R&S®NGU
Source Measure Units
Getting Started

1179247702
Version 03

ROHDE&SCHWARZ
Make ideas real

This manual describes the following R&S®NGU models with firmware version 1.00 and higher:

- R&S®NGU201 2-QUADRANT SMU (3639.3763.02)
- R&S®NGU401 4-QUADRANT SMU (3639.3763.03)

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1179.2477.02 | Version 03 | R&S®NGU

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

Contents

1 Safety information

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

Intended use

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

Where do I find safety information?

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

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

2 Korea certification class A

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

3 Documentation overview

This section provides an overview of the R&S NGU user documentation.

3.1 Manuals

You find the documents on the R&S NGU product page at:

www.rohde-schwarz.com/manual/ngu

Getting started

Introduces the R&S NGU source measure units and describes how to set up and start working with the instrument. The printed document is delivered with the instrument.

User manual

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 and instrument interfaces. Includes the contents of the getting started manual.

The *online version* of the user manual provides the complete contents for immediate display on the internet.

Basic safety instructions

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

3.2 Data sheet

The datasheet contains the technical specifications of the R&S NGU source measure units. It also lists all options with their order numbers and accessories.

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

3.3 Calibration certificate

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

3.4 Release notes, open source acknowledgment

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. It can also be read directly on the instrument.

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

4 Welcome to R&S NGU

The single source measure units are based on a classical transformer concept with linear regulators. This concept allows the instrument to achieve highest accuracy and lowest residual ripple.

Multi-purpose protection functions are available which you can set separately, such as overcurrent protection (OCP), overvoltage protection (OVP) and overpower protection (OPP). If such a limit is reached, the affected output is automatically turned off and an indicator icon (C, V, P) blinks on the display.

Additionally, the R&S NGU is protected with overtemperature protection (OTP). This safety feature protects the R&S NGU from overheating. When the temperature in the source measure unit exceeds the OTP limit, the output is automatically cut off.

The Arbitrary function allows a freely definable voltage and current sequences with a timeframe as short as 100 µs. It allows varying the voltage or current during a test sequence, for example to simulate different charging conditions of a battery. With "Ramp" function, the R&S NGU provides the operating condition to ramp up the supply voltage within a defined timeframe of 10 ms to 10 s.

All R&S NGU source measure units are equipped with a color TFT display (800 pixels x 480 pixels) and enhanced with touch input capability. The R&S NGU can be remotely controlled via USB, LAN (LXI) interface and optional GPIB option.

The digital I/O interface installed at the rear panel is activated with an option, it allows a single trigger-in signal to control multi trigger-out signals on the source measure unit, providing many possibilities to control outputs and associated devices in the event when a trigger occurs.

The user manual contains description of the functionalities that the instrument provides. The latest version is available for download at the product homepage (http://www.rohde-schwarz.com/product/ngu).

5 Putting into operation

This chapter describes how to set up the R&S NGU source measure units for the first time.

WARNING

Risk of injury due to disregarding safety information

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

- Do not open the instrument casing.

NOTICE

Risk of instrument damage due to inappropriate operating conditions

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

NOTICE

Instrument damage caused by electrostatic discharge

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

NOTICE

Risk of instrument damage during operation

An unsuitable operating site or test setup can cause damage to the instrument and the connected devices. Ensure the following operating conditions before you switch on the instrument:

- The instrument is dry and shows no sign of condensation
- The instrument is positioned as described in Chapter 5.4.1, "Bench operation", on page 16
- 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 correctly connected and not overloaded

EMI impact on measurement results

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.
- Always terminate open cable ends.
- Note the EMC classification in the data sheet.

5.1 Safety

NOTICE

Recommendations on secure operation

The R&S NGU is designed to operate at local workplaces or in secured networks (LAN). It should not be accessible from the internet, because of a potential security risk, e.g. attackers could misuse or damage your device.

Please always install the latest firmware.

It is highly recommended that you work closely with your IT department or system administrator to ensure compliance with your company policies when connecting devices to your company's network.

This instrument was built in compliance with DIN EN 61010-1, safety regulations for electrical instruments, control units and laboratory equipment.

It has been tested and shipped from the plant in safe condition. It is also in compliance with the regulations of the European standard EN 61010-1 and the international standard IEC 61010-1.

To maintain this condition and ensure safe operation, you must observe all instructions and warnings given in this user manual. Casing, chassis and all measuring ports are connected to a protective earth conductor. The instrument is designed in compliance with the regulations of protection class I.

For safety reasons, the instrument may only be operated with authorized safety sockets. The power cable must be plugged in before signal circuits may be connected.

Never use the product if the power cable is damaged. Check regularly if the power cables are in perfect condition. Choose suitable protective measures and installation types to ensure that the power cable cannot be damaged and that no harm is caused by tripping hazards or from electric shock, for instance.

⚠ DANGER

Risk of electric shock

It is prohibited to disconnect the earthed protective connection inside or outside of the instrument!

If it is assumed that a safe operation is no longer possible, the instrument must be shut down and secured against any unintended operation.

Safe operation can no longer be assumed when:

- Instrument shows visible damage
- Instrument includes loose parts
- Instrument no longer functions properly
  - After an extended period of storage under unfavorable conditions (e.g. outdoors or in damp rooms)
  - After rough handling during transport (e.g. packaging that does not meet the minimum requirements by post office, railway or forwarding agency)

DANGER

Exceeding the low voltage protection

Use insulated wires and not bare wires for the terminal connection.

It is assumed that only qualified and trained personnel service the source measure units and the connected loads.

Before switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network.

5.2 Intended operation

The instrument is intended only for use by personnel familiar with the potential risks of measuring electrical quantities.

For safety reasons, the instrument may only be connected to properly installed wall outlets. Separating the ground is prohibited.

The power cable must be inserted before signal circuits may be connected.

Use only the power cable included in the delivery package. See "Delivery package" on page 15.

Before each measurement, measuring cables must be inspected for damage and replaced if necessary. Damaged or worn components can damage the instrument or cause injury.

The instrument may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer’s specifications are not observed, this can result in electric shock, fire and/or serious personal injury, and in some cases, death.

Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

The instrument is designed for use in the following sectors: Industrial, residential, business and commercial areas and small businesses.

The instrument is designed for indoor use only. Before each measurement, you need to verify at a known source if the instrument functions properly.

To disconnect from the mains, unplug the IEC socket on the back panel.

See Table 5-1 for the general data on the instrument specification.

Table 5-1: General data on instrument specification

General data		
Mains nominal voltage	AC 100 V / 115 V / 230 V (±10 %) 50 Hz to 60 Hz	
Maximum power consumption	400 W	
Mains fuses	2 x IEC T4.0H 250 V	
Operating temperature range	+5 °C to +40 °C	
Storage temperature range	-20 °C to +70 °C	
Humidity noncondensing	5 % to 95 %	
Display	TFT 5" 800 pixels x 480 pixels WVGA Touch	
Rack installation	R&S HZN96 rack adapter 2U (P/N: 3638.7813.02)	
Dimensions (W x H x D)	222 mm x 97 mm x 436 mm (8.74" x 3.82" x 17.17")	
Weight	R&S NGU201	7.1 kg (15.65 lb)
	R&S NGU401	7.1 kg (15.65 lb)

5.3 Unpacking and checking the instrument

Unpack the R&S NGU source measure unit carefully and check the content of the package.

- Check the equipment for completeness using the delivery note and package contents list for the various items.
- Check the instrument for any damage and loose parts. If there is any damage, immediately contact the carrier who delivered the instrument.

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.

NOTICE

Risk of damage during transportation and shipment

Insufficient protection against mechanical and electrostatic effects during transportation and shipment can damage the instrument.

- Always ensure that sufficient mechanical and electrostatic protections are provided
- When shipping an instrument, the original packaging should be used. If you do not have the original packaging, use sufficient padding to prevent the instrument from moving around inside the box. Pack the instrument in antistatic wrap to protect it from electrostatic charging
- Secure the instrument to prevent any movement and other mechanical effects during transportation

Delivery package

The package contents contain the following items:

- R&S NGU source measure unit
- Four power cables
- One printed Getting Started manual
- One document folder containing a printed Basic Safety Instructions guide

5.4 Setting up the instrument

The R&S NGU is designed for benchtop and rackmount operation.

5.4.1 Bench operation

On a benchtop, the R&S NGU source measure unit can either lie flat or stand on its feet. As shown in Figure 5-1, feet on the bottom can be folded out to set the instrument in an inclined position.

Figure 5-1: Inclined position

NOTICE

Positioning of instrument

The instrument must be positioned in a manner that allows you to disconnect the unit from the mains at any time and without restrictions.

5.4.2 Rack mounting

The instrument can be installed in a 19" rack using the rack adapter R&S HZN96 (P/N 3638.7813.02). Proceed according to the installation instructions supplied with the rack adapter.

NOTICE

Ambient temperature

Place the R&S NGU source measure unit in an area where the ambient temperature is within +5 °C to +40 °C. The R&S NGU source measure unit is fan-cooled and must be installed with sufficient space along the sides to ensure free flow of air.

6 Instrument tour

This chapter provides an overview of all the controls available in the R&S NGU models and steps to switch on the instrument for the first time.

6.1 Overview of controls

6.1.1 Front panel

The front panel of the R&S NGU is shown in Figure 6-1. The function keys and navigation controls are located beside the display. The various connectors are located at the right side of the display.

Figure 6-1: Front panel of R&S NGU201 model

1 = Menu control keys
2 = Display with touch screen
3 = Rotary knob and back key
4 = Output key

5 = Output terminals
6 = Power key
7 = USB connector

Menu control keys (1)

The menu control keys allow you to access the home window, device/channel menu window and user button key in the instrument.

For a detailed description on menu control keys, see section "Menu Controls" in the User Manual.

Display (2)

The display is a color TFT touch screen with measurement settings and functions provided in the channel display area. The status bar which provides at both device and channel level shows the device operating mode and channel settings of the instrument.

For a detailed description on-screen layout, see section "Display Overview" in the User Manual.

Rotary knob and back key (3)

The rotary knob and back key are used for menu navigation and value adjustment in the instrument.

For a detailed description on rotary knob and back key, see section "Navigation Controls" in the User Manual.

Output key (4)

The output key allows you to enable or disable the output power.

Refer to datasheet for the channel voltage/current limits in the source and sink mode.

Output terminals (5)

The R&S NGU is a single channel source measure unit and it comes with the following models:

- R&S NGU201 model is a 2 quadrant source measure unit
- R&S NGU401 model is a 4 quadrant source measure unit

Both models are equipped with "Force (High)", 2 x "Force (Low)", "Sense (High)", "Sense (Low)" and a ground terminal.

With a jumper connecting the ground terminal and the additional "Force (Low)" connector, the R&S NGU provides good ground connection which is essential when measuring very small voltages and currents.

Power key (6)

The [Power] key switches the instrument on and off.

USB connector (7)

The USB connector is a Type-A connector. You can connect a USB flash drive to this connector to perform a firmware update, store logging data or screen shots.

6.1.2 Rear panel

Figure 6-2 shows the rear panel of the R&S NGU with its connectors.

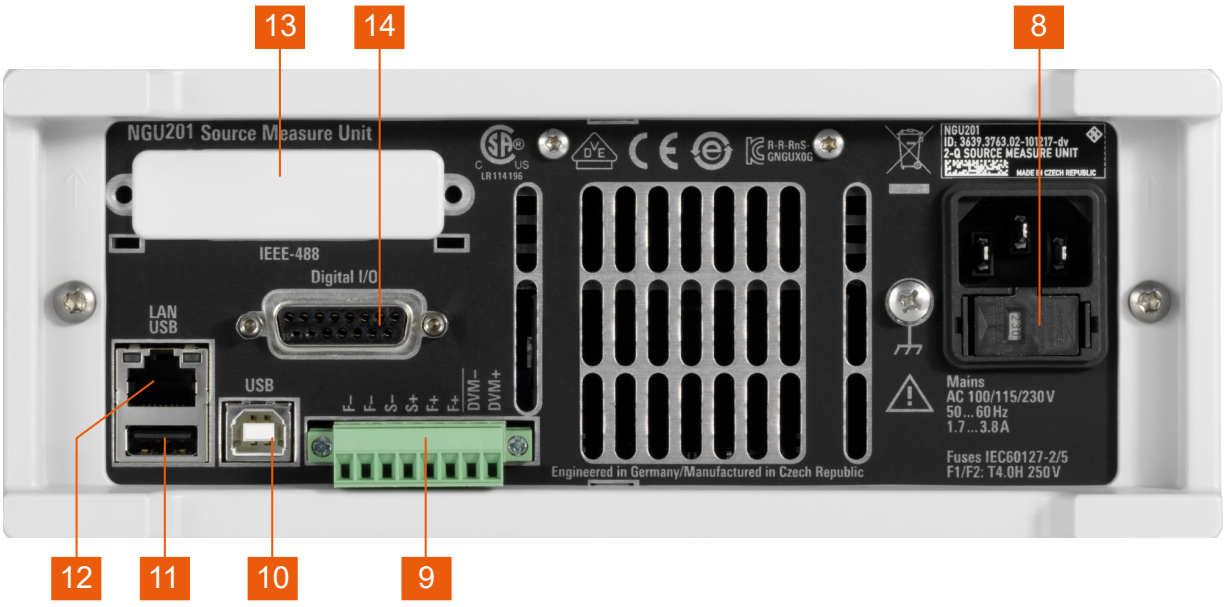

Figure 6-2: Rear panel of R&S NGU201 model

8 = AC inlet with fuse holder and voltage selector
9 = Channel 1 rear panel connector. For NGU201, the last two pins are labeled as DVM+ and DVM- as an option. For NGU401, the pins are labeled as MOD+ and MOD-.
10 = USB connector (Device)
11 = USB connector (Host)

12 = Ethernet (LAN) connector
13 = Cover for optional IEEE-488 (GPIB) interface
14 = Digital I/O connector

AC inlet with fuse holder and voltage selector (8)

Main supply cord

Do not use detachable mains supply cord with inadequate rating.

The power cable must be plugged in before signal circuits can be connected. Do not use the product if the power cable is damaged. See Chapter 6.2, "Switching on the instrument", on page 22 for more information.

The built-in voltage selector selects the mains voltage between 100 V, 115 V and 230 V. All voltage settings are using the same fuse rating.

Channel connectors (9)

NOTICE

Output terminals

Either the output terminals at the front panel or those at the back panel can be used. Using both terminals at the same time can cause instrument malfunction.

Digital voltmeter (DVM)

The DVM+ and DVM- pins on the channel connector are available only with R&S NGU201 model equipped with option R&S NGU-K104 (P/N: 3663.0390.02).

Modulating signal (MOD)

The MOD+ and MOD- pins on the channel connector are available only with R&S NGU401 model.

The channel connectors contain both output ("F+", "F-") and sense ("S+", "S-") connections.

USB connectors (10, 11)

The USB host connector (Type-A) can be used for mass storage devices like the USB connector at the front panel.

The USB device connector is a Type-B connector for remote control operation.

Ethernet connector (12)

10/100 Ethernet port for remote control operation via the local area network.

For a detailed description on the connection setup, see section "LAN Connection" in the User Manual.

Option IEEE-488 (GPIB) interface (13)

An IEEE-488 (GPIB) interface can be ordered with option R&S NGU-B105 (P/N: 3661.0763.02). This interface is not user installable.

Digital I/O connector (14)

The Digital I/O option, R&S NGU-K103 (P/N: 3662.9335.02) must be installed for this function to be available in the instrument.

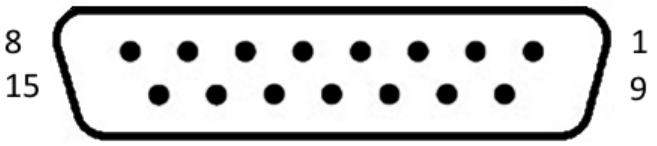

Figure 6-3: Digital I/O connector (female socket front view)

Table 6-1: Digital I/O pin layout

Pin	Signal	Direction	Pin	Signal	Direction
1	*Inhibit Ch1	IN	9	-	-
2	Ext. Trigger Ch1	IN	10	-	-
3	Digital In1	IN	11	Digital Output Fault	OUT
4	Digital Output Out1	OUT	12	--	-
5 - 8	Gnd	-	13 - 15	Gnd	-

* The inhibit signals can be used to turn off the outputs by a digital hardware signal.

Table 6-2: Inhibit signals

Signal name	Pin	Descriptions
Inhibit Ch1	Pin 1 of Digital I/O connector	If the inhibit signal goes active, channel 1 output is turned off. The inhibit signal is low active (inverted logic).

6.2 Switching on the instrument

Before switching on the instrument, check that all the instructions in the “Basic Safety Instruction” brochure and safety measures in previous sections are observed. Also, check if the value on the voltage selector corresponds to the mains voltage (100 V, 115 V or 230 V).

Fuse rating
The R&S NGU uses the same fuse ratings for all mains voltages.

To change power fuse / mains voltage setting:

1. Peel off the yellow label sticker on the AC inlet.
2. Release the latch of the fuse holder which is located at both side of the socket and pull it out.
3. Pull out the removable part of the fuse holder.
4. Turn this removable part until the correct voltage label (100, 115 or 230) is displayed in the window of the holder.
5. Return the fuse holder to its position in the panel.

To switch on instrument:

1. Connect the power cable to the AC power connector on the rear panel of the R&S NGU.
2. Connect the power cable to the socket outlet.
3. Press [Power] key on the front panel.
   The instrument performs a system check, boots the operating system, and starts the R&S NGU firmware.

By default, all output channels are turned off when the instrument is switched on to prevent connected loads from being damaged unintentionally.

During startup, the R&S NGU is loaded with the last saved instrument settings from internal memory. See "Store and Recall" in the User Manual.

To switch off instrument:

1. Press [Power] key.
   All current settings are saved to internal memory and the firmware shuts down.
2. Disconnect the AC power cable from the instrument.

7 Trying out the instrument

This chapter describes some basic functions that you can perform with the R&S NGU.

Source and sink current

The R&S NGU201 is a 2 quadrant source measure unit whereas the R&S NGU401 is a 4 quadrant source measure unit. Both models are able to source and sink current. When the voltage across the output terminal exceeds the set voltage, current flows into the instrument.

The default behavior "Auto" can be configured in the output menu to set the output operating mode, see section "Output Mode" in the User Manual.

On the display, sink mode is in operation if negative current in shown for NGU201. However, if both voltage and current are shown as opposite signs (e.g. negative voltage and positive current), it indicates that NGU401 is operated in the sink mode. See also "CR mode" on page 25.

7.1 Setting the output voltage and current

1. Press [Home] key.
   The R&S NGU displays the home window.
2. Select voltage or current parameter in the home window.
   The R&S NGU displays an on-screen keypad to set the value.
3. Enter the required value.
4. Confirm value with the unit key (V/mV or A/mA).
   See "Source and sink current" on page 24 for more information on the operating modes supported in different models.

7.2 Activating the channel output

The output voltages can be switched on or off regardless of the instrument's operating mode.

To switch on or off channel output.

► Press [Output] key on the front panel.
The R&S NGU outputs the set voltage level on the output terminal.

Depending on the operating mode which the R&S NGU is operated in, the following are observed:

CR mode

CR mode is available only with R&S NGU201 model.

CR mode is a special case of sink mode in which the instrument behaves like a constant resistor. Only in this mode, the display font color in the home window turns cyan.

In "normal" sink mode, the colors are the same as in source mode: green if the current flowing into the R&S NGU is below the set current and red if the current is limited to the set value. The only visible indication of sink mode is the change of sign of the current readout to "Minus".

Color illuminated on front panel keys and display font color of voltage and current in home window	Operating mode
Green	Constant voltage mode (CV)
Red	Constant current mode (CC)
Cyan	Available only with R&S NGU201 model Constant resistance mode (CR) Note: Instrument is operated in sink mode and "Constant Resistance" is activated.

Also, the operating symbol mode (CV, CC or CR) is displayed at the channel status bar.

8 Maintenance and support

8.1 Maintenance

Regular maintenance improves the life span of the instrument, the following chapter provides information on instrument maintenance.

Cleaning

Before cleaning the instrument, ensure that it has been switched off and the power cable is disconnected.

Clean the outer case of the instrument at regular intervals, using a soft, lint-free dust cloth.

NOTICE

Instrument damage caused by cleaning agents

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

Cleaning agents, solvents (thinners, acetone), acids and bases can damage the front panel labeling, plastic parts and display.

The display may only be cleaned with an appropriate glass cleaner. Rub the display with a dry, clean and lint-free cloth. Do not allow cleaning fluid to enter the instrument.

8.2 Contacting customer support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz product, contact our customer support center. A team of highly qualified engineers provides support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz products.

Contact information

Contact our customer support center at www.rohde-schwarz.com/support, or follow this QR code:

Figure 8-1: QR code to the Rohde & Schwarz support page

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