on how to configure the external PC for manual operation (see Chapter 2.3.1, "Installing the R&S SGMA-GUI Software", on page 21).

In addition to connecting an external controller, it may be useful to connect other external devices, e.g. a memory stick. The following interfaces are provided on the rear panel of the instrument, see also Chapter 3.2, "Rear Panel Tour", on page 30:

- PCI Express (refer to Chapter 2.3.3, "Connecting a Controller via PCI Express", on page 25
- USB interface (refer to Chapter 2.3.4, "Connecting a Controller or a USB Device via USB", on page 26)
- LAN interface (refer to Chapter 2.3.2, "Connecting a Remote PC via LAN", on page 22)

2.3.1 Installing the R&S SGMA-GUI Software

The R&S SGMA-GUI software is a graphical user interface program for one or more instruments. It runs on a remote PC.

The R&S SGMA-GUI software is provided as separate installation package for the different operating systems. The latest version of the software together with the release notes is available for download at:

http://www.rohde-schwarz.com/product/SGU100A.html > "Downloads" > "Software"

This page always offers the latest information on your R&S SGMA-GUI.



This description focuses on the handling of the Windows-32 version. The file naming conventions and the installation instructions for the other operating systems are analogous.

The R&S SGMA-GUI installation package for Windows-32 operating system consists of the file SGMA-GUI_<V.VV.VVV.VVV.exe. The version numbers in the file names vary with each update. To install the R&S SGMA-GUI, the following hardware and software requirements have to be met.

Table 2-1: Hardware and software requirements

| Requirement | Remark | | | |
|---|---|--|--|--|
| One of the following operating sys- tems: • Windows Vista | R&S SGMA-GUI has to be installed on one of the supported operat- ing systems. Also, the version of the operating system must be still supported by Microsoft. | | | |
| Windows 7 Windows 8/ 8.1 | Note: | | | |
| Windows 10Linux | Any other Windows version or other operating systems are not supported. | | | |
| | During installation, the operation system is checked. | | | |
| | The installation is terminated if this requirement is not fulfilled. | | | |
| R&S VISA | VISA drivers can be obtained on the Rohde & Schwarz website: http://www.rohde-schwarz.com/rsvisa | | | |
| CPU | At least Pentium or compatible, as from 1 GHz (recommended). | | | |
| VGA color display resolution | At least 800*600 pixels | | | |

Installing a new software version



Administrator rights are necessary for installation and starting.

- 1. Download the R&S SGMA-GUI software.
- In Windows Explorer, double-click SGMA-GUI_V.VV.VVV.exe. Follow the instructions.

After the installation of the R&S SGMA-GUI software, two icons will be shown in your Windows menu: one is the standard version and one for which the remote command of the software through SCPIs is disabled. The SCPI disabled version allows you to install and use the R&S SGMA-GUI on other instruments, without interfering with the remote control of the host instrument.



R&S SGMA-GUI 4.20.036 x64
R&S SGMA-GUI 4.20.036 x64 (SCPI disabled)

Start the version that is required for your application.

Uninstalling an old software version

An uninstallation of a previous version of the SW can be performed before the installation of the new one, but this is not mandatory.

To uninstall this version, go to "Start > Settings > Control Panel > Add/Remove Programs" and select the entry SGMA-GUI V.VV.VVV.VVV.

The script file identifies and removes all currently installed R&S SGMA-GUI software items.

2.3.2 Connecting a Remote PC via LAN

The R&S SGU is equipped with a network interface and can be connected to an Ethernet LAN (local area network). The interface can be used, for example:

- To connect an external computer for manual control of the instrument by the R&S SGMA-GUI software.
- To operate the device by a remote control program.
 See Chapter 10, "Network and Remote Control Operation", on page 113.

This section describes how to configure the LAN interface. It includes the following topics:

- Chapter 2.3.2.1, "Connecting the Instrument to the Network", on page 22
- Chapter 2.3.2.2, "Assigning the IP Address", on page 24
- Chapter 2.3.2.3, "Automatically Adding Instruments to the SGMA-GUI ", on page 25

2.3.2.1 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.

In both cases, an IP address has to be assigned to the instrument and the computer, see Chapter 2.3.2.2, "Assigning the IP Address", on page 24.

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.

Setting up a non- dedicated network (LAN) connection

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 dynamic TCP/IP configuration and obtain all address information automatically.

Setting up a dedicated network connection

If your network does not support DHCP, you can set a dedicated network connection between a stand-alone PC and a R&S SGU

Prerequisite: the computer and the R&S SGU are turned on and running.

- 1. Start the R&S SGMA-GUI.
- Connect the computer and the R&S SGU with a LAN network cable.
- Wait for about one minute for the automatic assignment of IP addresses to complete.
- 4. R&S SGMA-GUI main panel, select "Setup > Instruments".
- 5. In the "Configure Instruments" dialog, click "Scan".

The new instrument should appear with a Zeroconf IP address 169.254.xx.yy

- Assign a static IP address to the instrument, see "Assigning a static IP address to the R&S SGU" on page 24.
- Assign a static IP address to the PC, see "Assigning a static IP address to your Windows-PC network card" on page 24.

8. Edit the instrument settings, see Chapter 6.4.2.5, "How to Edit Instruments", on page 63

2.3.2.2 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 dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be 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, see "Setting up a dedicated network connection" on page 23.



The R&S SGU uses the Zeroconf IP addresses 169.254.xxx.yyy., where xxx takes values between 1...254 and yyy the values in the value range 1...255; the subnet mask is always 255.255.0.0. The IP address of the host must be within the same address area for Zeroconf.

By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

Assigning a static IP address to the R&S SGU

Prerequisites: A connection is established between the R&S SGU and the controller with installed SGMA-GUI.

For how to setup a LAN connection, see Chapter 2.3.2.1, "Connecting the Instrument to the Network", on page 22.

For how to set up a USB connection, see "Setting up a USB connection from a PC to the R&S SGU" on page 26.

- 1. Open "SGMA-GUI > Instrument > Setup > Network Settings" dialog.
- 2. Set the "Address Mode" to "Static".
- 3. Enter the "IP Address", for example 192.168.0.1..
- 4. Enter the "Subnet mask", for example 255.255.255.0.
- 5. Enter the "Default Gateway", for example 192.168.0.1.

Assigning a static IP address to your Windows-PC network card

 Obtain the IP address and subnet mask for the R&S SGU and the IP address for the local default gateway from your network administrator. If necessary, also obtain the name of your DNS domain and the IP addresses of the DNS and WINS servers on your network. If you use more than one LAN connector, you need separate address information for each connector.

- 2. Press the "Windows" key to access the operating system.
- 3. Open the "Control Panel" by selecting "Start > Settings > Control Panel".
- 4. Select "Network and Sharing Center".
- 5. In the left panel, click "Change adapter settings".
- Select the network adapter you want to change. Click "Change settings of this connection".
- On the "Networking" tab, click "Internet Protocol Version 4 (TCP/IPv4)". Select "Properties".
- Select "Use the following IP address" and enter the address information as obtained from the network administrator.
- 9. If necessary, you can also select "Use the following DNS server addresses" and enter your own DNS addresses.

For more information, refer to your Windows system Help.

2.3.2.3 Automatically Adding Instruments to the SGMA-GUI



For information on how to install the R&S SGMA-GUI software, refer to Chapter 2.3.1, "Installing the R&S SGMA-GUI Software", on page 21.

- 1. For each new instrument perform the following steps:
 - a) Connect the instrument to the network.
 - b) Press the [POWER ON /STAND BY] key to switch on the instrument.
 - c) Wait until the [POWER ON /STAND BY] LED is green and not blinking.
 - d) Press the [ID] key on the front panel of the instrument.
- 2. Start the SGMA-GUI on a computer connected to the same network.
- 3. Open the "Instruments" dialog and click "Scan".

Note: This step is performed automatically on the first start and can also be omitted for instruments with a direct LAN connection to the computer.

All instruments are added automatically to the main panel of the SIGMA-GUI.

2.3.3 Connecting a Controller via PCI Express

A PCI Express connector is provided on the rear panel of the instrument, see Chapter 3.2, "Rear Panel Tour", on page 30.

NOTICE

Risk of device failure

The R&S SGU is equipped with a single lane PCIe interface that supports hot plugging.

Do not connect an external PC to the PCIe connector of the instrument during operation if this external PC does not support hot-plugging!

Using the PCIe interface for remote control of the instrument requires extended knowledge. Refer to Chapter 10.3, "Advanced Remote Control Using PCIe", on page 123 for detailed information.

2.3.4 Connecting a Controller or a USB Device via USB

The USB interface on the rear panel of the R&S SGU allows you to connect either a USB device or use the R&S SGU as a device and connect it to a controller.

Connecting a controller (host PC or compatible signal generator)

If you connect a controller (host PC or compatible signal generator) to the R&S SGU, the R&S SGU acts as a USB device.

To connect the controller to the USB interface of the R&S SGU, always connect the **USB type Micro-B** connector to the R&S SGU. Refer to the documentation of the controller to find out which USB connector type you can connect to the controller.

The Figure 2-1 illustrates schematically the required connector type to emphasize on the different connector shape.



Figure 2-1: USB type Micro-B connectors

An external PC with installed R&S SGMA-GUI is required for manual operation of the R&S SGU.

Setting up a USB connection from a PC to the R&S SGU

If your network does not support DHCP, you can set a USB connection between a PC and a R&S SGU.

Prerequisite: the computer and the R&S SGU are turned on and running.

- 1. Start the R&S SGMA-GUI.
- 2. Connect the computer and the R&S SGU with a USB cable.

The new instrument should appear automatically.

If the instrument does not appear automatically, you can open the "Setup > Instruments > Configure Instruments" dialog and click "Scan".

- If your network does not support DHCP, you can now set a static IP address to your computer.
 - a) Assign a static IP address to the instrument, see "Assigning a static IP address to the R&S SGU" on page 24.
 - Assign a static IP address to the PC, see "Assigning a static IP address to your Windows-PC network card" on page 24.
 - c) Edit the instrument settings, see Chapter 6.4.2.5, "How to Edit Instruments", on page 63

Connecting a USB device

If you connect a USB device (memory stick, CD-ROM, an instrument) to the R&S SGU, the R&S SGU acts as a host.

To connect a USB device to the interface of the R&S SGU, always connect the **USB type Micro-A** connector to the R&S SGU. Refer to the documentation of the USB device to find out which USB connector type you can connect to the USB device.

The Figure 2-2 illustrates schematically the required connector type to emphasize on the different connector shape.



Figure 2-2: USB type Micro-A connectors

If you connect an R&S SGS to an R&S SGU via a USB cable, perform the steps as described in Chapter 5.2, "Setups for Connecting an R&S SGS and an R&S SGU", on page 41.



Using a USB Adapter

You can use a USB adapter to customize the connectors of a USB cable to the requirements of the instrument.

For example, you can use a Type-A / Micro-A adapter to customize a standard USB cable with type A and type Micro-B connectors for the connection of an R&S SGS (acting as a host) to an R&S SGU (acting as a USB device).

In some cases, you can also use a Type-A / Micro-B adapter to establish a connection to the instrument. To check, whether the adapter you have is suitable or not you can connect a USB stick with an LED through the adapter to the instrument. If the LED of the USB stick lights up after a connection to the instrument then you can use this adapter for further applications with the instrument.

3 Instrument Tour

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

- Front Panel Tour
- Rear Panel Tour

This section explains the control elements and the connectors of the R&S SGU with the aid of the front and rear views. Specifications of interfaces can be found in the data sheet.

3.1 Front Panel Tour

This section provides an overview of control elements on the front panel of the R&S SGU. The connectors of the R&S SGU are placed on the rear panel and are described in Chapter 3.2, "Rear Panel Tour", on page 30. As the R&S SGU is intended to be remote-controlled, the front panel of the R&S SGU contains no display but mostly LEDs to inform you about the status of the instrument. The user interface can be displayed on a remote PC station used to manually remote control the instrument.



Figure 3-1: Front panel view

[POWER ON /STAND BY]



The [POWER ON /STAND BY] key switches the instrument from the standby to ready state or vice versa.

In ready state, the button is green. The instrument is ready for operation.

In standby state, the button is orange. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply.

A blinking green color indicates that a booting operation is in process.



The [RF ON] key switches the RF signal on or off. If activated, the button is green.



The [LO IN] LED indicates the compatibility of the level of the LO input signal with the correct operation of the R&S SGU.

- Green indicates that the level of the LO input signal is in the range of correct operation.
- Red indicates that the level of the LO input signal is too high or too low.
- No light indicates that the instrument is in a bypass mode.

[ERROR / WARNING]



The [ERROR / WARNING] LED indicates the status of the R&S SGU.

- Red indicates that an error has occurred, e.g. temperature exceeded or power failure.
- Blinking orange indicates a running process (e.g calibration, self test).
- No light indicates that no errors or warnings have occurred.

For details on errors or warnings, refer to the graphical user interface on a remote PC ("SGMA-GUI > Info").

For more information, refer to the "Error Messages" section in the user manual.



The [LAN] key indicates if a LAN connection is established.

Green LED indicates that a network cable is connected to the instrument and no error in the DHCP connection is detected. But it does not indicate that the remote control connection is established for all cases. For example, if the instrument is set to use a "Static" IP address the instrument may still not be visible in the network.

Pressing the key resets the LAN interface settings, i.e the "IP Adress Mode" is reset to DHCP.



Pressing the [ID] key while the instrument is active, opens the "SGMA-GUI > Setup > Instruments > Configure Instruments > Edit Instrument" dialog of the corresponding instrument on the remote controller.

Pressing the ID key of an inactive instrument and starting "SGMA-GUI > Setup > Instruments > Scan", leads to an automatic activation of the instrument in the SGMA-GUI.

3.2 Rear Panel Tour

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



Figure 3-2: Rear panel view

NOTICE

Risk of damaging components

Always use an appropriate 8 mm torque wrench to tighten SMA connectors. Limit the tightening torque to 60 Ncm. Never use an open-end wrench.

[PCI Express Connector]



The PCIe (Peripheral Component Interconnect Express) single lane interface allows remote control with optimized speed.

For details, see Chapter 2.3.3, "Connecting a Controller via PCI Express", on page 25.

[USB Connector]



The USB (universal serial bus) interface, type micro, allows you to connect various external devices, e.g.:

 If the interface is configured as a device interface, the R&S SGU can be connected to other devices like a remote computer. On the computer, you can perform a firmware update, manual operation via the R&S SGMA-GUI software or for remote control of the instrument.

 If the interface is configured as a host interface, a memory stick for file transmission can be connected.

For details, see Chapter 2.3.4, "Connecting a Controller or a USB Device via USB", on page 26.

[LAN Connector]



The [LAN] (Ethernet) interface allows you to connect the R&S SGU to other devices like a remote computer. On the computer, you can perform a firmware update, manual operation via the R&S SGMA-GUI software or for remote control of the instrument. The connection to the remote computer can be direct or via a network.

For details, see Chapter 2.3.2, "Connecting a Remote PC via LAN", on page 22.



Provides an RF 50 Ohm signal output.

NOTICE! Maximum input levels. Do not overload the RF output. The maximum permissible back-feed is specified in the data sheet.

[LO IN, LO OUT]



SMA type connectors that can be used for local oscillator signals and alternatively also in MIMO setups.

Local oscillator input and output:

- [LO IN]: Input for external LO signals
- [LO OUT]: Output of internal LO signals

[TRIG]



Multi-purpose connector. The [TRIG] connector is used mainly as an input connector for an external pulse modulator source.

[I, Q IN / OUT]



The [I IN] and [Q IN] SMA female type connectors are the inputs of the I/Q modulator, provided for feeding of external signal.

The [I OUT] and [Q OUT] SMA female type connectors are for direct output of the analog I/Q signal.

NOTICE! Maximum input levels. Do not overload the I and Q inputs. The maximum permissible voltage is 1V. For details, refer to the data sheet.

Note: The I/Q modulator requires the hardware optionR&S SGU-B120V/-B140V.

[AC supply and power switch]



The AC supply and power switch allow you to connect the R&S SGU to the power supply and switch on the instrument.

For details, see "To connect the AC supply" on page 18.

R&S SGU as an Extension to the R&S SGS

4 First Steps with the Instrument

If an R&S SGU is connected to a signal generator, the instrument acts as an extension to the signal generator extending its frequency range.

This section provides an example on how to configure the instrument to convert a continuous wave (CW) signal.

4.1 R&S SGU as an Extension to the R&S SGS

In case the R&S SGU is connected to a compatible R&S signal generator, a controller only needs to talk to the signal generator which in turn takes care of the proper settings for the R&S SGU.

In the following example, the instrument is manually operated via the R&S SGMA-GUI software. The R&S SGU in this example is a base unit equipped with the frequency option R&S SGU-B120.

Configuring the R&S SGU to upconvert a CW signal generated by the R&S SGS

As a prerequisite for this example the R&S SGMA-GUI software has to be installed on a remote PC.



Figure 4-1: Example of a test setup for upconverting a CW signal generated by the R&S SGS

For higher setting/ measuring speeds, use a PCIe switch and PCIe connections.

- 1. Connect the test equipment as shown on Figure 4-1:
 - a) Connect the R&S SGS, R&S SGU and the controller to a LAN switch.
 - b) Connect the [RF OUT] of the R&S SGS to the [LO IN] of the R&S SGU.
 - c) Connect the [TRIG] connectors of the R&S SGS and the R&S SGU.

- d) Connect the [RF OUT] of the R&S SGU to the [RF IN] of the signal analyzer.
- 2. Switch on the R&S SGS and the R&S SGU.

The [POWER ON/STANDBY] keys have to be green and not blinking.

- 3. Press the [ID] keys on the front panels of the R&S SGS and the R&S SGU (only required if the components are connected via a company network).
- 4. On the connected remote PC, start the R&S SGMA-GUI software application.

The main panel of the application and the configure instruments dialog open. Both instruments are added automatically to the instruments list and to the main panel of the R&S SGMA-GUI software.

The main panel provides a quick access to the main settings of the configured and activated instruments. The display shows one row per instrument with the instrument specific settings. The rows comprise the instrument, the connection state, the used frequency and power level and the state of the RF output and the modulator.

| 🐟 SGM | IA-GI | UI | | | | | | | | |
|---------|-----------------------------------|----------------------------|--------|------------------------|-----------|-----------|--------------------------|--------------|-------------------|--------|
| File Se | etup | Help | | | | | | | | |
| | F 2 | | | | | | | | | |
| | | | | | | | | | | 1 Info |
| | 2 | SGS-100004 | Freq | 1.000 000 000 | 000 GHz - | RF Off | Mod PEP -10.00 dBm Level | -10.00 dBm • | Ext Ref Off | |
| 0 40 | כ | SGU-100014 | Freq | 1.000 000 000 | 000 GHz • | RF Off | Mod PEP -10.00 dBm Level | -10.00 dBm • | | |
| 🚸 Co | onfig | ure Instruments | | | × | | | | | |
| E | dit | Symbolic Name | | Instrument Type Active | 1 i | | | | | |
| 1 | | SGS-100004 | | SGS ON | | | | | | |
| 2 | | SGU-100014 | | SGU ON | | | | | | |
| | | | | | 3 | | | | | |
| S | Scan New Delete Clear Edit Export | | | | | | | | | |
| Scan | LAN | l instruments with host na | me pre | fix | <u> </u> | | | | | |
| | | | | | | | | | | |

- In the R&S SGMA-GUI main panel, the green indicator in front of the instrument's name confirms that there is a connection between the instrument and the remote PC and that the instrument is recognized by the software.
- In the R&S SGMA-GUI main panel, select the rows corresponding to the corresponding instruments to be configured and select "Instrument Name > Preset" to restore their predefined settings.
- 7. Select "SGMA-GUI main panel > R&S SGS > Extension".

The "Extension" dialog opens.
R&S SGU as an Extension to the R&S SGS

| 🚸 SGS-100004: Extension 💼 🗉 📧 | | | | | | |
|-------------------------------|---------------|--------------------|--------|--|--|--|
| Con | Connected 🕖 | | | | | |
| \subset | Availa | ble Instruments —— | | | | |
| | Symbolic Name | Channel | Select | | | |
| 1 | SGU-100014 | Socket | OFF | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| Scan Start | | | | | | |
| _ | | | | | | |

Tip: Instrument does not appear in the extension dialog. If the R&S SGU is not automatically shown in this dialog, press "Scan > Start" to find the instrument.

 Select the R&S SGU from the list and set "Available Instruments > Select > On" to enable it as an extension.

A green status indicator "Connected" indicates the successfully established remote connection between the R&S SGS ant the R&S SGU.

The R&S SGMA-GUI indicates the extended frequency range of the R&S SGS and the activated extension mode.

| SGMA-GUI | |
|--|------------------|
| File Setup Help | |
| | |
| | 🙃 Info |
| GGS-100004 Freq 1.000 000 000 GHz - RF Mod Off Off PEP -10.00 dBm Level -10.00 dBm - | xt Ref Dff |
| GU-100014 SGU-100014 SGU-100014 | |
| 🚸 SGS-100004: Extension | |
| Connected | |
| Available Instruments | |
| Symbolic Name Channel Select | |
| 1 SGU-100014 Socket ON | |
| | |
| 3 | |
| | |
| | |
| Scan Start | |
| Test Signal Connections | |
| Test | |
| | |
| | |
| | |

9. Select "Test Signal Connections > Test" to trigger a check of all required signal connections.

R&S SGU as an Extension to the R&S SGS

| 🚸 se | 🔅 SGS-100004: Extension | | | | | | | |
|--|-------------------------|---------|--------|--|--|--|--|--|
| Conn | Connected e | | | | | | | |
| | Available Instruments | | | | | | | |
| | Symbolic Name | Channel | Select | | | | | |
| 1 | SGU-100014 | Socket | ON | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| Sca | Scan Abort | | | | | | | |
| | Te | est | | | | | | |
| SGU Lo in Trig Ø RF @ Trig SGS | | | | | | | | |

The diagram displays the connection state of the tested connections.

- 10. Select "SGMA-GUI > R&S SGS > Freq = 40 GHz", "Lev = -30 dBm".
- 11. Select "SGMA-GUI >SGS> RF > State > On" to enable the output of the CW signal.

| 🚸 SGMA-GUI | | | | | | |
|---|---|--|--|--|--|--|
| File Setup Help | | | | | | |
|] 🗋 🖆 🔛 🧮 | | | | | | |
| | 🚯 Info | | | | | |
| 40 SGS-100004 F | Freq 40.000 000 000 000 GHz • RF Mod PEP 25.00 dBm Level -20.00 dBm • Ext Ref Off | | | | | |
| • 40 SGU-100014 Extension to SGS-100004 | | | | | | |

The extension adopts these values and states automatically and generates a CW signal with RF = 40 GHz and Level = -20 dBm.

The signal is output at the [RF OUT] connector on the rear panel of the R&S SGU.

R&S SGU as a Standalone Upconverter



Identifying a specific instrument

If several instruments are active in the R&S SGMA-GUI use one of the device identification functions to identify a specific device:

- Select "SGMA-GUI > Instrument Name > Setup > Remote > Remote Channels > Device Identify". The green [LAN] LED on the front panel of the instrument blinks.
- Press the [ID] key on the instrument's front panel. The "Edit Instrument" dialog of the respective instrument opens.

4.2 R&S SGU as a Standalone Upconverter

This section provides an example on how to configure the instrument to convert a continuous wave (CW) signal. The signal in this example is provided by an incompatible signal generator (local oscillator).

In the following example, the instrument is manually operated via the R&S SGMA-GUI software. The R&S SGU in this example is a base unit equipped with the frequency option R&S SGU-B120.

Configuring the R&S SGU to convert a CW signal

As a prerequisite for this example, the R&S SGMA-GUI software has to be installed on a remote PC and the local oscillator has to be prepared for use.



Figure 4-2: Example of a setup of the R&S SGU as an upconverter

- Connect the test equipment as shown in Figure 4-2. Additional connections may be needed to fulfill the requirements of the connected local oscillator. To find out what connections are needed refer to its user manual.
- 2. Switch on the R&S SGU.

The [POWER ON/STANDBY] key has to be green and not blinking.

- Press the [ID] key on the front panel the R&S SGU (only required if the components are connected via a company network).
- 4. On the connected remote PC, start the R&S SGMA-GUI software application.

The main panel of the application and the configure instruments dialog open. The R&S SGU is added automatically to the instruments list and to the main panel of the R&S SGMA-GUI software.

The main panel provides a quick access to the main settings of the configured and activated instruments. The display shows one row per instrument with the instrument specific settings. The rows comprise the instrument, the connection state, the used frequency and power level and the state of the RF output and the modulator.

| SGMA-GUI | | | | |
|--|--------|--|--|--|
| File Setup Help | | | | |
| | | | | |
| | 🚯 Info | | | |
| 40 SGU-100001 Freq 1.000 000 000 GHz - RF Mod OFF PEP -10.00 dBm Level -10.00 dBm - | | | | |
| Image: Sgu-100002 Freq 1.000 000 000 000 GHz RF Mod Off PEP -10.00 dBm Level -10.00 dBm | | | | |
| | | | | |
| | | | | |

- 5. In the R&S SGMA-GUI main panel, the green indicator in front of the instrument's name confirms that there is a connection between the instrument and the remote PC and that the instrument is recognized by the software.
- In the R&S SGMA-GUI main panel, select the row corresponding to the instrument to be configured and select "Instrument Name > Preset" to restore the predefined instrument's settings.

| 🔷 SGMA-GUI 🖂 🔂 | | | | | |
|----------------|---------------------|------|----------------------------|--------------------------|--------------|
| File Setup | Help | | | | |
| | 🖺 🧮 | | | | |
| | | | | | 🕕 Inf |
| 4 0 | SGU-100001 | Freq | 1.000 000 000 000 GHz - RF | Mod PEP -10.00 dBm Level | -10.00 dBm - |
| 0 40 | SGU-100002 | Freq | 1.000 000 000 000 GHz - RF | Mod PEP -10.00 dBm Level | -10.00 dBm • |
| | Local Oscillator | | | | |
| | Frequency | | | | |
| | Level | | | | |
| | I/Q Settings | | | | |
| | Pulse Modulation | | | | |
| | Connector | | | | |
| | | | | | |
| | Setup 🔸 | | | | |
| | Diagnostic / Test 🔸 | | | | |
| | Service + | | | | |
| | | | | | |

7. Select "SGMA-GUI > R&S SGU > Freq = 15 GHz", "Lev = -10 dBm", "RF > On".

R&S SGU as a Standalone Upconverter

| SGMA-GUI | |
|--|--------|
| File Setup Help | |
| | |
| | 😚 Info |
| 40 SGU-100001 Freq 1.000 000 000 GHz - Off Off Off PEP -10.00 dBm Level -10.00 dBm - | |
| 40 SGU-100002 Freq 15.000 000 000 GHz - RF Mod PEP -10.00 dBm Level -10.00 dBm - | |
| | |

8. Select "SGMA-GUI > Instrument Name >Ext. Local Oscillator". Read the required frequency and level values for the LO.

| 🚯 SGU-100014: Ext. Local Oscillator 🛛 🗖 💌 | | | | | |
|---|----------------------------|--|--|--|--|
| Frequency | 10.000 000 000 000 0 GHz 🝷 | | | | |
| Level | -20.01 dBm 🔻 | | | | |
| Confirm External LO Settings | | | | | |
| | | | | | |

- 9. Change the settings of the LO to the required values.
- 10. Select "SGMA-GUI > Instrument Name > Ext. Local Oscillator > Confirm External LO Settings" to apply the changes.

The 15 GHz signal is output at the [LO OUT] connector at the rear panel of the R&S SGU.



Identifying a specific instrument

If several instruments are active in the R&S SGMA-GUI, use one of the device identification functions to identify a specific device:

- Select "SGMA-GUI > Instrument Name > Setup > Remote > Remote Channels > Device Identify". The green [LAN] LED on the front panel of the instrument blinks.
- Press the [ID] key on the instrument's front panel. The "Edit Instrument" dialog of the respective instrument opens.

5 System Overview

The R&S SGU is an instrument intended either for the modulation of IQ signals or as an upconverter in the frequency range of 10 MHz to 40 GHz.

Optimized for use in automated test equipment (ATE), the instrument offers very fast settling times in an exceptionally small formfactor and low power consumption. The R&S SGU can be equipped optionally with a mechanical step attenuator.

5.1 Setups for Instrument Control

The R&S SGU is an instrument designed for the automated test equipment (ATE) needs. To maintain the small size, the instrument is not equipped with a display and hence additional equipment is required to control the instrument.

This section provides an overview of the possible configuration setups for controlling the R&S SGU.

5.1.1 Manual Operation from the R&S SGMA-GUI

The following example represents a basic configuration of the R&S SGU, operated manually by the configuration software R&S SGMA-GUI. The configuration software is installed on a remote PC and controls several instruments. The instruments are connected to the remote PC over different remote control interfaces. Any combination of the used interfaces is possible.



Figure 5-1: Configuration example: manual control from R&S SGMA-GUI



For information about the manual control, refer to:

- Chapter 6, "Understanding the R&S SGMA-GUI Software", on page 48
- Chapter 7, "Upconverter Settings", on page 73
- Chapter 8, "General Instrument Settings and Instrument Setup", on page 89

5.1.2 Remote Control from a Controller

The remote control provides access to the instrument's settings from a remote computer (external controller) by means of remote commands. To automate often repeating settings and settings sequences, these are grouped in the remote control programs, i.e. application programs. Setups for Connecting an R&S SGS and an R&S SGU

An instrument may be connected to the controller via any of the supported interfaces LAN, USB or PCIe.



Figure 5-2: Configuration example: remote control from a controller

For information about remote control, refer to:
 Chapter 10, "Network and Remote Control Operation", on page 113

Chapter A, "Remote Control Basics", on page 204

5.1.3 Control of an R&S SGU from a Compatible R&S Signal Generator

If an R&S SGU is connected to a compatible R&S Signal Generator (e.g. R&S SGS), it extends its frequency range. In this setup, a controller does not need to access the R&S SGU directly. Instead, the compatible R&S Signal Generator acts as a controller to the R&S SGU. The generator performs all required settings automatically depending on the required output signal parameters.

The Figure 5-3 shows a configuration example of the R&S SGU, directly controlled by an R&S SGS. For a detailed description of the connecting possibilities, refer to Chapter 5.2, "Setups for Connecting an R&S SGS and an R&S SGU", on page 41.



Figure 5-3: Configuration example: the R&S SGU as an extension to the R&S SGS

5.2 Setups for Connecting an R&S SGS and an R&S SGU

If an R&S SGU is connected to an R&S SGS, the R&S SGU acts as an extension to the R&S SGS extending its frequency range. In this setup, a controller does not need to access the R&S SGU directly. Instead, the R&S SGS acts as a controller to the R&S

SGU. The generator performs all required settings automatically depending on the required output signal parameters.

This chapter gives an overview of how to connect the instruments.

See:

- Chapter 5.2.1, "Direct Connection", on page 42
- Chapter 5.2.2, "Connection in a Company Network", on page 43
- Chapter 5.2.3, "Connection with a PCIe Switch", on page 46
- Chapter 4.1, "R&S SGU as an Extension to the R&S SGS", on page 33

5.2.1 Direct Connection

The R&S SGS and the R&S SGU can be connected through a direct connection as shown in Figure 5-4.

Direct connection of an R&S SGS and an R&S SGU



Figure 5-4: Direct connection of an R&S SGS and an R&S SGU

- Connect the R&S SGS and the R&S SGU directly using one of the following options:
 - a) USB cable. Use a Type Micro-A connector for R&S SGS and a Type Micro-B connector for R&S SGU. See also Chapter 2.3.4, "Connecting a Controller or a USB Device via USB", on page 26.
 - b) LAN cable. No additional cable considerations are required.
 - c) PCIe cable. Refer to Chapter 10.3.4, "Connecting the Controller and the Instrument", on page 127 for cable requirements and setup information.
- 2. Switch on the R&S SGS and the R&S SGU.

The R&S SGS automatically identifies the connected R&S SGU as its extension and starts the extension mode.

Setups for Connecting an R&S SGS and an R&S SGU

 $(\mathbf{1})$

For a direct PCIe connection, an automatic identification of the R&S SGU as an extension is only available for an R&S SGS with a "Controller > Revision" 5 or higher. For a description on how to manually set the PCIe identification, see Chapter 9.7, "How to Manually Set a PCIe Direct Connection between an R&S SGS and an R&S SGU", on page 111.

You can check the "Controller > Revision" of your instrument in the "SGMA-GUI > Instrument Name > Hardware Config" dialog.

If instrument is not automatically added as an extension

If the R&S SGU is not automatically added as an extension you can do that manually in the "SGMA-GUI > R&S SGS Name > Extension" dialog.

If the R&S SGU is not listed in the list of "Available Instruments", you can press "Scan > Start" to find the instrument.

| 4 | 🗞 SGS-100004: Extension 📃 📼 💌 | | | | | | |
|---|-------------------------------|---------------|---------|----------|--|--|--|
| С | Connected e | | | | | | |
| (| Available Instruments | | | | | | |
| | | Symbolic Name | Channel | Select | | | |
| | 1 | SGU-100014 | Socket | ON | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | T | | | |
| | Scan Start | | | | | | |
| (| Test Signal Connections | | | | | | |
| | Test | | | | | | |
| | | | | | | | |
| | | | | | | | |

5.2.2 Connection in a Company Network

Connection of an R&S SGS and an R&S SGU in a Company Network

As a prerequisite for this example the R&S SGMA-GUI software has to be installed on a remote PC.

Setups for Connecting an R&S SGS and an R&S SGU



Figure 5-5: Connection of an R&S SGS and an R&S SGU in a company network

- 1. Connect the test equipment as shown in Figure 5-5:
 - a) Connect the R&S SGS, the R&S SGU and the controller to the company network.
 - b) Connect the [RF OUT] of the R&S SGS to the [LO IN] of the R&S SGU.
- 2. Switch on the R&S SGS and the R&S SGU.

The [POWER ON/STANDBY] keys have to be **green** and not blinking.

- 3. Press the [ID] keys on the front panels of the R&S SGS and the R&S SGU.
- 4. On the connected remote PC, start the R&S SGMA-GUI software application.

The main panel of the application and the configure instruments dialog open. Both instruments are added automatically to the instruments list and to the main panel of the R&S SGMA-GUI software.

| 🚸 SG | MA-Gl | JI | | | | | | | |
|------|-----------------------------------|-----------------------------|---------|-----------------|---------------|-----------|------------------------------|--------------|-------------------|
| File | Setup | Help | | | | | | | |
| | | ₿ 🚍 | | | | | | | |
| | | | | | | | | | 🖨 Info |
| - | | | | | | | | | |
| | 12 | SGS-100004 | Freq | 1.000 000 | 000 000 GHz • | RF Off | Mod Off PEP -10.00 dBm Level | -10.00 dBm • | Ext Ref Off |
| | 40 | SGU-100014 | Freq | 1.000 000 | 000 000 GHz - | RF Off | Mod PEP -10.00 dBm Level | -10.00 dBm • | |
| | Config | ure Instruments | | | • | | | | |
| | Edit | Symbolic Name | | Instrument Type | Active | | | | |
| 1 | | SGS-100004 | | SGS | N | | | | |
| 2 | | SGU-100014 | | SGU C | NC | | | | |
| | | | | | | | | | |
| | Scan New Delete Clear Edit Export | | | | | | | | |
| Sca | an LAN | l instruments with host nan | ne pret | īx | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Note: If you connect the instruments to the company network for the first time this process may take several minutes.

R&S®SGU100A

- In the R&S SGMA-GUI main panel, the green indicator in front of the instrument's name confirms that there is a connection between the instrument and the remote PC and that the instrument is recognized by the software.
- 6. Select "SGMA-GUI main panel > R&S SGS > Extension".

The "Extension" dialog opens.

| SGS-100004: Extension | | | | | |
|-----------------------|---------------|-------------------|--------|--|--|
| Connected | | | | | |
| \square | Availa | ble Instruments — | | | |
| | Symbolic Name | Channel | Select | | |
| 1 | SGU-100014 | Socket | OFF | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| Scan Start | | | | | |
| _ | | | | | |

Tip: Instrument doesn't appear in the extension dialog. If the R&S SGU is not automatically shown in this dialog press "Scan > Start" to find the instrument.

 Select the R&S SGU from the list and set "Available Instruments > Select > On" to enable it as an extension.

A green status indicator "Connected" indicates the successfully established remote connection between the R&S SGS ant the R&S SGU.

The R&S SGMA-GUI indicates the extended frequency range of the R&S SGS and the activated extension mode.

| 📀 SGMA-GUI | | | | | | | |
|-----------------------|----------------------|--|--|--|--|--|--|
| File Setup Help | | | | | | | |
| | | | | | | | |
| | | 🕒 Info | | | | | |
| 9 40 SGS-100004 F | req 1.000 000 000 00 | 0 GHz · RF Mod PEP -10.00 dBm Level -10.00 dBm · Bet Ref | | | | | |
| 9 40 SGU-100014 | | Extension to SGS-100004 | | | | | |
| SGS-100004: Extension | | a [| | | | | |
| Connected | • | | | | | | |
| Available Ins | truments | | | | | | |
| Symbolic Name | Channel Select | | | | | | |
| 1 SGU-100014 | Socket ON | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| Scan | Start | | | | | | |
| | | | | | | | |
| Test Signal Co | innections | | | | | | |
| Tes | t | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

 Select "Test Signal Connections > Test" to trigger a check of all required signal connections. Setups for Connecting an R&S SGS and an R&S SGU

| ٩ | SGS-100004: Extension | | | | | | | |
|-------------------------|-----------------------|---------------|---------------|---------|--|--|--|--|
| C | Connected 🧧 | | | | | | | |
| 6 | | Available li | nstruments —— | | | | | |
| | | Symbolic Name | Channel | Select | | | | |
| | 1 | SGU-100014 | Socket | ON | | | | |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| | 4 | | | | | | | |
| | 5 | | | | | | | |
| | Sca | n | | Start | | | | |
| Test Signal Connections | | | | | | | | |
| | Test | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

The diagram displays the connection state of the tested signal connections. If the test connections are correct (shown by an uninterrupted blue line), you can start using the R&S SGS and the R&S SGU in extension mode.

Tip: If your connection is marked as faulty- a red line is crossing the blue connection line - check whether the cables are connected properly. Check also if the connection cables are functioning properly.



Figure 5-6: A faulty connection between an R&S SGU and an R&S SGS

5.2.3 Connection with a PCIe Switch

The R&S SGS and the R&S SGU can be connected through a PCIe switch as shown in Figure 5-7. This setup is recommended for achieving the highest setting/ measuring speeds.

Setups for Connecting an R&S SGS and an R&S SGU



PCIe switch connection of an R&S SGS and an R&S SGU

Figure 5-7: Connection of an R&S SGS and an R&S SGU through a PCIe switch

- 1. Connect the PCIe switch to a switched off computer with a single lane PCIe cable.
- 2. Connect the R&S SGS and the R&S SGU to the PCIe switch.
- 3. Switch on the R&S SGS and the R&S SGU.

The [POWER ON/STANDBY] keys of both instruments have to be **green** and not blinking.

- 4. Switch on the computer.
- 5. On the computer start one of the following:
 - a) The R&S SGMA-GUI
 - b) An application program for remote control of the instruments
- 6. Manually (or remotely) activate the R&S SGU as an extension to the R&S SGS.



The logical connection between an R&S SGS and an R&S SGU is established by the driver layer of a program (e.g. the R&S SGMA-GUI) or the library PCleController.dll (Linux: libpciecontroller.so) of a remote control program on the PC. Such a program has to be running on the PC so that an R&S SGS is able to communicate with an R&S SGU.

6 Understanding the R&S SGMA-GUI Software

This section gives a detailed description of the R&S SGMA-GUI user interface and information on how to work with it. The main panel with the overview of the configured instruments is the operating and control interface for the whole program. From here, all program functions are accessible. This panel is displayed after the start of R&S SGMA-GUI. The program always loads the previously used settings so you can continue your work in the next session.



6.1 Operating Menu and Toolbar

On the top of the main panel, there are the menu bar, the toolbar and the info bar with the corresponding "Info" button. Some of the functions are accessible via the toolbar with its icons below the menu selection line.

The dialogs are built using elements, e.g., selection lists, checkboxes, and entry fields. A blue frame indicates that the selected item is active. In a highlighted element, entries can be made.

| File | Setup | Help |
|---------|----------------|----------|
| □ New | Instruments | About |
| Popen | Software | Contents |
| Save | Reset SGMA-GUI | Index |
| Save as | Remote | |

Table 6-1: Content of the operating menu

| File | Setup | Help |
|--------------------------------|-------|------|
| Exit | | |
| Shut down instruments and exit | | |

6.1.1 File Menu

The R&S SGMA-GUI employs the standard Save/Recall file management function and allows you to store and reload settings in/to a file with a user-defined name and location (see also Chapter 6.4.1, "Storing and Loading Settings", on page 61).

In the following, the "File" menu of the R&S SGMA-GUI is described in detail. It incorporates standard functions.

New

Resets R&S SGMA-GUI and all connected instruments to their preset settings.

Open

Opens the standard file open browser for loading a saved R&S SGMA-GUI file (*.savrcl). The file contains the user-specific settings of a session, such as instruments configured in the software. The complete settings of a session can be saved and loaded.

Only files of this type are selectable.

Note: Instrument-specific settings, e.g. frequency and level settings, are stored locally on the particular instrument itself. These instruments settings are saved automatically in a predefined directory and loaded by default when starting the instrument again. The files with instrument settings are not accessible.

Save

Standard quick save of the settings of the current session if a filename previously has been applied. If not, the "Save As" dialog is opened.

Save as

Opens the standard file save browser for saving the settings of the current session. R&S SGMA-GUI files have the file extension .savrcl so the name typed in is equipped with this extension. The complete settings of a session are saved.

Exit

Quits the R&S SGMA-GUI. The current settings of the instrument's session are saved and loaded by default when starting the software again.

Note: The instruments configured in the R&S SGMA-GUI are not shut down.

Shut down instruments and exit

Quits the R&S SGMA-GUI and switches the connected instruments to the standby state (see alsoChapter 9.3, "How to Switch between the Operating States", on page 107).

6.1.2 Setup Menu

The setup menu provides access to dialogs for setting the general settings of the software, like dialogs for managing the connected instruments or dialogs providing information about the installed options.

6.1.2.1 Configure Instruments

This dialog is the central point for managing the instrument that is configured and operated via the R&S SGMA-GUI. New instruments can be created and appended to the list of available instruments. Connection settings can be edited, instruments can be removed from the list or they can be deactivated, but kept in the list for further use.

| 4 | 8 Configure Instruments | | | | | | | | |
|-----------------------------------|--|------|---------------|-----------------|--------|--|--|--|--|
| C | Available Instruments | | | | | | | | |
| | | Edit | Symbolic Name | Instrument Type | Active | | | | |
| | 1 | | SGS | SGS | ON | | | | |
| : | 2 | | SGU | SGU | ON | | | | |
| : | 3 | | SGT | SGT | ON | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| L | | | | | | | | | |
| Scan New Delete Clear Edit Export | | | | | | | | | |
| S | Scan LAN instruments with host name prefix | | | | | | | | |



Refer to Chapter 6.4.2, "Handling Instruments in the R&S SGMA-GUI", on page 61 for information on how to configure and manage instruments in R&S SGMA-GUI.

Available Instruments

This section comprises a list of configured instruments. Each instrument is represented by a "Symbolic Name" which is also displayed in the main panel and an "Instrument Type". It is also displayed whether the instrument is activated in the R&S SGMA-GUI and hence displayed in the main panel or not.

Remote command:

- :INSTruments:COUNt? on page 69
- :INSTruments:NAME on page 70
- :INSTruments:TYPE on page 72
- :INSTruments:ACTive[:STATe] on page 69

Scan

Triggers a scan function and searches for instruments connected to the remote computer via all the available interfaces. During the scan process, a progress bar is displayed. **Tip:** The first initialization of a newly connected instrument in a network and the instrument's request to the DHCP server for an IP address may take some time. During this time, the instrument does not respond to the query sent by the scan function. If the instrument does not appear in the list of "Available Instruments", trigger the scan function again after some minutes.

Remote command:

:INSTruments:SCAN on page 71

New Instrument

Calls the Add/Edit Instruments dialog.

Delete Instrument

Removes the selected instrument from the list of Available Instruments.

Edit Instrument

Calls the Add/Edit Instruments dialog.

Clear Instrument

Removes all instruments from the list of Available Instruments.

Export

Opens the standard file save browser for saving the list of the available instruments in a mapping file. The mapping files have the file extension .map so the filename typed in is automatically equipped with this extension.

A mapping file provides a cross-reference between the instruments' symbolic names and their respective remote control parameters. The information in the mapping file is grouped in rows, where one row corresponds to one configured instrument. The rows have the following structure:

```
<InstrumentType> <SymbolicName> <IP_Address/Hostname> <RemoteChannel> <SerialNumber>
```

| 📃 map | ping.map - l | Notepad | | | - • • |
|-------------------|-------------------|--|-------------------|----------------------------|-------|
| File E | dit Format | : View Help | | | |
| SGMA- Versi | GUI Instr on 1 | rument mapping | | | ^ |
| SGS SGU SGT | SGS SGU SGT | rsgs100a100002 rsgs100a100008 rsgs100a100006 | LAN LAN LAN | 100002 100008 100006 | |
| | | | | | + |
| | | | | | E. ₹ |

Figure 6-1: Mapping file example

Tip: In a remote control application program, address the instruments by their symbolic names and retrieve the remain required settings from the mapping file. This workflow is especially useful for frequent exchange of instruments.

```
Remote command:
:INSTruments:MAPPing:FILE on page 70
```

Scan LAN instruments with host name prefix

Sets the prefix the searched host names begin with. Use this function to limit the amount of the searched instruments and to speed up the scan process.

For example, set this field to "RsSGS, RsSGU, RsSGT", if you want to search for all available instruments.

Tip: If you start a scan for an instrument with a set IP address and it does not appear in the list of available instruments it may be due to the prefixes written in this field. You can perform another scan while leaving this field empty.

Remote command:

:INSTruments:SCAN:HNPRefix on page 71

6.1.2.2 Add/Edit Instruments

The dialog provides access to the main instrument's settings, such as "Symbolic Name", "Instrument Type" and connection settings.

| 🚸 Add Instrument | |
|------------------|---------------|
| Instrument Nr. | 2 |
| Symbolic Name | SGU-100002 |
| Instrument Type | SGU |
| Active | ⊘ On |
| Exclusive Access | ✔ On |
| Device Identify | On |
| Re | emote Control |
| Hardware Channel | PCIe |
| Serial Number | 100 001 |
| Ok | Apply Cancel |



Refer to Chapter 6.4.2, "Handling Instruments in the R&S SGMA-GUI", on page 61 for information on how to configure and manage instruments in R&S SGMA-GUI.

Instrument Nr.

Automatically assigned number that indicates the instrument's index in the list of "Available Instruments".

Symbolic Name

Selects the alias name of the instrument.

Operating Menu and Toolbar

Remote command: :INSTruments:NAME on page 70

Instrument Type

Selects the instrument's family.

Remote command: :INSTruments:TYPE on page 72

Active

Activates/deactivates the display of the instrument's settings in the main panel.

Note: Only instruments in an active state can be controlled from the R&S SGMA-GUI!

Remote command:

:INSTruments:ACTive[:STATe] on page 69

Exclusive Access

Checks whether the instrument is locked by another user and if not locks the instrument. When an instrument is locked, it is reserved and can be operated manually or remote **exclusively** from the remote PC on which the R&S SGMA-GUI is running or from which the SCPI command is sent.

For interfaces using VISA, i.e. for LAN and USB, enabling the "Exclusive Access" triggers the standard vilock request. For remote control over PCIe or Socket, the lock request is performed on a higher application level.

Note: It is recommended to lock the instrument before further configuration. Locked instruments are not found by the scan function.

The instrument has to be unlocked to allow operation from another remote PC.

Note: The two functions "Exclusive Access" and monitoring are mutually exclusive. Disable "Exclusive Access" if the instrument is monitored by an external PC.

Remote command:

:INSTruments:EACCess[:STATe] on page 69 :LOCK? on page 149

:UNLock on page 149

Device Identity

Triggers the device identification function. The [LAN] LED on the front panel of the selected instrument blinks.

See also Chapter 6.4.4, "Bidirectional Instrument Identification ", on page 64.

Hardware Channel

Selects the hardware interface used by the remote channel.

Remote command: :INSTruments:REMote:CHANnel on page 70

Instrument Name / IP Address

Enters the IP address or the host name of the connected instrument.

See also Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 64.

Operating Menu and Toolbar

Remote command: :INSTruments:REMote:NAME on page 70

GPIB Address

Enters the GPIB address of the connected instrument.

See also Chapter 10.1.5, "GPIB Interface (IEC/IEEE Bus Interface)", on page 121.

Remote command: :INSTruments:GPIB:ADDRess on page 71

Board Number

Identifies the GPIB bus card of the controller to that the adapter is connected.

See also Chapter 10.1.5, "GPIB Interface (IEC/IEEE Bus Interface)", on page 121.

Remote command:

:INSTruments:GPIB:BOARd on page 71

Serial Number

Enters the serial number as instrument's identification while using the USB or PCIe interfaces for remote control.

Remote command: :INSTruments:SERial on page 71

ΟΚ

Confirms the settings and closes the dialog.

Apply Confirms the settings.

Cancel Discards settings and closes the dialog.

6.1.2.3 Versions/Options Dialog

Querying information about the installed options and software version

Select "Setup > Software".

An info dialog opens, showing program information.

Operating Menu and Toolbar

| 🚸 Versions / Op | otions | | | | • 💌 | | |
|-----------------------------------|--------------|--------------|---------------|--|-----|--|--|
| Software | Versio | ns | | | | | |
| Package | | Versi | on | | | | |
| SGMA-GUI FV | V | 03.50.124.02 | | | | | |
| Service Pack | Service Pack | | not installed | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Show Open Source Acknowledgements | | | | | | | |

Software

Displays information on:

"Package" Installed software packages. "Version"

Release of the software package.

Show Open Source Acknowledgments

Accesses the list of the used open source software packages and the corresponding verbatim license texts.

Versions

Shows the installed software platform and its version.

6.1.2.4 Reset SGMA-GUI

Resets R&S SGMA-GUI to its factory preset settings.



The connected instruments are not affected by this preset.

To preset one specific instrument to its factory preset settings, select "SGMA-GUI > Instrument Name > Setup > Factory Preset". Refer to Chapter 8.9, "Factory Preset", on page 101 for an overview of the settings affected by this function.

6.1.2.5 Remote

Access: "SGMA-GUI > Setup > Remote".

| 🚸 Remote 🗖 🗖 | |
|------------------|-------|
| SCPI Socket Port | 5 025 |
| | |

SCPI Port

Sets the port number of the LAN interface for remote control with TCP/IP socket protocol.

This allows you to set different port numbers if you want to control different software, e.g. R&S SGMA-GUI and R&S WinIQSIM2, from the same application.

Info Dialog and Messages in the Info Bar

Remote command: :SYSTem:COMMunicate:SOCKet:PORT on page 189

6.1.3 Help

The R&S SGMA-GUI is equipped with a context-sensitive help function. A help page can be called any time during software operation.

The context-sensitive page which is opened with the [F1] button is part of a comprehensive help system.

It is possible to move from this context-sensitive page to any page of the help system. An overview of the contents of the online help can be reached via the menu "SGMA-GUI > Help > Contents".

A search for keywords within the help function is available via menu item "SGMA-GUI > Help > Index".

6.2 Info Dialog and Messages in the Info Bar

A few operating states and the current messages are displayed in the info line. For information on messages in greater detail and their management, an "Info" dialog can be opened.

6.2.1 Info Dialog

The "Info" dialog provides a list of currently active permanent messages and a detailed description of each message. The messages are color-coded according to their level.

Accessing the info dialog

In the "R&S SGMA-GUI main panel", select the "Info" button.

The "Info" dialog opens.

| SGMA-GUI | |
|--|-----------------|
| File Setup Help | |
| | |
| 6 | Info line |
| 🚯 History - Current time: Tue Jan 27 2015, 10:43:57 | |
| Lev SCPI Text | |
| Info 90 Sav/Rcl Handler Info -Save completed | List of current |
| into 90 Sav/Rci Handler Info - Save data to file C:/Users/AppData/Roaming/Rohde-Schwarz/sgma-gui/test.savrcl | |
| | messages |
| | with short |
| | message text |
| 1 | |
| 1: Jan-27-2015/ 10:42:32-059ms, Error code 90005, | |
| Sav/Rcl Handler Info -Save completed | Detailed |
| | description of |
| SCPI: Device specific error | description of |
| | a highlighted |
| | message |
| | 3 - |
| Delete Delete Show | |
| All Volatile | |
| | |

The upper part of the "Info" dialog lists the currently active permanent messages. See the following table for explanation of the displayed information.

| Parameter | Description |
|-----------|--|
| "LEV" | Message level. Messages referring to a logical component of R&S SGMA-GUI, e.g., Unicode, are marked in red color, info messages are marked in black color. The following levels might occur: • Err: Error message • Info: Information message • Sys: System message • Crit: Critical message |
| | For detailed information on the message types, see Chapter 6.2.2, "Understanding the Messages in the Info Bar", on page 57. |
| "SCPI" | Indicates the SCPI error code. |
| Text | A list of all currently permanent messages in the order of their occurrence, i.e., the most recent message is displayed first. |

The buttons in the lower part of the "Info" dialog provide quick access to some functions for managing these messages. For a detailed description on how to clear error messages or display a history of all messages, refer to Chapter 6.4.5, "Managing Messages in the Info Dialog", on page 66.

| Function | Description |
|-----------------------|---|
| "Delete" | Clears the highlighted message. This button is available only if the history of the messages is displayed. |
| "Delete All" | Clears all messages. |
| | This button is available only if the history of the messages is displayed. |
| "Del. volatile" | Clears all brief messages. This button is available only if the history of the mes- sages is displayed. |
| "Show History/Static" | Calls the list of all messages that have occurred since instrument switch-on. The most recent messages are displayed at the top of the list. When the button is pressed again, the list of current messages is displayed. |



Refer to Chapter 6.4.5, "Managing Messages in the Info Dialog", on page 66 for information on how to manage messages.

6.2.2 Understanding the Messages in the Info Bar

Messages indicate information, warnings, and errors. They are displayed in the info line in different colors depending on their importance and display duration. The following messages are displayed:

Error

There are two options:

 Critical errors are errors that prevent the instrument from working, e.g. an HW failure. Critical errors are displayed in red color.

Main Panel

- System errors are errors that concern the operating system, e.g., wrong file path. System errors are displayed in black color.
- Information

The information, e.g., file not found, is displayed in black color.

Warning

A warning indicates a less significant error and is displayed in black color.

Brief message

Brief messages report automatic settings in the program, e.g. switching on illegal entries that are not accepted by the program, 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.

Brief messages usually do not demand user actions and disappear automatically after a short period of time. They are stored in the history, however.

Permanent messages

Permanent messages are displayed if an error occurs that impairs further program operation. The error signaled by a permanent message must be eliminated before correct software operation can be ensured.

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.

6.3 Main Panel

The main panel of the R&S SGMA-GUI provides quick access to the main settings of the configured instruments. The display shows one row per instrument and comprises the instrument name and state, the used frequency and power level, the states of the RF output and modulator and the used reference source.

Click one of the buttons with an instrument name on it to access the menu tree with further settings for the corresponding instrument. For a detailed description of the provided settings, see:

- Chapter 8, "General Instrument Settings and Instrument Setup", on page 89 for general settings
- Chapter 7, "Upconverter Settings", on page 73 for R&S SGU settings.

Main Panel



Instrument/Connection State

The three colors of the state indicator in front of the instrument's name distinguish between the following states:

- Gray: the instrument is configured and activated in the R&S SGMA-GUI but there is no connection to the instrument.
- Green: the instrument is active, the connection is working and the instrument can be manually and remotely operated.
- Red: the instrument is in one of the following states:
 - Standby state

To operate the instrument manually, it has to be switched to ready state (see "To return the instrument from standby to ready state" on page 108).

Instrument locked

The red state indication together with the message "Instrument Locked" in the "Info" line indicates that the instrument is locked for Exclusive Access from another SGMA-GUI or controller.

The instrument is performing a time consuming operation, e.g. a selftest.

Maximum Frequency

The numbers in the rectangular box **I** on the left of the instrument's name indicate the maximum frequency of the instrument.

Pulse Modulation

A **I** sign on the left of the instrument's name indicates that the pulse modulation is switched on.

Instrument Name/ IP Address

Displays the alias name of the instrument and the IP address, as set by the parameters in "SGMA-GUI > Setup > Instruments > Add/Edit Instruments" dialog.

Click the button to access a menu tree for configuring the available instrument's settings, e.g. "Level" settings.

Frequency

Sets the RF frequency at the RF output connector of the selected instrument.

Remote command:

[:SOURce]:FREQuency[:CW|FIXed] on page 169



RF On/Off

Activates and deactivates the RF output signal.

The current state of the RF output (activated and deactivated) is indicated in the main panel with the different block color (blue or gray) and the status "On/Off".

Remote command: :OUTPut[:STATe] on page 167



Mod State

Switches the I/Q modulation on and off. Remote command:

[:SOURce]:IQ:STATe on page 170

PEP

Displays the Peak Envelope Power (PEP) of the RF signal of the selected instrument. The value is calculated as follows:

"PEP" = Level + Crest Factor

Remote command:

[:SOURce]:POWer:PEP? on page 177

Level/Level Offset

Sets the RF level at the RF output connector of the selected instrument.

If you set a level offset, it will be indicated in the R&S SGMA-GUI main panel by a change in the name of this parameter from "Level" to "Level Offset".



Note: The SCPI command [:SOURce]:POWer[:LEVel][:IMMediate][: AMPLitude] sets the level of the "Level" display, that means the level containing offset while [:SOURce]:POWer:POWer sets the level at the RF output connector.

Remote command:

```
[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude] on page 176
[:SOURce]:POWer:POWer on page 177
```

6.4 Working with R&S SGMA-GUI

This section explains how to work with the R&S SGMA-GUI software and perform configuration tasks for manual operation of the instruments.

6.4.1 Storing and Loading Settings

To proceed work with a particular configuration of the instruments in the R&S SGMA-GUI, it is useful to save the used settings and load them again later.

How to store and load settings

- 1. Select "SGMA-GUI main panel > File > Save As".
- Navigate to the desired directory and enter the filename. The extension *.savrcl is applied automatically.

The current settings of the software are saved to the selected file.

- 3. To load settings from a file, select "SGMA-GUI main panel > File > Open"
- 4. Navigate to the directory the file is stored in and select the setting file.

The saved settings are loaded to the R&S SGMA-GUI and the main panel of the software displays the saved instrument's configuration.

6.4.2 Handling Instruments in the R&S SGMA-GUI

This section provides information on how to configure and manage instruments in the R&S SGMA-GUI.

For reference information about all provided settings in the user interface, refer to the corresponding sections:

- Chapter 6.1.2.1, "Configure Instruments", on page 50 and Chapter 6.1.2.2, "Add/ Edit Instruments", on page 52
- Chapter 6.1.2.3, "Versions/Options Dialog", on page 54 Chapter 6.1.2.4, "Reset SGMA-GUI", on page 55

6.4.2.1 How to Automatically Add New Instruments to the SGMA-GUI

- 1. For each new instrument perform the following steps:
 - a) Connect the instrument to the network.
 - b) Switch on the instrument.
 - c) Press the [ID] key on the front panel of the instrument.
- 2. Start the SGMA-GUI on a computer connected to the same network.

All instruments are added automatically to the main panel of the SGMA-GUI.

6.4.2.2 How to Manually Add New Instruments to the SGMA-GUI

 In the R&S SGMA-GUI main panel, select "Setup > Instruments". The Configure Instruments dialog opens.

Working with R&S SGMA-GUI

2. Select the "New" button.

The Add Instrument dialog opens to register a new instrument.

- In the "Symbolic Name" field, enter an alias name of your choice, e.g. SGU-100021.
- 4. In the "Instrument Type" field, select the device family to connect to.
- 5. Select "Remote Control > Hardware Channel" and select the hardware interface.
- For LAN or Socket interfaces, select "Remote Control > Instrument Name / IP Address" and enter the IP Address or the hostname of the connected instrument, e.g. rssgu100a100021.

Tip: See also Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 64.

- For USB or PCIe interfaces, select "Remote Control > Serial Number" and enter the serial number of the connected instrument, e.g. 100021.
- Set "Active > On" to activate the instrument. Only active instruments are displayed in the R&S SGMA-GUI main panel.
- Click "OK" to confirm the settings and to close the dialog or press the "Apply" button to confirm the settings.
- 10. Click the "Cancel" button to discard settings and to close the dialog.

6.4.2.3 How to Scan for New Instruments

1. In the R&S SGMA-GUI main panel, select "Setup > Instruments".

The Configure Instruments dialog opens.

Click the "Scan" button to trigger the instrument to scan all remote channel interfaces for connected instruments.

Tip: To limit the amount of the searched instruments and to speed up the scan process, select "Configure Instruments > Scan LAN instruments with hostname prefix" and enter the prefix the searched hostnames begin with. The scan function searches only for instruments whose hostnames begin with the selected prefix.

All instruments which are connected to one of the available interfaces, are switched on and are not locked are displayed in the "Available Instruments" list. The R&S SGMA-GUI obtains all information for connecting to the instrument, so further configuration is not necessary.

6.4.2.4 How to Activate Instruments for Control from the R&S SGMA-GUI

1. In the R&S SGMA-GUI main panel, select "Setup > Instruments".

The "Available Instruments" in the Configure Instruments dialog lists all instruments configured in the software.

 Select the newly configured/connected or deactivated instrument and set "Active > On" to activate it.

Tip: Only active instruments are displayed in the R&S SGMA-GUI main panel!

6.4.2.5 How to Edit Instruments

- In the R&S SGMA-GUI main panel, select "Setup > Instruments". The Configure Instruments dialog opens and lists the "Available Instruments".
- Select the instrument to be edited and click the "Edit" button.
 The Edit Instrument dialog opens.
- Change the settings and confirm with OK.
 The edited settings are applied.

6.4.2.6 How to Delete an Instrument

- In the R&S SGMA-GUI main panel, select "Setup > Instruments". The Configure Instruments dialog opens.
- 2. Select the instrument to be deleted and click the "Delete" button.

The selected instrument is deleted from the list of "Available Instruments".

6.4.2.7 How to Delete All Instruments

- In the R&S SGMA-GUI main panel, select "Setup > Instruments". The Configure Instruments dialog opens.
- 2. Click the "Clear" button.

All instruments are deleted from the list of "Available Instruments".

6.4.2.8 How to Reserve the Instrument for Control

- 1. Open the "SGMA-GUI > Setup > Instruments > Configure Instruments" dialog, select the instrument in the list of "Available Instruments" and select "Edit".
- 2. In the "Edit Instrument" dialog, enable "Exclusive Access".

3. Alternatively, send the SCPI command : INSTruments: EACCess[:STATe] from the external PC the R&S SGMA-GUI is installed on.

The instrument is reserved for control from this external PC and cannot be accessed from any other controller. A scan function started from another controller finds the instrument but the instrument is indicated as locked.



The two functions "Exclusive Access" and monitoring are mutually exclusive! The "Exclusive Access" must be disabled to remote control or monitor the instrument form another external PC (see Chapter 10.6, "Using the R&S SGMA-GUI to Monitor the Remote Control Operation", on page 135).

6.4.3 Finding Out the Default Hostname of the Instrument

The default hostname of the instrument is a non-case-sensitive string built as follows:

hostname = <instrument name><serial number>, where

<serial number> is the individual serial number of the instrument

<instrument name> is the complete name of the instrument, written without spaces.

How to query the hostname of the instrument

- 1. Find the individual serial number on rear of the instrument , e.g. 100021.
- 2. Build the default hostname.

For the R&S SGU with serial number 100021, the default hostname is rssgu100a100021.



For instructions on how to change the default hostname, refer to Chapter 9.4, "How to Use Computer Names", on page 109.

6.4.4 Bidirectional Instrument Identification

In practice, instruments are integrated into a large network or placed in racks together with several other instruments of the same kind. It might be difficult then to find out which of the instruments configured in the R&S SGMA-GUI corresponds to which physical instrument or to localize all instruments operated by the current controller.

The R&S SGMA-GUI and the instrument provide the "Device Identification" function for this purpose.

How to find an instrument in the R&S SGMA-GUI

If several instruments have been configured and activated in the R&S SGMA-GUI, press the [ID] button on the instrument's front panel to trigger device identification.

The "Edit Instrument" dialog of this instrument opens.

Working with R&S SGMA-GUI

| 🚸 Add Instrument | | |
|------------------|----------------|--------|
| Instrument Nr. | | 2 |
| Symbolic Name | SGU-100002 | |
| Instrument Type | SGU | · |
| Active | ✓ On | |
| Exclusive Access | ✓ On | |
| Device Identify | On On | |
| F | Remote Control | |
| Hardware Channel | PCle | • |
| Serial Number | 1 | 00 001 |
| Ok | Apply Cancel | |

Field "Edit Instrument > Symbolic Name" displays the name of the instrument as shown in the R&S SGMA-GUI main panel.



Dialog "Edit Instrument" does not appear

If this dialog does not open, perform the following:

- Check whether the instrument is correctly connected to the external PC on which you work with the R&S SGMA-GUI.
- Check if the instrument is configured in the R&S SGMA-GUI and perform, if necessary, the steps described in Chapter 6.4.2, "Handling Instruments in the R&S SGMA-GUI", on page 61.
- Select "SGMA-GUI > Setup > Instruments", check the state of the instrument in the "Configure Instruments > Available Instruments" table and activate it, if disabled.

| Edit | Available Instrum Symbolic Name | nents | • • • |
|--|---------------------------------|--------------------|--|
| Edit | Symbolic Name | Instrument Type | • ··· · |
| | | mon annone type | Active |
| | SGS | SGS | ON |
| 2 | SGU | SGU | ON |
| 3 | SGT | SGT | ON |
| | | | |
| | | | |
| | | | _) |
| Scan New Delete Clear Edit Export Scan LAN instruments with host name prefix | | | |
| | Scan | Scan New Delete Cl | Scan New Delete Clear Edit can LAN instruments with host name prefix |

How to identify an instrument in an instrument set

- To identify the instrument in an instrument set, use one of the device identification functions:
 - a) Select "SGMA-GUI > Setup > Instruments > Available Instruments > Instrument > Edit > Edit Instrument" and trigger "Device Identify"
 - b) Select "SGMA-GUI > Instrument Name > Setup > Remote > Remote Channels" and trigger "Device Identify"

The green [LAN] LED on the front panel of the instrument blinks.

6.4.5 Managing Messages in the Info Dialog

How to get additional information on the message

In the "Info" dialog, click a message to select it.

In the lower section of the dialog, additional information on the highlighted message is displayed.

How to display all messages

▶ In the "Info" dialog, click the "History" button.

A history of all messages that have occurred since the R&S SGMA-GUI software was started is listed in the upper dialog pane. The most recent message is displayed first.

How to delete an error message

In the "Info" dialog, select the highlighted message and click the "Delete" button.
 Tip: This button is available only when the history of the messages is displayed.
 The highlighted message is cleared.

How to delete all error messages

In the "Info" dialog, click the "Delete All" button.

Tip: This button is available only when the history of the messages is displayed. All messages are cleared.

How to delete all brief messages

In the "Info" dialog, click the "Del. volatile" button.
 Tip: This button is available only when the history of the messages is displayed.
 All brief messages are cleared.

How to call the history

1. In the "Info" dialog, click the "History" button.

A list of all messages that have occurred since the instrument switch-on is displayed. The most recent messages are displayed at the top of the list.

 Click the "History" button once more. A list of current messages is displayed.

6.5 Remote Control of the R&S SGMA-GUI

This section focuses on the remote control of the R&S SGMA-GUI software.

6.5.1 Configuring Instruments in the R&S SGMA-GUI

This section provides an example of the automation of the R&S SGMA-GUI.

In the following example we assume that a remote PC with installed R&S SGMA-GUI on it is connected to a LAN and that the remote PC and the instruments are switched on.

For more information, refer to Chapter 2.3, "Connecting an External PC and Devices", on page 20.

```
// Trigger the scan function to search for instruments connected
// to the remote computer via all of the available interfaces.
:INSTruments:SCAN:HNPRefix "rssg"
// scan returns only instruments with hostname beginning with "rssg"
:INSTruments:SCAN 1
*OPC?
// Query the number of available instruments and the settings of each
// configured instrument: instrument type, symbolic name,
// remote channel used, serial number, hostname/IP address
// Adjust settings if required
:INSTruments:COUNt?
// Response: 3
:INSTruments:TYPE?
// Response: SGU, SGS, SGT
:TNSTruments:NAME?
```

```
// Response: SGU-100002,SGS-100006, SGT-100008
:INSTruments:SERial?
// Response: 100002,100006,100008
:INSTruments:REMote:CHANnel?
// Response: LAN, USB, PCIe
:INSTruments:REMote:NAME?
// Response: rssgu100a100002, rssgs100a100006, rssgt100a100008
// Check the instrument state and activate instruments if required
:INSTruments:ACTive:STATe?
// Response: 0,1,1
:INSTruments:ACTive:STATe ON,OFF,OFF
// Activates the first instruments in the list,
// i.e. the instruments with symbolic names SGS-100006
//\ {\tt Export} the configuration into a mapping file
:INSTruments:MAPPing:FILE 'd:\mapping_files\mapping.map'
// Enable exclusive access for the selected instrument
:INSTruments:EACCess:STATe?
// Response: 0,0,0
:INSTruments:EACCess:STATe ON,OFF, OFF
// Locks the first instrument
```

6.5.2 R&S SGMA-GUI Settings

This section comprises the SCPI commands provided to remote control the R&S SGMA-GUI.

| :INSTruments:ACTive[:STATe] | |
|------------------------------|----|
| :INSTruments:COUNt? | |
| :INSTruments:EACCess[:STATe] | |
| :INSTruments:MAPPing:FILE. | |
| :INSTruments:NAME | |
| :INSTruments:REMote:CHANnel | |
| :INSTruments:REMote:NAME | |
| :INSTruments:GPIB:ADDRess | 71 |
| | |

| :INSTruments:GPIB:BOARd | 71 |
|----------------------------|----|
| :INSTruments:SCAN | 71 |
| :INSTruments:SCAN:HNPRefix | 71 |
| :INSTruments:SERial | 71 |
| :INSTruments:TYPE | 72 |
| | |

:INSTruments:ACTive[:STATe] <State>

Enables/disables the instrument for the R&S SGMA-GUI. The main panel of this software displays only activated instruments.

Parameters:

| <state></state> | List of BOOL-values |
|-------------------|--|
| | <stateinstr#1>,<stateinstr#2>, 0, 1, ON, OFF</stateinstr#2></stateinstr#1> |
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Available Instruments" on page 50 |

:INSTruments:COUNt?

Queries the number of the currently available instruments.

| Return values: | |
|-------------------|---|
| <count></count> | float |
| | Range: 0 to 12 |
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Usage: | Query only |
| Manual operation: | See "Available Instruments" on page 50 |

:INSTruments:EACCess[:STATe] <State>

"Locks" the instruments, meaning the instrument is reserved and can be operated exclusively from the remote PC that sent this SCPI command.

Tip: It is recommended to lock the instrument prior to further configuration.

| Parameters: <state></state> | List of BOOL-values <lockinstr#1>,<lockinstr#2>,</lockinstr#2></lockinstr#1> |
|--------------------------------|---|
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Exclusive Access" on page 53 |

:INSTruments:MAPPing:FILE <File>

Saves the list of the available instruments in a mapping file. Mapping files are stored with the predefined file extension .map; the file extension may be omitted.

The file is saved in the default directory. Use the command MMEM: CDIRectory to change the default directory or specify the complete path.

| Parameters: <file></file> | string |
|------------------------------|---|
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Export" on page 51 |

:INSTruments:NAME <Name>

Selects the alias name of the instruments, i.e. sets the "Symbolic Name".

| Parameters: <name></name> | <symbolicnameinstr#1>,<symbolicnameinstr#2>,</symbolicnameinstr#2></symbolicnameinstr#1> |
|-------------------------------------|--|
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Available Instruments" on page 50 |

:INSTruments:REMote:CHANnel <Channel>

Sets the hardware interface used by the remote channel.

| Parameters: | |
|---------------------|---|
| <channel></channel> | List of CHAR-Data |
| | <channelinstr#1>,<channelinstr#2>,</channelinstr#2></channelinstr#1> |
| | The available interfaces are: LAN, USB, SOCKET, PCIe, GPIB, HISLIP |
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Hardware Channel" on page 53 |

:INSTruments:REMote:NAME <Name>

Enters the IP Address or the host name of the connected instrument.

| <hostname ip-addressinsr#1="">,<hostname ip-addres-<br="">sInsr#2>,</hostname></hostname> |
|--|
| See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| See "Instrument Name / IP Address" on page 53 |
| |
Remote Control of the R&S SGMA-GUI

:INSTruments:GPIB:ADDRess <Serial>

Sets the GPIB Address of the connected instrument.

Parameters:

<Serial>

List of Numbers

Manual operation: See "GPIB Address" on page 54

:INSTruments:GPIB:BOARd <Board>

Identifies the GPIB bus card the controller uses.

| Parameters: | |
|-------------------|-------------------------------|
| <board></board> | List of Numbers |
| Manual operation: | See "Board Number" on page 54 |

:INSTruments:SCAN <State>

Triggers a scan function and searches for instruments connected to the remote computer via all of the available interfaces.

Parameters:

| <state></state> | number |
|-------------------|--|
| | 1 = triggers the scan function, 0 = aborts the running scan proc- ess |
| | The query command returns 1 as long as scan is running; 0 indi- cates completed scan process. |
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Scan" on page 50 |

:INSTruments:SCAN:HNPRefix <Prefix>

Sets the prefix the searched host names begin with.

| Parameters: <prefix></prefix> | string |
|----------------------------------|---|
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Scan LAN instruments with host name prefix" on page 52 |

:INSTruments:SERial <Serial>

Enters the serial number as instrument's identification while using the USB interface for remote control.

Remote Control of the R&S SGMA-GUI

| Parameters: <serial></serial> | <serialnumberinstr#1>, <serialnumberinstr#2>,</serialnumberinstr#2></serialnumberinstr#1> |
|----------------------------------|---|
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Serial Number" on page 54 |

:INSTruments:TYPE <Type>

Selects the instrument's family.

| Parameters: | |
|-------------------|---|
| <type></type> | List of CHAR-Data |
| | <typeinstr#1>,<typeinstr#2>,</typeinstr#2></typeinstr#1> |
| Example: | See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 67. |
| Manual operation: | See "Available Instruments" on page 50 |

6.5.3 List of R&S SGMA-GUI Commands

| :INSTruments:ACTive[:STATe] | 69 |
|------------------------------|----|
| :INSTruments:COUNt? | |
| :INSTruments:EACCess[:STATe] | 69 |
| :INSTruments:GPIB:ADDRess | 71 |
| :INSTruments:GPIB:BOARd | 71 |
| :INSTruments:MAPPing:FILE | |
| :INSTruments:NAME | |
| :INSTruments:REMote:CHANnel | 70 |
| :INSTruments:REMote:NAME | |
| :INSTruments:SCAN | 71 |
| :INSTruments:SCAN:HNPRefix | 71 |
| :INSTruments:SERial | 71 |
| :INSTruments:TYPE | |
| | |

7 Upconverter Settings

This section summarizes the settings necessary to configure the instrument for signal generation. The description in this section follows the menu tree structure of the graphical user interface. Each of the discussed topics follows a common structure, providing basic background information and reference to the user interface.

For step-by-step instructions for fulfilling typical tasks, refer to Chapter 9, "Performing Configuration Tasks", on page 104.

7.1 Frequency Settings

Depending on the installed options, the instrument provides an adjustable output frequency in the frequency range of 10 MHz to 40 GHz.

To access this dialog, select "SGMA-GUI > Instrument Name > Frequency".

| 🚸 SGU-100014: F | requency 🗖 🗉 💌 |
|-----------------|-------------------------|
| Frequency | 1.000 000 000 000 GHz 🗸 |
| | |

Configuring the RF frequency

- To change the RF frequency of the selected instrument, perform one of the following:
 - a) Select "SGMA-GUI main panel > Freq" and enter the desired frequency.
 - b) Select "SGMA-GUI > Instrument Name > Frequency/Phase > Frequency" and enter the desired frequency.

You have to confirm the changes of the RF frequency in the External Local Oscillator Settings dialog for them to be applied to the signal.

Frequency

Sets the RF frequency at the RF output connector of the selected instrument.

```
Remote command:
```

[:SOURce]:FREQuency[:CW|FIXed] on page 169

7.2 Level and Power-On Settings

This section explains the level settings of the R&S SGU. The instrument can be equipped optionally with an active electronic step attenuator (R&S SGU-B26).

Configuring RF level

- ► To change the RF level of the selected instrument, perform one of the following:
 - a) Select "SGMA-GUI main panel > Level" and enter the desired value.
 - b) Select "SGMA-GUI > Instrument Name > Level > RF Level > Level" and enter the desired value.

You have to confirm the changes of the RF level in the External Local Oscillator Settings menu for them to be applied to the signal.

7.2.1 RF Level

To access the RF level settings, select "SGMA-GUI > Instrument Name > Level > RF Level".

| 🚸 SGU: Level | | | - • × |
|---------------|------------|--------------|-----------|
| RF Level | Attenuator | Power-On/EMF | ALC |
| Level | | -10.00 |) dBm 🔹 |
| Mode | | Normal | • |
| Setting Chara | cteristic | Auto | • |
| Level Range: | 3 | 0.00 dBm | 30.00 dBm |
| Limit | | 30.00 |) dBm 🔹 |
| Readju | ıst | | |
| | | |) |

This dialog comprises settings like the RF level and level limit.

Level/Level Offset

Sets the RF level at the RF output connector of the selected instrument.

If you set a level offset, it will be indicated in the R&S SGMA-GUI main panel by a change in the name of this parameter from "Level" to "Level Offset".

| Level | -30.00 dBm 🔻 | Lev Offs | -30.10 dBm | • |
|-------|--------------|-------------|------------|---|
| | | | | |

Note: The SCPI command [:SOURce]:POWer[:LEVel][:IMMediate][: AMPLitude] sets the level of the "Level" display, that means the level containing offset while [:SOURce]:POWer:POWer sets the level at the RF output connector. Remote command:

```
[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude] on page 176
[:SOURce]:POWer:POWer on page 177
```

Offset

Sets a level offset.

This value represents the level shift of a downstream instrument, as, for example, an attenuator or an amplifier, and is indicated in the status bar of the display. It does not change the level at the RF output.

Remote command:

[:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet on page 176

Mode

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

"Normal" In normal mode, the generator provides an RF output signal with high signal to noise ratio and low distortion, according to the data sheet.

"Low Noise" This setting forces the generator to optimize the signal to noise ratio.

"Low Distortion"

In this mode, the generator reduces distortions of the RF signal to a minimum.

Remote command:

[:SOURce]:POWer:LMODe on page 175

Setting Characteristic

Selects the characteristic for the level setting. For some general applications, the instrument operation can be optimized by choosing one of the predefined level setting characteristics.

"Auto" The instrument provides the highest dynamic range and the fastest setting times according to the data sheet. The RF signal is shortly blanked during the moment the step attenuator is switched on.

"Uninterrupted Level setting"

Suppresses level blanking at frequency and level changes. This mode reduces the dynamic range of the instrument. The step attenuator is fixed.

"Strictly Monotone"

Provides level setting without discontinuities. All electronic switches in the RF path are clamped. The operation mode is useful for applications using level searching algorithms.

This mode further reduces the dynamic range of the instrument.

"Constant-VSWR"

Suppresses output impedance variations at the [RF Out] connector due to switching of the step attenuator. The step attenuator is fixed. This mode reduces the dynamic range of the instrument. Remote command:

[:SOURce]:POWer:SCHaracteristic on page 176

Level Range

Displays the level range within which the level setting is expected to work properly. The range limits depend on several parameters like "Mode", "Setting Characteristic", the I/Q signal's crest factor etc.

Remote command:

[:SOURce]:POWer:RANGe:LOWer? on page 178
[:SOURce]:POWer:RANGe:UPPer? on page 178

Limit

Sets the level limit.

The value specifies the upper limit of the level at the [RF OUT] connector. A message appears if an attempt is made to set a level above this limit and the level at the RF output is confined to the upper limit. However, the level indication is not influenced.

The value is not affected by an instrument preset function. This parameter is influenced only by the Factory Preset and its factory value is equal to the upper limit.

```
Remote command:
[:SOURce]:POWer:LIMit[:AMPLitude] on page 177
```

Readjust

Recalculates the instrument internal settings optimized for the current level. Not required for automatic modes.

Remote command:

[:SOURce]:POWer:ALC:SONCe on page 174

7.2.2 Attenuator

To access the attenuator settings, select "SGMA-GUI > Instrument Name > Level >Attenuator".

| 🚸 SGU: Level | |
|-------------------------|---------------------|
| RF Level Attenuator | Power-On/EMF ALC |
| Mode | Auto • |
| SATT Switch-Over Offset | 0.0 dB - |
| Level Range: | 30.00 dBm 30.00 dBm |
| RF OFF Mode | ATT = Max |
| | |

This dialog comprises the settings for the power-on behavior of the instrument.

Mode

Sets the attenuator mode at the RF output.

"Auto" Standard mode.

The electronically switching attenuator switches with a \sim 6 dB step width at optimized switching points. The entire level range is available. The level setting is performed by continuous electronic level control combined with switching the step attenuator.

"Fixed" The level settings are made without switching the attenuator. When this operating mode is switched on, the attenuator is fixed in the current position to provide level settings without interruption. The resulting variation range is defined and displayed under Level Range.

Note: The function is effective when automatic level control is activated ("ALC State = On"). If the normal variation range is overranged or underranged, level errors increase considerably and the warning "Level under/overrange" appears in the info line. The spectral purity of the output signal decreases with high attenuation.

Remote command:

:OUTPut:AMODe on page 167

Level Range

If "Attenuator > Mode = Fixed" is selected, displays the level range in which the level is set without interruption.

Remote command:

:OUTPut:AFIXed:RANGe:LOWer? on page 168 :OUTPut:AFIXed:RANGe:UPPer? on page 168

SATT Switch-Over Offset

Sets the switch-over offset value of the attenuator.

Remote command:

[:SOURce]:POWer:ATTenuation:SOVer[:OFFSet] on page 175

RF-Off-Mode

Determines the attenuator's state after the instrument is switched off.

In default setting, the electronic step attenuator switches to highest attenuation when RF is off. By setting the RF-Off mode, the electronic step attenuator can be fixed to keep the output impedance constant during RF off.

Remote command:

[:SOURce]:POWer:ATTenuation:RFOFf:MODE on page 175

7.2.3 Power-On/EMF

To access the power- on/EMF settings, select "SGMA-GUI > Instrument Name > Level > Power-On/EMF".

| < | 💲 SGU: Level | | | | × |
|---|--------------|------------|------------------|-----|---|
| | RF Level | Attenuator | Power-On/EMF | ALC | |
| | Power-On Sta | ate F | Previous Setting | | • |
| l | | | | | |

This dialog comprises the settings for the power-on behavior of the instrument.

Power-On State

Selects the state which the RF output takes after the instrument is switched on.

```
"RF Off" The output is deactivated when the instrument is switched on.
```

"Previous Setting"

When the instrument is switched on, the output takes the same state as it had when the instrument was switched off.

```
Remote command:
:OUTPut[:STATe]:PON on page 168
```

7.2.4 ALC

To access the automatic level control (ALC) settings, select "SGMA-GUI > Instrument Name > Level > ALC".



Automatic level control can be used with almost all applications, especially I/Q modulation. It only has to be deactivated for certain settings in the baseband and when I/Q impairments ("Impairments State On") are activated. This is indicated under the respective function.

By default, the instrument operates in "Table & On" mode to provide the highest level accuracy and fastest setting time. Level control can be switched to "Off (Table)" or "On" for particular applications. The "Off (Table)" state (level control Off) is recommended if in CW mode the signal/intermodulation ratio is to be improved for multi-transmitter measurements.

State

Sets the internal level control.

| "Table & On" | Default mode. First sets the level to the target value using the internal level table. Then activates the level control circuit to achieve maximum level accuracy. |
|---------------|---|
| "On" | Internal level control is permanently activated. If "On" and "Attenuator Mode Fixed" is selected, the level is recalibra ted for every level and frequency setting. |
| "Off (Table)" | Internal level control is performed according to the ALC table. |

Remote command:

[:SOURce]:POWer:ALC[:STATe] on page 174

Detector Sensitivity

Allows you to fix the internal level detector. It is recommended to use the Auto mode (default).

| "Auto" | Automatic detector selection. Recommended mode of operation. |
|--------|---|
| "Low" | Low sensitivity detector selected. This setting is intended for signals with high internal electronic levels. |
| "Med" | Medium sensitivity detector selected. This setting corresponds to normal mode. It is intended for signals with medium internal electronic levels. |
| "High" | High sensitivity detector selected. Selects the detector path with high sensitivity, intended for signals with low internal electronic levels. |
| "Fix" | Fixes the last set sensitivity setting. |

7.3 I/Q Modulation and Signal Impairment

The R&S SGU offers I/Q modulation with external analog I/Q signals. I/Q modulation with an external analog I/Q signal is possible for the instrument equipped with frequency options R&S SGU-B120V/-B140V. The external signal is input via the [I IN] and [Q IN] connectors and transferred to the I/Q modulator.

Before the signal is fed into the I/Q modulator, the signal can be impaired. Impairment at this point along the signal flow is offered to allow error correction of the supplied signal or set dedicated impairments.

7.3.1 I/Q Impairments

Signal impairments are well-defined arithmetic modifications of the data. Every data sample is modified in the same way. The purpose of adding impairments to the data stream is to simulate frequent sources of distortions in a real signal-processing chain to generate a test signal with dirty transmitter conditions.

7.3.1.1 Gain and Gain Imbalance

An I/Q gain is a multiplication of all I/Q amplitudes by a common factor. The effect is equivalent to two identical I and Q gain factors. The effect of an increased gain factor in the I/Q constellation diagram is shown below.



Figure 7-1: Effect of an increased amplitude in the I/Q constellation diagram

An I gain multiplies the I amplitudes by a factor, leaving the Q amplitudes unchanged. A Q gain has the opposite effect. Different I and Q gain factors result in an I/Q imbalance. This is usually due to different gains of the amplifiers in the I and Q channels of the I/Q modulator. The effect of a positive and negative gain imbalance is shown below.

I/Q Modulation and Signal Impairment



Figure 7-2: Negative gain imbalance (left) and positive (right) gain imbalance in the I/Q constellation diagram

7.3.1.2 I and Q Offset

An I offset adds a constant value to all I amplitudes, leaving the Q amplitudes unchanged. A Q offset has the opposite effect. A combination of I and Q values results in an I/Q offset, which is usually due to carrier feedthrough in the I/Q modulator. Possible reasons are interfering signals at the RF carrier frequency, e.g. an unsuppressed RF carrier subchannel. The effect of a positive I and Q offset in the I/Q constellation diagram is shown below.



Figure 7-3: I offset (left) and Q offset (right) in the I/Q constellation diagram

7.3.1.3 Quadrature Offset

Changes the phase angle between the I and Q vectors from the ideal 90 degrees, while the amplitudes are maintained. A positive quadrature offset results in a phase angle greater than 90 degrees. The effect of a positive quadrature offset in the I/Q constellation diagram is shown below.

I/Q Modulation and Signal Impairment



Figure 7-4: Positive quadrature offset in the I/Q constellation diagram

7.3.2 General I/Q Settings

To access the settings of the I/Q modulator, select "SGMA-GUI > Instrument Name > I/Q Settings > General".



Comprises the settings for setting the state and the analog wideband I/Q input.



Mod State

Switches the I/Q modulation on and off. Remote command:

[:SOURce]:IQ:STATe on page 170

Crest Factor

Sets the crest factor of the I/Q modulation signal.

The crest factor gives the difference in level between the peak envelope power (PEP) and average power value (RMS) in dB. This value is necessary for the generation of the correct output power at the RF output, i.e. the instrument uses the PEP value to compensate the average power.

The maximum input voltage at the I/Q input is equated to the peak power and is used as the "reference" for setting the level of the output signal. Since the signal does not usually supply the peak power at a constant level but instead supplies lower average power, the crest factor specifies how many dB have to be added internally so that the correct output power is achieved.

Remote command: [:SOURce]:IQ:CREStfactor on page 172

7.3.3 Analog Impairment Settings

To access the settings of the I/Q modulator, select "SGMA-GUI > Instrument Name > I/Q Settings > Analog Impairments".

| 🚸 I/Q Modulator SG | J-100014 | | - • • | 3 |
|--------------------|------------------|-------|-------|---|
| General An: | alog Impairments | | | _ |
| State | | Off (| On Or | |
| I Offset | | 0.00 | % - | |
| Q Offset | | 0.00 | % - | |
| Gain Imbalance | | 0.000 | dB • | |
| Quadrature Offset | | 0.00 | deg - | |
| | | | | |

Comprises the settings like I/Q offset and quadrature offset.

State

Activates/deactivates I/Q impairments.

If activated, the settings for offset, gain imbalance and quadrature offset become effective.

Note: It is recommended to switch automatic level control to the "Off (Table)" mode, as otherwise level errors may occur.

Remote command:

[:SOURce]:IQ:IMPairment:STATe on page 172

Offset

Sets the carrier offset (in percent) of the amplitudes (scaled to the peak envelope power (PEP) for the I and/or Q signal component. An ideal I/Q modulator suppresses the carrier offset completely (offset = 0 percent).

For more information, see Chapter 7.3.1.2, "I and Q Offset", on page 81.

Remote command:

[:SOURce]:IQ:IMPairment:LEAKage:I on page 171
[:SOURce]:IQ:IMPairment:LEAKage:Q on page 171

Gain Imbalance

Sets the imbalance of the I and Q vector (see Chapter 7.3.1.1, "Gain and Gain Imbalance", on page 80).

The entry is made in dB (default) or %, where 1 dB offset is roughly 12 % according to the following:

Imbalance [dB] = 20log (| GainQ | / | GainI |)

Positive values mean that the Q vector is amplified more than the I vector by the corresponding percentage. Negative values have the opposite effect.

Remote command:

[:SOURce]: IQ: IMPairment: IQRatio on page 170

Quadrature Offset

Sets the quadrature offset (see Chapter 7.3.1.3, "Quadrature Offset", on page 81).

```
Remote command:
[:SOURce]:IQ:IMPairment:QUADrature[:ANGLe] on page 171
```

7.4 Pulse Modulation Setting

The R&S SGU offers pulse modulation using external pulse signals. The external pulse signal has to be connected to the multi-purpose [TRIG] connector.

7.4.1 Pulse Modulation Settings

To access the pulse modulation settings, select "SGMA-GUI > Instrument Name > Pulse Modulation".

| 🚸 SGU-100014: Pulse M | odulation | - • • |
|-----------------------|-------------------|--------|
| OPulse Modulation | Connector/Trigger | |
| State | | Off On |
| Polarity | Normal | • |
| Impedance | 50 Ω | • |
| | | |

The "Pulse Modulation" dialog contains all parameters required to configure pulse modulation and pulse signal generation.

Pulse Modulation Setting

State

Sets the state of the pulse modulator.

Remote command: [:SOURce<hw>]:PULM:STATe on page 178

Polarity

Sets the polarity of the pulse modulator signal. "Normal" The RF signal is suppressed during the pulse pause. "Inverse" The RF signal is suppressed during the pulse. Remote command: [:SOURce<hw>]:PULM:POLarity on page 178

7.4.2 Pulse Connector/Trigger Settings

To access the pulse connector/trigger settings, select "SGMA-GUI > Instrument Name > Pulse Modulation > Connector/Trigger".

| 🚸 SGU-100014: Pulse Mo | SGU-100014: Pulse Modulation | | |
|------------------------|------------------------------|---|--|
| Pulse Modulation | Connector/Trigger | | |
| Connector Mode | Signal Valid | • | |
| | | | |

Comprises the settings necessary to configure the signal at the multi-purpose [TRIG] connector in the external trigger mode.

Trigger Connector Mode

Determines the signal at the input/output of the multi purpose [TRIG] connector.

"Signal Valid"

Output of high signal to mark valid frequency and level settings.

"Not Signal Valid "

Output of high signal to mark the transition state when frequency and level change.

"Pulse Mod Ext Source"

Input for an externally provided pulse modulation signal Used when an external pulse modulator source is provided at the

connector.

Remote command:

:CONNector:TRIGger:OMODe on page 155

7.5 External Local Oscillator Settings

In a setup where an R&S SGU is connected to an incompatible signal generator (local oscillator), the controller has to change the frequency and the level of this local oscillator (LO) to output the desired signal from the R&S SGU. The required settings of the local oscillator are shown in the "Local Oscillator" dialog.

To access this dialog select "SGMA-GUI > Instrument Name >Ext. Local Oscillator".

| 🚸 SGU: Ext. Local Oscillator 👘 📼 💌 | | | |
|------------------------------------|---------------------------|--|--|
| Frequency | 1.000 000 000 000 0 GHz - | | |
| Level | -10.00 dBm 👻 | | |
| Confirm External LO Settings | | | |
| | | | |

When changing any parameters which affect the output signal of the combined system of an incompatible LO and an R&S SGU, follow these steps:

Setting the signal of the R&S SGU

- Set the parameters of the R&S SGU like frequency and level in the R&S SGMA-GUI as needed.
- Open the "SGMA-GUI > Instrument Name >Ext. Local Oscillator" dialog and read the settings for "Frequency" and "Level".
- 3. Apply the required changes to the LO.
- Press the "Confirm External LO Settings" button to confirm that you have made the settings on the LO.

The desired signal is output by the R&S SGU.

Frequency

Shows the desired frequency for the LO input signal.

Remote command:

[:SOURce]:LOSCillator:FREQuency? on page 173

Level

Shows the desired level for the LO input signal.

Remote command: [:SOURce]:LOSCillator:POWer? on page 173

Confirm External LO Settings

Outputs the signal.

```
Remote command:
[:SOURce]:SETTings:APPLy[:IMMediate] on page 169
```

7.6 Trigger Connector Settings

To access this dialog select "SGMA-GUI > Instrument Name > Connector".

| In SGU-100014: Connector | | | |
|--------------------------|-------------------------------|--|--|
| Connecto | Connector Mode Signal Valid 🔹 | | |
| | | | |

This dialog comprises the settings for configuring the connector.

Trigger Connector Mode

Determines the signal at the input/output of the multi purpose [TRIG] connector.

"Signal Valid"

Output of high signal to mark valid frequency and level settings.

"Not Signal Valid "

Output of high signal to mark the transition state when frequency and level change.

"Pulse Mod Ext Source"

Input for an externally provided pulse modulation signal Used when an external pulse modulator source is provided at the connector.

Remote command: :CONNector:TRIGger:OMODe on page 155

7.7 Preset

Calls up a defined instrument setup. All parameters and switching states are preset (also those of inactive operating modes). The default instrument settings provide a reproducible initial basis for all other settings. However, functions that concern the integration of the instrument into a measurement setup are not changed.

Overview of the most important preset states

The following list gives an overview of the presets for the most important generator settings. The other presets can be found in the information accompanying the remote commands.

- "RF frequency" = 1 GHz
- "RF output" switched off
- "Modulator State" = Off

Preset

Settings that are **not affected** by the "SGMA-GUI > Instrument Name > Preset" function:

- Power on settings ("Level" dialog)
- Network settings ("Setup" dialog)
- Password and settings protected by passwords ("Setup" dialog)



To preset the R&S SGMA-GUI itself and all configured instruments to their predefined state, use the "SGMA-GUI > File > New" function.

SCPI command:

:SYSTem:PRESet on page 150

8 General Instrument Settings and Instrument Setup

This section describes the settings which do not directly affect signal generation.

Access:

▶ Select "SGMA-GUI > Instrument Name > Setup" and select the required dialog.



8.1 Hardware Configuration

Querying information about the installed assemblies

Select "SGMA-GUI > Instrument Name > Setup > Hardware Config".

In the "Hardware Config" dialog, the installed assemblies together with their variants and revision states can be displayed for servicing purposes.

Hardware Configuration

| | Counter — | | |
|---|--|---|---|
| | | | |
| | Common Assom | blu | |
| Accombly | Dart Number | Sorial Number | Povision |
| scii | 1419 2005k02 | 100014 | Revision |
| Controller | 1416 1201 02 | 101184 | 04.01 |
| | 1410.1201.02 | 101104 | 04.01 |
| | | | 01.11.01 |
| | | | |
| Accombly | RF Assembly | Sorial Number | Povision |
| Assembly | RF Assembly Part Number | Serial Number | Revision |
| Assembly IqUpcon FPGA | RF Assembly Part Number | Serial Number | Revision 01.02.17 |
| Assembly IqUpcon FPGA IqUpcon20 | RF Assembly Part Number 1418.2705.02 | Serial Number | Revision 01.02.17 06.02 |
| Assembly IqUpcon FPGA IqUpcon20 IqUpcon40 | RF Assembly Part Number 1418.2705.02 1315.2003.02 | Serial Number 101376 101072 | Revision 01.02.17 06.02 03.05 |
| Assembly IqUpcon FPGA IqUpcon20 IqUpcon40 IqUpcon40 BRD | RF Assembly Part Number 1418.2705.02 1315.2003.02 1418.3201.02 | Serial Number 101376 101072 101072 | Revision 01.02.17 06.02 03.05 06.05 |

The dialog is a table that lists the installed assemblies. It is divided into the sections:

- "Common Assembly"
- "RF Assembly"

Assembly

The tables list the installed assemblies.

"Assembly" Name of the assembly

"Part Number" Part Number of the assembly

"Serial Number"

Serial number of the assembly

"Revision" Revision state of assembly

Remote command:

:SYSTem:HARDware:ASSembly<dir>:SNUMber? on page 191

8.2 Software / Options

Querying information about the installed options and software version

Select "SGMA-GUI > Instrument Name > Setup > Software/Options".

The "Software/Options" dialog shows the firmware version of the instrument software and all installed hardware and software options.

| 560-100014: Softwar | e / Options | | | | | | |
|--|--|-------------------|---|----------|----------|-----------------|----|
| | | Sc | ftware — | | | | |
| Package | | | Version | | | | |
| SGU100A Base Softw | are | | 3.20.140.32 beta (2015-01-20; 06:50:06) | | | | |
| R&S COMPASS | | | 3.1.19.5 | | | | |
| | | | | _ | | | ų. |
| | | | | | | | |
| | | ——— На | rdware — | | | | |
| Option | | Designation | | | Licenses | Expiration Date | F |
| SGU-B120V | | 1 MHz to 20 GHz | u IQ | | | | |
| SGU-B140V | | 1 MHz to 40 GHz | u IQ | | | | |
| | | | | | | | |
| | | | | | | | T |
| | | | | | | | |
| | | Sc | ftware — | | | | |
| Option | | Designation | | | Licenses | Expiration Date | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | Wi | inIQSIM —— | | | | |
| | | | | | | 1 | |
| Option | | Designation | | | Licenses | Expiration Date | - |
| Option | | Designation | | | Licenses | Expiration Date | F |
| Option | | Designation | | | Licenses | Expiration Date | |
| Option | | Designation | | | Licenses | Expiration Date | |
| Option | | Designation | | | Licenses | Expiration Date | • |
| Option | | Designation | | | Licenses | Expiration Date | |
| Option | | Designation | d Modules – | | Licenses | Expiration Date | |
| Option Path | Module | Designation | ed Modules – Version | Descript | Licenses | Expiration Date | |
| Option Path ro/opt/bin | Module mainstartup | Designation | d Modules – Version | Descript | Licenses | Expiration Date | |
| Option Path Iro/opt/bin Iro/opt/bin | Module mainstartup libbusyledwrapp | Designation | d Modules – Version | Descript | ion | Expiration Date | Y |
| Path ro/opt/bin ro/opt/bin ro/opt/bin | Module mainstartup libbusyledwrapp libcaldatahandle | Designation Loade | d Modules – Version | Descript | ion | Expiration Date | V |

The dialog is divided into the following sections:

- "Firmware"
- "Hardware"
- "Software"
- "Loaded Modules"



Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. An instruction on how to install options is described in the service manual. Most hardware options need to be installed at an authorized Rohde & Schwarz service center.

Software

Shows the software/firmware version and the version of the software platform.

Note: Your instrument is delivered with the latest firmware version available. Firmware updates and the Release Notes describing the improvements and modifications are provided on the Internet at the download site of the instrument's home page. This home page always offers the latest information on your instrument, e.g. also on changes of the firmware update procedure.

Hardware / Software/WinIQSIM

The tables in the sections "Hardware" and "Software" list the installed hardware and software options.

"Option" Short name of the option

"Designation" Name of the option

"Licenses" Number of licenses

"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.

Loaded Modules

Section "Loaded Modules" is provided for service purposes. It lists all loaded software modules with their versions and offers a short description of each module.

Show Open Source Acknowledgments

Accesses the list of the used open source software packages and the corresponding verbatim license texts.

8.3 Install SW-Options

Newly purchased software options are enabled in the "Install SW-Option" dialog. They are ready to operate after they are enabled by a key code supplied with the option.

| 🚸 SGU-100014: Install SW-Option 🛛 🗖 🔳 🔤 | | |
|---|--|--|
| Option Key | | |
| | | |

Only if the instrument is equipped with an older firmware version, a firmware update before enabling the software option may be required. The information on the valid firmware versions for the purchased software option is provided together with the option.

Protection

See:

- Chapter 9.5, "How to Install a New Firmware Version on the Instrument", on page 110 for information on how to perform firmware update
- Chapter 9.6, "How to Activate Options", on page 111 for instruction on how to install new options

The firmware update is also described in the service manual.

8.4 Protection

The "Protection" dialog provides access to the unlocking of protected service functions (authorized personnel of R&S Service Departments only).

Unlocking of protected service functions

1. Select "SGMA-GUI main panel > Instrument Name > Setup > Protection".

The "Protection" dialog provides access to the unlocking of protected service functions (authorized personnel of R&S Service Departments only).

To deactivate the protection, the correct password has to be entered. After the instrument has been switched on, the protection levels 1 to 4 are automatically activated.

Enter "Protection Level 1 > Password > 123456".

Protection Level 1 is activated.

| 🚸 SGU-100014: Protection | - • × |
|--------------------------|-----------------|
| Protection Level 1 🗸 On | Password ****** |
| Protection Level 2 🖌 On | Password ****** |
| Protection Level 3 ✔ On | Password ****** |
| Protection Level 4 🖌 On | Password ***** |

Protection Level / Password

"Protection Level 1" can be activated to expand the functionality of the internal adjustment. The password is 123456.

The other protection levels 2 to 4 provide access to protected service functions. Only the authorized personnel of R&S Service Departments can access these functions.

8.5 Security Setting

The R&S SGU employs a security concept based on user and security password. The security password is required for changing several critical settings, like performing firmware updates. Access to the passwords and mass storage security settings is provided in the "Security" dialog.

To access the "Security" dialog, select "SGMA-GUI > Instrument Name > Setup > Security"

The menu is divided into the password sections and the security settings section. In the password section, the passwords for securing a controlled access to the instrument are defined and changed.

A change of passwords for the operating system and security password requires the entry of the old and new password and the conformation of the new password. All settings are only accepted after the "Change Password" button is pressed.

| 🚸 SGU-100014: Security | - • • | | | |
|--------------------------|----------------|--|--|--|
| Change User Password | | | | |
| valid for VNC,FTP and SA | MBA access | | | |
| User Name | instrument | | | |
| Old Password | | | | |
| New Password | | | | |
| Confirm Password | | | | |
| Change Password | | | | |
| Change Secu | urity Password | | | |
| Old Password | | | | |
| New Password | | | | |
| Confirm Password | | | | |
| Change Password | | | | |
| Securit | y Settings | | | |
| USB Device | Enable - | | | |
| Lan Connections | Enable - | | | |
| Security Password | | | | |
| Accept | | | | |

Î

The settings of this dialog are not accessible over remote control (e.g. SCPI commands).

Change User Password

The user name and password are required for remote access to the instrument via VNC, FTP or SAMBA.

Note: It is highly recommended to change the default user password before connecting the instrument to the network.

User Name ← Change User Password

Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SAMBA access.

Enter the currently used user password. The default password is "instrument".

Enter the new user password.

Confirm Password ← Change User Password

Enter the new password for conformation.

The new password is only valid after the "Change Password" button is pressed.

Change Password - Change User Password

Changes the password accordingly.

Change Security Password

Note: It is highly recommended to change the default security password before connecting the instrument to the network.

The security password is, for example, required when changing the status of the USB and LAN interface.

Old Password Change Security Password

Enter the currently used security password. The default password is '123456'.

New Password ← Change Security Password

Enter the new security password. The security password may contain decimal characters only.

Enter the new password for conformation.

The new password is only valid after the "Change Password" button is pressed.

Change Password ← Change Security Password

Changes the password accordingly.

Security Settings

Comprises the settings for enabling and disabling the USB and LAN interfaces. The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

Enable/disable the USB interface.

Note: The instrument does not recognize any device connected to the USB interface when the interface is disabled.

Enable/disable the LAN interface.

Note: It is not possible to access the instrument via LAN while the LAN connection is disabled.

An enabled LAN connection is a prerequisite for the remote control of the instrument via VNC, FTP or SAMBA.

Security Password - Security Settings

Enters the password that is required to enable or to disable the settings protected by a security password. The default is '123456'.

Note: It is highly recommended to change the default security password before connecting the instrument to the network. To change the security password, select "SGMA-GUI > Instrument Name > Setup > Security > Change Security Password".

The settings are only accepted after the "Accept" button is pressed.

Accept a new entry or selection and change the settings accordingly.

8.6 Maintenance

The R&S SGU provides a special dialog for performing some maintenance procedures, like installing firmware packages.

To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Maintenance".

Network Settings

| 🚸 SGU-100014: Maintenance | |
|---------------------------|----------------------------------|
| Operation | Install firmware package |
| Select Package | None Install firmware package |
| Update All SGUs | On |
| Security Password Accept | |

Operation

Selects the desired maintenance operation.

Select Package

Available only for "Operation > Install Firmware Package".

Selects the firmware package to be installed, see also Chapter 9.5, "How to Install a New Firmware Version on the Instrument", on page 110.

Update All

Available only for "Operation > Install Firmware Package".

Enable this function to perform a simultaneous firmware update on all instruments, that are in active state and are connected to this controller.

Note: A firmware update and the required subsequent restart and the automatically initiated internal adjustment process of the controller may be a time consuming operation. This feature accelerates the update process and the required restart of the external PC can be executed once after the update operation of all instruments is completed.

Security Password

Enters the password that is required to enable or to disable the settings protected by a security password. The default is '123456'.

Note: It is highly recommended to change the default security password before connecting the instrument to the network. To change the security password, select "SGMA-GUI > Instrument Name > Setup > Security > Change Security Password".

The settings are only accepted after the "Accept" button is pressed.

Accept

Accept the selected operation and perform the required procedure.

8.7 Network Settings

The instrument is equipped with a network interface and can be connected to an Ethernet LAN (local area network). The "Network Settings" dialog provides access to the network settings.

NOTICE

Risk of network errors!

Connection errors can affect the entire network.

If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN.

Contact your network administrator to obtain a valid IP address.

To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Network Settings".

| 🚸 SGU: Network Settings | | - • × | | | |
|-------------------------------|------------|-----------------|--|--|--|
| | | Restart Network | | | |
| | ngs | | | | |
| Hostname rssgu100a100014 | | | | | |
| MAC Address 00 90 b8 1c 05 cb | | | | | |
| | IP Address | | | | |
| Address Mode | | Auto (DHCP) 🔻 | | | |
| IP Address | | 111.111.0.116 | | | |
| Subnet Mask | | 255.255.252.0 | | | |
| Default Gateway | | 111.111.0.1 | | | |
| Арріу | | | | | |
| | | | | | |

The dialog provides access to the network settings, like settings about the general network environment and specific identification of the computer in the network. The dialog also displays an indication whether the instrument is connected to the network or not.

Restart Network

Shuts down the network connection of the instrument and then re-establishes the connection.

This function can be used to resolve network problems.

Note: Only the connection of the instrument to the network restarts, the network itself is not affected.

Hostname

Displays the individual computer name of the instrument.

Network Settings

A predefined name is indicated and can be used for network connections, see Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 64.

It is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Remote command:

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname on page 187

MAC Address

Indicates the MAC address of the network adapter.

Address Mode

Selects if the IP address is assigned automatically or manually.

It is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Note: Lost LAN connection to an instrument.

If the connection to an instrument configured to use static IP addresses is lost, press the [LAN LED] on the instrument front panel.

This resets the "Address Mode" to its default value ("Auto (DHCP)").

"Auto (DHCP)" The IP address is assigned automatically. The network used must support automatic assignment of IP address via DHCP or APIPA (Zeroconf) to use this function.

"Static" The IP address is assigned manually.

Remote command:

:SYSTem:COMMunicate:NETWork:IPADdress:MODE on page 186

IP Address

Displays the IP address. To enter the IP address manually, select "Address Mode > Static".

If there is manual input of the IP address, it is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Remote command:

:SYSTem:COMMunicate:NETWork:IPADdress on page 186

Subnet Mask

Displays the subnet mask. To enter the subnet mask manually, select "Address Mode > Static".

This number is used together with the IP address to identify the network segment the instrument is in.

It is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Remote command:

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK on page 188

Default Gateway

Displays the IP address of the default gateway. To enter the default gateway manually, select "Address Mode > Static".

This address identifies the router on the same network as the instrument that is used to forward traffic to destinations beyond the local network.

It is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Remote command: :SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway on page 188

Apply

Applies the network settings to the instrument.

8.8 Remote Channels

The "Remote" dialog provides access to the settings for remote control.

To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Remote".

| 🚸 SGU-100014: Remote Channels | | | | |
|-------------------------------|-------------------------------------|--|--|--|
| Visa Resource Strings | | | | |
| LAN (VXI-11) | TCPIP::10.111.12.73::inst0::INSTR | | | |
| Socket | TCPIP::10.111.12.73::5025::SOCKET | | | |
| HISLIP | TCPIP::10.111.12.73::hislip0::INSTR | | | |
| USB | USB::0x0AAD::0x00ce::100014::INSTR | | | |
| PCIe | PCIe::0x162f::0x132f::100014::INSTR | | | |
| Device Identify | Off | | | |

Visa Resource Strings

Indicates the VISA resource strings used for remote control of the instrument. A separate string is provided for remote control via the different interfaces.

Note: For background information and description of the syntax of the VISA resource strings, refer to the description of the corresponding interface in Chapter 10.1, "Remote Control Interfaces and Protocols", on page 113.

Remote command:

- :SYSTem:COMMunicate:HISLip:RESource? on page 188
- :SYSTem:COMMunicate:NETWork:RESource? on page 188
- :SYSTem:COMMunicate:SOCKet:RESource? on page 189

Factory Preset

:SYSTem:COMMunicate:USB:RESource? on page 190 :SYSTem:COMMunicate:PCIexpress:RESource? on page 189

Device Identity

Triggers the device identification function. The [LAN] LED on the front panel of the selected instrument blinks.

See also Chapter 6.4.4, "Bidirectional Instrument Identification ", on page 64.

8.9 Factory Preset

The "Factory Preset" dialog provides a function to reset the instrument's settings to their factory states

 To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Factory Preset".

| 🚸 SGU-100014: Factory Preset 💼 📼 | | |
|--|--|--|
| Execute Factory Preset | | |
| Resets instrument to factory configuration. Security settings and user data are not effected. | | |

Select "Execute Factory Preset".

The instrument's settings are reset to their factory states. Security settings and user data are not effected.

Execute Factory Preset

Reset the instrument's settings to their factory state.

Note: Because "Factory Preset" resets the "Remote Channel Settings" and "Network Settings" to the default values, executing factory preset via remote control may terminate the connection to the instrument, if these settings had been configured to values different to the default ones!

The factory preset function resets nearly all instrument settings. In addition to the regular preset, a "Factory Preset" resets also the following values:

- Power on settings ("Level" dialog)
- Network settings including hostname ("Setup > Network Setting" dialog)
- Remote Channel settings ("Setup > Remote Channel" dialog)
- Eco Mode state ("Setup > Eco Mode" dialog)

To maintain security, password settings and all settings protected by these passwords like disabled USB and LAN connections are not changed.

Not affected by the "Factory Preset" are also user data, lists or instrument settings files, created, for example, with the "File Save As" function.

Remote command:

:SYSTem:FPReset on page 150

8.10 Eco Mode

This energy saving mode is available only for instruments equipped with optionR&S SGU-B140/B140V.

To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Eco Mode".

| 🚸 SGU-100014: EcoMode 🗖 🗉 💌 | | |
|-----------------------------|----------------------|--|
| Eco Mode | Eco Mode 1 (20 GHz - | |
| | | |

With enabled "Eco Mode 1" the doubler stage in a 40 GHz instrument is permanently switched off to reduce power consumption and the maximum frequency is limited to 20 GHZ. An enabled "Eco Mode" is indicated by a green coloring of the frequency range in the R&S SGMA-GUI.



NOTICE

Risk of invalid adjustment after changing the Eco Mode

The switching off and on of the doubler stage changes the thermal conditions in the instrument.

In order to achieve correct adjustment of the instrument, make sure that the instrument is warm before performing adjustments. The warm-up time is 30 minutes.

The state of this parameter is not affected by an instrument "Preset". This parameter is influenced only by the Factory Preset.

SCPI command:

8.11 Standby and Restart

See Chapter 9.3, "How to Switch between the Operating States", on page 107.

8.12 Diagnostic and Tests

This section describes the settings provided for diagnostic and test purposes.

8.12.1 Keyboard Tests

Access:

Select "SGMA-GUI > Instrument Name > Diagnostic Tests > Keyboard Test".

| 🚸 SGU-100014: Keyboard Test | - • • |
|-----------------------------|-------|
| Keyboard Test | O Off |

Use this function to check the proper operation of all front panel elements.

If "Keyboard Test" is enabled, all front panel LEDs except the [POWER ON] are orange.

The exact test procedure is described in the service manual.

SCPI command:

:TEST:KEYBoard[:STATe] on page 193

How to Generate I/Q Signals with an R&S SGS and an R&S SGU Upconverter

9 Performing Configuration Tasks

This section provides a general explanation on how to operate the instrument manually via the R&S SGMA-GUI software.

We assume, that the R&S SGU is connected to a remote PC. The R&S SGMA-GUI software has to be installed on this remote PC and the instrument has to be added to the list of "Available Instruments".



For information on how to fulfill these requirements, refer to:

- Chapter 2.3.2.1, "Connecting the Instrument to the Network", on page 22
- Chapter 2.3.1, "Installing the R&S SGMA-GUI Software", on page 21
- Chapter 2.3.2.3, "Automatically Adding Instruments to the SGMA-GUI ", on page 25

9.1 How to Generate I/Q Signals with an R&S SGS and an R&S SGU Upconverter



Options R&S SGS-B112V and R&S SGU-B120V/-B140V are required for the I/Q modulation.

To generate an I/Q modulated signal with higher frequency

In this example, the R&S SGU acts as an extension to the R&S SGU extending its frequency range to 40 GHz.

The Figure 9-1 shows an example of the test setup.

How to Generate I/Q Signals with an R&S SGS and an R&S SGU Upconverter







For higher setting/ measuring speeds, use a PCIe switch and PCIe connections.

If a common reference frequency is required, use the internal reference signal of the signal generator and provide it to the R&S SGU and the connected signal analyzer, e.g. the R&S FSW.

- 1. Connect the test equipment as shown on Figure 9-1:
 - a) Connect the R&S SGS, the R&S SGU and the controller to a LAN switch.
 - b) Connect the [I/Q OUT] of the base band signal source to the [I/Q IN] of the R&S SGU.
 - c) Connect the [I/Q OUT] of the R&S SGS to the I and Q connectors of the R&S SGS.
 - d) Connect the [RF OUT] of the R&S SGS to the [LO IN] of the R&S SGU.
 - e) Connect the [TRIG] connectors of the R&S SGS and the R&S SGU.
 - f) Connect the [RF OUT] of the R&S SGU to the [RF IN] of the signal analyzer.
- 2. Select "SGMA-GUI main panel > R&S SGS > Extension".

Tip: Steps 3 to 5 can be omitted if the R&S SGS and a single R&S SGU are connected using PCIe or USB or by a direct LAN connection. In this case, the R&S SGS automatically activates the R&S SGU.

- Press the ID key on the front panel of the R&S SGU (only required if the components are connected via a company network).
- 4. In the "Extension" dialog, trigger "Scan".

How to Restore the LAN Connection to an Instrument

The scan function finds out the connected R&S SGU.

 Select the R&S SGU from the list and set "Available Instruments > Select > On" to enable it as an extension.

A green status indicator "Connected" indicates the successfully established remote connection to the extension.

Select "Test Signal Connections > Test" to trigger a check of all required signal connections.

| 🚸 so | 🚯 SGS-100004: Extension | | | | | | |
|------|------------------------------------|----------|-------------------------|--|--|--|--|
| Conr | Connected 🧧 | | | | | | |
| | Available Instruments | | | | | | |
| | Symbolic Name | Channel | Select | | | | |
| 1 | SGU-100014 | Socket | ON | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| Sca | Scan Abort Test Signal Connections | | | | | | |
| | Te | est | | | | | |
| | Q out I out P | GU Lo | In Trig P P RF | | | | |
| | 🧕 🧔 🧔 I 🔅 | Trig SGS | | | | | |

The diagram displays the connection state of the tested connections.

 Select "SGMA-GUI > R&S SGS > Freq = 20 GHz", "Lev = -30 dBm" and enable "RF > State > On".

The extension adopts these values and states automatically. Generated is an I/Q signal with "RF = 20 GHz" and "Level = -30 dBm".

9.2 How to Restore the LAN Connection to an Instrument

If the LAN connection to an instrument configured to use a static IP address is lost, press the [LAN LED] on the instrument's front panel for more than 3 seconds to reset the LAN settings and to set the "Address Mode" on page 99 to DHCP.
Provided the network supports automatic assignment of IP address, new IP address is automatically assigned to the instrument.

9.3 How to Switch between the Operating States

The Figure 9-2 gives an overview of the operating states of the instruments and how to trigger the switch-over between them.



The Table 9-1 provides a short description of the operating states and their indication.

How to Switch between the Operating States

| Operating state | Description | Indication |
|--------------------------------|---|--|
| Off | The instrument is shut down. | All LEDs on the front panel of the instrument are off. |
| Booting | The instrument boots the operating system and starts the instrument firmware. If the previous session was terminated reg- ularly, the instrument uses the last setup with the relevant instrument settings. | The green [POWER ON /STAND BY] key blinks. |
| Standby | The standby power mode keeps the power switch circuits and the remote control sys- tem active. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply. | In the R&S SGMA-GUI, the status indicator in front of the instrument name is red. The orange [POWER ON /STAND BY] key is on. |
| Ready (normal operation) | The instrument is ready for operation. All modules are power-supplied. | In the R&S SGMA-GUI, the status indicator in front of the instrument name is green. The green [POWER ON /STAND BY] key is on. |

Table 9-1: Indication of the operating states

To switch the instrument to standby state

- Use one of the following:
 - a) On the remote PC, select "SGMA-GUI > Instrument Name > Setup > Standby".
 - b) Press the [POWER ON /STAND BY] key on the front panel of the instrument.
 - c) Send the SCPI command:

:SYSTem:REBoot

The current instruments settings are automatically stored. The instrument switches to a power-saving mode.

In the R&S SGMA-GUI, the standby state is indicated by the red state symbol in front of the corresponding instrument's name, on the front panel, by the orange [POWER ON /STAND BY] button.

The instrument can still be remote controlled.

To return the instrument from standby to ready state

- ► Use one of the following:
 - a) On the remote PC, select "SGMA-GUI > Instrument Name > Setup > Restart".
 - b) Press the orange [POWER ON /STAND BY] key on the front panel of the instrument.
 - c) Send the SCPI command:

:SYSTem:RESTart

The instrument loads the last setup with all instrument settings, switches to ready state and is ready for normal operation.

In the R&S SGMA-GUI, the ready state is indicated by the green state symbol in front of the instrument's name.

How to Use Computer Names

On the front panel, the ready state is indicated by the green [POWER ON /STAND BY] button.

To switch all connected instruments to standby state and close the R&S SGMA-GUI

In the R&S SGMA-GUI main panel, select "File > Shut down instruments and exit".

The R&S SGMA-GUI quits and switches the connected instruments to standby state.

For description on how to terminate work and shut down the instrument regularly, refer to Chapter 2.1.5, "Switching the Instrument On and Off", on page 17.

9.4 How to Use Computer Names

If there is a name server in the network, alternatively to the IP address each PC or instrument connected in a LAN can be accessed via an unambiguous computer name. Each instrument is delivered with an assigned computer name, but this name can be changed.



For instruction on how to find out the default computer name, refer to Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 64.

To query and change a computer name



To avoid violations and to make use of the easy identification provided by the computer name, it is recommended to keep the default hostname unchanged.

1. Open "SGMA-GUI > Instrument Name > Setup > Network Settings" dialog.

The computer name is displayed under "Hostname".

 Select "SGMA-GUI > Instrument Name > Setup > Protection" and enable the "Protection Level 1".

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

- 3. Change the "Hostname".
- 4. Press the [POWER ON /STAND BY] key to restart the instrument.

Note: The "Factory Preset" function restores the factory value of the parameter "Hostname".

9.5 How to Install a New Firmware Version on the Instrument

You can update the firmware of the R&S SGU .

Firmware installation through the R&S SGMA-GUI

If an update to a new firmware version is required for both the R&S SGMA-GUI and the instrument, it is mandatory that the new instrument's firmware is installed before the update of the R&S SGMA-GUI to the new version.

- Select "SGMA-GUI main panel > Instrument Name > Setup > Maintenance > Operation > Install firmware package".
- 2. Press "Select Package" and navigate to the directory the new firmware is stored in.
- If several instruments have to be updated to new firmware version, enable the feature "Update All " to accelerate the update process.

All instruments that are in active state and are connected to this controller are updated simultaneously.

- 4. Enter the "Security Password".
- 5. Confirm the update with "Accept".

The software transfers the firmware file and automatically starts the update procedure. During the update, the message "Updating Firmware" is displayed in the "Info" line. The update process is indicated by an LED running light.

Note: The update procedure requires a restart of the instrument. The restart is performed automatically. The instrument is not accessible during that time.

Wait until the message "Updating Firmware" disappears and the update is completed.

The green [POWER ON /STAND BY] LED is on.

- If necessary, install the new R&S SGMA-GUI.
 For detailed description, refer to Chapter 2.3.1, "Installing the R&S SGMA-GUI Software", on page 21
- 8. If the instrument and the controller/PC are connected over the PCIe interface and the external PC does not support hot-plugging, restart the external PC.

Firmware update through a session control protocol (SCP)



If an update to a new firmware version is required for both the R&S SGMA-GUI and the instrument, it is mandatory that the new instrument's firmware is installed before the update of the R&S SGMA-GUI to the new version.

1. Connect the R&S SGU and a Windows PC to the same network.

How to Manually Set a PCIe Direct Connection between an R&S SGS and an R&S SGU

- 2. On the PC, open a windows explorer window.
- To connect to the R&S SGU, enter the name of the instrument or its IP address in the windows taskbar.
- 4. Enter the user name and password to connect to the R&S SGU. The default user name is *instrument* and the password is *instrument*.

A folder opens, containing the share and the update folder.

5. Open the update folder and copy the new firmware update file in it.

The update starts automatically.



Unsuccessful or erroneous firmware update

An erroneous or unsuccessful installation of firmware update package is indicated by a combination of one orange and red LEDs on the front panel.

Refer to the service manual for a description of the displayed error code or contact the customer support center.

9.6 How to Activate Options



A firmware update before the activation of the SW option may be required. Refer to the description of the SW option for the required firmware version. See also Chapter 9.5, "How to Install a New Firmware Version on the Instrument", on page 110 for instruction on how to update the firmware version.

- Select "SGMA-GUI main panel > Instrument Name > Setup > Install SW-Options".
- 2. Select "Option Key" and enter the key code delivered with the new option.

The new option is now enabled and ready for operation.

9.7 How to Manually Set a PCIe Direct Connection between an R&S SGS and an R&S SGU

To build a direct PCIe connection between an R&S SGU and an R&S SGS, which has a "Controller > Revision" < 5, first you have to set the correct PCIe interface mode manually. If your R&S SGS has a "Controller > Revision" 5 or higher, these settings are done automatically.



You can check the "Controller > Revision" of your instrument in the "SGMA-GUI > Instrument Name > Hardware Config" dialog.

How to Manually Set a PCIe Direct Connection between an R&S SGS and an R&S SGU

Toset a PCIe direct connection between an R&S SGS and an R&S SGU manually

- Connect the R&S SGS and the R&S SGU directly using a PCIe cable. Refer to Chapter 10.3.4, "Connecting the Controller and the Instrument", on page 127 for cable requirements and setup information.
- 2. Switch on the R&S SGS and the R&S SGU.
- 3. Select "SGMA-GUI main panel > Instrument Name > Setup > Maintainance".
- 4. Select "Operation > PCIe Interface Mode".
- 5. Select "PCIe Interface Mode > Root Complex".
- 6. Restart your instrument for the changes to take place.

The PCIe connection between the R&S SGS and the R&S SGU is established and the instruments can be used.

Remote Control Interfaces and Protocols

10 Network and Remote Control Operation

As an alternative to operating the R&S SGU interactively via the R&S SGMA-GUI, one can also control the R&S SGU using programmed commands from a remote PC.

The description in this section requires basic knowledge of the remote control operation. Definitions specified in the SCPI standard are not provided.

Nevertheless, you can find some basic information to the SCPI syntax, command lists, and general programming recommendations in Chapter A, "Remote Control Basics", on page 204. In addition, this chapter provides information on the status reporting system of the instrument.

10.1 Remote Control Interfaces and Protocols

The instrument supports several interfaces for remote control. The following table gives an overview.

| 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] VXI-11 TCPIP::host address::inst0[::INSTR] Library: VISA socket communication (Raw Ethernet, simple Telnet) TCPIP::host address[:: LAN device name]::<port>::SOCKET Library: VISA or socket controller</port> | A LAN connector is located on the rear panel of the instrument. The interface is based on TCP/IP and supports various protocols. For details, see Chapter 10.1.2, "LAN Interface", on page 116 |
| USB | USB:: <vendor id="">::<product id="">:: <serial number="">[::INSTR] Library: VISA</serial></product></vendor> | A USB connector is located on the rear panel of the instrument. For details, see Chapter 10.1.3, "USB Interface", on page 119 |
| PCle | <pre>Proprietary PCIe::<vendor id="">::<pre>cycle::<vendor id="">::</vendor></pre> <serial number="">[::INSTR] Library: pcie controller</serial></vendor></pre> | A PCIe connector is located on the rear panel of the instrument. For details, see Chapter 10.1.4, "PCI Express Interface", on page 120 |
| GPIB (IEC/ IEEE Bus Interface) | - • GPIB:: <address>[::INSTR] (no secondary address) VISA</address> | The instrument is not equipped with GPIB bus interfaces. Use a GPIB-to- LAN or GPIB-to-USB adapter instead. For details, see Chapter 10.1.5, "GPIB Interface (IEC/IEEE Bus Inter- face)", on page 121 |

Table 10-1: Remote control interfaces and protocols

*) VISA 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) or USB. However, no VISA installation is necessary for remote control while using socket communication. For more information about VISA, refer to the user documentation.



Rohde & Schwarz provides the standardized I/O software library R&S VISA for communication 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.

SCPI (Standard Commands for Programmable Instruments)

SCPI commands 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 (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

10.1.1 Remote Control Programs and Libraries

The Figure 10-1 provides a schematic illustration of the remote control capabilities of the instrument.



Figure 10-1: Remote control interfaces, protocols and libraries

The following examples give an overview of the dependencies between the available libraries, the possible interfaces and protocols, and whether an instrument driver is provided. The involved parts are **highlighted**.

Remote control program using VISA

Remote Control Interfaces and Protocols



Figure 10-2: Remote control program using VISA

| Protocol | Remote control program |
|----------|--|
| Socket | <pre>viOpen (, "TCPIP:rssgu100a100010::5025::SOCKET",) viPrintf (, "SOUR:FREQ 2GHz\n")</pre> |
| VXI-11 | <pre>viOpen (, "TCPIP:rssgu100a100010::inst0::INSTR",) viPrintf (, "SOUR:FREQ 2GHz\n")</pre> |
| HISLIP | <pre>viOpen (, "TCPIP:rssgu100a100010::hislip0::INSTR",) viPrintf (, "SOUR:FREQ 2GHz\n")</pre> |
| USBTMC | <pre>viOpen (, "USB::0x0aad::0x00ce::1000010::INSTR",) viPrintf (, "SOUR:FREQ 2GHz\n")</pre> |

Remote control program using instrument driver (VISA available)



Figure 10-3: Remote control program using instrument driver (VISA available)

Remote Control Interfaces and Protocols

| Protocol | Remote control program |
|----------|---|
| Socket | <pre>rssgu_init ("TCPIP:rssgu100a100010::5025::SOCKET",) rssgu_SetFrequency (, 2e9)</pre> |
| VXI-11 | <pre>rssgu_init ("TCPIP:rssgu100a100010::inst0::INSTR",) rssgu_SetFrequency (, 2e9)</pre> |
| HiSLIP | <pre>rssgu_init ("TCPIP:rssgu100a100010::hislip0::INSTR",) rssgu_SetFrequency (, 2e9)</pre> |
| USBTMC | <pre>rssgu_init ("USB::0x0aad::0x00ce::1000010::INSTR",) rssgu_SetFrequency (, 2e9)</pre> |
| PCle | <pre>rssgu_init ("PCIe::0x162f::0x132e::1000010::INSTR",) rssgu_SetFrequency (, 2e9)</pre> |

• Remote control program using instrument driver (VISA not available)



Figure 10-4: Remote control program using instrument driver (VISA not available)

| Protocol | Remote control program |
|----------|--|
| Socket | <pre>rssgu_init ("TCPIP:rssgu100a100010::5025::SOCKET",) rssgu_SetFrequency (, 2e9)</pre> |
| PCle | <pre>rssgu_init ("PCIe::0x162f::0x132e::1000010::INSTR",) rssgu_SetFrequency (, 2e9)</pre> |

10.1.2 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. They are connected using a RJ45 cable (shielded or unshielded twisted-pair category 5). The TCP/IP network protocol and the associated network services are preconfigured on the instru-

ment. 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.

10.1.2.1 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 VISAspecific keywords.

TCPIP::host address[::LAN device name][::INSTR]

- TCPIP designates the network protocol used
- host address is the IP address or host name of the device See also Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 64.
- [::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**.

You can find the IP address in the "SGMA-GUI > Instrument Name > Setup > Remote" dialog, and also adjust it manually, if necessary.

See below 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 10.1.2.2, "HiSLIP Protocol", on page 118.

VXI-11

TCPIP::host address[::inst0][::INSTR]

[::inst0] LAN device name, indicates that the VXI-11 protocol is used (optional).

Remote Control Interfaces and Protocols

inst0 currently selects the VXI-11 protocol by default and can be omitted.

For details of the VXI-11 protocol, refer to .Chapter 10.1.2.3, "VXI-11 Protocol", on page 119

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 10.1.2.4, "Socket Communication", on page 119.

Example:

- Instrument has the IP address 10.113.11.91; the valid resource string using VXI-11 protocol is:
 - TCPIP::10.113.11.91::INSTR
- The DNS host name is rssgu100a100021; the valid resource string is: TCPIP::rssgu100a100021::hislip0 (HiSLIP) TCPIP::rssgu100a100021::inst0 (VXI-11)
- A raw socket connection can be established using: TCPIP::10.113.11.91::5025::SOCKET

10.1.2.2 HiSLIP Protocol

The HiSLIP (High Speed LAN Instrument Protocol) 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 <code>viWrite()</code> 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

10.1.2.3 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.

10.1.2.4 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 require a VISA installation on the remote controller side.

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 communication with the software on a command-by-command basis.

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 instruments 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 running on a connected PC.

10.1.3 USB Interface

For remote control via USB connection, the PC and the instrument must be connected via the USB 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.

USB resource string

The syntax of the used USB resource string is: USB::<vendor ID>::<product ID>::<serial number>[::INSTR], where:

• **USB** denotes the used interface

Remote Control Interfaces and Protocols

- **<vendor ID>** is the manufacturer ID for Rohde&Schwarz
- <product ID> is the product identification of the R&S instrument
- serial number> is the individual serial number on the rear of the instrument
- [::INSTR] indicates the instrument resource class (optional)

You can retrieve the USB resource string from the "SGMA-GUI > Instrument Name > Setup > Remote" dialog.

Example:

USB::0x0AAD::0x00ce::100021::INSTR 0x0AAD is the vendor ID for Rohde&Schwarz 0x00ce is the product ID for the R&S SGU 100021 is the serial number of the particular instrument

10.1.4 PCI Express Interface

A PCI Express (PCIe) connector is provided on the rear panel of the instrument.

Refer to Chapter 10.3, "Advanced Remote Control Using PCIe", on page 123 for a description of how to set up a remote control connection via PCIe and the permitted cables.

Via PCI Express some commands can be sent to the instrument with optimized speed (memory-mapped remote control), e.g. frequency or level settings. This allows minimum setup time.

PCIe resource string

The syntax of the used PCIe resource string is:

PCIe::<vendor ID>::<serial number>[::INSTR], where:

- PCIe denotes the used interface
- <vendor ID> is the manufacturer ID for Rohde&Schwarz
- <product ID> is the product identification of the R&S instrument
- <serial number> is the individual serial number on the rear of the instrument
- [::INSTR] indicates the instrument resource class (optional)

You can retrieve the PCIe resource string from the "SGMA-GUI > Instrument Name > Setup > Remote" dialog.

Example:

PCIe::0x162f::0x132e::100021::INSTR 0x162f is the vendor ID for Rohde&Schwarz 0x132e is the product ID for the R&S SGU 100021 is the serial number of the particular instrument

10.1.5 GPIB Interface (IEC/IEEE Bus Interface)

The R&S SGU is not equipped with an IEC/IEEE bus interface.

To be able to control the instrument via the GPIB bus:

- 1. Connect a GPIB-to-LAN or a GPIB-to-USB adapter to the instrument.
- 2. Use a GPIB bus cable to connect the instrument and the controller.
- 3. Provide the GPIB bus card, the card drivers and the program libraries for the programming language in the controller.
- In the "SGMA-GUI > Setup > Instruments > instrument name > Remote Control", set the "GPIB Address".
 See "GPIB Address" on page 54.
- 5. If the controller is equipped with several GPIB bus cards, define the used "Board Number".

GPIB address

The controller must address the instrument with the GPIB bus channel. GPIB provides channel addresses from 0 to 30.

The GPIB resource string is GPIB::<address>[::INSTR], where:

- GPIB denotes the used interface
- <address> indicates 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.



Any connected IEC bus cable must be terminated by an instrument or controller.

10.2 Starting a Remote Control Session

The instrument and the controller have to be connected with a 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.

Starting a Remote Control Session



Instrument address

To operate the instrument via remote control, it must be addressed using the defined interface address.

See Chapter 10.1.2, "LAN Interface", on page 116, Chapter 10.1.3, "USB Interface", on page 119 or Chapter 10.1.4, "PCI Express Interface", on page 120 for details.

The VISA resource strings are indicated in the "SGMA-GUI main panel > Instrument name > Setup > Remote Channels" dialog.

10.2.1 How to Find the VISA Resource String

To find the VISA resource strings of your instrument:

Select "SGMA-GUI main panel > Instrument name > Setup > Remote Channels".

| 🚸 SGU-100014: Remote Channels | ; | - • • |
|-------------------------------|-------------------------------------|-------|
| | Visa Resource Strings | |
| LAN (VXI-11) | TCPIP::10.111.12.73::inst0::INSTR | |
| Socket | TCPIP::10.111.12.73::5025::SOCKET | |
| HISLIP | TCPIP::10.111.12.73::hislip0::INSTR | |
| USB | USB::0x0AAD::0x00ce::100014::INSTR | |
| PCle | PCIe::0x162f::0x132f::100014::INSTR | |
| Device Identify | | Off |

The "Remote Channel Settings" dialog shows all specified resource strings of the supported remote control interfaces.

10.2.2 Example: Remote Control over LAN Using Socket Communication

This section provides an example on how to establish a remote control connection over telnet protocol and a simple sockets-based program example that can be further developed (see also Chapter B, "Telnet program examples", on page 225).

Basic knowledge of programming and operation of the controller are assumed. A description of the interface commands can be obtained from the relevant manuals.



Refer to the getting started manual for an example on how to set up remote control connection over LAN using VXI-11 protocol.

Advanced Remote Control Using PCIe

To set 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 SGU, start the telnet program. Enter the socket address.

The socket address is a combination of the IP address or the host name of the R&S SGU and the number of the port configured for remote-control via telnet. **Tip:** The R&S SGU uses the port number 5025 for remote connection via Telnet.

| 🖅 Run | — |
|-------|---|
| | Type the name of a program, folder, document, or Internet resource, and Windows will open it for you. |
| Open: | telnet 10.113.11.91 5025 🔹 |
| | OK Cancel Browse |

The connection to the instrument is set up and remote-control commands can be sent.

| 📕 Telnet 10.113.11.91 | _ 🗆 🗙 |
|-----------------------|----------|
| - | |
| | |
| | - |

 Even if the cursor is not visible on the screen, enter blind a remote-control command and confirm with Enter.



10.3 Advanced Remote Control Using PCIe

The PCIe bus is a high-speed serial bus, composed of point-to-point serial links. A pair of serial links, one transmitting and one receiving link, make up a lane.

Fast settings

The PCIe interface can be utilized not only to transfer text messages e.g. SCPI commands but also to carry register based remote control messages. The latter mode is called fast settings mode. The specially for this purpose provided instrument's driver is mandatory for the instrument control with fast settings. This instrument driver contains special functions for fast setup.



- To use the advantage of the fast settings, the following prerequisites must be fulfilled:
- Using the PCIe interface is mandatory (see also Chapter 10.3.1, "Setting Up a Remote Control Connection via PCIe", on page 124)
- The fast settings must be enabled with the function rssgu_useFastSettings (see also Chapter 10.3.5, "Enabling Fast Settings", on page 128).

The instrument driver automatically uses the fast settings method whenever possible currently only for the parameters frequency, level, RF state, modulator state - and sends SCPI messages in all other cases.

Remote control programs written for PCIe will, without modifications, also run if one of the other control channels, LAN or USB is used.

10.3.1 Setting Up a Remote Control Connection via PCIe

To set up a remote control connection vie PCIe, perform the following steps:

- 1. Download the drivers, see 10.3.2.
- 2. Configure the controller, see 10.3.3
- 3. Connect the controller and the instrument, see 10.3.4
- 4. Enable fast settings, see 10.3.5.

10.3.2 Download the Drivers

All required driver files are available for download on the product page at:

http://www.rohde-schwarz.com/product/SGU100A.html > "Downloads" > "Drivers"

Provided are the following files:

- LabWindows/CVI, Linux/OSX driver rssgu (InstrumentDriver)
 C source code files which provide a functional application programming interface (API) to R&S SGU instruments. Required if you want to control an instrument via PCIe.
- Low-Level SGU drivers

Archive file that contains the following:

- KernelDriver

 $\rm c$ source code files from which you can build a Linux kernel mode driver for the R&S SGU PCIe remote control interface.

- SguDriverDemo

c source code module for a demo program using the instrument driver API.

- SharedLibraries-Dlls
 Shared libraries (Dlls) for remote control channels Socket and PCIe. To be used with the instrument driver.
- VXIplug&play x64/x86 driver rssgu

Download the required archive and extract the files on a remote PC.

10.3.3 Configuring the Controller

This section lists the steps necessary to configure a controller with Linux or Windows operating system.

10.3.3.1 Building and Installing the Hardware Driver

The hardware driver defines the way to communicate with the instrument via PCIe interface.



For Windows operating systems, the hardware driver is installed automatically together with the installation of the R&S SGMA-GUI software.

See also section "Installation of R&S SGMA-GUI Software" in the getting started manual.

For Linux operating system, the source code of the driver is included in the Low-Level SGU drivers file.

To build and install this driver, root authority is required.

- 1. Copy folder KernelDriver to your hdd
- 2. Go to directory host.
- 3. On the command line, enter make.

The driver sgshost.ko is automatically built.

4. Enter make install.

Device nodes sguX are created under the folder /dev (X from 0 to 31). The module sguhost is loaded.

5. Enter lsmod to verify the module.

10.3.3.2 Making Shared Libraries Accessible

Two library files per operating system are included in SharedLibraries-Dlls file:

- For Linux operating system libsocketcontroller.so and libpciecontroller.so
- For Windows operating system SocketController.dll and PCIeController.dll

These libraries act as the dynamic link libraries for programs using the socket or PCIe interface.

Linux operating system

- ▶ To make the libraries accessible, perform one of the following:
 - a) Append the environment variable LD_LIBRARY_PATH with the path of these two files e.g. by changing the /etc/environment file.
 - b) Move these two files to /usr/lib or /lib directory.

Windows operating system

- ▶ To make the libraries accessible, perform one of the following:
 - a) Copy these two files to the folder of your executable.
 - b) Copy these two files to the WINDOWS\system32 folder.

10.3.3.3 Building a Program

The help file rssgu_vxi.chm shows all functions of the instrument which you can use in your own remote control program.

An example file is provided (SguDriverDemo.c), too.

Building the example program (Linux)

- 1. Copy folders InstrumentDriver and SguDriverDemo to your hard disk.
- 2. Go to folder Build
- 3. On the command line, enter cmake ...
- 4. Enter make

Folder Build contains the executable SguDriverDemo.

Building the example program (Windows)

- 1. Copy folders InstrumentDriver and SguDriverDemo to your hard disk.
- 2. Open SguDriverDemo.vcproj with Visual Studio.
- 3. Build the program.

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Running the example program

- On the command line, enter ./SguDriverDemo RESOURCESTRING [cmd].
 Where
 - RESOURCESTRING is the (VISA) resource string of your instrument, e.g. TCPIP::ipaddress::5025::SOCKET or PCIE::0x162f:: 0x132e::serialno::INSTR.

Where ipaddress is the IP address or hostname of your instrument and serialno is its serial number.

• cmd is an optional command (see table).

The following table list the available commands.

| Command | Description |
|---------|---|
| ? | Usage |
| ď | Quit |
| f value | Set frequency |
| f? | Query frequency |
| 1 value | Set level |
| 1? | Query level |
| r value | Set RF state (value = 0 1 ON OFF) |
| r? | Query RF state |

If you enter an additional optional command, SguDriverDemo executes it and enters a loop waiting for further commands.

Example:

```
TCPIP::10.111.11.44::5025::SOCKET ? Lists the available commands.
```

10.3.4 Connecting the Controller and the Instrument

A PCIe connector is provided on the rear panel of the instrument.

NOTICE

Risk of device failure

The R&S SGU is equipped with a single lane PCIe interface that supports hot plugging. Do not connect an external PC to the PCIe connector of the instrument during operation if this external PC does not support hot-plugging!

Advanced Remote Control Using Fast Socket



Permitted PCIe cables

PCIe extension cables must fulfill the following requirements:

- Single lane connectors
- Max. cable length of 5 m.

For example: OSS-PCIe-CBL-x1 cable from One Stop Systems or 74576-000x cable from Molex.

Connecting an external PC that does not support hot-plugging

- Switch off the external PC and the instrument. See also Chapter 2.1.5, "Switching the Instrument On and Off", on page 17.
- 2. Connect the instrument and the controller with the suitable cable.
- 3. Switch on the instrument.
- 4. Wait until the instrument has completed the booting (the "POWER" LED on the instrument's front panel is constantly on).
- 5. Switch on the external PC.

Connecting an R&S SGS and an R&S SGU

If you use the R&S SGU as an upconverter to the R&S SGS, the R&S SGS acts as a controller to the R&S SGU. For a description of how to connect the instruments refer to Chapter 5.2, "Setups for Connecting an R&S SGS and an R&S SGU", on page 41.

10.3.5 Enabling Fast Settings

► To enable the special PCI express feature fast settings, enable the function rssgu_UseFastSettings (ViSession instrumentHandle, ViBoolean fastEnabled, ViBoolean asynchronousEnabled) included in the instrument driver.

Settings for some parameters like level and frequency accelerate.

To disable the fast settings, call the function rssgu_UseFastSettings with argument fastEnabled=false.

10.4 Advanced Remote Control Using Fast Socket

Fast settings

The socket interface can be utilized not only to transfer text messages e.g. SCPI commands but also to carry register based remote control messages. The latter mode is called fast settings mode. The fast socket communication is based on the Ethernet pro-

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tocol which does not support routing. Therefore a controller PC can only control devices within its own network segment using the fast socket method.



To use the advantage of the fast settings, the following prerequisites must be fulfilled:

- On Windows operating systems, the fast socket driver must be installed.
- The application program must be run with root/administrator rights.
- The fast settings must be enabled with the function rssgu_useFastSettings (see also Chapter 10.3.5, "Enabling Fast Settings", on page 128).

The instrument driver automatically uses the fast settings method whenever possible, currently for the parameters frequency, level, RF state, I/Q modulator state, crest factor, host frequency, host level, apply settings. In all other cases, SCPI messages are sent.

10.4.1 Setting Up a Remote Control Connection via Fast Socket

Download the required archive and extract the files on a remote PC, as described in Chapter 10.3.2, "Download the Drivers", on page 124.

Windows operating systems

To set up a remote control connection via fast socket for Windows operating systems, perform the following steps:

- Connect the controller and the instrument, see Chapter 2.3.2, "Connecting a Remote PC via LAN", on page 22.
- Install the protocol driver to the controller, see Chapter 10.4.2, "Installing the Protocol Driver", on page 130.
- 3. On the controller start the driver by using one of the following:
 - a) Start the Windows console user interface as an administrator. Excute the command net start SGMANDISPROT.
 - b) Use a program for opening the driver.See for example the example file SguDriverDemo.c.
- 4. Start the application with administrator rights.
- 5. Enable fast settings, see Chapter 10.4.3, "Enabling Fast Settings", on page 130.

Linux operating systems

To set up a remote control connection via fast socket for Linux operating systems, perform the following steps:

- Connect the controller and the instrument, see Chapter 2.3.2, "Connecting a Remote PC via LAN", on page 22.
- 2. Start the application as root.

3. Enable fast settings, see Chapter 10.4.3, "Enabling Fast Settings", on page 130.

10.4.2 Installing the Protocol Driver

The protocol driver defines the way to communicate with the instrument via the LAN fast socket interface.

For Linux operating system, no special driver is needed.

For Windows operating systems, the SGMANDISPROT driver is required. The protocol driver is installed automatically together with the installation of the R&S SGMA-GUI software. It is also provided in the Low-Level SGU drivers file.

To install the driver manually on a Windows operating system:

- 1. Open "Control Panel > Network and Sharing Center".
- Select the network adapter on which you want to install the driver and click it. The "Local Area Connection Status" dialog opens.
- 3. Click "Properties" to open the "Local Area Connection Properties" dialog.
- 4. Click "Install" to open the "Select Network Feature Type" dialog.
- 5. Select "Protocol" and select "Add".
- In the "Select Network Protocol" dialog, select "Have Disk". Navigate to the directory where the driver is saved and click "OK" to install the driver.

10.4.3 Enabling Fast Settings

To enable the fast settings for the fast socket, call function rssgu_UseFastSettings (ViSession instrumentHandle, ViBoolean fastEnabled, ViBoolean asynchronousEnabled) included in the instrument driver.

Settings for some parameters like level and frequency accelerate.

To disable the fast settings, call the function rssgu_UseFastSettings with argument fastEnabled=false.

10.5 LXI Configuration

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.

On the R&S SGU the LXI functionality is already installed and enabled. 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 of the instrument
- Performing SCPI remote diagnostics

10.5.1 Default State of the Network Settings

According to the LXI standard, an LCI must set the following parameters to a default state.

| Parameter | Value |
|--------------------------------|------------------------|
| TCP/IP mode | DHCP + Auto IP Address |
| Dynamic DNS | Enabled |
| ICMP ping | Enabled |
| Password for LAN configuration | LxiWeblfc |

The LAN reset also resets the following parameters for the R&S SGU:

| Parameter | Value |
|------------------|---|
| Hostname | <instrument-specific host="" name=""></instrument-specific> |
| Description | Signal generator |
| Negotiation | Auto detect |
| VXI-11 discovery | Enabled |

The LAN settings are configured using the instrument's LXI Browser Settings.

10.5.2 LXI Browser Settings

To access the instrument via the web browser:

Note: Do not add the missing zeros in the IP address, while opening the instrument home page.

The instrument home page (welcome page) opens.

The navigation pane of the browser interface contains the following elements:

- "LXI"
 - "Home" opens the instrument home page.
 - The home page 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 in the browser dialog. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates that no LAN cable is connected.

- "Lan Configuration" allows you to configure LAN parameters and to initiate a ping, see Chapter 10.5.3, "LAN Configuration", on page 132.
- "Status" displays information about the LXI status of the instrument.
- "Utilities" provides access to the LXI event log functionality required by the LXI standard.
- "Diagnostics"
 - "SCPI Remote Trace" records messages exchanged via the remote control interface, see Chapter 10.5.3.4, "SCPI Remote Trace", on page 133.
- "Help"
 - "Glossary" explains terms related to the LXI standard.
 - www.rohde-schwarz.com opens the Rohde & Schwarz home page.

10.5.3 LAN Configuration

The "LAN Configuration" web page displays all mandatory LAN parameters and allows their modification.

It comprises the following navigation entries.

| • | IP Configuration | 132 |
|---|-------------------|------|
| • | Advanced Config | .132 |
| • | Ping Client. | .133 |
| • | SCPI Remote Trace | 133 |

10.5.3.1 IP Configuration

The "IP configuration" web page displays all mandatory LAN parameters and allows their modification.

The "IP Address Mode" selects a configuration mode for the IP address of the instrument. With static configuration, the entered IP address, subnet mask, and default gateway are used. With dynamic configuration, DHCP or dynamic link local addressing (automatic IP) are used to obtain the instrument IP address.



Password protection

Changing the LAN configuration is password-protected and requires the security password. The default password is "instrument".

10.5.3.2 Advanced Config

The "Advanced Config" web page provides LAN settings that are not declared mandatory by the LXI standard. The following advanced parameters are available:

- "mDNS and DNS-SD": The additional protocols "multicast DNS" and "DNS service discovery" are used for device communication in zero configuration networks, working without DNS and DHCP.
- "ICMP Ping": Must be enabled to use the ping utility.
 If you disable this setting, the instrument does not answer ping requests. The setting does not affect the LXI ping client. You can ping other hosts from the instrument, even if the setting is disabled.
- "VXI-11 Discovery": Must be enabled to detect the instrument in the LAN.
 If you disable this setting, the instrument cannot be detected by the VXI-11 discovery protocol mechanism. The setting does not affect other detection mechanisms.
 Setting up a VXI-11 connection via the IP address or the host name is independent of this setting.



Password protection

Changing the LAN configuration is password-protected and requires the security password. The default password is "instrument".

10.5.3.3 Ping Client

The "Ping Client" page provides the ping utility to verify the connection between the LXI-compliant instrument and another device.

The ping is initiated from the instrument. Using the ICMP echo request and echo reply packets, the 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 10.111.0.125).
- 2. Select "Submit".

10.5.3.4 SCPI Remote Trace

The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S SGU, see Chapter 10.5.4, "How to Record SCPI Commands and Messages exchanged via the LXI Web Browser Interface", on page 134.

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: 💿 on 🔵 off 🛛 logging: 💿 on 🔵 off 🐴 🏹 filter 👻 log file: 😰 refresh 🛃 download 🗙 clear

- "Live mode" / "logging": If logging is switched on, messages are traced. They are stored in an internal database and can be displayed upon request, using the refresh button (live mode off) or they can be displayed automatically (live mode on).
- "Filter": applies a filter to columns and/or rows when working (live mode off)
- "Refresh": reads the message log from the internal database and displays it
- "Download": stores the SCPI trace log to a *.csv file
- "Clear": deletes all message log entries in the database and at the screen
- "Details": displays details of the selected message, for example an SCPI command in hex format (also possible by double\-clicking a message)

Columns

The following columns are available if no column filter is applied:

- "Rec": record number of the message within the message log
- "MT": indicates the type of the message. Possible values and related message contents are:
 - > = incoming command
 - < = outgoing response to a query</p>
 - E = error message, highlighted by red color
 - T = execution time, i.e. time required by the instrument to process the command internally
- I: number of the subinstrument
- "message": indicates the type of the message. Possible values and related message contents are:
 - > = incoming command
 - < = outgoing response to a query</p>
 - E = error message, denoted in red
 - T = execution time, i.e. time required by the instrument to process the command internally

10.5.4 How to Record 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 SGU.

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 SGU in the browser's address bar.

The R&S SGU's welcome page is displayed.

- 3. In the navigation pane, select "Diagnostics > SCPI Remote Trace".
- 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 SGU 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 stores 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 store the log in a file.

10.6 Using the R&S SGMA-GUI to Monitor the Remote Control Operation

The R&S SGMA-GUI can be used to monitor the behavior of one or more instruments while they are remote controlled.

A typical configuration consists of one monitor, controllers and instruments. The monitor is the remote PC on which the R&S SGMA-GUI is installed and the controller is the remote PC on which the application program runs.

Simultaneous control of an instrument from a controller and a monitor may lead to collisions whenever both the controller and the monitor utilize the same remote channel. These collisions are indicated by an error message in the "Info" line, e.g. "Query interrupted" or "Resource locked". Simultaneous monitoring and control over the same remote channel is only possible, if the used protocols support viLock()/viUnlock() and the remote program use these functions.

The Table 10-2 shows whether a collision-free communication over a particular combination of remote channels is possible or not and if there are any restrictions.

| Monitor/ Controller | LAN (VXI-11) | LAN (HiSLIP) | USB | LAN (Socket) | PCle |
|------------------------|-----------------|--------------|-----------------|--------------|------|
| LAN (VXI-11) | OK* | ОК | ОК | ОК | OK |
| LAN (HiSLIP) | ОК | ОК | ОК | ОК | OK |
| USB | ОК | OK | viLock/viUnlock | OK | OK |
| LAN (Socket) | ОК | ОК | ОК | Х | OK |
| PCle | ОК | ОК | ОК | ОК | х |

Table 10-2: Cross-reference between used remote channels and collision-free communication

Where:

- OK: communication possible, no collisions
 *) the R&S SGMA-GUI always uses the LAN device name instr1, see also Chapter 10.1.2.3, "VXI-11 Protocol", on page 119.
- X: communication is not possible without collisions
- viLock/viUnlock: communication is only possible, if the remote control commands are enclosed in a viLock () viUnlock() pair.



The figure below shows an example of configuration where the monitor and the controller are two different computers, connected to the same instrument over two different hardware interfaces.



Figure 10-5: Example of a setup for remote control monitoring

Connecting and configuring the monitoring PCs



In the "Setup > Security > Security Settings" dialog, check the state of the LAN and USB interfaces and enable them if necessary.

1. Connect the monitoring PC to the instrument.

Note: Choose the hardware interface considering the limitations described in Table 10-2.

- 2. Configure the instrument in the R&S SGMA-GUI, see Chapter 6.4.2, "Handling Instruments in the R&S SGMA-GUI", on page 61.
- In the "SGMA-GUI > Setup > Instruments > Edit Instruments" dialog, disable "Exclusive Access".

Note: The two functions "Exclusive Access" and monitoring are mutually exclusive.

4. Send remote control commands from the controller to the instrument.

Using the R&S SGMA-GUI to Monitor the Remote Control Operation

5. Open the corresponding dialogs in the R&S SGMA-GUI. Observe the status of the parameters.

11 Remote Control Commands

In the following, all remote-control commands will be presented in detail with their parameters and the ranges of the numerical values.

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 SGU 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.

11.1 Programming Examples

This chapter provides simple programming examples for the R&S SGU. 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 (e.g. comments) start with two // characters.

At the beginning of most remote control programs, an instrument (p)reset is recommended to set the R&S SGU to a defined state. The commands *RST and SYSTem: PRESet are equivalent for this purpose. *CLS also resets the status registers and clears the output buffer.

It is also recommended to lock the instrument for remote control from the selected controller prior to further configuration. Use the LOCK command for this purpose.

11.1.1 Performing General Tasks for Instrument Setup

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established.

```
// Reset the instrument first
*RST; *CLS
// :SYSTem:PRESet
// :RESTart
// :SYSTem:FPReset
// Lock the instrument to the controller
:LOCK? 12345
// Lock the instrument to avoid interference by other controllers
// Use an arbitrary number
// Response: 1
// Request granted, i.e. the instrument is locked
// Abort program if request is refused
// Launch diagnostic
:DIAGnostic:POINt:CATalog?
// Response: : D TEMP UP20,D TEMP CPU
:DIAGNostic:MEASure:POINt? 'D TEMP UP20'
// Query the entries in the error queue
// *********************************
```

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```
SYSTem:SERRor?
// Query static errors
// SYSTem:ERRor:CODE:NEXT?
// SYSTem:ERRor:COUNT?
// SYSTem:ERRor:NEXT?
// STATus:QUEue:NEXT?
// SYSTem:ERRor:CODE:ALL?
SYSTem:ERRor:ALL?
// Query error queue
// Query system information
:SYSTem:VERSion?
:SYSTem:OSYStem?
// Activate eco mode
:SYSTem:EMODe EM1
// Unlock the instrument
```

:UNL 12345

11.1.2 Generating an I/Q Modulated Signal

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established. An external analog signal is provided at the I and Q connectors of the instrument.

```
// Use an arbitrary number
// Response: 1
// Request granted, i.e. the instrument is locked
// Abort program if request is refused
// Set RF frequency and level
:SOURce:FREQuency:CW 2 GHz
:SOURce:POWer:-10dBm
:SOURce:POWer:PEP?
// Define and enable impairments
// Enable modulation
:SOURce:IQ:STATe ON
:SOURce:IQ:IMPairment:STATe ON
:SOURce:IQ:IMPairment:LEAKage:I -1
:SOURce:IQ:IMPairment:LEAKage:Q 1
:SOURce:IO:IMPairment:IORatio: 1
:SOURce:IQ:IMPairment:QUADrature:ANGLe 2
:SOURce:IQ:CREStfactor 0.05
// Enable output of the generated signal at the RF connector
:OUTPut:STATe ON
:OUTPut:STATe:PON UNCH
// Query LO frequency and power values and set LO \,
:LOSCillator:FREQuency?
:LOSCillator:POWer?
// Set frequency and power on the local oscillator as required
// Switch on the signal
:SETTings:APPLy
```

Programming Examples

11.1.3 Advanced Task for Optimizing Performance

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established.

```
// Reset the instrument first
*RST; *CLS
// :SYSTem:PRESet
// :RESTart
// :SYSTem:FPReset
// Lock the instrument to the controller
:LOCK? 12345
//\ {\rm Lock} the instrument to avoid interference by other controllers
// Use an arbitrary number
// Response: 1
// Request granted, i.e. the instrument is locked
// Abort program if request is refused
// Query the level that can be set without adjustments of the attenuator
:OUTPut:AFIXed:RANGe:LOWer?
:OUTPut:AFIXed:RANGe:UPPer?
// Optimizing the quality characteristics of the RF signal
:SOURce:POWer:LMODe LNOise
// optimize the signal to low noise ratio
:SOURce:POWer:SCHaracteristic AUTO
// ensure highest dynamic range
:SOURce:POWer:LEVel:IMMediate:AMPLitude -30dBm
:SOURce:POWer:LIMit:AMPLitude 30dBm
```
:OUTPut:STATe:PON UNCHanged

11.1.4 Adjusting Network and Remote Channel Settings

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established.

Common Commands

```
:SYSTem:COMMunicate:NETWork:RESource?
// Response: TCPIP::10.113.10.187::INSTR
:SYSTem:COMMunicate:SOCKet:RESource?
// Response: TCPIP:10.113.10.187::5025::SOCKET
:SYSTem:COMMunicate:USB:RESource?
// Response: USB::0x0AAD::0x00ce::100021::INSTR
:SYSTem:COMMunicate:PCIexpress:RESource?
// Response: PCIe::0x162f::0x132f::100002::INSTR
// Query network settings
:SYSTem:COMMunicate:NETWork:COMMon:HOSTname?
// Response: rssgu100a100002
:SYSTem:COMMunicate:NETWork:IPADdress:MODE?
// Response: AUTO
:SYSTem:COMMunicate:NETWork:IPADdress?
// Response: 10.113.10.187
:SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK?
// Response: 255.255.0.0
:SYSTem:COMMunicate:NETWork:IPADdress:GATeway?
// Response: 10.113.0.1
// Unlock the instrument
:UNL 12345
```

11.2 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 | |
|-------|-----|
| *ESE. | |
| *ESR? | |
| *IDN? | |
| *IST? | |
| *OPC | |
| *OPT? | 146 |
| *PRE | |
| | |

Common Commands

| *PSC | 146 |
|-------|------|
| *RCL | .147 |
| *RST | .147 |
| *SAV | 147 |
| *SRE | 147 |
| *STB? | 148 |
| *TBG | 148 |
| *WAI | 148 |
| | |

*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></contents> | Range: | 0 | to | 255 |
|-----------------------|------------|---|----|-----|
| Usage: | Query only | | | |

*IDN?

Identification

Returns the instrument identification.

Return values:

| <id></id> | "Rohde&Schwarz, <device type="">,<part number="">/<serial num<br="">ber>,<firmware version="">"</firmware></serial></part></device> |
|-----------|--|
| Example: | Rohde&Schwarz,SGU100A, |
| | 1412.0000K02/000000,3.1.17.1-03.01.158 |

Usage:

Query only

*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></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></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

*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.

*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

*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.

*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.

Query only

Usage:

*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

*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

11.3 General Commands

| :REMote:OPMode | 148 |
|----------------|-----|
| :LOCK? | 149 |
| :UNLock | 149 |

:REMote:OPMode <OpMode>

Sets the remote operation mode of the instrument.

Parameters:

<OpMode>

STDalone | EXTension STDalone The instrument acts standalone.

EXTension

The instrument is controlled by another Rohde&Schwarz instrument. This parameter is used by the SGMA-GUI to disable settings when the instrument is in extension mode. *RST: STDalone

:LOCK? <Lock Request Id>

Sends a lock request ID which uniquely identifies the controller of the instrument.

| Number |
|---|
| 0 |
| test query to check whether the instrument is locked |
| Controller ID |
| request lock from the controller with the specified Controller ID |
| |
| Number |
| 0 |
| request refused; the instrument is already locked to another <lock id="" request="">, i.e. to another controller</lock> |
| 1 |
| request granted |
| :LOCK? 12345 |
| Response: 1 |
| :UNL 12345 |
| Query only |
| See "Exclusive Access" on page 53 |
| |

:UNLock <Unlock Id>

Unlocks an instrument locked to a controller with Controller ID = <Unlock Id>.

Setting parameters:

| <unlock id=""></unlock> | Number |
|-------------------------|--|
| | Unlock ID which uniquely identifies the controller of the instru- ment. The value must match the Controller ID <lock request<br="">Id> set with the command :LOCK?.</lock> |
| Usage: | Setting only |
| Manual operation: | See "Exclusive Access" on page 53 |

11.4 Preset Commands

The following preset actions are available:

- Activation of the default state of all internal instrument functions (*RST on page 147). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. TCP/IP address or remote operating mode.
- Activation of the original state of delivery (factory reset, :SYSTem: FPReset on page 150). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

:SOURce<hw>:PRESet :SYSTem:PRESet

Triggers an instrument reset. It has the same effect as:

- The *RST command
- The "SGMA-GUI > Instrument Name > Preset" function

For an overview of the settings affected by the preset function, see Chapter 7.7, "Preset", on page 87.

| 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

The command triggers an instrument reset to the original state of delivery. Only functions that are protected by a password remain unchanged.

The factory preset function resets nearly all instrument settings. In addition to the regular preset a "Factory Preset" resets also the following values:

- Power on settings ("Level" dialog)
- Network settings including hostname ("Setup > Network Setting" dialog)
- Remote Channel settings ("Setup > Remote Channel" dialog)

For an overview of the settings affected by the factory preset function, see Chapter 8.9, "Factory Preset", on page 101.

| Example: | SYST: FPR all instrument settings (also those that are not currently active) are reset to the factory values. |
|-------------------|---|
| Usage: | Event |
| Manual operation: | See "Execute Factory Preset" on page 101 |

11.5 CALibration Subsystem

The CALibration system contains the commands needed for calibrating the R&S SGU.

R&S SGU cannot be calibrated on its own. Therefore a connection with a signal generator (local oscillator (LO)) is needed. If you use a compatible R&S signal generator, then the calibration process will be completed automatically after starting the calibration process. Otherwise you have to follow the steps described in "Calibration process of the R&S SGU" on page 151. We assume that a remote PC is connected to the instruments, the remote PC and the instruments are switched on and a connection between them is established.

The selftest of an R&S SGU also requires a similiar instrumental setup. You can perform the selftest and read its results using the commands :TEST:ALL:STARt and : TEST:ALL:RESult?.



Calibration process of the R&S SGU

Figure 11-1: Calibration process of the R&S SGU. No physical connections between the instruments are shown in this graphic.

In order to complete the calibration process you have to complete the following steps:

- Start an adjustment request with the SCPI command :CALibration:xxx:STARt, where xxx stands for IQModulator, IQModulator:LOCal or LEVel.
- 2. :CALibration:HREQuest?
 - a) Query R&S SGU for the required LO settings with the SCPI command : CALibration: HREQuest?.

b) Interpret the response of the query. The response is returned in the form of a SCPI command. For example a response : SOUR: POW 6 asks for a power of 6 dBm.

For a list of all possible responses see :CALibration:HREQuest? on page 153.

- 3. Set the LO according to the required settings.
- 4. Repeat steps 2 and 3 until the value of step 2b is :CALibration:HREQ:STOP.
- 5. :CALibration:xxx:RESult?
 xxx stands for IQModulator, IQModulator:LOCal or LEVel
 - a) Query the result of the adjustment request with the SCPI command :CALibration:xxx:RESult?.
 - b) The query returns either 0 or 1 signifying pass or fail.

The instrument is calibrated and can be further used.

How the described process may take place is shown in Table 11-1. If you use a compatible R&S signal generator the whole process will be completed automatically.

Table 11-1: Programming example of a calibration process

| Local Oscillator/ Controller | R&S SGU Response | Interpretation |
|--------------------------------|-------------------------------------|--|
| 1):CALibration:LEVel: STARt | - | R&S SGU starts the Level Adjustment. |
| 2):CALibration:HREQuest? | :PROG:CREate Level Adjustment | To do: create a progress bar with a caption "Level Adjustment". |
| 3):CALibration:HREQuest? | :OUTP:STATe 1 | To do: activate the RF output of the LO. |
| 4):CALibration:HREQuest? | :PROG:UPDate 5 | The progress of the level adjustment is 5 %. |
| 5):CALibration:HREQuest? | :SOUR:FREQ 15e9; :SOUR:POW -10.0 | To do: set the frequency of the LO to 15GHZ and its level to -10dBm |
| 6):CALibration:HREQuest? | :SOUR:POW 5 | To do: set the level of the LO to 5dBm. |
| 7):CALibration:HREQuest? | :PROG:UPDate 20 | The progress of the level adjustment is 20 %. |
| 8):CALibration:HREQuest? | :SOUR:POW 20 | To do: set the level of the LO to 5dBm. |
| 9):CALibration:HREQuest? | :PROG:UPDate 100 | The progress of the level adjustment is 100 %. |
| 10):CALibration:HREQuest? | :PROG:REMove | To do: delete the progress bar. |
| 11):CALibration:HREQuest? | :OUTP:STATe 0 | To do: deactivate the RF output of the LO. |
| 12):CALibration:HREQuest? | :CAL:HREQ:STOP | End of the calibration process. |

| :CALibration:HREQuest? | 153 |
|---------------------------------------|-----|
| :CALibration:IQModulator:STARt | |
| :CALibration:IQModulator:RESult? | |
| :CALibration:IQModulator:TEMPerature? | |

CALibration Subsystem

| :CALibration:IQModulator:LOCal:STARt. | 154 |
|--|-----|
| :CALibration:IQModulator:LOCal:RESult? | 154 |
| CAI ibration: I EVel: STARt | 154 |
| CAI ibration: I EVel: RESult? | 155 |
| :CALibration:LEVel:TEMPerature? | 155 |
| | 100 |

:CALibration:HREQuest?

Queries the settings required from the instrument during a calibration or a selftest.

See "Calibration process of the R&S SGU" on page 151 for a step by step description of the calibration process.

Return values:

<Command>

string

All of the commands described below return the values in the parameter's default unit.

:VERsion <Number> Shows the command set version with which the instrument is compliant

:OUTP:STATe <Number> Shows the state required of the local oscillator

:SOUR:FREQ <Number> Shows the frequency required of the local oscillator

:SOUR:POW<Number> Shows the power required of the external local oscillator

:PROG:CREate <Text>

Asks the controller to create a progress bar

:PROG:REName <Text> Asks the controller to rename the progress bar

:PROG:REMove

Asks the controller to delete the most recently created progress bar

:PROG:UPDate <Number>

Shows the current progress value in percent

:NOP/:NO DATA

See Table 11-1.

Intermediate message. No action is required

:CAL:HREQ:STOP

End of the calibration procedure

Example:

.

Usage: Query only

:CALibration:IQModulator:STARt

Starts an internal I/Q adjustment. Query the result of the adjustment with the SCPI command :CALibration:IQModulator:RESult?.

See "Calibration process of the R&S SGU" on page 151 for a step by step description of the calibration process.

Usage:

:CALibration:IQModulator:RESult?

Queries the result of the internal I/Q adjustment. Start the adjustment with the SCPI command :CALibration:IQModulator:STARt.

| Return values: | |
|-------------------|---------------------------|
| <result></result> | 0 1 RUNning STOPped |
| Usage: | Query only |

Event

:CALibration:IQModulator:TEMPerature?

Queries the delta temperature since the last adjustment of the IQ modulator.

Return values:<Temperature>stringUsage:Query only

:CALibration:IQModulator:LOCal:STARt

Starts an adjustment for the I/Q modulator of the current frequency. The I/Q modulator is adjusted with respect to carrier leakage, I/Q imbalance and quadrature. Query the result of the adjustment with the SCPI command :CALibration:IQModulator: LOCal:RESult?.

See "Calibration process of the R&S SGU" on page 151 for a step by step description of the calibration process.

Usage: Event

:CALibration:IQModulator:LOCal:RESult?

Queries the result of the I/Q modulation adjustment for the current frequency. Start the adjustment with the SCPI command :CALibration:IQModulator:LOCal:STARt on page 154.

 Return values:

 <Result>
 0 | 1 | RUNning | STOPped

Usage: Query only

:CALibration:LEVel:STARt

Starts an internal level adjustment. Query the result of the adjustment with the SCPI command :CALibration:LEVel:RESult?.

See "Calibration process of the R&S SGU" on page 151 for a step by step description of the calibration process.

Usage: Event

:CALibration:LEVel:RESult?

Queries the result of the internal level adjustment. Start the adjustment with the SCPI command :CALibration:LEVel:STARt.

Return values:<Result>0 | 1 | RUNning | STOPpedUsage:Query only

:CALibration:LEVel:TEMPerature?

Queries the delta temperature since the last level adjustment.

| Return values: | |
|-----------------------------|------------|
| <temperature></temperature> | string |
| Usage: | Query only |

11.6 CONNector Subsystem

:CONNector:TRIGger:OMODe <Mode>

Sets the operating mode of the trigger connector.

| Parameters: | |
|-------------------|--|
| <mode></mode> | SVALid SNValid PEMSource |
| | SVALid SNValid signal valid /not valid |
| | PEMSource external pulse modulator source |
| Manual operation: | See "Trigger Connector Mode" on page 85 |

11.7 DIAGnostic Subsystem

| :DIAGnostic:POINt:CATalog? | |
|------------------------------|--|
| :DIAGnostic[:MEASure]:POINt? | |

:DIAGnostic:POINt:CATalog?

Queries the test points available in the instrument.

For description of the test points, see the service manual.

Example: See Chapter 11.1.1, "Performing General Tasks for Instrument Setup", on page 139.

Usage: Query only

:DIAGnostic[:MEASure]:POINt? <Name>

Triggers a voltage or a temperature measurement at the specified test point and returns the measured value.

Use the command :DIAGnostic:POINt:CATalog? to retrieve a list of the available test points.

For description of the test points, see the service manual.

| Query parameters: <name></name> | string |
|--|---|
| Return values: <value></value> | number Default unit: V or °C |
| Example: | See Chapter 11.1.1, "Performing General Tasks for Instrument Setup", on page 139. |
| Usage: | Query only |

11.8 Fast Speed Commands

This section describes special commands that allow a fast frequency and level setting.

| :FFASt | 156 |
|--------|-----|
| :PFASt | 157 |

:FFASt <Freq>

Special command to set the RF output frequency with minimum latency. No unit (e.g. Hz) allowed.

Bypasses the status system so command ***OPC?** cannot be appended.

Parameters:

<Freq>

Example: FFASt 1275000000

float

:PFASt <Pow>

Special command to set the RF output level with minimum latency at the RF output connector. This value does not consider a specified offset. No unit (e.g. dBm) allowed.

Bypasses the status system so command *OPC? cannot be appended.

Parameters:

<Pow> float

Example: :PFASt -20

11.9 FORMat Subsystem

The FORMat subsystem contains the commands which determine the format of the data that the R&S SGU returns to the controller. This affects all query commands which return a list of numerical data or block data. Reference is made to this in the descriptions of the commands.

| :FORMat:BORDer | . 157 |
|-------------------|-------|
| :FORMat[:DATA] | 158 |
| :FORMat:SREGister | . 158 |

: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

The instrument expects (with setting commands) and sends (with queries) the least significant byte of each IEEE754 floating-point number first and the most significant byte last.

SWAPped

The instrument expects (with setting commands) and sends (with queries) the most significant byte of each IEEE754 floating-point number first and the least significant byte last.

*RST: NORMal

 Example:
 FORM: BORD SWAP

 The data is transferred with the most significant bit first.

:FORMat[:DATA] <Data>

Determines the data format which the R&S SGU uses to return data. When data is transferred from the control computer to the instrument, the instrument detects the data format automatically. In this case, the value set here is irrelevant.

Parameters:

<Data>

ASCii | PACKed

ASCii

Numerical data is transferred as plain text separated by commas.

PACKed

Numerical data is transferred 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

FORM ASC

Example:

The data is transferred as ASCII data.

:FORMat:SREGister <Format>

Determines the numerical format which is returned when the status registers are queried.

Parameters:

<Format> ASCii | BINary | HEXadecimal | OCTal ASCii The register content is returned as a decimal number. **BINary** The register content is returned as a binary number. #B is placed in front of the number. **HEXadecimal** The register content is returned as a hexadecimal number. #H is placed in front of the number. **OCTal** The register content is returned as an octal number. #Q is placed in front of the number. *RST: ASCii Example: FORM:SREG HEX The register content is returned as a hexadecimal number.

11.10 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.

The files are stored on the internal flash memory of the instrument or on external USB memory devices.

The default directory is determined using the command MMEMory:CDIR.



Use the command :SYSTem:MMEMory:PATH:USER? to query the path of the directory for user-defined data.

The /opt directory is a protected and therefore a not accessible system directory. The files on this directory contain data that must not be changed. Therefore, this directory should not be accessed, since reconstruction of the system partition will lead to data loss.

11.10.1 File Naming Conventions

To enable files in different file systems to be used, the following file naming conventions should be observed.

The file name can be of any length and is case-sensitive, meaning it is distinguished between uppercase and lowercase letters.

The file and the optional file extension are separated by a dot. All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the file name). If possible, special characters should not be used. The use of the slashes "\" and "/" should be avoided since they are used in file paths. A number of names are reserved for the operating system, e.g. CLOCK\$, CON, AUX, COM1...COM4, LPT1...LPT3, NUL and PRN.

In the R&S SGU all files in which lists and settings are stored are given a characteristic extension. The extension is separated from the actual file name by a dot (see Chapter 11.10.2, "Extensions for User Files", on page 160 for an overview of the file types).

The two characters "*" and "?" function as "wildcards", meaning 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 file name. "*.*" therefore stands for all files in a directory.

When used in conjunction with the commands, the parameter <file_name> is specified as a string parameter with quotation marks. It can contain either the complete path including the drive, only the path and the file name, or only the file name. The file name must include the file extension. The same applies for the parameters <directory name> and <path>. Depending on how much information is provided, either the values specified in the parameter or the values specified with the command MMEM:CDIR (default directory) are used for the path and the drive settings in the commands.

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 subsequently used in the :MMEMory:STORe:STATe on page 167 command. Also, subsequently to loading a file with instrument settings with command :MMEMory: LOAD:STATe on page 165, these settings have to be activated with the common command *RCL <number>.

11.10.2 Extensions for User Files

The following table lists all available file extensions for user files.

Table 11-2: Automatically assigned file extensions in the instrument

| Function | Contents | File suffix |
|---------------------------|-------------------|-------------|
| R&S SGMA-GUI Save As/Open | Software settings | *.savrcl |

11.10.3 Examples

In these examples, the current instrument setting is stored in the file test.savrcltxt in the directory /var/user/..

Storing and Loading Current Settings

 Store the current setting in an intermediate memory with the number 4. This setting can be called using command *RCL and the associated number of the memory, for example *RCL 4.

*SAV 4

- To store the settings in a file in a specific directory, specify the complete path. MMEM:STOR:STAT 4, "/var/user/test.savrcltxt"
- 3. To store the settings in a file in the default drive, set the default drive and specify only the file name. MMEM:CDIR '/var/user/'*SAV 4 MMEM:STOR:STAT 4, "test.savrcltxt"
- Load the file test.savrcltxt in the user directory. MMEM:LOAD:STAT 4, '/var/user/test.savrcltxt'
- Activate the instrument setting of the file test.savrcltxt.
 *RCL 4

Working with Files and Directories

1. Read out all files in the specified directory. MMEM:CAT? '/usb/user' Response: 127145265,175325184,"test,DIR,0","temp,DIR,0",
"readme.txt,ASC,1324","state.savrcltxt,STAT,5327",
"waveform.wv,BIN,2342"

the directory /usb/user contains the subdirectories test and temp as well as the files readme.txt, state.savrcltxt and waveform.wv which have different file types.

Tip: To query only the subdirectories of the current or specified directory, perform: MMEM:DCAT? '/usb/user'

Response: 'test', 'temp'

To query only the number of subdirectories in the current or specified directory, perform:

MMEM:DCAT:LENG? '/usb/user'

Response: 2

- 2. To query the number of files in the current or specified directory, perform: MMEM:CAT:LENG? '/usb/user' Response: 3
- 3. Create a new subdirectory for mass memory storage in the specified directory. MMEM:MDIR '/usb/new'
- 4. Copy the file state to a new file. MMEM:COPY '/var/user/state.savrcltxt', '/usb/new'
- Rename the file state.
 MMEM:MOVE 'state.savrcltxt', 'state new.savrcltxt'
- 6. Remove the test directory. MMEM:RDIR 'usbtest'

11.10.4 Remote Control Commands

| :MMEMory:CATalog? | |
|---------------------------|-----|
| :MMEMory:CATalog:LENGth? | 162 |
| :MMEMory:CDIRectory | |
| :MMEMory:COPY | 163 |
| :MMEMory:DATA | 163 |
| :MMEMory:DCATalog? | 164 |
| :MMEMory:DCATalog:LENGth? | |
| :MMEMory:DELete | |
| :MEMory:HFRee? | 165 |
| :MMEMory:LOAD:STATe | |
| :MMEMory:MDIRectory | |
| :MMEMory:MOVE | 166 |
| :MMEMory:MSIS | |
| :MMEMory:RDIRectory | |
| :MMEMory:STORe:STATe | |
| | |

:MMEMory:CATalog? <path>

Returns the content of a particular directory.

| Query parameters: | |
|---------------------------------|---|
| <path></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></useddiskspace> | Byte size of all files in the directory. |
| <freediskspace></freediskspace> | Remaining disk space in bytes. |
| <fileinfo></fileinfo> | <namefilen>,<suffixfilen>,<sizefilen></sizefilen></suffixfilen></namefilen> |
| | List of files, separated by commas |
| | <namefilen></namefilen> |
| | Name of the file. |
| | <suffixfilen></suffixfilen> |
| | Type of the file. Possible suffixes are: ASCii, BINary, DIRectory |
| | <sizefilen></sizefilen> |
| | Size of the file in bytes. |
| Example: | See "Working with Files and Directories" on page 160. |
| Usage: | Query only |

:MMEMory:CATalog:LENGth? <Path>

Returns the number of files in the current or in the specified directory.

| Query parameters: | |
|-------------------------|---|
| <path></path> | string |
| | String parameter to specify the directory. If the directory is omit- ted, the command queries the content of the current directory, queried with :MMEMory:CDIRectory command. |
| Return values: | |
| <filecount></filecount> | integer |
| | Number of files. |
| Example: | See "Working with Files and Directories" on page 160. |
| 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> | <directory_name></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 ''. |
| Example: | See "Working with Files and Directories" on page 160. |
| Usage: | SCPI confirmed |
| | |

: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></sourcefile> | string String containing the path and file name of the source file |
|-------------------------------------|--|
| <destinationfile></destinationfile> | <pre>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.</sourcefile></destinationfile></pre> |
| Example: | See "Working with Files and Directories" on page 160. |
| Usage: | Setting only SCPI confirmed |

: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></binaryblock> | # <number><length_entry><data></data></length_entry></number> |
|-----------------------------|---|
| | #: Hash sign; always comes first in the binary block |
| | <number>: the first digit indicates how many digits the subse-</number> |
| | quent length entry has |
| | <length_entry>: indicates the number of subsequent bytes</length_entry> |
| | <data>: binary block data for the specified length.</data> |
| | |

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></filename> | string String parameter to specify the name of the file. |
|-----------------------|--|
| Example: | <pre>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</pre> |
| 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 omit-
ted, 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.Example:See "Working with Files and Directories" on page 160.Usage:Query only

:MMEMory:DCATalog:LENGth? [<Path>]

Returns the number of subdirectories in the current or specified directory.

| Query parameters: <path></path> | String parameter to specify the directory. If the directory is omit- ted, the command queries the contents of the current directory, to be queried with :MMEMory:CDIRectory command. |
|--|--|
| Return values: <directorycount></directorycount> | integer Number of parent and subdirectories. |
| Example: | See "Working with Files and Directories" on page 160. |
| Usage: | Query only |

:MMEMory:DELete <Filename>

Removes a file from the specified directory.

| Setting parameters: | |
|-----------------------|---|
| <filename></filename> | string |
| | String parameter to specify the name and directory of the file to be removed. |
| Example: | See "Working with Files and Directories" on page 160. |
| Usage: | Event SCPI confirmed |

:MEMory:HFRee?

Returns the used and available memory in Kb.

| Return values: | |
|-------------------------------------|------------------------|
| <totalphysmemkb></totalphysmemkb> | integer |
| | Total physical memory. |
| <applicmemkb></applicmemkb> | integer |
| | Application memory. |
| <heapusedkb></heapusedkb> | integer |
| | Used heap memory. |
| <heapavailablekb></heapavailablekb> | integer |
| | Available heap memory. |
| Usage: | Query only |
| | |

: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 $\star_{\tt RCL}$ command.

Setting parameters:

| <savrclstatenumb></savrclstatenumb> | Command, e.g. *RCL 4. |
|-------------------------------------|---|
| <file_name></file_name> | String parameter to specify the file name with extension *.savrcltxt. |
| Example: | See "Storing and Loading Current Settings" on page 160. |
| Usage: | Setting only |

: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></directory> | string |
|-------------------------|---|
| | String parameter to specify the new directory. |
| Example: | See "Working with Files and Directories" on page 160. |
| Usage: | Event |

: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></sourcefile> | string |
|-------------------------------------|---|
| | String parameter to specify the name of the file to be moved. |
| <destinationfile></destinationfile> | string |
| | String parameters to specify the name of the new file. |
| Example: | See "Working with Files and Directories" on page 160. |
| Usage: | Event SCPI confirmed |

: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></directory> | string |
|-------------------------|--|
| | String parameter to specify the directory to be deleted. |
| Example: | See "Working with Files and Directories" on page 160. |
| 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></savrcl_state_nr> | Corresponds to the specific <number> defined with the *SAV command, e.g. *SAV 4.</number> |
|-------------------------------------|---|
| <file_name></file_name> | String parameter to specify the file name with extension *.savrcltxt. |
| Example: | See "Storing and Loading Current Settings" on page 160. |
| Usage: | Event |

11.11 OUTPut Subsystem

| OUTPut:AMODe | 167 |
|------------------------------------|-----|
| :OUTPut[:STATe] | 167 |
| :OUTPut[:STATe]:PON | 168 |
| :OUTPut:AFIXed:RANGe:LOWer? | 168 |
| :OUTPut:AFIXed:RANGe:UPPer? | 168 |
| :OUTPut <hw>:PROTection:CLEar</hw> | 169 |
| | |

:OUTPut:AMODe <AMode>

Sets the mode of the attenuator (Attenuator MODe) at the RF output.

Parameters:

<AMode>

AUTO | FIXed

AUTO

The attenuator is switched automatically. The level settings are made in the full range.

FIXed

The level settings are made without switching the attenuator. When this operating mode is switched on, the attenuator is fixed to its current position and the resulting variation range is defined. *RST: AUTO

Manual operation: See "Mode" on page 77

:OUTPut[:STATe] <State>

Activates/deactivates the RF output.

Parameters:

<State> 0 | 1 | OFF | ON

OUTPut Subsystem

| Example: | See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 140. |
|-------------------|--|
| Manual operation: | See "RF On/Off" on page 60 |

:OUTPut[:STATe]:PON <Mode>

Selects the state which the RF output takes when the instrument is switched on.

| Parameters: | |
|-------------------|---|
| <mode></mode> | OFF UNCHanged |
| | OFF When the instrument is switched on, the output is deactivated . |
| | UNCHanged When the instrument is switched on, the output remains in the same state as it was before the instrument was switched off. *RST: UNCHanged |
| Example: | See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 140. |
| Manual operation: | See "Power-On State" on page 78 |
| | |

:OUTPut:AFIXed:RANGe:LOWer?

Queries the minimum level which can be set without the attenuator being adjusted.

| Return values: | |
|-------------------|---|
| <lower></lower> | float |
| | Default unit: dBm |
| Example: | See Chapter 11.1.3, "Advanced Task for Optimizing Perform- ance", on page 142. |
| Usage: | Query only |
| Manual operation: | See "Level Range" on page 77 |

:OUTPut:AFIXed:RANGe:UPPer?

Queries the maximum level which can be set without the attenuator being adjusted.

| Return values: <upper></upper> | float |
|-----------------------------------|---|
| | Default unit: dBm |
| Example: | See Chapter 11.1.3, "Advanced Task for Optimizing Performance", on page 142 . |
| Usage: | Query only |
| Manual operation: | See "Level Range" on page 77 |

:OUTPut<hw>:PROTection:CLEar

Resets the protective circuit after it has been tripped. The state of the output is again determined by OUTPut:STATE.

Example: OUTP:PROT:CLE

resets the protective circuit for RF output.

Usage:

Event

11.12 SOURce Subsystem

| [:SOURce]:SETTings:APPLy[:IMMediate] | 169 |
|--------------------------------------|-----|
| [:SOURce]:FREQuency[:CW FIXed] | 169 |
| [:SOURce]:TRAits <ch></ch> | 169 |
| SOURce]:TRAits:COUNt? | 170 |
| | 170 |

[:SOURce]:SETTings:APPLy[:IMMediate]

Applies the signal settings and outputs the signal.

See Chapter 11.14, "SOURce:Local Oscillator Subsystem", on page 172 for a description of the setting process.

Usage: Event

Manual operation: See "Confirm External LO Settings" on page 86

[:SOURce]:FREQuency[:CW|FIXed] <Cw>

Sets the RF frequency at the RF output connector of the instrument.

| Parameters: | | |
|-------------------|-------------------------------|---|
| <cw></cw> | float | |
| | Range: Increment: *RST: | 1E+6 to 40E+9 1E-3 1E+9 |
| Example: | See Chapte on page 14 | r 11.1.2, "Generating an I/Q Modulated Signal", D. |
| Manual operation: | See "Freque | ency" on page 60 |

[:SOURce]:TRAits<ch>

Queries for a list of values for the corresponding trait. The following values values are available for the channel number:

- 1: queries the upper edge frequencies for the frequency bands
- 2: queries the upconverter frequency multiplication factors for each band
- 3: queries if the bypass mode is active for each band

- 4: queries the pulsmodulation performed in LO for each band
- 5: queries the AM signal allowed for each band
- 6: queries the PM / PhiM signal allowed for each band

[:SOURce]:TRAits:COUNt?

Queries the number of trait lists.

| Return values: | |
|-----------------|------------|
| <count></count> | float |
| Usage: | Query only |

11.13 SOURce:IQ Subsystem

The IQ Impairment remote commands are available only for R&S SGU-B120V/-B140V.

| [:SOURce]:IQ:STATe | 170 |
|--|-----|
| :SOURce]:IQ:IMPairment:IQRatio | |
| [:SOURce]:IQ:IMPairment:LEAKage:I | 171 |
| [:SOURce]:IQ:IMPairment:LEAKage:Q | |
| [:SOURce]:IQ:IMPairment:QUADrature[:ANGLe] | |
| :SOURce]:IQ:IMPairment:STATe | |
| [:SOURce]:IQ:CREStfactor | 172 |
| | |

[:SOURce]:IQ:STATe <State>

Switches the I/Q modulation on and off.

| Parameters: | |
|-------------------|--|
| <state></state> | 0 1 OFF ON |
| | *RST: 0 |
| Example: | See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 140. |
| Options: | R&S SGU-B120V/-B140V |
| Manual operation: | See "Mod State" on page 60 |

[:SOURce]:IQ:IMPairment:IQRatio < IqRatio>

Sets the ratio of I modulation to Q modulation (gain "imbalance"). The input may be either in dB or %. An input in percent is rounded to the closest valid value in dB. A query returns the value in dB.

| Parameters: | fl4 | |
|---------------------|--|--------|
| <iqratio></iqratio> | Range: -1 to 1 Increment: 1E-3 *RST: 0 | |
| Example: | See Chapter 11.1.2, "Generating an I/Q Modulated Sig on page 140. | ynal", |
| Options: | R&S SGU-B120V/-140V | |
| Manual operation | See "Gain Imbalance" on page 84 | |

[:SOURce]:IQ:IMPairment:LEAKage:I <I> [:SOURce]:IQ:IMPairment:LEAKage:Q <Q>

Sets the carrier leakage amplitude for the I-signal/ Q-signal component.

| Parameters: <q></q> | float |
|------------------------|--|
| | Range:-5 to 5Increment:0.01*RST:0Default unit:PCT |
| Example: | See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 140. |
| Options: | R&S SGU-B120V/-B140V |
| Manual operation: | See "Offset" on page 83 |

[:SOURce]:IQ:IMPairment:QUADrature[:ANGLe] <Angle>

Sets the quadrature offset for the digital I/Q signal.

| Da | ira | m | ٥t | 0 | re | |
|----|------|---|----|----|----|---|
| 10 | li a | | Cι | CI | 3 | • |

| <angle></angle> | float |
|-------------------|--|
| | Range:-8 to 8Increment:0.01*RST:0Default unit:DEG |
| Example: | See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 140. |
| Options: | R&S SGU-B120V/-B140V |
| Manual operation: | See "Quadrature Offset" on page 84 |

[:SOURce]:IQ:IMPairment:STATe <State>

Activates/deactivates the impairment or correction values LEAKage, QUADrature and IQRatio for the baseband signal prior to input to the I/Q modulator.

| Parameters: | |
|-------------|--|
|-------------|--|

| <state></state> | 0 1 OFF ON |
|-------------------|--|
| | *RST: 0 |
| Example: | See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 140. |
| Options: | R&S SGU-B120V/-B140V |
| Manual operation: | See "State" on page 83 |

[:SOURce]:IQ:CREStfactor <Crest>

Sets the crest factor of the I/Q modulation signal.

| <pre>Parameters: <crest></crest></pre> | float | | |
|--|---|--|--|
| | Range:0 to 35Increment:0.01*RST:0Default unit:dB | | |
| Example: | See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 140 | | |
| Manual operation: | See "Crest Factor" on page 82 | | |

11.14 SOURce:Local Oscillator Subsystem

R&S SGU as an extension to a compatible R&S signal generator

If a R&S SGU is connected to a compatible R&S signal generator the R&S SGU acts as an extension to the signal generator extending its frequency range. In this setup a controller does not need to access the R&S SGU directly. Instead, the signal generator acts as a controller to the R&S SGU and depending on the required output signal parameters performs all required settings automatically.

For example, if the signal generator is set to an output frequency of 15 GHz it passes this value on to the R&S SGU. On reception of the new frequency R&S SGU blanks its output and computes the necessary settings for the local oscillator (signal generator). Next, the signal generator queries R&S SGU for the required frequency and level values of the local oscillator, which answers with for example 7.5 GHz and -10 dBm. The signal generator applies these settings to its own oscillator hardware and confirms that the required signal is now present at its output connector by sending the apply command to the R&S SGU. The R&S SGU unblanks its own output thus finishing the cycle.

R&S SGU as an upconverter for any signal generator

If, on the other hand, the R&S SGU is connected to an incompatible signal generator the controller has to perform the above steps instead of the signal generator. We assume that a remote PC (controller) is connected to both the R&S SGU and the signal generator (local oscillator). When changing any parameters which affect the output signal of the combined system of local oscillator and R&S SGU the controller has to follow these steps:

Setting the signal of the R&S SGU

- 1. Set the parameters of the R&S SGU like frequency and level as needed.
- Query the local oscillator frequency and the local oscillator level from R&S SGU with the SCPI commands [:SOURce]:LOSCillator:FREQuency? and [: SOURce]:LOSCillator:POWer?.
- 3. Interpret the result and apply the required changes to the LO.
- 4. Send the SCPI command [:SOURce]:SETTings:APPLy[:IMMediate] to R&S SGU to output the signal.

See Chapter 11.1.3, "Advanced Task for Optimizing Performance", on page 142 for an example.

| [:SOURce]:LOSCillator:FREQuency? | 173 |
|----------------------------------|-----|
| [:SOURce]:LOSCillator:POWer? | 173 |

[:SOURce]:LOSCillator:FREQuency?

Queries the frequency of the local oscillator input signal.

See Chapter 11.14, "SOURce:Local Oscillator Subsystem", on page 172 for a description of the setting process.

Return values:

| Dangai | |
|-------------------------------|--|
| Range. Increment: *RST: | 1E+6 to 20E+9 1E-3 1E+9 |
| Query only | |
| See "Freque | ency" on page 86 |
| | Range: Increment: *RST: Query only See "Freque |

[:SOURce]:LOSCillator:POWer?

Queries the level of the local oscillator input signal.

See Chapter 11.14, "SOURce:Local Oscillator Subsystem", on page 172 for a description of the setting process.

SOURce:POWer Subsystem

| Return values: | | |
|-------------------------|-------------------------------|---------------------------|
| <amplitude></amplitude> | float | |
| | Range: Increment: *RST: | -120 to 25 0.01 -10 |
| Usage: | Query only | |
| Manual operation: | See "Level" | on page 86 |

11.15 SOURce:POWer Subsystem

| [:SOURce]:POWer:ALC[:STATe] | 174 |
|---|-------|
| [:SOURce]:POWer:ALC:DSENsitivity | 174 |
| [:SOURce]:POWer:ALC:SONCe | 174 |
| [:SOURce]:POWer:ATTenuation:RFOFf:MODE | 175 |
| [:SOURce]:POWer:ATTenuation:SOVer[:OFFSet] | 175 |
| [:SOURce]:POWer:LMODe | 175 |
| [:SOURce]:POWer:SCHaracteristic | .176 |
| [:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude] | .176 |
| [:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet | 176 |
| [:SOURce]:POWer:LIMit[:AMPLitude] | .177 |
| [:SOURce]:POWer:PEP? | 177 |
| [:SOURce]:POWer:POWer | . 177 |
| [:SOURce]:POWer:RANGe:LOWer? | 178 |
| [:SOURce]:POWer:RANGe:UPPer? | 178 |
| | |

[:SOURce]:POWer:ALC[:STATe] <State>

Activates/deactivates the automatic level control.

| OFFTable | e ONTable ON |
|----------|------------------|
| RST: | ONTable |
| | OFFTable RST: |

Manual operation: See "State" on page 79

[:SOURce]:POWer:ALC:DSENsitivity <Sensitivity>

Sets the sensitivity of the power detector.

Parameters:

<Sensitivity>

OFF | LOW | MED | HIGH *RST: OFF

[:SOURce]:POWer:ALC:SONCe

Briefly activates automatic level control for correction purposes.

SOURce:POWer Subsystem

Usage: Event

Manual operation: See "Readjust" on page 76

[:SOURce]:POWer:ATTenuation:RFOFf:MODE <Mode>

Selects the state which the attenuator assumes when the instrument is switched on.

Parameters:

| <mode></mode> | MAX FIXed |
|-------------------|--|
| | MAX Sets attenuation to maximum when the RF signal is switched off. This setting is recommended for applications that require a high level of noise suppression. |
| | FIXed Retains the current setting and keeps the output impedance constant during RF off. *RST: MAX |
| Manual operation: | See "RF-Off-Mode" on page 77 |

[:SOURce]:POWer:ATTenuation:SOVer[:OFFSet] <Offset>

Sets the switch-over offset value of the attenuator.

Parameters: <Offset>

| floa | at |
|------|-----|
| *R | ST: |

Manual operation: See "SATT Switch-Over Offset" on page 77

0

[:SOURce]:POWer:LMODe <LevMode>

Selects the level mode.

Parameters:

| <levmode></levmode> | NORMal LNOise LDIStortion | |
|---------------------|---|--|
| | NORMal automatic selection of the best settings | |
| | LNOISe settings for lowest noise | |
| | LDIStortion settings for lowest distortions *RST: n.a. (factory preset: NORMal) | |
| Example: | see Chapter 11.1.3, "Advanced Task for Optimizing Perform- ance", on page 142 | |
| Manual operation: | See "Mode" on page 75 | |

[:SOURce]:POWer:SCHaracteristic < Characteristic>

Selects the characteristic for the level setting.

Parameters:

| <characteristic></characteristic> | AUTO UNINterrupted CVSWr USER MONotone | |
|-----------------------------------|--|--|
| | UNINterrupted: Uninterrupted Level setting, CVSWr: Con- stant-VSWR, MONotone: Strictly Monotone | |
| | *RST: AUTO | |
| Example: | see Chapter 11.1.3, "Advanced Task for Optimizing Perform- ance", on page 142 | |
| Manual operation: | See "Setting Characteristic" on page 75 | |

[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

Sets the RF level at the RF output connector of the instrument.

| Parameters: <amplitude></amplitude> | float | |
|--|---|---------------------------|
| | Range: Increment: *RST: | -120 to 25 0.01 -10 |
| Example: | See Chapter 11.1.3, "Advanced Task for Optimizing Perform- ance", on page 142. | |
| Manual operation: | See "Level/Level Offset" on page 60 | |

[:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

Specifies the constant level offset of a downstream attenuator/amplifier. If a level offset is entered, the level entered with [:SOURce]:POWer:POWer no longer corresponds to the RF output level.

The following correlation applies:

: POWer = RF output level + POWer: OFFSet.

Entering a level offset does not change the RF output level, but rather the query value of : POWer.

Only dB is permitted as the unit here. The linear units (V, W, etc.) are not permitted.

Parameters:

<Offset>

float Range: -100 to 100 Increment: 0.1 *RST: 0

Manual operation: See "Offset" on page 75

[:SOURce]:POWer:LIMit[:AMPLitude] <Amplitude>

Sets the upper limit of the RF signal power.

The value is not affected by an instrument preset and *RST function. This parameter is influenced only by the factory preset (SYST: FPR) and its factory value is equal to the upper limit.

Parameters:

| <amplitude></amplitude> | float | | | |
|-------------------------|---------------|------|----|----|
| | Range: | -300 | to | 30 |
| | Increment: | 0.01 | | |
| | Default unit: | dBm | | |
| | | | | |

Manual operation: See "Limit" on page 76

[:SOURce]:POWer:PEP?

Queries the RF signal's peak envelope power at the DUT.

| Return values: <pep></pep> | float |
|--------------------------------------|---|
| | Range: -120 to 25 Increment: 0.01 *RST: -10 |
| Example: | see Chapter 11.1.3, "Advanced Task for Optimizing Perform- ance", on page 142 |
| Usage: | Query only |
| Manual operation: | See "PEP" on page 60 |

[:SOURce]:POWer:POWer <Power>

Sets the level at the RF output connector.

This value does not consider a specified offset. The command [:SOURce]:POWer[: LEVel][:IMMediate]:OFFSet sets the level of the "Level" display, that means the level containing offset.

Parameters:

| <power></power> | float | | |
|-------------------|---|---------------------------|--|
| | Range: Increment: *RST: | -120 to 25 0.01 -10 | |
| Example: | POW: POW 15 sets the RF level at output to 15 dBm. | | |
| Manual operation: | See "Level/Level Offset" on page 60 | | |

[:SOURce]:POWer:RANGe:LOWer? [:SOURce]:POWer:RANGe:UPPer?

Queries the minimum/maximum level range in the current level mode

Return values:

| <upper></upper> | float | | |
|-------------------|-------------------------------|--------------------------|--|
| | Range: Increment: *RST: | -300 to 30 0.01 30 | |
| Usage: | Query only | | |
| Manual operation: | See "Level | Range" on page 76 | |

11.16 SOURce:PULM Subsystem

| [:SOURce <hw>]:PULM:STATe</hw> | 178 |
|-----------------------------------|-----|
| [:SOURce <hw>]:PULM:POLarity</hw> | 178 |

[:SOURce<hw>]:PULM:STATe <State>

Activates the pulse modulation.

| Parameters: | | |
|-------------------|--|----|
| <state></state> | 0 1 OFF ON | |
| | *RST: 0 | |
| Example: | PULM:STAT ON activates pulse modulation | n. |
| Manual operation: | See "State" on page 85 | |

[:SOURce<hw>]:PULM:POLarity <Polarity>

Sets the polarity of the pulse modulator signal. This command is effective only for an external modulation signal.

Parameters:

| <polarity></polarity> | NORMal INVerted | | |
|-----------------------|----------------------------------|---|--|
| | NORMal The RF sig | nal is suppressed during the pulse pause. | |
| | INVerted The RF sign *RST: | nal is suppressed during the pulse. NORMal | |
| Example: | PULM: POL selects inve | INV erted polarity. | |
| Manual operation: | See "Polarity" on page 85 | | |
| | | | |
11.17 STATus Subsystem

This system contains the commands for the status reporting system. See also Chapter A.5, "Status Reporting System", on page 215 for detailed information.

*RST on page 147 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 (=2¹⁵-1)

 The configuration commands set the respective register thus determining which status changes of the R&S SGU cause the status registers to be changed. Setting values: A decimal value in the range 0 to 32767 (=2¹⁵-1)

| :STATus:OPERation:CONDition? | |
|----------------------------------|-----|
| :STATus:OPERation:ENABle | 179 |
| :STATus:OPERation[:EVENt] | |
| :STATus:OPERation:NTRansition | 180 |
| :STATus:OPERation:PTRansition | |
| :STATus:PRESet | |
| :STATus:QUEStionable:CONDition | 181 |
| :STATus:QUEStionable:ENABle | |
| :STATus:QUEStionable[:EVENt] | 181 |
| :STATus:QUEStionable:NTRansition | |
| :STATus:QUEStionable:PTRansition | |
| :STATus:QUEue[:NEXT]? | |
| | |

: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></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></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></ntransition> | string |
|-----------------------------|---|
| Example: | :STAT:OPER:NTR 0 a transition from 1 to 0 in the condition part of the Status:Opera- tion 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></ptransition> | string |
|-----------------------------|--|
| Example: | :STAT:OPER:PTR 32767 all transitions from 0 to 1 in the condition part of the Status:Oper- ation 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></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.

| <condition></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 reported to the next higher level.

Parameters:

Devenetere

| <enable></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></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: <pre></pre> <pre><</pre> | string |
|---|--|
| Example: | STAT:QUES:NTR 0 a transition from 1 to 0 in the condition part of the STA- Tus:QUEStionable register does not cause an entry to be made in the EVENt part |

:STATus:QUEStionable:PTRansition < PTransition>

Sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register.

Parameters:

Example:

<PTransition> string

STAT:QUES:PTR 32767 all transitions from 0 to 1 in the condition part of the STA-Tus:QUEStionable register cause an entry to be made in the EVENt part

:STATus:QUEue[:NEXT]?

Queries the oldest entry in the error queue and then deletes it. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI. If the error queue is empty, 0 ("No error") is returned.

The command is identical to :SYSTem:ERROr[:NEXT]? on page 185.

| <pre>Return values: <next></next></pre> | 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 |

11.18 SYSTem Subsystem

The SYSTem subsystem contains a series of commands for general functions which do not directly affect signal generation.

| :SYSTem:EMODe | 183 |
|----------------------------|-----|
| :SYSTem:ERRor:ALL? | 183 |
| :SYSTem:ERRor:CODE:ALL? | 184 |
| :SYSTem:ERRor:CODE[:NEXT]? | 184 |
| :SYSTem:ERRor:COUNt? | 185 |
| :SYSTem:ERRor[:NEXT]? | 185 |

SYSTem Subsystem

| :SYSTem:SERRor? | 186 |
|---|-----|
| :SYSTem:VERSion? | |
| :SYSTem:COMMunicate:NETWork:IPADdress | 186 |
| :SYSTem:COMMunicate:NETWork:IPADdress:MODE | 186 |
| :SYSTem:COMMunicate:NETWork:MACaddress | |
| :SYSTem:COMMunicate:NETWork:RESTart | 187 |
| :SYSTem:COMMunicate:NETWork:STATus? | 187 |
| :SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname | 187 |
| :SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway | |
| :SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK | 188 |
| :SYSTem:COMMunicate:NETWork:RESource? | |
| :SYSTem:COMMunicate:HISLip:RESource? | 188 |
| :SYSTem:COMMunicate:PClexpress:RESource? | |
| :SYSTem:COMMunicate:SOCKet:PORT | 189 |
| :SYSTem:COMMunicate:SOCKet:RESource? | |
| :SYSTem:COMMunicate:SERial:RESource? | |
| :SYSTem:COMMunicate:SERial:BAUD | 190 |
| :SYSTem:COMMunicate:SERial:PARity | 190 |
| :SYSTem:COMMunicate:SERial:SBITs | 190 |
| :SYSTem:COMMunicate:USB:RESource? | 190 |
| :SYSTem:HARDware:ASSembly <dir>:SNUMber?</dir> | 191 |
| :SYSTem:MMEMory:PATH:USER? | 191 |
| :SYSTem:OSYStem? | 191 |
| :SYSTem:REBoot | 191 |
| :SYSTem:RESTart | 191 |
| :SYSTem:SHUTdown | 192 |
| :SYSTem:PROTect <ch>[:STATe]</ch> | |
| :SYSTem:STARtup:COMPlete? | 192 |

:SYSTem:EMODe <Mode>

Enables and selects the eco mode.

| Parameters: | |
|-------------|--|
|-------------|--|

| <mode></mode> | OFF EM1 | |
|---------------|-----------------------------|---|
| | *RST: | OFF |
| Example: | See Chapter Setup", on p | r 11.1.1, "Performing General Tasks for Instrument age 139. |

: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. Identi- cal 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 |

:SYSTem:ERRor:CODE:ALL?

Queries the error numbers of all entries in the error queue and then deletes them.

| Return values: | |
|----------------|--|
| <all></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. |
| | 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></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></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 | va | lues: |
|--------|----|-------|
|--------|----|-------|

| <next></next> | string |
|---------------|--|
| | Error/event_number,"Error/event_description>[;Device-depend- ent 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. Identi- cal 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 |

:SYSTem:SERRor?

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:

| <serror></serror> | string |
|-------------------|---|
| Example: | SYST: SERR queries all errors existing in the error queue. |
| Example: | Response: -221, 'Settings conflict', 153, 'Input voltage out of range' The two returned errors have occurred since the error queue was last queried. |
| Usage: | Query only |

:SYSTem:VERSion?

Queries the SCPI version the instrument's command set complies with.

| Return values: <version></version> | string |
|---------------------------------------|--|
| Example: | SYST:VERS queries the SCPI version. Response: "1996" The instrument complies with the SCPI version from 1996. |
| Usage: | Query only |

:SYSTem:COMMunicate:NETWork:IPADdress < IpAddress>

Sets the IP address.

Parameters:

| <ipaddress></ipaddress> | string | | |
|-------------------------|--|-------------------------|--|
| | Range: | 0.0.0.0. to ff.ff.ff.ff | |
| Example: | SYSTem:COMMunicate:NETWork:IPADdress "7.8.9.10" sets the IP address of the instrument. | | |
| Manual operation: | See "IP Add | lress" on page 99 | |

: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)

SYSTem Subsystem

| Example: | SYSTem:COMMunicate:NETWork:IPADdress:MODE | AUTO |
|-------------------|---|------|
| | The IP address is assigned automatically (DHCP) | |
| Manual operation: | See "Address Mode" on page 99 | |

:SYSTem:COMMunicate:NETWork:MACaddress <MacAddress>

Queries the MAC address of the network adapter.

| Parameters: | |
|---------------------------|--------------------------|
| <macaddress></macaddress> | string |
| Example: | SYST:COMM:NETW:MAC |
| | queries the MAC address. |

:SYSTem:COMMunicate:NETWork:RESTart

Restarts the network connection to the instrument, terminates the connection and sets it up again.

| Example: | SYSTem:COMMunicate:NETWork:RESTart |
|----------|------------------------------------|
| Usage: | Event |

:SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

| Return values: | |
|-----------------|------------------|
| <state></state> | 0 1 OFF ON |
| Usage: | Query only |

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

Sets the individual host name of the R&S SGU.

Note: it is recommended that you do not change the host name in order to avoid problems with the networdk connection. However, if you change the host name be sure to use an unique name.

The host name is a protected parameter, To change it, first disable protection level 1 with command :SYSTem:PROTect<ch>[:STATe] on page 192.

| Parameters: <hostname></hostname> | string |
|--------------------------------------|---|
| Example: | SYSTem:PROTect1:STATe OFF,123456 SYSTem:COMMunicate:NETWork:HOSTname 'SIGGEN' sets the individual computer name of the R&S SGU. |
| Manual operation: | See "Hostname" on page 98 |

:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway <Gateway>

Sets the IP address of the default gateway.

Parameters:

| <gateway></gateway> | string | string | |
|---------------------|--|-------------------------|--|
| | Range: | 0.0.0.0 to ff.ff.ff.ff | |
| Example: | SYSTem:COMMunicate:NETWork:IPADdress:GATeway '1.2.3.4' sets the IP address of the default gateway. | | |
| Manual operation: | See "Defau | It Gateway" on page 100 | |

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK <Mask>

Sets the subnet mask.

| Parameters: <mask></mask> | string |
|------------------------------|---|
| Example: | SYSTem:COMMunicate:NETWork:IPADdress:SUBNet: MASK '255.255.0.0' determines the subnet mask. |
| Manual operation: | See "Subnet Mask" on page 99 |

:SYSTem:COMMunicate:NETWork:RESource?

Queries the VISA resource string, used for remote control of the instrument with VXI-11 protocol.

Return values:

| <resource></resource> | string |
|-----------------------|---|
| Example: | SYSTem:COMMunicate:NETWork:RESource? Response: "TCPIP::192.1.2.3::INSTR" |
| Usage: | Query only |
| Manual operation: | See "Visa Resource Strings" on page 100 |

:SYSTem:COMMunicate:HISLip:RESource?

Queries the VISA resource string, used for remote control of the instrument with HiSLIP protocol.

| Return values: <resource></resource> | string |
|---|---|
| Example: | SYSTem:COMMunicate:HISLip:RESource? Response: "TCPIP::192.1.2.3::hislip0::INSTR" |
| Usage: | Query only |

Manual operation: See "Visa Resource Strings" on page 100

:SYSTem:COMMunicate:PClexpress:RESource?

Queries the visa resource string for remote control via the PCIe interface.

| Return values: | |
|-----------------------|---|
| <resource></resource> | string |
| Usage: | Query only |
| Manual operation: | See "Visa Resource Strings" on page 100 |

:SYSTem:COMMunicate:SOCKet:PORT <ScpiEthPort>

Sets the port number for remote control via socket communication.

| Parameters: | |
|-----------------------------|---------|
| <scpiethport></scpiethport> | integer |
| | Dango: |

| | Ra *R\$ | nge: ST: | 1000 n.a. (| to 658 (factory) | 535 prese | et: 5025) |
|----------|------------|-------------|----------------|---------------------|--------------|-----------|
| Example: | SYS | Tem:COMM | unica | te:SOCK | et:POI | RT 5030 |
| | // | specifies | s the | socket | port | number. |
| | ~ | | | | | |

Manual operation: See "SCPI Port" on page 55

:SYSTem:COMMunicate:SOCKet:RESource?

Queries the VISA resource string for remote control via LAN interface, using TCP/IP socket protocol.

| Return values: <resource></resource> | string |
|---|--|
| Example: | SYSTem:COMMunicate:SOCKet:RESource? Response: "TCPIP::10.113.1.150::5025::SOCKET" |
| Usage: | Query only |
| Manual operation: | See "Visa Resource Strings" on page 100 |

: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></resource> | string |
|---|--|
| Example: | SYSTem:COMMunicate:SERial:RESource? queries the VISA resource string. |
| | Response: "ASRL1::INSTR" |

SYSTem Subsystem

Usage: Query only

:SYSTem:COMMunicate:SERial:BAUD <Baud>

Sets the baudrate for the serial remote control interface.

| Parameters: | 2400 4000 | | |
|---------------|---|---|--|
| <baud></baud> | 2400 4800 9600 19200 38400 57600 115200 | | |
| | *RST: | n.a. (factory preset: 115200) | |
| Example: | SYSTem:CO Sets 115200 | MMunicate:SERial:BAUD 115200) baudrate. | |

:SYSTem:COMMunicate:SERial:PARity <Parity>

Sets the parity for the serial remote control interface.

| Parameters: <parity></parity> | NONE ODD EVEN | | | |
|----------------------------------|---------------------------|-----------------------------|--|--|
| | *RST: | n.a. (factory preset: NONE) | | |
| Example: | SYST:COMM Selects pari | :SER:PAR NONE ty NONE. | | |

:SYSTem:COMMunicate:SERial:SBITs <SBits>

Sets the number of stop bits for the serial remote control interface.

| Parameters: | | |
|-----------------|----------------------|-----------------------------|
| <sbits></sbits> | 1 2 | |
| | *RST: | n.a. (factory preset: 1) |
| Example: | SYST:CC Selects 2 | MM:SER:SBIT 2 Stop bits. |

:SYSTem:COMMunicate:USB:RESource?

Queries the VISA resource string for remote control via the USB interface.

| Return values: <resource></resource> | string |
|---|---|
| Example: | SYSTem:COMMunicate:USB:RESource? queries the VISA resource string for remote control via the USB interface. Response: "USB::72::000000::INSTR" |
| Usage: | Query only |
| Manual operation: | See "Visa Resource Strings" on page 100 |
| | |

:SYSTem:HARDware:ASSembly<dir>:SNUMber?

Queries the list of hardware module serial numbers.

Suffix:<dir>1 | 2
Defines the section: 1 = common assembly, 2 = RF assembly.Return values:<SNumber>stringExample:SYSTem:HARDware:ASSembly1:SNUMber?Usage:Query onlyManual operation:See "Assembly" on page 90

:SYSTem:MMEMory:PATH:USER?

Queries the user directory, that means the directory the instrument stores user files on.

| Return values: <pathuser></pathuser> | string |
|--|---|
| Example: | SYSTem:MMEMory:PATH:USER? Response: "/var/user/" |
| Usage: | Query only |

:SYSTem:OSYStem?

Queries the operating system of the instrument.

| Return values: <opersystem></opersystem> | string |
|--|--|
| Example: | SYSTem:OSYStem? Response: " Linux" |
| Usage: | Query only |

:SYSTem:REBoot

Restarts the firmware and the operating system.

Usage: Event

:SYSTem:RESTart

Restarts the firmware. The operating system remains active.

Usage: Event

| vn |
|--|
| ument. |
| Event |
| <ch>[:STATe] <state>[, <key>]</key></state></ch> |
| vates the specified protection level. |
| Indicates the protection level. |
| select *RST: n.a. (factory preset: 1) |
| : 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 password for the first level is 123456. |
| <pre>// 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</pre> |
| |

:SYSTem:STARtup:COMPlete?

Queries if the startup of the instrument is completed.

| Return values: <complete></complete> | 0 1 OFF ON *RST: 0 |
|---|--|
| Example: | SYST:STAR:COMP? // 1 // the startup of the instrument is completed |
| Usage: | Query only |

11.19 TEST Subsystem

The TEST system contains the commands for performing the routines. R&S SGU cannot perform the selftest on its own. Therefore a connection with a signal generator is needed. If you use a compatible R&S signal generator, then the calibration process will be completed automatically after starting the calibration process. Otherwise you have to follow the steps described in "Calibration process of the R&S SGU" on page 151. In the given example, replace the :CALibration:xxx:STARt SCPI command with :TEST:ALL:STARt and :CALibration:xxx:RESult

with :TEST:ALL:RESult. We assume that a remote PC is connected to the instruments, the remote PC and the instruments are switched on and a connection between them is established.

The self tests returns 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.

NOTICE

Improper use can destroy the assembly

The respective hardware assembly responds directly to the :TEST:DIRect command; any safety mechanisms are bypassed. The command is intended for servicing purposes and should be used only by the Rohde & Schwarz service personnel.

| :TEST:ALL:STARt | .193 |
|------------------------|-------|
| :TEST:ALL:RESult? | . 193 |
| :TEST:KEYBoard[:STATe] | 193 |

:TEST:ALL:STARt

Starts a selftest. Use the command :TEST:ALL:RESult? to query the result.

Use : CALibration: HREQuest? to query for settings required by the instrument.

Usage: Event

:TEST:ALL:RESult?

Queries the result of the performed selftest. Start the selftest with :TEST:ALL:STARt.

| Return values: | | |
|-------------------|----------------------------|---|
| <result></result> | 0 1 RUNi | ning STOPped |
| | *RST: | STOPped |
| Example: | See Chapte Setup", on p | er 11.1.1, "Performing General Tasks for Instrument page 139. |
| Usage: | Query only | |

:TEST:KEYBoard[:STATe] <State>

Enables/disables the keyboard and the LED test state.

Parameters:

<State> 0 | 1 | OFF | ON *RST: OFF

11.20 UNIT Subsystem

The UNIT subsystem contains the commands specifying which units are valid if no unit is indicated in a command. These settings are valid for the entire instrument.

:UNIT:ANGLe <Angle>

Sets the default angle unit for remote control. Does not influence the manual control parameter units and the display.

| Parameters: | | |
|-----------------|---------------------------------------|--|
| <angle></angle> | DEGRee | RADian |
| | *RST: | RADian |
| Example: | UNIT:ANG sets DEG a angle value | L DEG as a default unit for all commands which determine es. |

:UNIT:POWer <Power>

Defines the default unit for power parameters. This setting affects the GUI, as well as all remote control commands that determine power values.

| Parameters: | | |
|-----------------|-------------------------------------|---|
| <power></power> | V DBUV | DBM |
| | *RST: | DBM |
| Example: | UNIT: POW sets V as a values. | $\ensuremath{\mathbb{V}}$ default unit for all commands which determine power |

11.21 List of R&S SGU Commands

| :CALibration:HREQuest? | 153 |
|--|-----|
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| :CALibration:IQModulator:RESult? | 154 |
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| :OUTPut:AFIXed:RANGe:UPPer? | |
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| :OUTPut[:STATe] | |
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| :STATus:PRESet | |
| :STATus:QUEStionable:CONDition | |
| :STATus:QUEStionable:ENABle | |
| :STATus:QUEStionable:NTRansition | |
| :STATus:QUEStionable:PTRansition | |
| :STATus:QUEStionable[:EVENt] | |
| STATus:QUEue[:NEXT]? | |
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| :SYSTem:COMMunicate:NETWork:IPADdress | |
| :SYSTem:COMMunicate:NETWork:IPADdress:MODE | |
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| | |

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| :SYSTem:COMMunicate:SERial:RESource? | |
|--|-----|
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| :SYSTem:COMMunicate:SOCKet:PORT | |
| :SYSTem:COMMunicate:SOCKet:RESource? | |
| :SYSTem:COMMunicate:USB:RESource? | |
| :SYSTem:EMODe | |
| :SYSTem:ERRor:ALL? | |
| :SYSTem:ERRor:CODE:ALL? | |
| :SYSTem:ERRor:CODE[:NEXT]? | |
| :SYSTem:ERRor:COUNt? | |
| :SYSTem:ERRor[:NEXT]? | |
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| [:SOURce]:IQ:STATe | |
| [:SOURce]:LOSCillator:FREQuency? | |
| [:SOURce]:LOSCillator:POWer? | |
| [:SOURce]:POWer:ALC:DSENsitivity | |
| [:SOURce]:POWer:ALC:SONCe | |
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| [:SOURce]:POWer:LMODe | |
| [:SOURce]:POWer:PEP? | |
| : SOURce]:POWer:POWer | |
| : [:SOURce]:POWer:RANGe:LOWer? | |
| [:SOURce]:POWer:RANGe:UPPer? | |
| | |

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12 Maintenance

The instrument does not need periodic maintenance. Only cleaning the instrument is essential.

Follow the instructions in the service manual and the safety instructions when exchanging modules or ordering spare parts. The order number for spare parts is included in the service manual. The service manual includes further information particularly on troubleshooting, repair, exchange of modules (including battery exchange, adjustment of the OCXO oscillator) 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.

12.1 Cleaning

A 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, lintfree 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.

12.2 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.

Error Messages

13 Error Messages and Troubleshooting

This chapter describes the error messages of the R&S SGU. The error messages are output in the "Info" line on the screen and entered in the error/event queue of the status reporting system.

A great variety of different messages such as status messages, error messages, warnings or information are displayed in the header field of the screen. Some error messages require that the error must be eliminated before correct instrument operation can be ensured. The "Info" window with a list of current messages and a detailed description of each message can be opened with the "Info" button (see also Chapter 6.2.1, "Info Dialog", on page 56).

13.1 Status Information

The status messages are displayed in the Info line of the R&S SGMA-GUI main panel. The status information gives the user an overview of the main operating states and settings of the instrument. The states are indicated for information only and do not necessitate any action by the user.

Status Information displayed in the Info line

AttFixed

Attenuator fixed mode is active.

The uninterrupted level settings are made in a fixed range without attenuator switching. The variation range is set automatically when this mode is activated. The range is displayed with the parameter "SGMA-GUI > Instrument Name > Level > Attenuator Fixed Range".

13.2 Error Messages

Messages indicate errors in the instrument. They are displayed in the info line 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).

See also Chapter 6.2.1, "Info Dialog", on page 56 and Chapter 6.2.2, "Understanding the Messages in the Info Bar", on page 57.

13.2.1 Volatile messages

Volatile messages report automatic settings in the instrument (e.g. switching off of 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.

SCPI command: :SYSTem:ERRor:ALL? and :SYSTem:ERRor[:NEXT]?.

13.2.2 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 ensured.

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.

SCPI command: :SYSTem:SERRor?

13.3 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.

13.4 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 of 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.

Device-Specific Error Messages

| Error Code | Error | Description | Remedy |
|---------------|---------------------------------|--|--|
| 180 | Adjustment failed | Adjustment could not be executed | The adjustment data have to be generated first by an internal or external adjustment or to be loa- ded into the device. |
| 182 | Adjustment data miss- ing | Adjustment data are missing. | The adjustment data have to be generated first by an internal or external adjustment or to be loa- ded into the instrument. |
| 183 | Adjustment data inva- lid | Adjustment data are invalid and must be restored. | The adjustment data have to be generated again by an internal or external adjustment or to be loa- ded into the instrument. |
| 200 | Cannot access hard- ware | 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 | A error occurs when writing or reading a EEPROM. | The EEPROM might be defect and has to be replaced. |
| 203 | Invalid EEPROM data | | |
| 204 | Driver initialization failed | Initialization of a driver fails when booting the instrument firmware. | The driver is not compatible with the hardware or software config- uration of the instrument. |
| 241 | No current list | There is no list selected. | To execute the required opera- tion, a list has to be selected in the related dialog. If no list is available, a new list must be cre- ated. |
| 242 | Unknown list type specified | The list type selected is not valid for the required operation. For instance, the file extension for mapping files is * .map. It is not possi- ble to enter another file extension when selecting a list. | Check the selected list type. |
| 460 | Cannot open file | The selected file can not be opened. | Check the path and file name. |
| 461 | Cannot write file | The file can not be written. | Check if the file is read-only. |
| 462 | Cannot read file | The file can not 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. | A file name has to be entered when creating a new list. |
| 464 | Invalid filename exten- sion | The file extension is not valid for the required operation. | Check the file extension. For instance, the file extension for the mapping files is *.map. It is not possible to enter another file extension when storing a list. |

Device-Specific Error Messages

| Error Code | Error | Description | Remedy |
|---------------|----------------------------|--|--|
| 465 | File contains invalid data | The selected file contains data that is not valid for the file type. | Check the file extension. 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 are therefore inva- lid. |
| 468 | Cannot find directory | Required folder cannot be found. | Check drive and path. |
| 469 | No files found | Folder is empty | |

Annex

A Remote Control Basics

This chapter provides basic information on operating an instrument via remote control.

A.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.3, "SCPI Command Structure", on page 205. 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.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. |
| >L | 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.) |
| >R | 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 $\>R$.) |
| &POL | Serial Poll | Starts a serial poll. |

A.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.3.1 Syntax for Common Commands

Common (= device-independent) commands consist of a header preceded by an asterisk (*), and possibly one or more parameters.

| *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. |

Table A-1: Examples of common commands

A.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 | 207 |
|---|---------------------|-----|
| • | Numeric Suffixes | |
| • | Optional Mnemonics. | |

A.3.2.1 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.

A.3.2.2 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.

A.3.2.3 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.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 | 208 |
|---|------------------------|-------|
| • | Special Numeric Values | . 209 |
| • | Boolean Parameters | . 210 |
| • | Text Parameters | 210 |
| • | Character Strings | . 210 |
| • | Block Data | 210 |
| | | |

A.3.3.1 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

A.3.3.2 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.

A.3.3.3 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

A.3.3.4 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

A.3.3.5 Character Strings

Strings must always be entered in quotation marks (' or ").

Example:

```
HCOP:ITEM:LABel "Test1"
HCOP:ITEM:LABel 'Test1'
```

A.3.3.6 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 #45168xxxxxxx

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.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

| 1 | 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></numeric_value> | | | | | | |
| | The two following commands with identical meaning can be created: | | | | | |
| | SENS:BAND:RES 1 | | | | | |
| | SENS:BWID:RES 1 | | | | | |
| [] | Mnemonics in square brackets are optional and may be inserted into the header or omitted. | | | | | |
| | Example: HCOPy[:IMMediate] | | | | | |
| | HCOP: IMM is equivalent to HCOP | | | | | |
| {} | Parameters in curly brackets are optional and can be inserted once or several times, or omitted. | | | | | |
| | Example : SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}</numeric_value></numeric_value> | | | | | |
| | The following are valid commands: | | | | | |
| | SENS:LIST:FREQ 10 | | | | | |
| | SENS:LIST:FREQ 10,20 | | | | | |
| | SENS:LIST:FREQ 10,20,30,40 | | | | | |

A.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:

Example:

HCOP:ITEM ALL

HCOP:IMM

A new command line always begins with the complete path.

A.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).

Command Sequence and Synchronization

A.4 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command is one which finishes executing before the next command starts executing. Commands that are processed quickly are usually implemented as sequential commands. Sequential commands are not implemented in the instrument, however the execution time of most commands is so short that they act as sequential commands when sent in different command lines.
- An overlapping command is one which does not automatically finish executing before the next command starts executing. Usually, overlapping commands take longer to process and allow the program to do other tasks while being executed. If overlapping commands do have to be executed in a defined order, e.g. in order to avoid wrong measurement results, they must be serviced sequentially. This is called synchronization between the controller and the instrument.

Setting commands within one command line, even though they may be implemented as sequential commands, are not necessarily serviced in the order in which they have been received. In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line.



As a general rule, send commands and queries in different program messages.

A.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.

| Com- mand | Action | Programming the controller |
|--------------|--|---|
| *OPC | Sets the Operation Complete bit in the ESR after all previous commands have been exe- cuted. | 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 exe- cuted. | Send *WAI directly after the command whose processing must be terminated before other commands are executed. |

Table A-4: Synchronization using *OPC, *OPC? and *WAI

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.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.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 SGU uses the following status registers:

• Status Byte (STB) and Service Request Enable (SRE), see Chapter A.5.3, "Status Byte (STB) and Service Request Enable Register (SRE)", on page 219.

- Standard Event Status, i.e. the Event status Register (ESR) and the Event Status Enable (ESE), see Chapter A.5.4, "Event Status Register (ESR) and Event Status Enable Register (ESE)", on page 220.
- Questionable Status and Operation Status, the (SCPI status registers, see Chapter A.5.2, "Structure of a SCPI Status Register", on page 217, Chapter A.5.5, "Questionable Status Register (STATus:QUEStionable)", on page 220 and Chapter A.5.6, "Operation Status Register (STATus:OPERation)", on page 221.

• 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.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.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?.

| Bit No. | Meaning |
|---------|---|
| 01 | 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. |
| 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. |

Table A-5: Meaning of the bits used in the status byte

A.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?.

| 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. |
| 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. |

| Table A-6: | Meaning | of the | bits | used in | the | event | status | register |
|------------|---------|--------|------|---------|-----|-------|--------|----------|
| TUDIC A V. | meaning | or the | NILU | uocu m | | Crein | Junio | register |

A.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.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]?.

| 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 |

Table A-8: Meaning of the bits used in the operation status register

A.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

A.5.7.1 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.

A.5.7.2 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.

A.5.7.3 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.

A.5.7.4 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 regu-

larly since faulty commands from the controller to the instrument are recorded there as well.

A.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.

| Event | Switching voltage Power-On- Clear | on supply Status- | DCL, SDC (Device Clear, | *RST Or SYSTem: PRESet | STATus: PRESet | *CLS |
|---|--|----------------------|---|-------------------------------------|-------------------|--------|
| Effect | 0 | 1 | Selected Device Clear) | | | |
| 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 comm | and line that | immediately | follows a <p< td=""><td>ROGRAM N</td><td>ESSAGE TE</td><td>RMINA-</td></p<> | ROGRAM N | ESSAGE TE | RMINA- |

Table A-9: Resetting the status reporting system

1) The first command in a command line that immediately follows a <PROGRAM MESSAGE TERMINA-TOR> clears the output buffer.

A.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.

B 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 SGU 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;
                  receiveBufferSize;
   int
};
```

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 )</pre>
 {
  throw string("can't connect server\n" );
 }
 clientIsConnected = true;
}
void TcpClient::disconnect( )
{
 if( clientIsConnected )
 {
   close( currentSocketDescr );
 }
 currentSocketDescr = 0;
 currentHostName = "";
                  = 0;
 currentPort
 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 )</pre>
   {
     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;</pre>
}
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;</pre>
        }
      }
     if( useSingleCommand )
     {
       terminate = true;
     }
   }
  }catch( const string errorString )
  {
   cout<<errorString<<endl;</pre>
 }
 client.disconnect( );
  return errorCode;
}
```

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