

# R&S®SGS100A SGMA RF Source Specifications



# CONTENTS

<b>Key features .....</b>	<b>3</b>
<b>Definitions .....</b>	<b>4</b>
<b>Specifications.....</b>	<b>5</b>
Frequency .....	5
<i>Reference frequency.....</i>	<i>5</i>
Level.....	6
Spectral purity .....	7
Phase coherence (R&S®SGS-K90 option) .....	8
Pulse modulation (R&S®SGS-K22 option) .....	9
Input for external pulse modulation and pulse generator trigger .....	9
Internal pulse generator.....	9
I/Q modulation .....	10
<i>I/Q modulator.....</i>	<i>10</i>
<i>Baseband bypass mode.....</i>	<i>10</i>
<i>I/Q inputs .....</i>	<i>11</i>
Remote control .....	11
Connectors .....	11
<i>Rear panel connectors .....</i>	<i>11</i>
General data.....	12
<b>Ordering information .....</b>	<b>13</b>

# Key features

## Dedicated ATE signal generation

- I/Q-modulated or pure CW source in frequency range from 80 MHz to 12.75 GHz (I/Q) and 1 MHz to 12.75 GHz (CW)
- Very fast settling times via PCIe and Ethernet interface
- Maximum level of typ. > +20 dBm (with electronic attenuator)
- Optional wear-free electronic attenuator
- External software (SGMA GUI) for remote control of multiple instruments
- Field-upgradeable

## Space-saving operation due to small dimensions

- Smallest signal generator in its class: 1 height unit, ½ x 19"
- Lightweight

## High performance at an attractive price

- Low SSB phase noise of  $-133$  dBc (meas., 20 kHz carrier offset,  $f = 1$  GHz, 1 Hz measurement bandwidth)
- Wideband noise of  $< -145$  dBc
- Nonharmonics of  $< -76$  dBc ( $> 10$  kHz carrier offset,  $f \leq 1500$  MHz)
- Very high level accuracy and repeatability
- Optional pulse modulation capability and internal pulse generator
- Optional high-stability reference oscillator
- Optional coherent LO input/output

## Minimized total cost of ownership

- Attractive initial cost
- Long calibration interval
- Simplified error diagnostics through built-in selftests

# Definitions

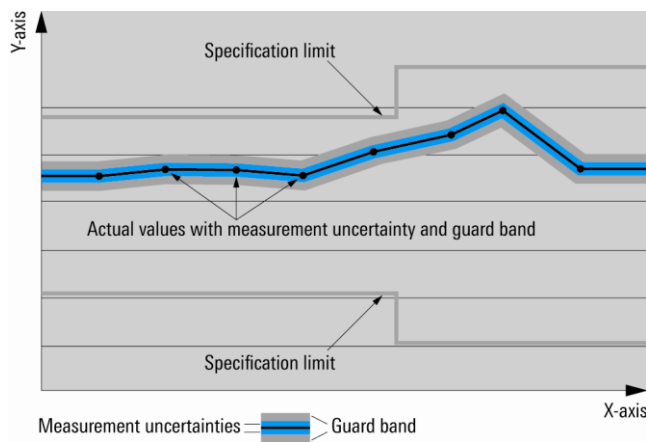
## General

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  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , 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 (e.g. 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 (e.g. 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.

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

# Specifications

## Frequency

Frequency range	with the R&S®SGS-B106 option	1 MHz to 6 GHz
	with the R&S®SGS-B106 and R&S®SGS-B112 options	1 MHz to 12.75 GHz
	with the R&S®SGS-B106V option	1 MHz to 6 GHz (CW), 80 MHz to 6 GHz (I/Q)
	with the R&S®SGS-B106V and R&S®SGS-B112V options	1 MHz to 12.75 GHz (CW), 80 MHz to 12.75 GHz (I/Q)
Resolution of setting		0.001 Hz
Resolution of synthesis	f = 1 GHz	0.174 μHz (nom.)
Setting time	to within < 2 × 10 <sup>-7</sup> for f > 500 MHz or < 100 Hz for f ≤ 500 MHz	
	with PCIe or Ethernet (fast socket) remote control	< 500 μs
Resolution of phase offset setting		0.1°

## Reference frequency

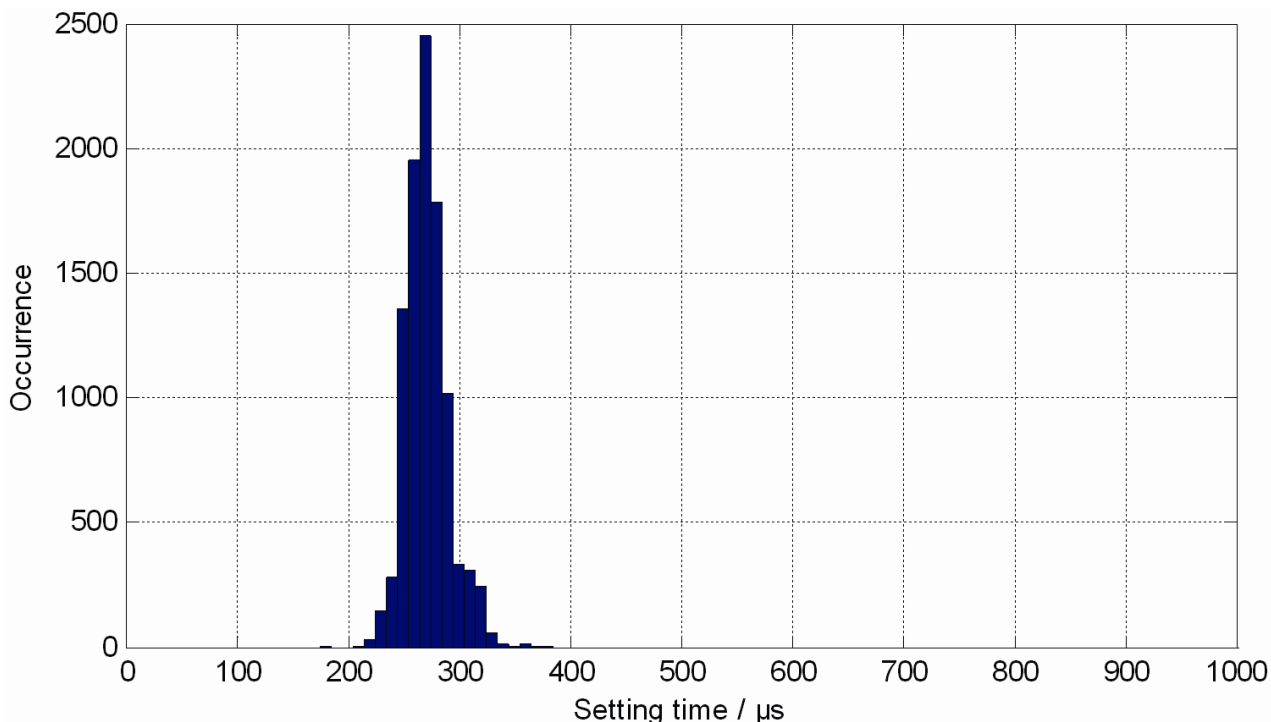
Frequency error	at time of calibration in production	< 1 × 10 <sup>-7</sup>
	with the R&S®SGS-B1 option	< 1 × 10 <sup>-8</sup>
Aging (after 30 days of uninterrupted operation)		< 1 × 10 <sup>-6</sup> /year
	with the R&S®SGS-B1 option	< 1 × 10 <sup>-9</sup> /day, < 1 × 10 <sup>-7</sup> /year
Temperature effect (0 °C to +50 °C)		< 2 × 10 <sup>-6</sup>
	with the R&S®SGS-B1 option	< 1 × 10 <sup>-7</sup>
Warm-up time	to nominal thermostat temperature (with R&S®SGS-B1 option only)	≤ 10 min
<b>Reference frequency output</b>		
Connector type	REF/LO OUT on rear panel	SMA female
Output frequency	sine wave	
	instrument set to internal reference	10 MHz, 1000 MHz
	instrument set to external reference	applied external reference input frequency or 1000 MHz
Output level		+6 dBm to +12 dBm, 9 dBm (typ.)
Source impedance		50 Ω (nom.)
<b>Reference frequency input</b>		
Connector type	REF/LO IN on rear panel	SMA female
Input frequency		10 MHz, 13 MHz, 100 MHz, 1000 MHz
Frequency locking range		±10 × 10 <sup>-6</sup>
Input level range		0 dBm to +16 dBm
Input impedance		50 Ω (nom.)

## Level

**Setting Characteristic: auto** – The step attenuator is switched over automatically. The output level is specified over the full range from –120 dBm to +15 dBm.

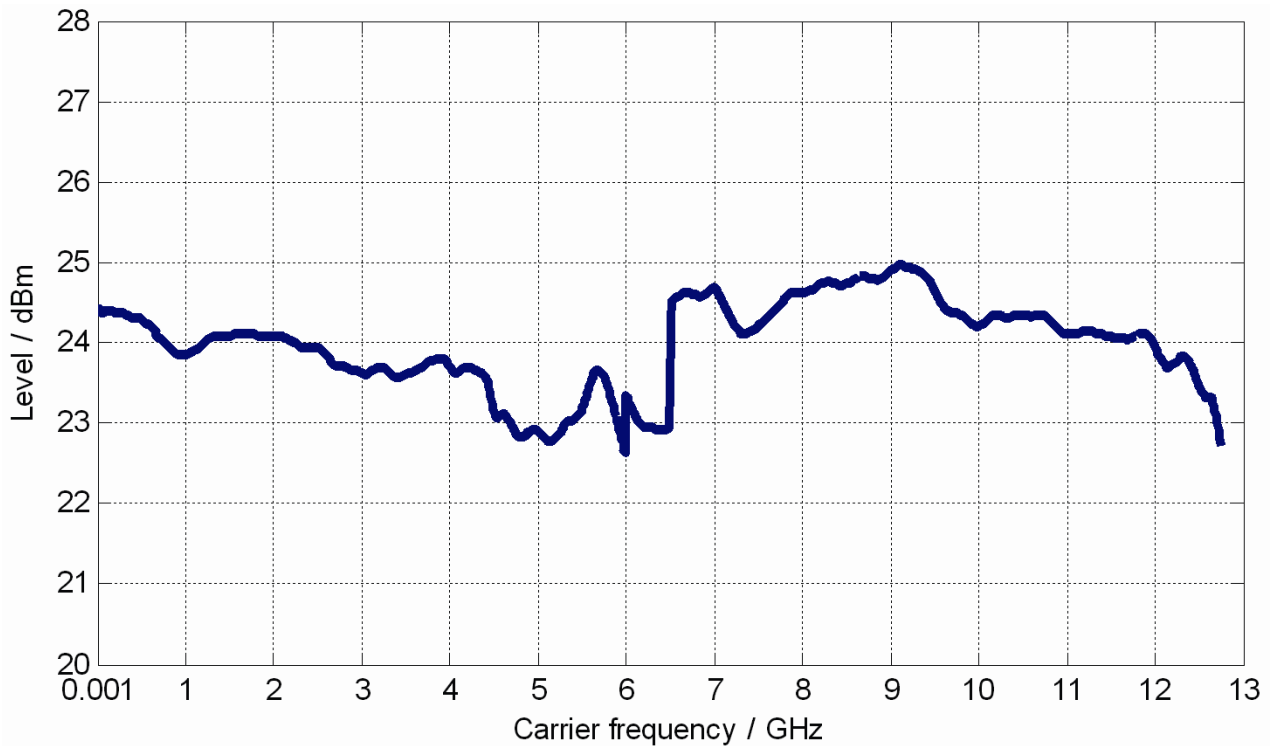
**Setting Characteristic: uninterrupted level setting** – The level is set without changing the step attenuator. The step attenuator is fixed to the current setting. Level changes are performed without interruption. The maximum interruption-free setting range is limited. If this range is exceeded, the spectral purity of the output signal may decrease.

Setting range		–20 dBm to +25 dBm
	with the R&S®SGS-B26 option	–120 dBm to +25 dBm
Specified level range		–10 dBm to +15 dBm (PEP) <sup>1</sup>
	with the R&S®SGS-B26 option	–120 dBm to +15 dBm (PEP) <sup>1</sup>
Resolution of setting		0.01 dB
Level error	Setting Characteristic: auto, temperature range from +18 °C to +33 °C	
	1 MHz ≤ f ≤ 3 GHz	< 0.5 dB
	3 GHz < f ≤ 12.75 GHz	< 0.9 dB
Additional level error for pulse modulation	pulse width ≥ 100 ns	< 0.3 dB (meas.)
Output impedance VSWR in 50 Ω system	in full frequency range, Setting Characteristic: auto	< 2.0
	in full frequency range, with the R&S®SGS-B26 option	< 1.8
Setting time	to < 0.1 dB deviation from final value, Setting Characteristic: auto, with PCIe or Ethernet (fast socket) remote control	< 500 μs
Interruption-free level setting range	Setting Characteristic: uninterrupted level setting	0 dB to +20 dB
Reverse power from 50 Ω	maximum permissible RF power in output	0.5 W
Maximum permissible DC voltage	at RF power connector	35 V



*Histogram of level setting times measured via PCIe/Ethernet interface, Setting Characteristic auto.*

<sup>1</sup> PEP = peak envelope power.

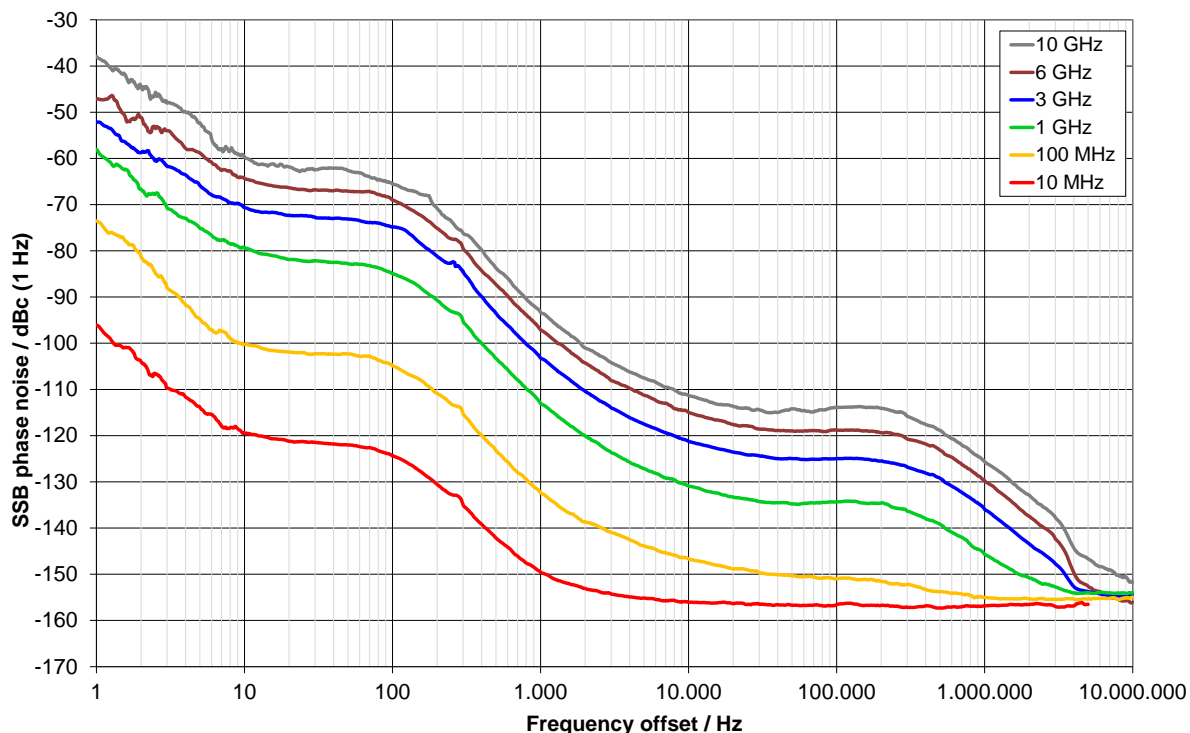


Maximum available level in CW mode, Setting Characteristic: auto, with the R&S®SGS-B26 electronic step attenuator option (meas.).

## Spectral purity

Harmonics	level $\leq 8$ dBm, CW, I/Q wideband off	< -30 dBc
Nonharmonics	level > -10 dBm <sup>2</sup> , offset > 10 kHz from carrier	
	f $\leq 1500$ MHz	< -76 dBc
	1500 MHz < f $\leq 3000$ MHz	< -70 dBc
	3000 MHz < f $\leq 6000$ MHz	< -64 dBc
	6000 MHz < f $\leq 12750$ MHz	< -58 dBc
Subharmonics	level > -10 dBm <sup>2</sup>	
	f $\leq 3000$ MHz	< -76 dBc
	3000 MHz < f $\leq 6500$ MHz	< -68 dBc
Wideband noise	6500 MHz $\leq f \leq 12750$ MHz	< -60 dBc
	1 MHz $\leq f \leq 6$ GHz and carrier offset 10 MHz, 6 GHz < f $\leq 12.75$ GHz and carrier offset 30 MHz, level > 5 dBm, Setting Characteristic: auto, 1 Hz measurement bandwidth, CW	< -145 dBc
Wideband noise	200 MHz $\leq f \leq 6$ GHz and carrier offset 10 MHz, 6 GHz < f $\leq 12.75$ GHz and carrier offset 30 MHz, level > 5 dBm, Setting Characteristic: auto, 1 Hz measurement bandwidth, I/Q	< -135 dBc
	SSB phase noise	20 kHz carrier offset, 1 Hz measurement bandwidth
SSB phase noise	f = 1 GHz	< -126 dBc, -133 dBc (meas.)
	f = 2 GHz	< -120 dBc, -127 dBc (meas.)
	f = 10 GHz	< -106 dBc, -113 dBc (meas.)

<sup>2</sup> > 0 dBm for instruments without the R&S®SGS-B26 electronic step attenuator.



SSB phase noise with the R&S®SGS-B1 internal OCXO option (meas.).

## Phase coherence (R&S®SGS-K90 option)

The R&S®SGS-K90 option provides phase-coherent RF outputs for two or more instruments. For frequencies above 6.5 GHz (instruments equipped with the R&S®SGS-B112 or R&S®SGS-B112V frequency extension), the LO output and input frequency are set to half the output frequency.

LO coupling modes	this mode corresponds to internal LO operation; the REF/LO OUT connector can provide the internal LO oscillator signal to enable phase-coherent coupling on other instruments	internal
	this mode corresponds to external LO operation at the REF/LO IN connector; the REF/LO OUT connector can provide the external LO oscillator signal to enable phase-coherent coupling on additional instruments.	external
REF/LO OUT states	active local oscillator signal can be routed to the REF/LO OUT connector (in order to couple two or more instruments)	REF/LO/OFF
Phase drift over temperature	drift of RF signal phase difference between two LO coupled instruments R&S®SGS100A when changing ambient temperature by +1 °C, f = 6 GHz, level = +10 dBm	0.4° (meas.)



<b>Input of phase coherence signal</b>		
Connector type	REF/LO IN on rear panel	SMA female
Input impedance		50 $\Omega$ (nom.)
Input level range of external local oscillator signal		7 dBm to 13 dBm
Frequency range of external local oscillator signal	for RF setting 80 MHz to 6.5 GHz	80 MHz to 6.5 GHz
	for RF setting > 6.5 GHz to 12.75 GHz	3.25 GHz to 6.375 GHz
<b>Output of phase coherence signal</b>		
Connector type	REF/LO OUT on rear panel	SMA female
Output impedance		50 $\Omega$ (nom.)
Output level range of internal local oscillator signal		7 dBm to 13 dBm
Frequency range of internal local oscillator signal	for RF setting 80 MHz to 6.5 GHz	80 MHz to 6.5 GHz
	for RF setting > 6.5 GHz to 12.75 GHz	3.25 GHz to 6.375 GHz

## Pulse modulation (R&S®SGS-K22 option)

The R&S®SGS-K22 option provides pulse modulation capabilities. The pulse modulator can be controlled by an internal pulse generator (delivered with the R&S®SGS-K22) or by an external pulse signal.

Modulation source		external, internal
On/off ratio		> 80 dB
Rise/fall time	10 % to 90 % of RF amplitude	< 20 ns
External pulse modulation delay		45 ns (meas.)
Pulse repetition frequency		0 Hz to 10 MHz
Video feedthrough	level < 10 dBm, with the R&S®SGS-B26 option	< 10 % of RF
Pulse overshoot	f $\geq$ 500 MHz	< 10 %

## Input for external pulse modulation and pulse generator trigger

Connector type	TRIG on rear panel	SMA female
Input impedance	selectable	10 k $\Omega$ or 50 $\Omega$ (nom.)
Threshold voltage		1 V (nom.)
Input damage voltage		$\pm$ 5 V
Input polarity	selectable	normal, inverse

## Internal pulse generator

Pulse mode		single pulse, double pulse
Trigger mode	free run, internally triggered	auto
		externally triggered
		externally gated
Active trigger edge		positive or negative
Pulse period		
Setting range		100 ns to 100 s
Setting resolution		10 ns
Pulse width		
Setting range	the pulse widths of double pulses can be set independently	20 ns to 100 s
Setting resolution		10 ns
Pulse delay		
Setting range	with external trigger	0 s to 100 s
Setting resolution	with external trigger	10 ns
Double pulse delay		
Setting range		40 ns to 100 s
Setting resolution		10 ns
External trigger delay jitter		< 20 ns
Pulse/video output	available on TRIG connector on rear panel in auto trigger mode	LVTTTL signal, 3.3 V (nom.)

## I/Q modulation

### I/Q modulator

Modulation bandwidth	80 MHz < f ≤ 1 GHz	±5 % of carrier frequency
	1 GHz < f ≤ 12.7 GHz	±50 MHz
	100 MHz < f ≤ 2.5 GHz, I/Q wideband	±20 % of carrier frequency
	2.5 GHz < f ≤ 12.25 GHz, I/Q wideband	±500 MHz
RF frequency response	80 MHz < f ≤ 1 GHz, up to ±5 % of carrier frequency	< 3 dB (meas.)
	1 GHz < f ≤ 12.7 GHz, up to ±50 MHz	< 3 dB (meas.)
	100 MHz < f ≤ 2.5 GHz, up to ±20 % of carrier frequency, I/Q wideband	< 6 dB (meas.)
	2.5 GHz < f ≤ 12.25 GHz, up to ±500 MHz, I/Q wideband	< 9 dB (meas.)
Carrier leakage	without input signal, referenced to full-scale input <sup>3</sup>	< -45 dBc, < -55 dBc (meas.)
Suppression of image sideband	up to ±10 MHz	40 dB (meas.)
Error vector	measured with 16QAM, filter root cosine $\alpha = 0.5$ , 10 kHz symbol rate	
	f > 80 MHz, RMS	< (0.4 % + 0.2 % × f/GHz)
	f > 80 MHz, peak value	< (0.8 % + 0.4 % × f/GHz)
3GPP FDD digital standard, adjacent-channel leakage ratio (ACLR)	test model 1, 64 DPCs, level ≤ 10 dBm <sup>4</sup> PEP, frequency range from 1800 MHz to 2200 MHz	
	5 MHz offset	> 67 dB, 70 dB (meas.)
	10 MHz offset	> 69 dB, 71 dB (meas.)
<b>I/Q impairment settings</b>		
Offset setting range		-5 % to +5 %
Offset setting resolution		0.01 %
Gain imbalance setting range		-1.0 dB to +1.0 dB
Gain imbalance setting resolution		0.001 dB
Quadrature offset setting range		-8° to +8°
Quadrature offset setting resolution		0.01°

### Baseband bypass mode

The baseband bypass mode allows generation of modulated signals below the I/Q modulator's specified frequency range. Externally generated signals applied to the I or Q baseband input connector can be leveled and amplified by the instrument and are provided at the RF output connector.

For the baseband bypass mode, only the data specified in this section is valid.

Level setting range		-10 dBm to +25 dBm
	with the R&S®SGS-B26 option	-120 dBm to +25 dBm
Specified level range		-5 dBm to +15 dBm
	with the R&S®SGS-B26 option	-120 dBm to +15 dBm
Frequency response	1 MHz ≤ f ≤ 80 MHz, level = 10 dBm	< 3 dB, < 1 dB (meas.)
Level error	auto attenuator mode, temperature range from +18 °C to +33 °C, referenced to full-scale input at I or Q connector, 1 MHz ≤ f ≤ 80 MHz	< 3 dB
Level linearity	fixed attenuator mode, for setting range of 0 dB to +20 dB	< 2 dB, < 0.5 dB (meas.)

<sup>3</sup> Value applies after internal readjustment.

<sup>4</sup> 5 dBm for instruments without the R&S®SGS-B26 electronic step attenuator.

**I/Q inputs**

Connector types	I, Q on rear panel	SMA female
Input impedance		50 $\Omega$ (nom.)
VSWR	up to 100 MHz	< 1.2
	100 MHz to 500 MHz	< 1.5
Input voltage for full-scale input		$\sqrt{V_i^2 + V_q^2} = 0.5 \text{ V}$ (nom.)
Input damage voltage		$\pm 1 \text{ V}$

**Remote control**

Systems		PCIe (single lane)
		Ethernet (TCP/IP) 10/100/1000BaseT
		USB 2.0
Command set	remote control via Ethernet, USB	SCPI 1999.5 or compatible command sets
	remote control via PCIe	Rohde & Schwarz instrument driver

**Connectors****Rear panel connectors**

RF 50 $\Omega$	RF output	SMA female
REF/LO IN	reference frequency input or external LO signal input	SMA female
REF/LO OUT	reference frequency output or internal LO signal output	SMA female
I, Q	input connector for I and Q baseband signals, input for I/Q vector-modulated IF signals up to 80 MHz	SMA female
TRIG	trigger input/output, pulse input/output	SMA female
USB IN	remote control of instrument	USB (micro USB)
LAN	remote control of instrument	RJ-45
PCI Express	remote control of instrument	single lane, according to PCI Express external cabling specification

## General data

<b>Power supply</b>		
AC input voltage range		100 V to 240 V $\pm$ 10 %
AC supply frequency		50 Hz to 60 Hz, $-5\%/+5\%$
Max. input current		1.7 A
Power consumption		70 W (meas.)
Power factor correction		in line with EN 61000-3-2
<b>Electrical safety</b>		
Compliance		in line with IEC 61010-1, EN 61010-1, CAN/CSA-C22.2 No. 61010-1-04, UL 61010-1
Test mark		VDE-GS, cCSA <sub>US</sub>
<b>EMC</b>		
Electromagnetic compatibility		in line with EN 55011 class B, EN 61326-1 (industrial environment), EN 61326-2-1
<b>Mechanical resistance</b>		
Vibration	sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, const. 0.5 g at 55 Hz to 150 Hz, in line with EN 60068-2-6
	random	10 Hz to 300 Hz, acceleration 1.2 g (RMS), in line with EN 60068-2-64
Shock		in line with MIL-STD-810E, method no. 516.4, procedure I, 40 g shock spectrum
<b>Environmental conditions</b>		
Temperature range	operating temperature range	0 °C to +50 °C, in line with EN 60068-2-1, EN 60068-2-2
	storage temperature range	-40 °C to +71 °C
Climatic resistance		+40 °C/95 % rel. humidity, in line with EN 60068-2-30
Altitude	operating	up to 4600 m
	storage	up to 4600 m
<b>Dimensions</b>	W x H x D	250 mm x 52.5 mm x 401 mm (9.84 in x 2.07 in x 15.79 in) 1 HU, ½ 19" rack width
<b>Weight</b>	when fully equipped	4.0 kg (8.82 lb)
<b>Calibration interval</b>		
Recommended calibration interval	40 h/week operation in the full range of the specified environmental conditions	3 years

## Ordering information

Designation	Type	Order No.
SGMA RF source <sup>5</sup>	R&S®SGS100A	1416.0505.02
Including power cable and quick start guide		
<b>Options</b>		
1 MHz to 6 GHz, CW (no modulation)	R&S®SGS-B106	1416.2308.02
1 MHz to 6 GHz, I/Q (with vector modulation)	R&S®SGS-B106V	1416.2350.02
Frequency extension to 12.75 GHz, CW <sup>6</sup>	R&S®SGS-B112	1416.1553.02
Frequency extension to 12.75 GHz, I/Q <sup>7</sup>	R&S®SGS-B112V	1416.1576.02
Electronic step attenuator	R&S®SGS-B26	1416.1353.02
Reference oscillator OCXO	R&S®SGS-B1	1416.2408.02
Pulse modulation	R&S®SGS-K22	1416.2650.02
Phase coherent input/output	R&S®SGS-K90	1416.2608.02
<b>Recommended extras</b>		
19" rack adapter (for two 1 HU instruments next to each other), suitable for installation of two R&S®SGMA instruments	R&S®ZZA-KN20	1175.3191.00
19" rack adapter (for one instrument and spacing module)	R&S®ZZA-KN21	1175.3204.00
Cable kit R&S®SGU100A to R&S®SGS100A (side-by-side)	R&S®SGU-Z3	1418.3801.02
Connection kit R&S®SGU100A to R&S®SGS100A	R&S®SGU-Z4	1418.3701.02
R&S®SGMA adapter	R&S®SGS-Z8	1416.2914.02
<b>Accessories</b>		
Documentation of calibration values	R&S®DCV-2	0240.2193.18

<b>Service options</b>		
Extended warranty, one year	R&S®WE1SGS100A	Please contact your local Rohde & Schwarz sales office.
Extended warranty, two years	R&S®WE2SGS100A	
Extended warranty, three years	R&S®WE3SGS100A	
Extended warranty, four years	R&S®WE4SGS100A	
Extended warranty with calibration coverage, one year	R&S®CW1SGS100A	
Extended warranty with calibration coverage, two years	R&S®CW2SGS100A	
Extended warranty with calibration coverage, three years	R&S®CW3SGS100A	
Extended warranty with calibration coverage, four years	R&S®CW4SGS100A	

### Extended warranty with a term of one to four years (WE1 to WE4)

Repairs carried out during the contract term are free of charge <sup>8</sup>. Necessary calibration and adjustments carried out during repairs are also covered. Simply contact the forwarding agent we name; your product will be picked up free of charge and returned to you in top condition a couple of days later.

### Extended warranty with calibration (CW1 to CW4)

Enhance your extended warranty by adding calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs <sup>8</sup> and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

<sup>5</sup> The base unit must be ordered together with an R&S®SGS-B106 or R&S®SGS-B106V frequency option.

<sup>6</sup> Requires R&S®SGS-B106.

<sup>7</sup> Requires R&S®SGS-B106V.

<sup>8</sup> Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.



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