R&S®NGU
SOURCE MEASURE UNITS

The top-class in supplying power

3 year warranty

海洋儀器®
致力于电子测试、维护领域!

Data Sheet
Version 01.01

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

Thanks to their extremely high accuracy and fast load recovery time, the R&S®NGU source measure units (SMU) are perfect for challenging applications. A special ammeter design is used to precisely measure current drains from nA to A in one pass – no need to make multiple measurement sweeps. The instruments' short recovery times enable them to handle fast load changes that occur, for example, when mobile communications devices switch from sleep mode to transmit mode. With high speed data acquisition, every detail is detected down to 2 µs resolution. The R&S®NGU source measure units provide two- or four-quadrant architecture, allowing them to function both as a source and a sink to simulate batteries and loads.

The two-quadrant R&S®NGU201 and the four-quadrant R&S®NGU401 provide up to 60 W of output power and sink power, respectively. The channels are floating, galvanically isolated and protected against overload and short circuits.

With six measurement ranges for current and a resolution of up to 6½ digits when measuring voltage, current and power, the R&S®NGU source measure units are perfect for characterizing devices that work from extremely low power consumption to high currents in the ampere range. Using ammeters with feedback-amplifier technology increases accuracy and widens the sensitivity down to the nA range.

With an acquisition rate of up to 500 000 samples per second, even extremely fast variations in voltage or current can be captured.

The instruments provide fast load recovery time of < 30 µs combined with minimum overshoot even during a demanding load change.

The linear design of the output stages allows the R&S®NGU source measure units to operate as a source and sink with minimum residual ripple and noise.

The two-quadrant R&S®NGU201 source measure unit is a new member in the family of wireless communications test instruments, mainly designed to supply devices under test with extremely low sleep currents, such as Bluetooth® low energy devices.

It is ideal for powering battery-operated devices due to its adjustable output impedance and fast impedance regulation. The optional battery simulation function provides test conditions that imitate the use of a real battery. An optional voltmeter input makes an additional digital multimeter unnecessary in many applications.

The four-quadrant R&S®NGU401 source measure unit is the semiconductor testing specialist for general-purpose applications that span many different industries and many different devices under test. It can act as bipolar power supply or bipolar electronic load. It comes with a modulation input to connect an arbitrary generator, for instance, enabling the instrument to act also as an AC source.

Key facts

	R&S®NGU201	R&S®NGU401
Quadrants	2	4
Output voltage	0 V to 20 V	–20 V to +20 V
Max. output/sink power	60 W	
Max. output/sink current	≤ 6 V: 8 A; > 6 V: 3 A	
Load recovery time	< 30 µs	
Max. acquisition rate	500 ksample/s	

BENEFITS AND KEY FEATURES

Technology for challenging tasks

- Fast load regulation
- Minimum residual ripple and low noise
- Readings with up to 6½ digit resolution
- Galvanically isolated, floating channels
- Output stage isolated with relays
- Voltage priority and current priority mode
- High-capacitance mode
- High speed data acquisition (FastLog function)
- Protection functions to safeguard instrument and DUT
- Safety limits to safeguard the DUT
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R&S®NGU201 – the wireless communications specialist

- Two quadrants: operates as source and sink
- Variable output impedance and constant resistance mode
- Digital voltmeter (DVM) function
- Battery simulation
- page 9

R&S®NGU401 – the semiconductor testing specialist

- Four quadrants: source or sink operation with arbitrary polarity
- Modulation input
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Easy operation

- High-resolution touchscreen
- Color coding of operating modes
- Graphical display
- QuickArb function
- EasyRamp function
- Save and recall instrument settings
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Ideal for use in labs and test systems

- Tailored for use in labs and system racks
- Remote sensing
- Front and rear connectors
- Full remote capabilities
- Fast on the bus and on the bench
- Advanced instrument design: compact form factor, quiet operation
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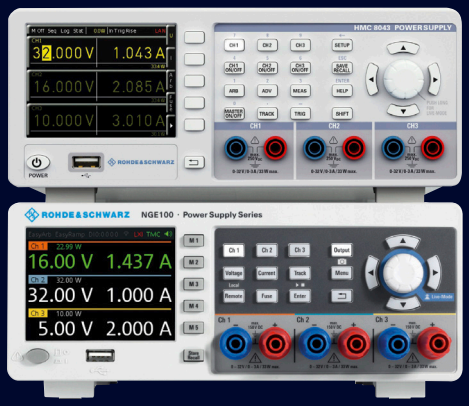
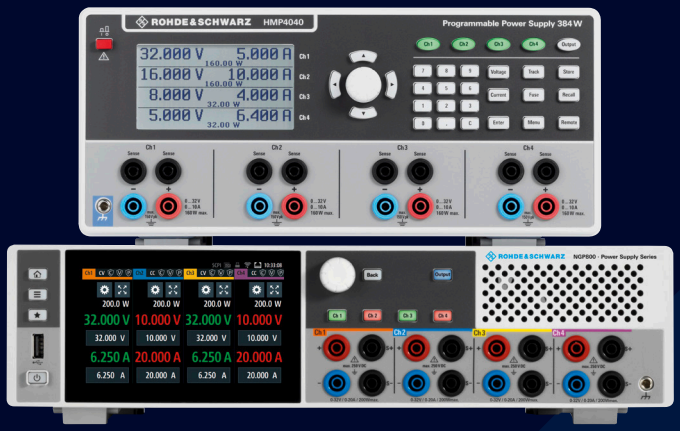
DIFFERENT POWER SUPPLY CLASSES



R&S®HMC8043 and R&S®NGE100B
three-channel power supply

Basic power supplies

- Economical, quiet and stable instruments
- For manual operation and simple computer-controlled operation
- Used in education, on the bench and in system racks



R&S®HMP4040 four-channel and
R&S®NGP814 four-channel power supply

Performance power supplies

- When speed, accuracy and advanced programming features are factors in test performance
- Features such as DUT protection, fast programming times and downloadable V and I sequences
- Used in labs and ATE applications

R&S®NGU401 single-channel SMU and
R&S®NGM202 two-channel power supply

Specialty power supplies

- Tailored to specific applications
- Unique features such as
  - Emulation of the unique characteristics of a battery
  - Electronic loads to accurately sink current and dissipate power in a controlled manner
- Used in labs and ATE environments

TECHNOLOGY FOR CHALLENGING TASKS

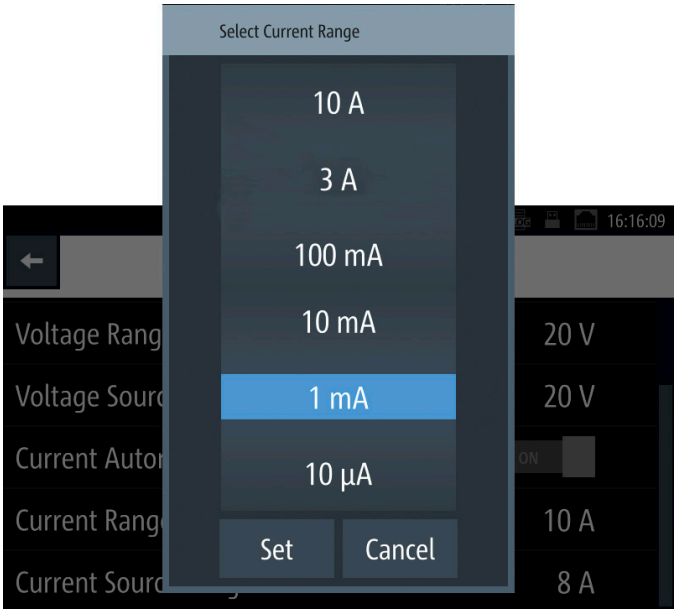
Fast load regulation

Consumer electronics such as mobile phones and IoT devices require very little power in sleep mode. However, the current increases abruptly as soon as the device switches to transmit mode. A power supply used to power such DUTs must be capable of handling load changes from a few nA to the ampere range without creating voltage drops or overshoots.

The R&S®NGU source measure units have a circuit design that allows the user to determine how the instrument regulates load changes. The "Fast" default setting is optimized for speed, achieving recovery times of < 30 µs. Deactivating "Fast" slightly increases the recovery time, focusing on preventing overshoots under special load conditions.

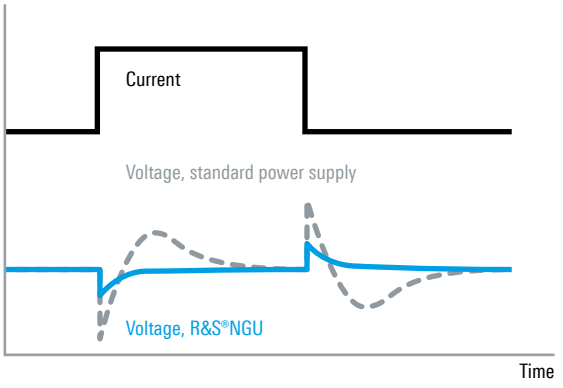
Minimum residual ripple and low noise

Advanced electronic circuitry is often very complex and sensitive to interference on the supply lines. In order to supply interference-free voltage to such sensitive DUTs, the power supplies must provide extremely stable output voltages and currents. All types of ripple and noise need to be avoided. The R&S®NGU source measure units have linear regulation and are ideal for sensitive DUTs.



The measured currents and voltages are displayed with 6 ½ digit resolution. Two voltage measurement ranges and six current measure ranges provide extremely high accuracy and resolutions down to 1 µV/100 pA.

Optimized load recovery time



Power supplies usually respond to abrupt load changes with overshoot and slow recovery times. Thanks to specially optimized control circuits, the R&S®NGU soure measure units achieve recovery times of < 30 µs.

Readings with up to 6½ digit resolution

With a resolution of up to 6½ digits when measuring voltage, current and power, the R&S®NGU source measure units are perfect for characterizing devices that have low power consumption in standby mode and high current in full load operation. Two voltage measurement ranges and six current measurement ranges provide extremly high accuracy and resolutions down to 1 µV/100 pA.

Galvanically isolated, floating outputs

The outputs of the R&S®NGU source measure units are not connected to chassis ground, and are galvanically isolated and protected against overload and short circuits.

Output stage isolated with relays

Switching off an output channel of a standard power supply usually simply switches off the output voltage. The output stage of the supply remains connected to the output terminals. The R&S®NGU source measure units use relays to isolate the SMU circuits from the connector sockets.

Voltage priority and current priority mode

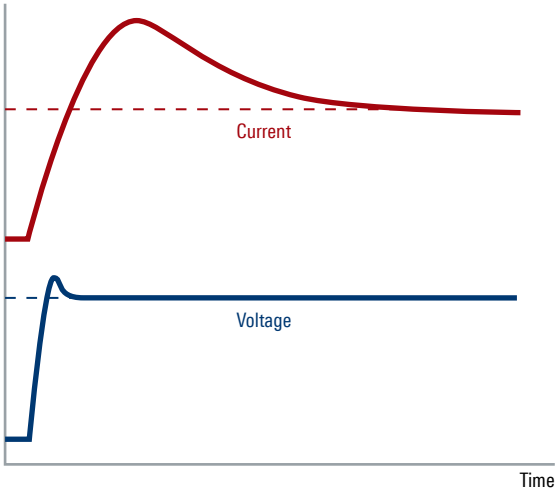
Configuring and regulating the output voltage (constant voltage mode) is the standard application for power supplies. Most power supplies can also be used in constant current mode, where current limiting ensures that only the configured current can flow.

However, these devices are not optimized for fast current limiting. There is a risk of damage to sensitive DUTs due to excessive currents from overshoots in current regulation. To avoid this risk, the R&S®NGU source measure units have separate operating modes for voltage and current regulation.

In voltage priority mode, fast voltage regulation provides short recovery times of less than 30 µs. Current regulation is designed to be somewhat slower to avoid a tendency to oscillation.

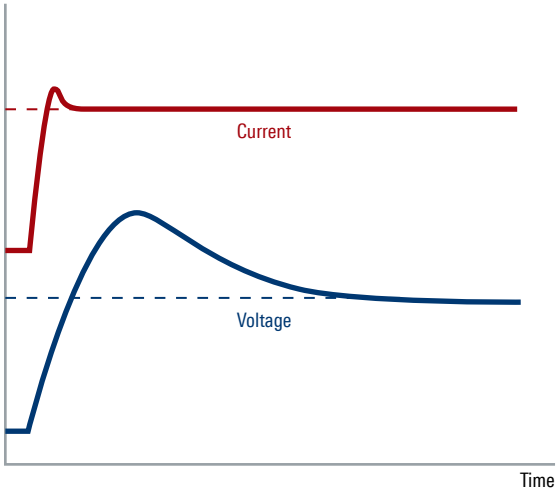
When precise and quick current regulation is desired, the R&S®NGU source measure units can be operated in current priority mode. Optimized for fast current regulation (load recovery time < 50 µs), this mode allows tasks such as LED testing, which are sensitive to even short current spikes.

Voltage priority mode



The standard mode of power supplies provides fast voltage regulation with the risk of overshoots in current.

Current priority mode



The special mode for current-sensitive DUTs provides fast current regulation. It is the right choice whenever you have to avoid excessively high currents to protect your DUT.

High-capacitance mode

Quite often in a typical measurement configuration, there is a capacitance at the input of the DUT. Connecting the power supply by leads results in a low pass behavior formed by the leads and the capacitance.

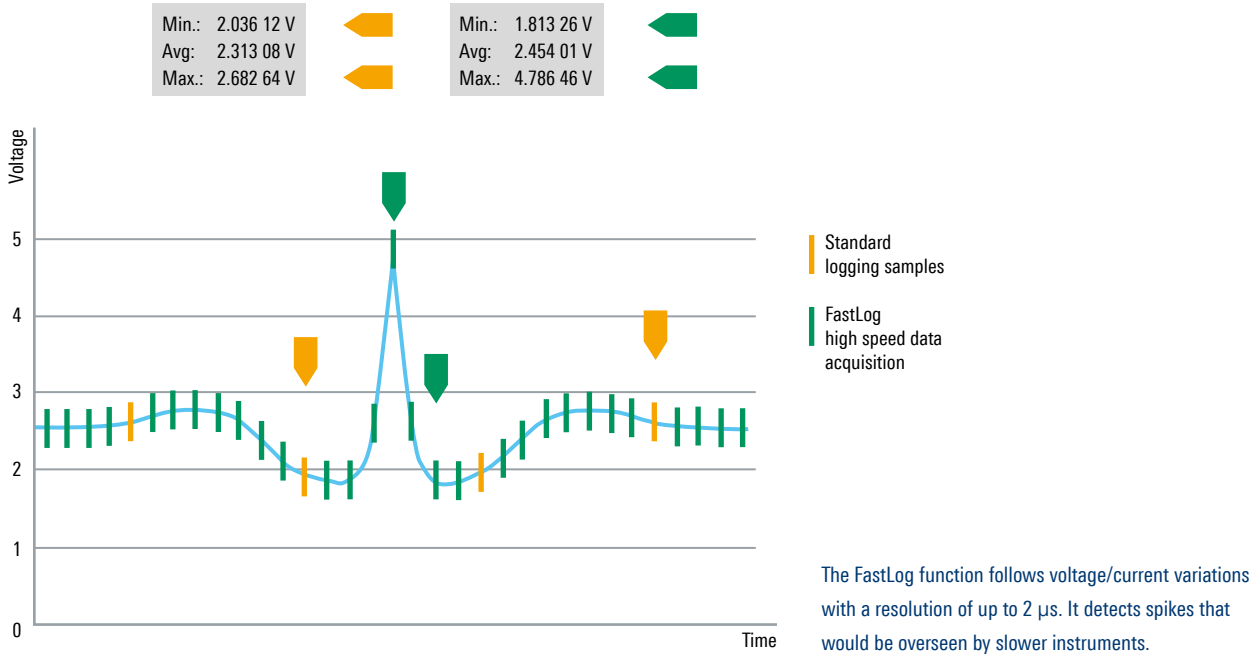
Providing the high-capacitance mode, the R&S®NGU source measure units compensate the capacitance and display the current directly at the DUT.

High speed acquisition (FastLog function)

The R&S®NGU source measure units offer the FastLog function to capture voltage and current measurement results. This data can be stored on an external USB storage device or can be transferred to an external PC via USB or LAN. With an acquisition rate of up to 500 ksample/s, voltage and current results are available every 2 µs.

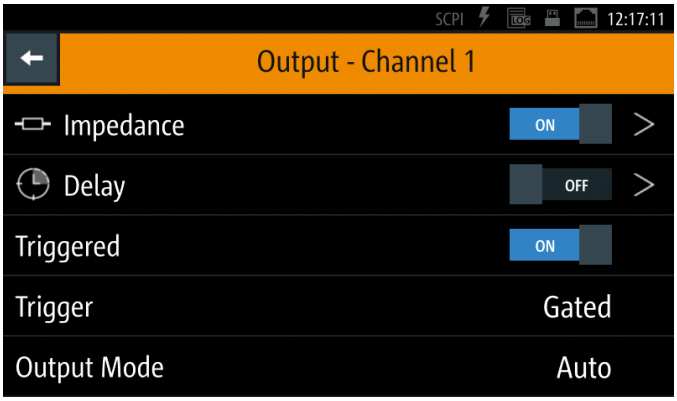
Thanks to this FastLog function, even spikes in the microsecond range that cannot be detected with slower instruments can be detected in min./max. values.

FastLog high speed data acquisition

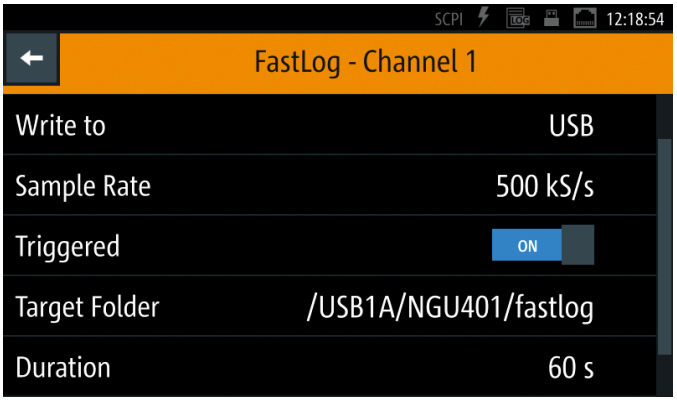


The FastLog function follows voltage/current variations with a resolution of up to 2 µs. It detects spikes that would be overseen by slower instruments.

Various parameters can be set at the outputs of the R&S®NGU source measure units, for example the output impedance, a delay to switch on the outputs and different trigger modes.



The FastLog function provides an acquisition rate up to 500 ksample/s.



Protection functions to safeguard instrument and DUT

The R&S®NGU source measure units provide protection functions to make sure the DUT and the instrument are not damaged in the event of a fault. The output channels are protected against overload and short circuits. The maximum voltage, current and power can be set. When an output reaches the set limit, it is automatically switched off and a message is displayed.

Overvoltage protection (OVP)

If the voltage exceeds the configured maximum value, the channel is switched off and the corresponding symbol flashes on the display. In current priority mode, different limits can be set for source and sink mode.

Overcurrent protection (electronic fuse, OCP)

To better protect sensitive loads, the channels of the R&S®NGU source measure units provide electronic fuses that can be set individually. If the channel current exceeds the set current, the channel is automatically switched off and the overcurrent symbol flashes.

Electronic fuses can be set in source and in sink mode with different values.

There are two settings to define the response behavior of the electronic fuses. The "Fuse Delay At Output-On" specifies how long the fuse remains inactive after the channel is activated. The sensitivity of the fuse is specified using the "Fuse Delay Time". This allows users to modify the behavior of the power supply to prevent a channel from being switched off due to a short current spike during operation.

Overpower protection (OPP)

Alternatively, instead of the maximum voltage, the maximum power can be set and used as the switch-off parameter.

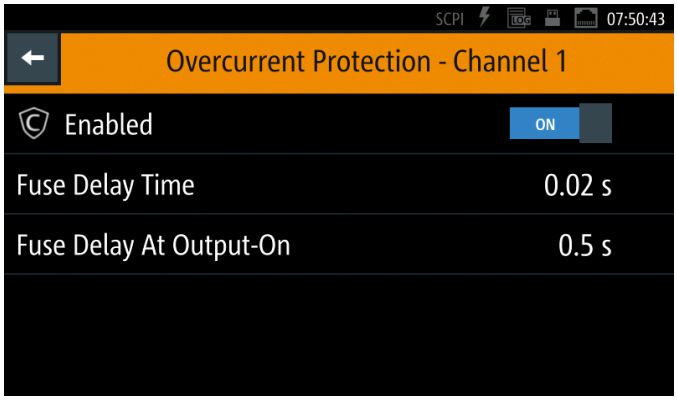
Overtemperature protection (OTP)

The R&S®NGU source measure units have internal overtemperature protection that switches the instrument off if a thermal overload is imminent.

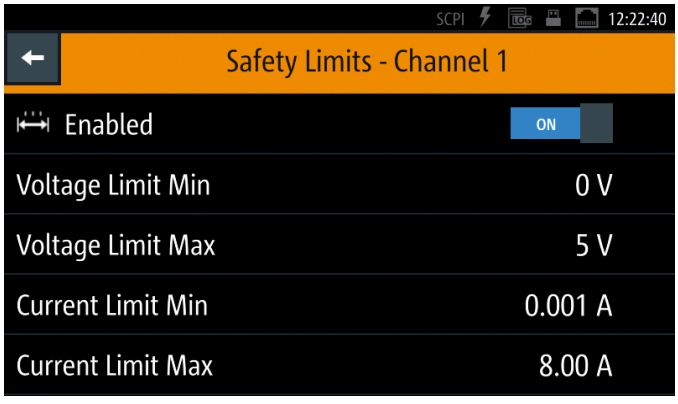
Safety limits to safeguard the DUT

To prevent a DUT from being destroyed by too high voltages or currents, safety limits can be set on the R&S®NGU source measure units. Before starting the actual measuring task, the user can limit the instrument to values that are not dangerous for the DUT.

Electronic fuse with additional functions: "Fuse Delay At Output-On" specifies how long the fuse remains inactive after the channel is activated. The sensitivity of the fuse is specified using the "Fuse Delay Time". Different limits can be set for source and sink mode.



The user can set safety limits to limit the adjustment range of the instrument and prevent a DUT from being damaged due to accidentally using the wrong setting.



R&S®NGU201 – THE WIRELESS COMMUNICATIONS SPECIALIST

The R&S®NGU201 source measure unit is tuned for battery drain analysis of any battery-powered device up to 60 W, including mobile phones, tablets and IoT devices, for example. Furthermore, it can be used for battery tests and simulations, thanks to its adjustable output impedance and optional battery simulation tool.

Two quadrants: operates as source and sink

The two-quadrant architecture of this source measure unit allows it to function both as a source and a sink and simulate batteries or loads. The source measure unit automatically switches from source mode to sink mode. As soon as the externally applied voltage exceeds the set nominal voltage, current flows into the instrument. This is indicated by a negative current reading.

Variable output impedance and constant resistance mode

A power supply should have an output impedance as low as possible to suppress loading effects on the DUT. However, there are applications where certain battery types need to be simulated in a controlled manner or where it is necessary to simulate the increase in internal impedance as the battery discharges. The R&S®NGU201 source measure unit supports these applications, thanks to its adjustable output impedance range.

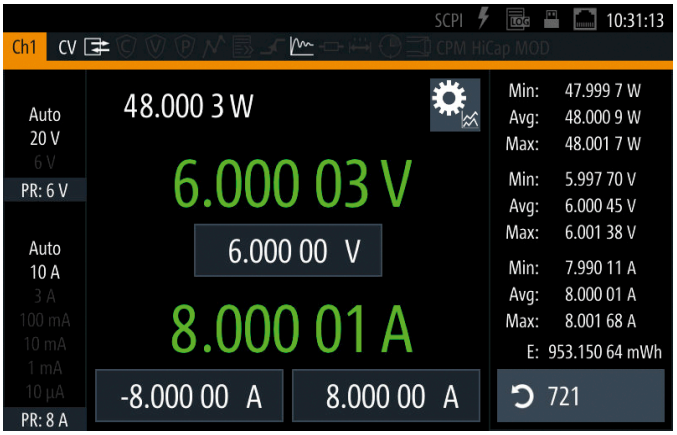
The output impedance is regulated very fast. Especially in the range from –50 mΩ to 2 Ω, recovery times of < 200 µs can be achieved.

When operating as an electronic load, constant resistance mode is also available. In this mode, the instrument behaves like an adjustable resistance over the entire load range. This makes it possible to simulate battery discharge with a constant load resistance, for example.

Digital voltmeter (DVM) function

While the R&S®NGU201 source measure unit measures the voltage supplied to the DUT, the R&S®NGU-K104 option activates a port that allows an additional internal DVM function to be connected to any other point in the circuitry. This DVM function runs in parallel to the readback function, and is galvanically separated from the channel circuitry. In many cases, an additional digital multimeter is not necessary.

The large high-resolution display makes it easy to read the voltage and current values (even at great distances) and provides a lot of additional information.



Battery simulation

Real batteries show different characteristics depending on the type of battery and its charging condition. Capacity, open circuit voltage (Voc) and equivalent series resistance (ESR) are important battery characteristics that depend on its state of charge (SoC). The R&S®NGU-K106 option allows users to simulate the behavior of batteries under different charging conditions, e.g. when powering a DUT.

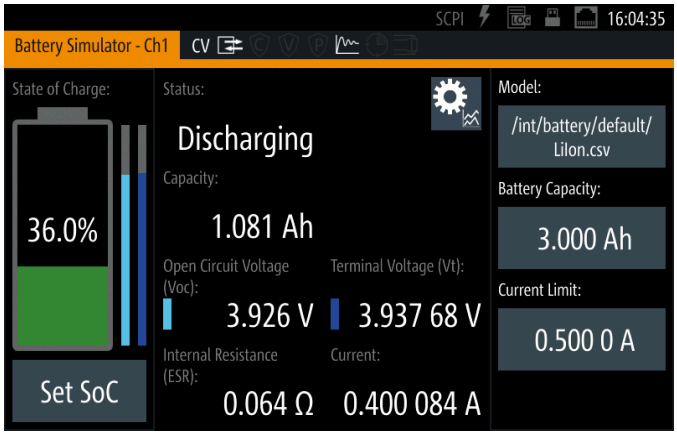
To define a battery model, the data of the battery can be entered easily using the integrated battery model editor. Data sets for the common battery types (Pb, lithium-ion, NiCd and NiMH) are available as preconfigured files. These can be easily modified according to the needs of a specific application. Additional battery model data sets can be loaded from a USB device and stored on the R&S®NGU201 source measure unit.

In particular, when battery-operated devices have to be optimized for lifecycle, the discharging behavior of the battery type needs to be considered. The battery simulator function of the R&S®NGU201 makes it possible to simulate the real battery output performance. Testing can be based on a selected battery model, and battery capacity, SoC and Voc can be set to any state to test the device under specific circumstances.

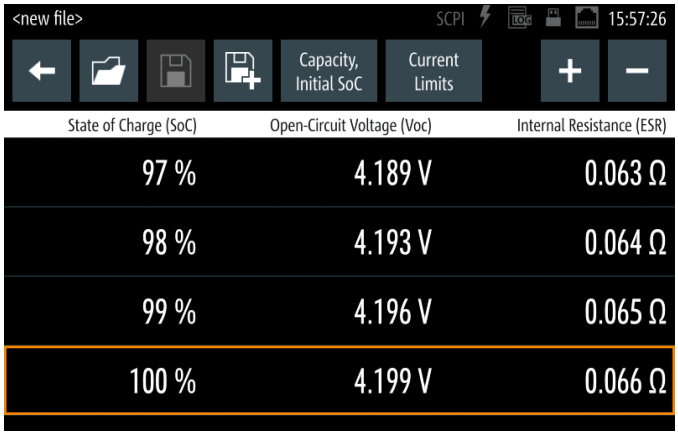
The charging behavior of a battery can also be simulated. This is particularly important when designing battery chargers. In this application, the R&S®NGU201 source measure unit is used in sink mode.

Both cases provide dynamic simulation, meaning Voc, ESR and SoC change according to charging/discharging conditions like a real battery. The state of charge is shown graphically; all other values are displayed numerically.

Battery simulation: the main parameters to characterize a battery's condition are summarized in one display.



The battery simulation software includes data sets of common battery types that can be easily modified.



R&S®NGU401 – THE SEMICONDUCTOR TESTING SPECIALIST

The R&S®NGU401 source measure unit is the specialist for semiconductor testing. It is designed for general-purpose applications that span many different industries and many different devices under test. The R&S®NGU401 source measure unit can act as bipolar power supply or bipolar electronic load.

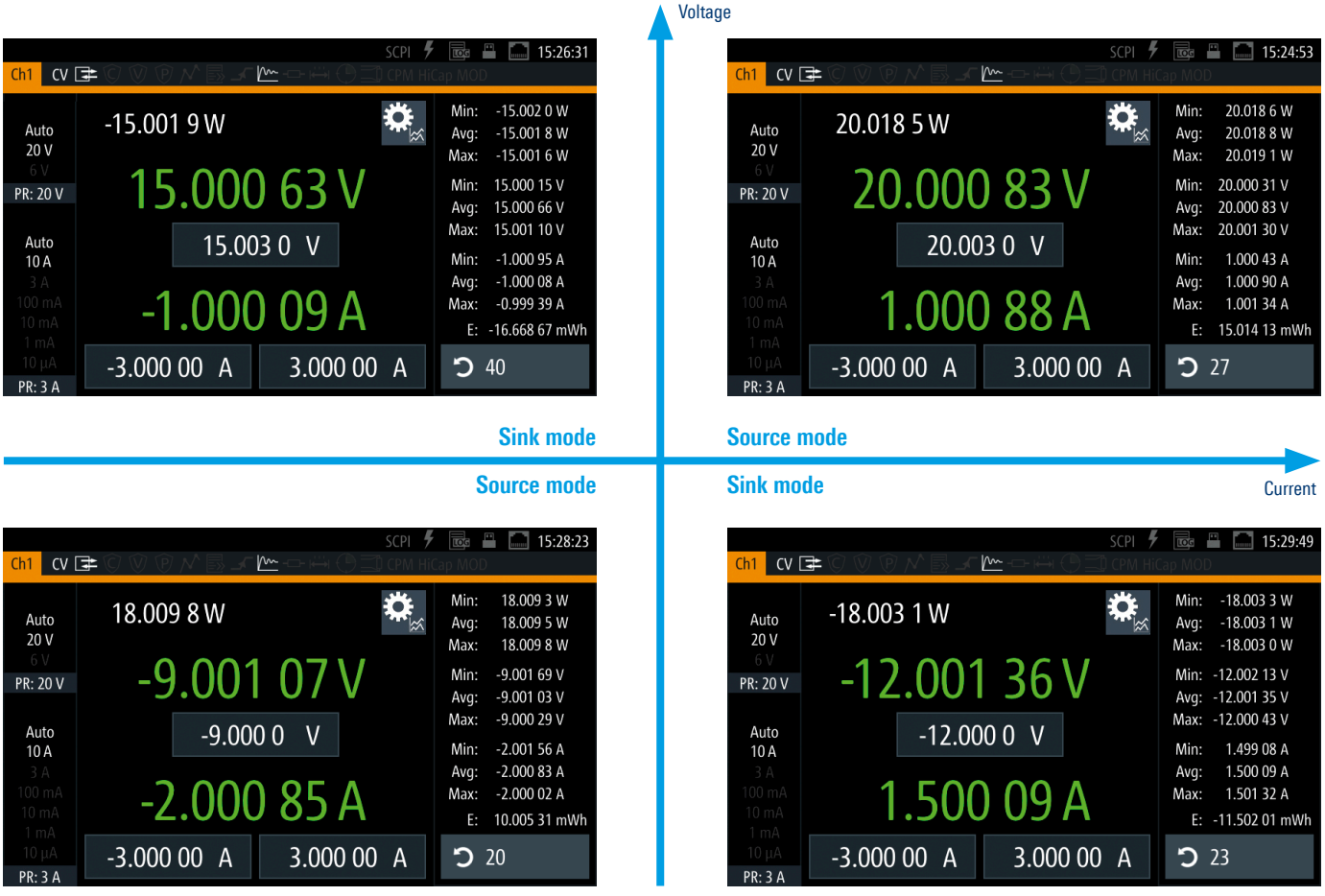
Four quadrants: source or sink operation with arbitrary polarity

With its four-quadrant architecture, the R&S®NGU401 can supply positive or negative voltages or currents and can act as a source or sink in both polarities. This enables tasks such as measuring the forward and reverse characteristics of semiconductor devices in a single test operation without having to make changes to the circuit.

The power supply automatically switches from source mode to sink mode. When the applied external voltage exceeds the set output voltage, current flows into the device. This is indicated by the opposite sign for current measurement.

Modulation input

The R&S®NGU401 source measure unit provides a modulation input to connect an arbitrary generator, for instance. The output follows the modulation input signal, enabling the instrument to act as an AC source or be used to simulate glitches or unstable conditions.



EASY OPERATION

High-resolution touchscreen

The large capacitive touchscreen is the central operating element of the R&S®NGU source measure units. Lightly tapping a numerical value will display a virtual keyboard to input the desired value. Alternatively, the voltage, current and limits for the various protection functions can be set using the rotary knob. Functions that are less frequently used can be accessed and operated via menus.

With a very high resolution, the display sets new standards for this class of instruments. This makes it easy to read the voltage and current values, even at long distances. A variety of additional information such as power values and statistics can also be displayed. Icons clearly show the status of the actual configuration.

Color coding of operating modes

Colors are used to indicate the different modes. For example, an active channel in constant voltage mode light up green, while red is used for constant current mode. When the instrument is in constant resistance mode, the numbers are displayed in cyan.

Graphical display

The large display can also be used for graphics. Up to four measurement functions can be selected and plotted versus time, and minimum and maximum values can additionally be marked.

QuickArb function

Some applications require the voltage or the current to be varied during a test sequence, for example when simulating different charging conditions of a battery. The QuickArb function allows users to manually configure time/voltage or time/current sequences via the user interface or to program them via external interfaces.

The QuickArb function of the R&S®NGU source measure units sets new standards: 2048 points are supported per cycle. It is also possible to interpolate between the discrete points and select whether the sequence of voltage values 1 V – 2 V – 3 V is to be run as steps, or whether the voltage values are to be increased using linear interpolation.

Arb sequences can be programmed to run much faster with the R&S®NGU than with standard power supplies.

The dwell time for a single voltage or current value can be set with a resolution of up to 100 µs. This makes it possible to program very short drops in voltage to test the power-up behavior of a DUT. The dwell times can also be set in the range of hours to implement test sequences extending over days or weeks for long-term testing.

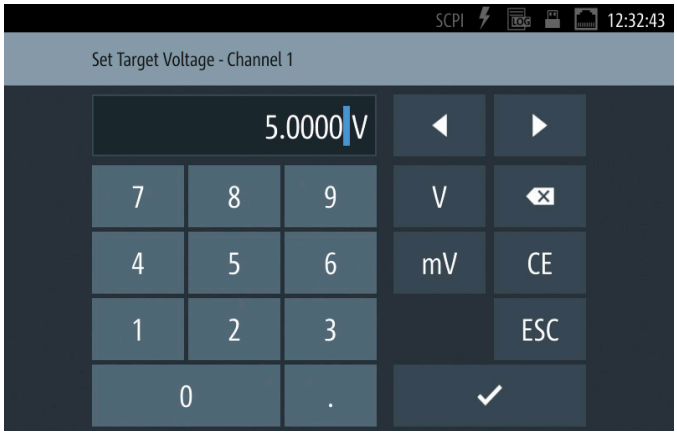
EasyRamp function

Sometimes test sequences have to simulate operating conditions where the abrupt rise of the supply voltage has to be avoided. The EasyRamp function of the R&S®NGU source measure units provides the solution. The output voltage can be increased continuously within a timeframe of 10 ms to 10 s. The EasyRamp function can be operated both manually and remotely.

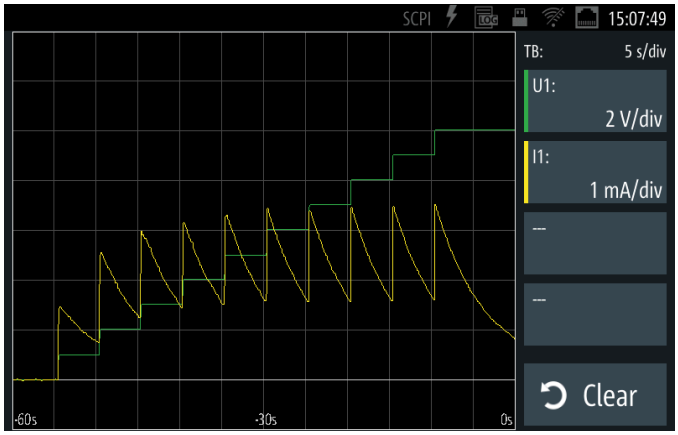
Save and recall instrument settings

The save and recall functions make it easy to save and recall frequently used settings.

Numerical values can be entered using the virtual touchscreen keyboard or the rotary knob.



The high-resolution display can also be used for graphical presentations; in this example the charging current of a capacitor is displayed while the voltage is increased stepwise.



IDEAL FOR USE IN LABS AND TEST SYSTEMS

Tailored for use in labs and system racks

The R&S®NGU source measure units are the right choice for challenging applications. They are used in R&D labs and integrated into production test systems.

The instruments can be installed in 19" racks using the R&S®HZN96 rack adapter. Connectors on the rear panel and a compact design are important criteria for use in test systems.

Remote sensing

There is often a significant voltage drop over the supply leads, especially in applications with high current consumption. Since power supplies usually maintain a constant output voltage, the voltage on the DUT will be lower than the voltage displayed on the power supply. The remote sensing function compensates this voltage drop over the supply leads. The voltage actually present at the load is measured by an additional pair of sense lines, and this value is used to regulate the voltage directly at the load.

Front and rear connectors

The safety sockets on the front panel of the R&S®NGU source measure units are designed for 4 mm banana plugs. Additional connections (including sense lines) are provided on the rear panel to simplify use in rack systems.

Digital inputs and outputs are optionally available. They can be used as trigger/inhibit inputs and control/fault outputs. The hardware of the R&S®NGU-K103 option is preinstalled. The function can be activated using a keycode (to be ordered separately).

Full remote capabilities

For use in test systems, the R&S®NGU source measure units can be remotely controlled. The following interfaces are available.

USB and LAN

USB and LAN (Ethernet) interfaces are installed as standard. All supply parameters can be remotely controlled via these interfaces.

IEEE-488 (GPIB) interface (R&S®NGU-B105 option)

The R&S®NGU-B105 interface with an IEEE-488 (GPIB) port is available as an option that can be ordered ex-factory.

Fast on the bus and on the bench

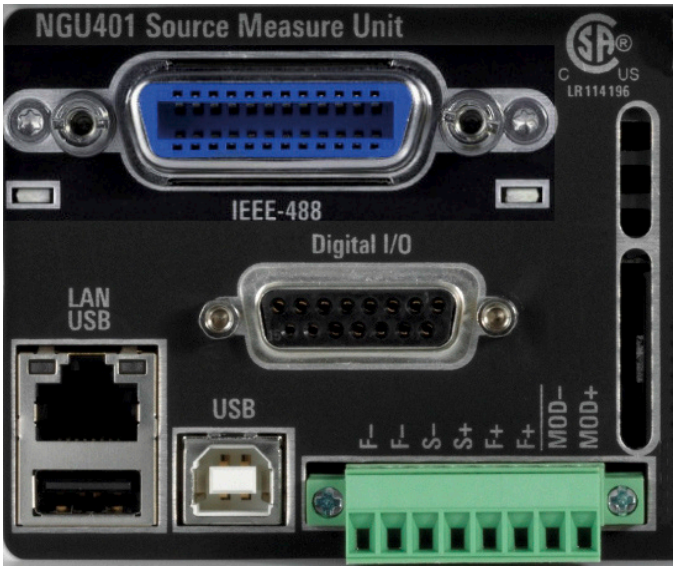
Complicated measurement sequences require ever faster setting, measuring and command processing times. The R&S®NGU source measure units meet these needs. Thanks to a state-of-the-art multicore architecture, they not only process control commands much faster than conventional power supplies, they process them internally in parallel. Users benefit from this in ATE systems. There are also advantages in manual operation, such as faster sequences in Arb mode.

Advanced instrument design: compact form factor, quiet operation

There is never enough space on the bench or in the rack. The R&S®NGU source measure units take up very little space thanks to their compact design.

Since the built-in fan is temperature-controlled, it often runs at a low speed or powers down completely, resulting in very low operating noise.

All connections are also provided on the rear panel (example: R&S®NGU with IEEE-488 option installed).



SPECIFICATIONS

Definitions

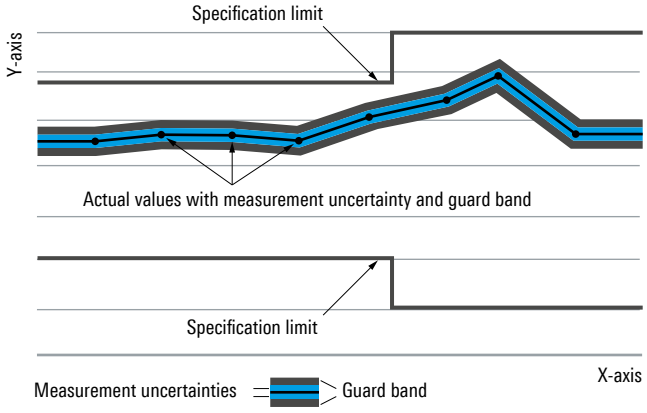
General

Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as <, ≤, >, ≥, ±, or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (for example, dimensions or resolution of a setting parameter). Compliance is ensured by design.

Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with <, > or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (for example, nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: “parameter: value”.

Typical data as well as nominal and measured values are not warranted by Rohde&Schwarz.

In line with the 3GPP/3GPP2 standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bits per second (Gbps), million bits per second (Mbps), thousand bits per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

All data is valid at +23 °C (–3 °C/+7 °C) after 30 minutes warm-up time.

Electrical specifications		
Outputs	The channel outputs are galvanically isolated and not connected to ground.	
Number of output channels		1
Maximum output power		60 W
Output voltage	R&S®NGU201	0 V to 20 V
	R&S®NGU401	–20 V to +20 V
Maximum output current	≤ 6 V output voltage	8 A
	> 6 V output voltage	3 A
Adjustable output impedance	R&S®NGU201	–50 mΩ to 100 Ω
Increments	R&S®NGU201	1 mΩ
Recovery time	R&S®NGU201: ≤ 2 Ω, resistive load	< 200 µs
	R&S®NGU201: > 2 Ω, resistive load	< 10 ms
Adjustable output impedance	R&S®NGU401	not available
Voltage ripple and noise	20 Hz to 20 MHz	< 500 µV (RMS), < 2 mV (peak-to-peak) (meas.)
Current ripple and noise	20 Hz to 20 MHz	< 1 mA (RMS) (meas.)
Electronic load		
Sink voltage range	R&S®NGU201	0 V to 20 V
	R&S®NGU401	–20 V to +20 V
Maximum sink power		60 W
Maximum sink current	voltage: ≤ 6 V	8 A
	voltage: > 6 V	3 A
Sink modes	R&S®NGU201	constant voltage, constant current, constant resistance
	R&S®NGU401	constant voltage, constant current
Constant resistance range	R&S®NGU201	0 Ω to 10 kΩ (0.1 Ω increments)
Load regulation in voltage priority mode	load change: 10 % to 90 %	
Voltage	±(% of output + offset)	< 0.01 % + 0.5 mV
Voltage load recovery time in standard mode	regulation to within a band of ±20 mV of the set voltage	< 30 µs (meas.)
Voltage load recovery time in high-capacity mode	regulation to within a band of ±20 mV of the set voltage	10 µF to 50 µF (mode low): < 30 µs (meas.) > 50 µF to 470 µF (mode high): < 100 µs (meas.)
Load regulation in current priority mode	load change: 10 % to 90 %	
Current	±(% of output + offset)	< 0.01 % + 0.1 mA
Current load recovery time	regulation to within a band of ±20 mA of the set current	< 50 µs (meas.)
Rise time	10 % to 90 % of rated output voltage, resistive load	full load: < 100 µs no load: < 100 µs
Fall time	90 % to 10 % of rated output voltage, resistive load	full load: < 100 µs no load: < 100 µs
Minimum pulse width		100 µs
Programming resolution		
Voltage		20 V range: 200 µV 6 V range: 50 µV
Current		8 A range: 50 µA 3 A range: 25 µA 100 mA range: 1 µA 10 mA range: 100 nA
Programming accuracy		
Voltage	±(% of setting + offset)	20 V range: < 0.02 % + 2 mV 6 V range: < 0.02 % + 1 mV
Current	±(% of setting + offset)	8 A range: < 0.05 % + 2 mA 3 A range: < 0.025 % + 500 µA 100 mA range: < 0.025 % + 25 µA 10 mA range: < 0.025 % + 10 µA

Output measurements		
Measurement functions		voltage, current, power, energy
Readback resolution		
Voltage		20 V range: 10 µV 6 V range: 1 µV
Current		10 A range: 10 µA 3 A range: 1 µA 100 mA range: 100 nA 10 mA range: 10 nA 1 mA range: 1 nA 10 µA range: 100 pA
Readback accuracy		
Voltage	±(% of output + offset)	20 V range: < 0.02 % + 2 mV 6 V range: < 0.02 % + 500 µV
Current	±(% of output + offset)	10 A range: < 0.025 % + 500 µA 3 A range: < 0.025 % + 250 µA 100 mA range: < 0.025 % + 15 µA 10 mA range: < 0.025 % + 1.5 µA 1 mA range: < 0.025 % + 150 nA 10 µA range: < 0.025 % + 15 nA
Temperature coefficient (per °C)	+5 °C to +20 °C and +30 °C to +40 °C	
Voltage		0.15 × specification/°C
Current		0.15 × specification/°C
Remote sensing		yes
Maximum sense compensation	20 V range	2 V (meas.)

Ratings		
Maximum voltage to ground		250 V DC
Maximum counter voltage	voltage with the same polarity connected to the outputs	
	R&S®NGU201	22 V
	R&S®NGU401	± 22 V
Maximum reverse voltage	voltage with opposite polarity connected to the outputs	
	R&S®NGU201	0.5 V
Maximum reverse current	for 5 minutes (max.)	
	R&S®NGU201	3 A

Remote control		
Command processing time		< 6 ms (nom.)

Protection functions		
Overvoltage protection		adjustable
Overpower protection		adjustable
Overcurrent protection (electronic fuse)		adjustable
Programming resolution		0.1 mA
Response time	(I_{load} > I_{resp} × 2) at I_{load} ≥ 2 A	< 1.5 ms (meas.)
Fuse delay at output-on		0 ms to 10 s (1 ms increments)
Fuse delay time		0 ms to 10 s (1 ms increments)
Overtemperature protection		yes

Special functions		
Output ramp function		EasyRamp
EasyRamp time		10 ms to 10 s (10 ms increments)
Output delay		
Delay per channel		1 ms to 10 s (1 ms increments)
Arbitrary function		QuickArb
Parameters		voltage, current, time
Maximum number of points		2048
Dwell time		100 µs to 10 h (100 µs increments)
Repetition		continuous or burst mode with 1 to 65535 repetitions
Trigger		manually via the keyboard, via remote control or via optional interface
Statistics (sampling time)	voltage	minimum, maximum, average (2 µs)
	current	minimum, maximum, average (2 µs)
	power	minimum, maximum, average (2 µs)
	energy	(2 µs)
Digital trigger and control interfaces		digital I/O, R&S®NGU-K103
Maximum voltage (IN/OUT)		24 V
Pull-up resistors (IN/OUT)	connected to 3.3 V	20 kΩ
Input level	low	< 0.8 V (nom.)
	high	> 2.4 V (nom.)
Maximum drain current (OUT)		500 mA
Modulation input	R&S®NGU401	yes
Maximum voltage to ground/channel		250 V DC
Modulation bandwidth	R&S®NGU401	DC to 1 kHz
Input level	R&S®NGU401	–24 V to +24 V
Accuracy (displayed modulation value)	R&S®NGU401	< 0.02 % + 2 mV
Data logging standard mode		
Maximum acquisition rate	each recorded sample is the average of 50 000 measured values	10 sample/s
Memory depth		internal 800 Mbyte or external memory size
Voltage resolution		see readback resolution
Voltage accuracy		see readback accuracy
Current resolution		see readback resolution
Current accuracy		see readback accuracy
Data logging fast mode		FastLog
Maximum acquisition rate	for voltage, current	500 ksample/s (2 µs)
Memory depth		external memory size
Voltage resolution		20 V range: 20 µV 6 V range: 5 µV
Voltage accuracy	±(% of output + offset)	20 V range: < 0.02 % + 2 mV 6 V range: < 0.02 % + 500 µV
Current resolution		10 A range: 20 µA 3 A range: 2 µA 100 mA range: 200 nA 10 mA range: 20 nA 1 mA range: 2 nA 10 µA range: 200 pA
Current accuracy	±(% of output + offset)	10 A range: < 0.025 % + 500 µA 3 A range: < 0.025 % + 250 µA 100 mA range: < 0.025 % + 15 µA 10 mA range: < 0.025 % + 1.5 µA 1 mA range: < 0.025 % + 150 nA 10 µA range: < 0.025 % + 15 nA
Digital voltmeter input	R&S®NGU201	optional, R&S®NGU-K104
DVM voltage		–24 V to +24 V
DVM accuracy	±(% of output + offset)	< 0.02 % + 2 mV
Maximum voltage to ground/channel		250 V DC

Display and interfaces		
Display		TFT 5" 800 × 480 pixel WVGA touch
Front panel connections		4 mm safety sockets
Rear panel connections		8-pin connector block
Remote control interfaces	standard	USB-TMC, USB-CDC (virtual COM port),
		LAN
	R&S®NGU-B105	IEEE-488 (GPIB)

General data		
Environmental conditions		
Temperature	operating temperature range	+5 °C to +40 °C
	storage temperature range	–20 °C to +70 °C
Humidity	noncondensing	5 % to 95 %
Power rating		
Mains nominal voltage		100 V/115 V/230 V (± 10 %)
Mains frequency		50 Hz to 60 Hz
Maximum power consumption		400 W
Mains fuses		2 × T4.0H/250 V
Product conformity		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EU	applied standards: ► EN 61326-1 ► EN 55011 (Class A)
	Korea	KC mark
Electrical safety	EU: in line with Low Voltage Directive 2014/35/EU	applied harmonized standard: EN 61010-1
	USA, Canada	CSA-C22.2 No. 61010-1
RoHS	in line with EU Directive 2011/65/EU	EN 50581
Mechanical resistance		
Vibration	sinusoidal	5 Hz to 55 Hz, 0.3 mm (peak-to-peak) 55 Hz to 150 Hz, 0.5 g const., in line with EN 60068-2-6
	wideband noise	8 Hz to 500 Hz, acceleration: 1.2 g (RMS), in line with EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810E, method 516.4, procedure I
Mechanical data		
Dimensions	W × H × D	222 mm × 97 mm × 436 mm (8.74 in × 3.82 in × 17.17 in)
Weight		7.1 kg (15.6 lb)
Rack installation		R&S®HZN96 option
Recommended calibration interval	operation 40 h/week over entire range of specified environmental conditions	1 year

R&S®NGU201, front view

R&S®NGU401, front view

R&S®NGU201, rear view

ORDERING INFORMATION

Designation	Type	Order No.
Base unit		
Two-quadrant source measure unit	R&S®NGU201	3639.3763.02
Four-quadrant source measure unit	R&S®NGU401	3639.3763.03
Accessories supplied		
Set of power cables, quick start guide		
Options for R&S®NGU201		
Digital trigger I/O	R&S®NGU-K103	3662.9335.02
Digital voltmeter function	R&S®NGU-K104	3663.0390.02
IEEE-488 (GPIB) interface	R&S®NGU-B105	3661.0763.02
Battery simulation	R&S®NGU-K106	3663.0625.02
Options for R&S®NGU401		
Digital trigger I/O	R&S®NGU-K103	3662.9335.02
IEEE-488 (GPIB) interface	R&S®NGU-B105	3661.0763.02
System components		
19" rack adapter, 2 HU	R&S®HZN96	3638.7813.02

Warranty		
Base unit		3 years
All other items [1]		1 year
Options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	