R&S®SGU100A
SGMA UPCONVERTER

Specifications

Specifications
Version 04.01

ROHDE&SCHWARZ
Make ideas real

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Key features

Modular frequency extension unit with I/Q upconversion

- I/Q-modulated – or pure LO – frequency extension from 12 GHz to 40 GHz
- External software (R&S®SGMA GUI) for remote control
- Vector modulated solution from 80 MHz to 40 GHz with R&S®SGS100A acting as one combined instrument for manual and automated use once connected
- Extends existing analog Rohde & Schwarz signal generators (R&S®SMF100A, R&S®SMB100A) up to 40 GHz and adds vector modulation capabilities above 12 GHz
- Optional step attenuator with high dynamic range down to –120 dBm

Space-saving operation due to small dimensions

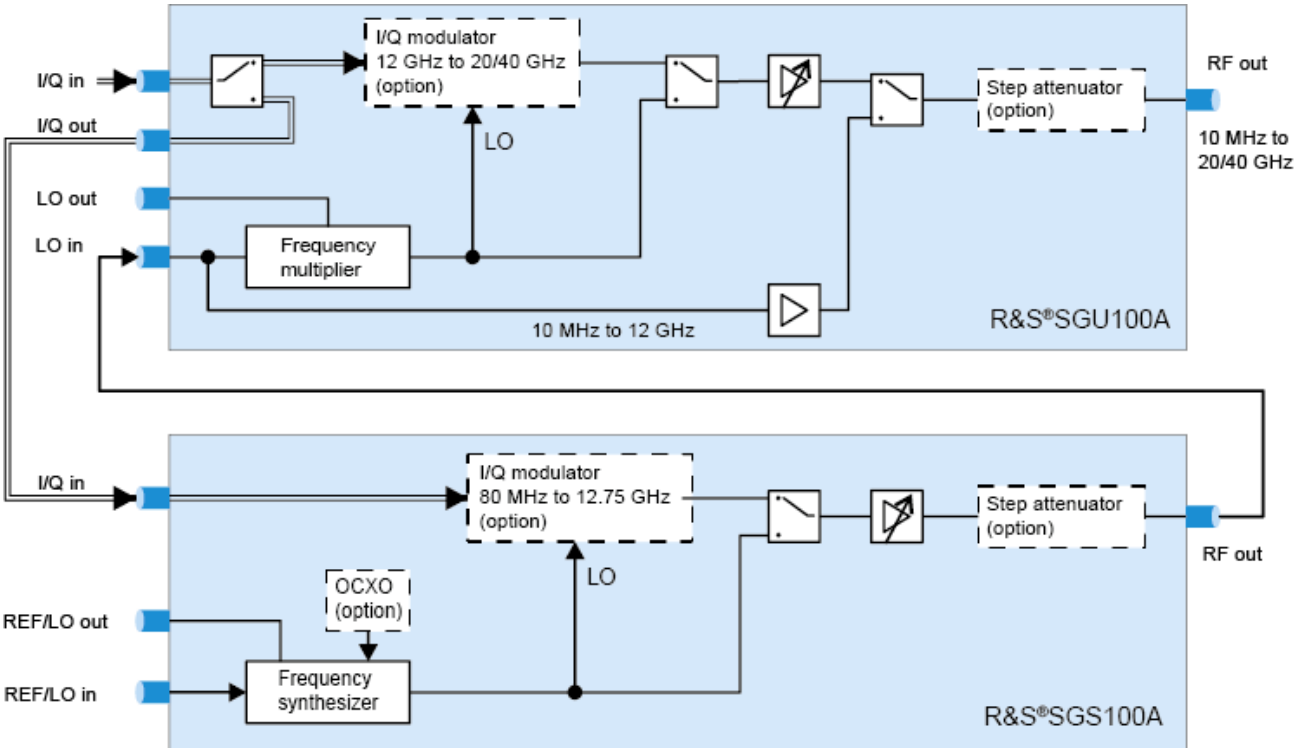
- Only ½ 19", 1 HU
- Lightweight

High performance at an attractive price

- Maximum output level of +21 dBm (typ.) (f = 20 GHz, with options R&S®SGU-B120/-B120V and R&S®SGU-B26)
- Maximum output level of +17 dBm (typ.) (f = 40 GHz, with options R&S®SGU-B140/-B140V and R&S®SGU-B26)
- Subharmonics of < –65 dBc (typ.)
- High RF modulation bandwidth of 2 GHz
- Very high level accuracy and linearity thanks to closed ALC loop, even with I/Q modulation

Minimized total cost of ownership

- Attractive initial cost
- Long calibration interval of 3 years
- Simplified error diagnostics through built-in selftests



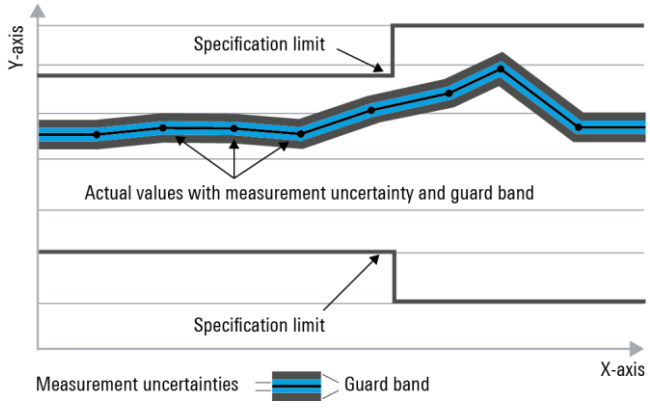
Functional diagram of R&S®SGU100A in combination with R&S®SGS100A signal generator.

Definitions

General
Product data applies under the following conditions:

- Three hours of storage at ambient temperature followed by 30 minutes of 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 (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 measured. 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.

Specifications

RF performance

Frequency

Output frequency range	with R&S®SGU-B120 or R&S®SGU-B120V option	10 MHz to 20 GHz
	with R&S®SGU-B140 or R&S®SGU-B140V option	10 MHz to 40 GHz
Input frequency range	For frequency settings below 12 GHz the CW or modulated input signal is amplified and sent to the output of the instrument or to the optional step attenuator. For frequency settings > 12 GHz, the input CW signal is used to generate the I/Q modulator LO or CW output RF signal.	10 MHz to 12.75 GHz
Setting time	to within < 2 × 10^{-7} for f > 500 MHz or < 100 Hz for f ≤ 500 MHz, without switching of mechanical step attenuator	
	with PCIe remote control [1]	< 2 ms

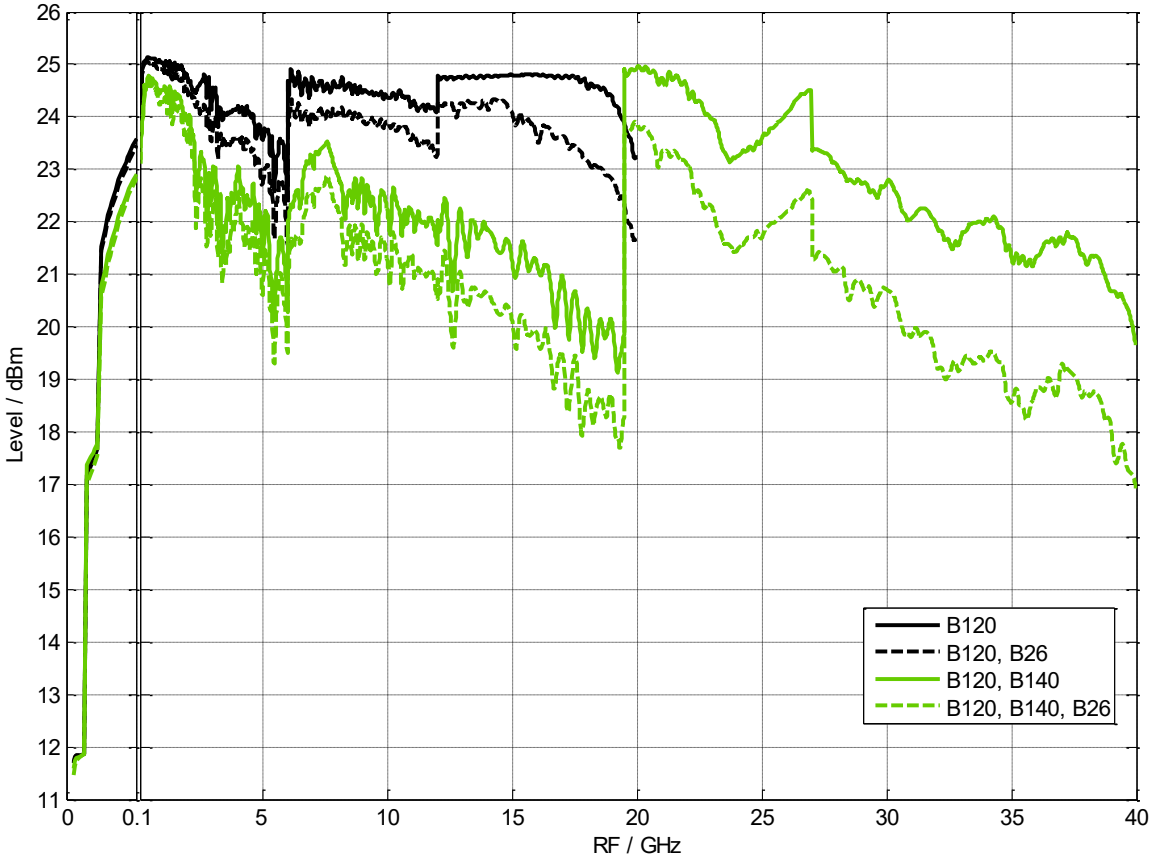
Level

Setting characteristic AUTO: The step attenuator is switched over automatically. This mode maximizes the specified level range.

Setting characteristic uninterrupted level setting: The level is set without switching the step attenuator. The step attenuator is thus fixed to the current setting. Level changes are performed without interruption. The recommended interruption-free setting range is indicated by the instrument depending on the frequency, level and modulation settings. If this range is exceeded, the spectral purity of the output signal may decrease.

Setting range	10 MHz ≤ f < 30 MHz	–20 dBm to +12 dBm
	30 MHz ≤ f < 50 MHz	–20 dBm to +18 dBm
	f ≥ 50 MHz	–20 dBm to +25 dBm
	instruments equipped with R&S®SGU-B26 option	
	10 MHz ≤ f < 30 MHz	–120 dBm to +12 dBm
	30 MHz ≤ f < 50 MHz	–120 dBm to +18 dBm
	f ≥ 50 MHz	–120 dBm to +25 dBm
Specified level range [1]	instruments equipped with R&S®SGU-B120 or R&S®SGU-B120V, without R&S®SGU-B26 option	
	10 MHz < f ≤ 50 MHz (bypass mode)	–10 dBm to +8 dBm (PEP)
	50 MHz < f ≤ 12 GHz (bypass mode)	–10 dBm to +15 dBm (PEP)
	12 GHz < f ≤ 20 GHz	–10 dBm to +17 dBm (PEP)
	with R&S®SGU-B26 option	
	10 MHz < f ≤ 50 MHz (bypass mode)	–100 dBm to +8 dBm (PEP)
	50 MHz < f ≤ 12 GHz (bypass mode)	–100 dBm to +13 dBm (PEP)
	12 GHz < f ≤ 20 GHz	–100 dBm to +15 dBm (PEP)
	instruments equipped with R&S®SGU-B140 or R&S®SGU-B140V, without option R&S®SGU-B26	
	10 MHz < f ≤ 50 MHz (bypass mode)	–10 dBm to +7 dBm (PEP)
	50 MHz < f ≤ 12 GHz (bypass mode)	–10 dBm to +13 dBm (PEP)
	12 GHz < f ≤ 40 GHz	–10 dBm to +15 dBm (PEP)
	with R&S®SGU-B26 option	
	10 MHz < f ≤ 50 MHz (bypass mode)	–100 dBm to +7 dBm (PEP)
	50 MHz < f ≤ 12 GHz (bypass mode)	–100 dBm to +11 dBm (PEP)
	12 GHz < f ≤ 40 GHz	–100 dBm to +13 dBm (PEP)
Resolution of setting		0.01 dB

Level error [1]	setting characteristic: AUTO, temperature range from +18 °C to +33 °C, CW or I/Q mode with full scale modulation	
	10 MHz < f ≤ 12 GHz	< 0.9 dB (meas.)
	12 GHz < f ≤ 20 GHz	
	> –30 dBm	< 0.9 dB
	≤ –30 dBm	< 1.1 dB
	20 GHz < f ≤ 40 GHz	
	> –30 dBm	< 0.9 dB
	–70 dBm to –30 dBm	< 1.1 dB
	< –70 dBm	< 1.5 dB
Additional level error [1]	ALC state off (table)	< 0.5 dB (meas.)
Output impedance VSWR in 50 Ω system [1]	instruments equipped with R&S®SGU-B120 or R&S®SGU-B120V	< 1.7 (meas.)
	with R&S®SGU-B26 option	< 1.7 (meas.)
	instruments equipped with R&S®SGU-B140 or R&S®SGU-B140V	< 2.0 (meas.)
	with option R&S®SGU-B26	< 1.8 (meas.)
Setting time [1]	to < 0.2 dB deviation from final value, PCIe remote control	
	without switching of mechanical step attenuator	< 2 ms
	with switching of mechanical step attenuator	< 25 ms
Reverse power from 50 Ω	maximum permissible RF power in output	0.5 W
Maximum permissible DC voltage		0 V

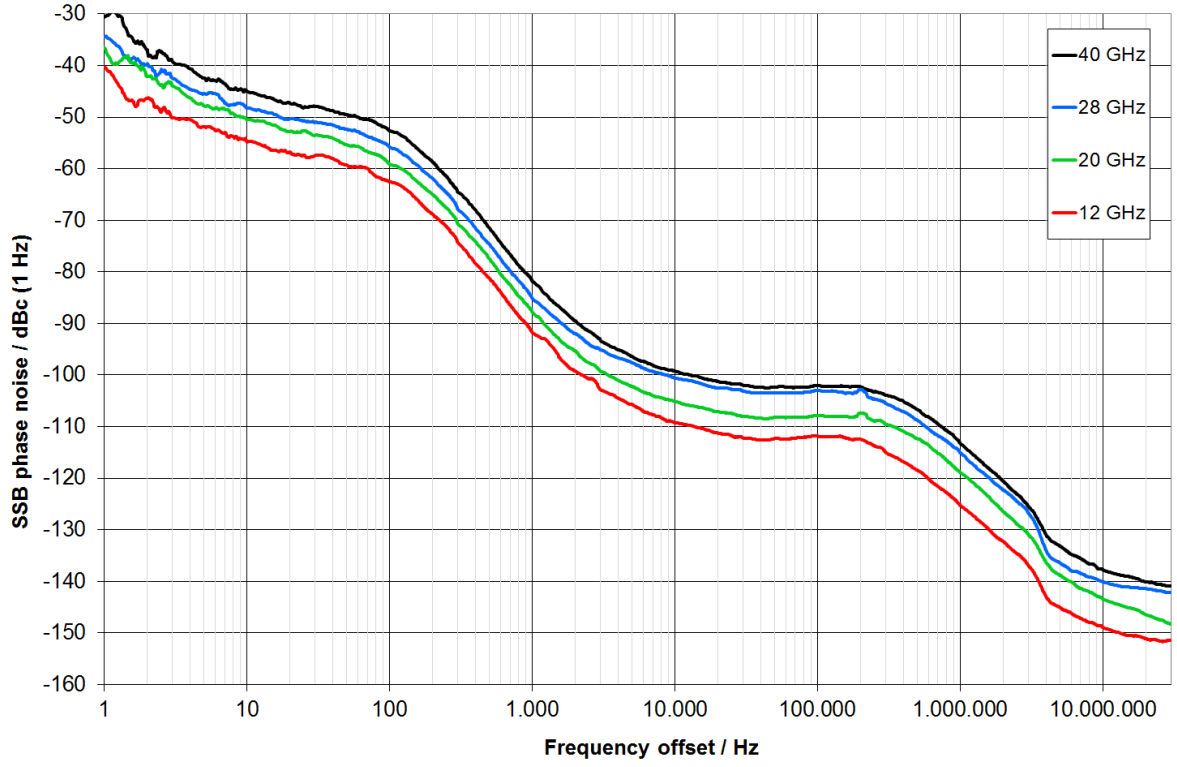


Maximum available level in combination with R&S®SGS100A (meas.)

[1] In combination with R&S®SGS100A.

Spectral purity

Harmonics	f > 12 GHz, level ≤ 8 dBm	< –30 dBc
Nonharmonics [2]	level > –10 dBm, offset > 10 kHz from carrier	
	12 GHz < f ≤ 20 GHz	< –56 dBc (meas.)
	f > 20 GHz	< –50 dBc (meas.)
Subharmonics	f > 12 GHz	< –55 dBc, < –65 dBc (typ.)
Wideband noise [2]	carrier offset = 30 MHz, level = 10 dBm, measurement bandwidth 1 Hz	
	instruments equipped with R&S®SGU-B120 or R&S®SGU-B120V option	
	CW, f ≤ 12 GHz	< –140 dBc (meas.)
	CW, f > 12 GHz	< –142 dBc
	vector modulation with full scale DC input, f > 12 GHz	< –135 dBc, < –138 dBc (typ.)
	instruments equipped with R&S®SGU-B140 or R&S®SGU-B140V option	
	CW, f ≤ 12 GHz	< –140 dBc (meas.)
	CW, 12 GHz < f ≤ 19.5 GHz	< –142 dBc
	CW, f > 19.5 GHz	< –136 dBc, < –139 dBc (typ.)
	vector modulation with full scale DC input, 12 GHz < f ≤ 19.5 GHz	< –135 dBc, < –138 dBc (typ.)
	vector modulation with full scale DC input, f > 19.5 GHz	< –134 dBc, < –137 dBc (typ.)



SSB phase noise in combination with R&S®SGS100A (meas.)

[2] In combination with R&S®SGS100A.

LO input

For frequency settings > 12 GHz, the local oscillator signal for the I/Q modulator of the R&S®SGU100A is derived from the RF signal fed into the LO input. CW or modulated signals up to 12 GHz can also be amplified and bypassed from LO input to the RF output of the instrument or to the optional step attenuator.

Input frequency range	instruments with R&S®SGU-B120 or R&S®SGU-B120V option	
	10 MHz ≤ f ≤ 12 GHz, bypass operation, CW or modulated	10 MHz to 12 GHz
	12 GHz < f ≤ 12.75 GHz	12 GHz to 12.75 GHz
	12.75 GHz < f ≤ 20 GHz	6.375 GHz to 10 GHz
	instruments equipped with R&S®SGU-B140 or R&S®SGU-B140V option	
	10 MHz ≤ f ≤ 12 GHz, bypass operation, CW or modulated	10 MHz to 12 GHz
	12 GHz < f ≤ 12.75 GHz	12 GHz to 12.75 GHz
	12.75 GHz < f ≤ 25.5 GHz	6.375 GHz to 12.75 GHz
	25.5 GHz < f ≤ 40 GHz	6.375 GHz to 10 GHz
Connector type	LO IN on rear panel	SMA female
Input impedance		50 Ω (nom.)
Input level range	upconverter operation, f > 12 GHz	+7 dBm to +13 dBm
Input damage level	upconverter operation, f > 12 GHz	+18 dBm
	bypass operation, f ≤ 12 GHz	+25 dBm

Phase coherence output

The R&S®SGU100A provides a phase coherent LO output signal. At instruments equipped with R&S®SGU-B140 or R&S®SGU-B140V frequency option, the LO output signal is set to the half output frequency for frequencies above 19.5 GHz.

Output frequency range	instruments with R&S®SGU-B120 or R&S®SGU-B120V option	
	upconverter operation, 12 GHz < f ≤ 20 GHz	12 GHz to 20 GHz
	instruments equipped with R&S®SGU-B140 or R&S®SGU-B140V option	
	upconverter operation, 12 GHz < f ≤ 19.5 GHz	12 GHz to 19.5 GHz
	upconverter operation, 19.5 GHz < f ≤ 40 GHz	9.75 GHz to 20 GHz
Connector type	LO OUT on rear panel	SMA female
Output impedance		50 Ω (nom.)
Output level range		+7 dBm to +13 dBm

Pulse modulation

The R&S®SGU-B120 and R&S®SGU-B120V options include an internal pulse modulator for the frequency range from 12 GHz to 20 GHz.

For frequencies lower than 12 GHz, pulse modulation on the RF signal provided on the LO input is transferred to the RF output.

Instruments equipped with R&S®SGU-B140 or R&S®SGU-B140V option include an internal pulse modulator for the frequency range from 12 GHz to 19.5 GHz. For frequencies from 19.5 GHz to 40 GHz, pulse modulation of the output signal can be accomplished by feeding an externally pulse modulated LO signal to the LO input of the instrument.

Once the R&S®SGU100A is connected to an R&S®SGS100A with pulse modulation capability, the required settings to realize internal and external pulse modulation over the full frequency range are automatically performed.

Modulation source		external
Connector type	TRIG on rear panel	SMA female
Input impedance		50 Ω (nom.), 10 kΩ (nom.)
On/off ratio [3]		> 80 dB
Rise/fall time [3]	10 %/90 % of RF amplitude	< 20 ns
Pulse repetition frequency [3]		0 Hz to 10 MHz
Video feedthrough [3]	setting characteristic: auto	
	level < 10 dBm with R&S®SGU-B26 option	< 10 % of RF
	level > 3 dBm and < 12 dBm without R&S®SGU-B26 option	< 10 % of RF
Pulse overshoot [3]		< 10 %

I/Q modulation

I/Q modulator

Modulation bandwidth	f > 12 GHz	up to ±1000 MHz
RF frequency response	up to ± 100 MHz	< 2 dB (meas.)
	up to ±1000 MHz	< 6 dB (meas.)
Carrier leakage	without input signal, referenced to full-scale input [4]	< –35 dBc, < –45 dBc (typ.)
Suppression of image sideband	up to ±10 MHz [4]	40 dB (meas.)
Error vector [5]	measured with 16QAM, filter root cosine, α = 0.5, symbol rate 10 MHz	
	f > 12 GHz, RMS	< (2 % + 0.04 % × f/GHz)
	f > 12 GHz, peak value	< (5 % + 0.1 % × f/GHz)
Two tone IMD (2 carriers)	level (PEP) = 0 dBm, up to 80 MHz carrier spacing	
	12 GHz < f ≤ 19.5 GHz	< –40 dBc (typ.)
	19.5 GHz < f ≤ 30 GHz	< –38 dBc (typ.)
	30 GHz < f ≤ 40 GHz	< –32 dBc (typ.)
I/Q impairment settings		
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		0.01 dB
Quadrature offset setting range		–8° to +8°
Quadrature offset setting resolution		0.01°

[3] In frequency range of internal pulse modulator.

[4] Value applies after internal readjustment.

[5] In combination with R&S®SGS100A.

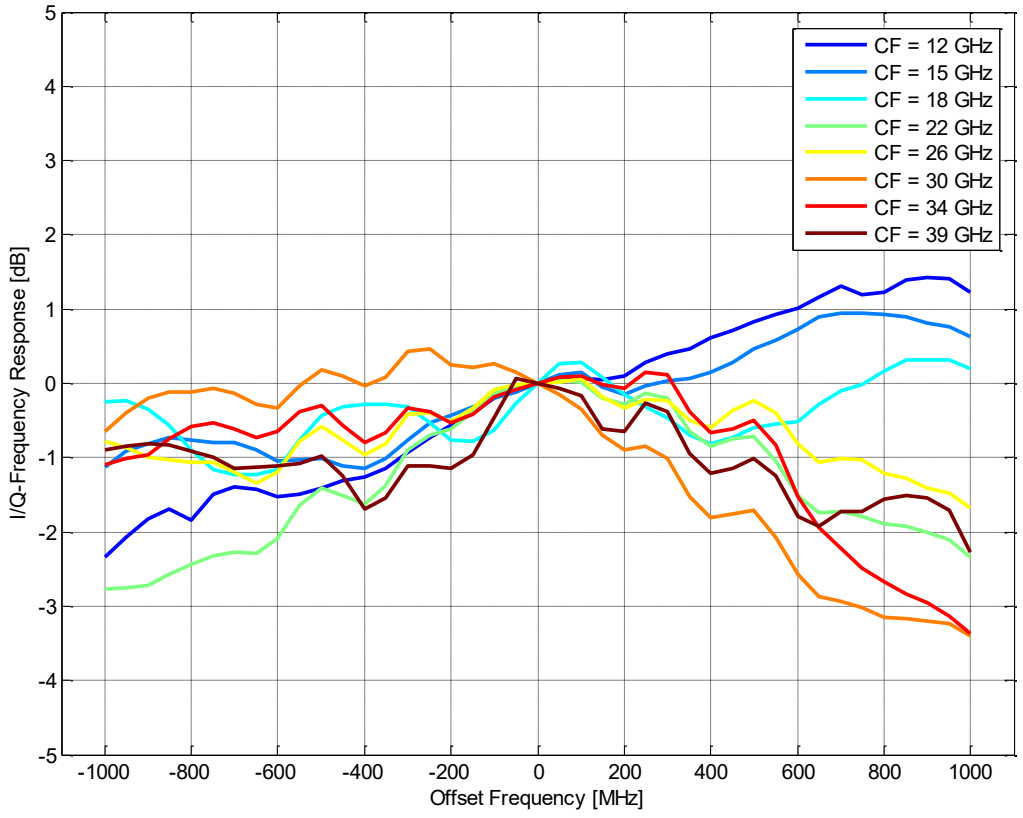
I/Q inputs

Connector types	I in, Q in on rear panel	SMA female
Input impedance		50 Ω (nom.)
VSWR	f > 12 GHz	
	up to 100 MHz	< 1.3
	100 MHz up to 1000 MHz	< 1.5
Input voltage for full scale input		$\sqrt{V_i^2 + V_q^2} = 0.5\ V$ (nom.)
Input damage voltage	electronic input protection	± 5 V

I/Q outputs

Allows routing of I and Q baseband signals to R&S®SGS100A for I/Q modulation below 12 GHz

Connector types	I out, Q out on rear panel	SMA female
Output impedance		50 Ω (nom.)
Losses in feedthrough path		< 2 dB (meas.)



I/Q modulation frequency response at various carrier frequencies (meas.)

Remote control

Systems		PCIe (single lane)
		Ethernet (TCP/IP) 10/100/1000BASE-T
		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 Ω	RF output	K female
LO IN	RF/LO input	SMA female
LO OUT	coherent LO output signal	SMA female
I in, Q in	input connector for I and Q baseband signals	SMA female
I out, Q out	output connector for I and Q baseband signals (to R&S®SGS100A)	SMA female
TRIG	trigger input/output, pulse input	SMA female
USB IN	remote control of instrument	USB (micro USB, type B)
LAN	remote control of instrument	RJ-45
PCIe	remote control of instrument	single lane

General data

Power supply		
Input voltage range	AC	100 V to 240 V ± 10 %
Supply frequency	AC	50 Hz to 60 Hz, –5 %/+5 %
Max. input current		1.7 A
Power consumption	instruments equipped with R&S®SGU-B120 or R&S®SGU-B120V option	40 W (meas.)
	instruments equipped with R&S®SGU-B140 or R&S®SGU-B140V option	70 W (meas.)
Power factor correction		in line with EN 61000-3-2
Electrical safety		
Compliance		in line with IEC 61010-1, EN 61010-1, CAN/CSA-C22.2 No. 61010-1-04, UL 61010-1
Test marks		VDE, $_{C}CSA_{US}$
EMC		
Electromagnetic compatibility		in line with EN 55011 class A, EN 61326-1 (industrial environment), EN 61326-2-1
Mechanical resistance		
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		40 g shock spectrum, in line with MIL-STD-810E, method no. 516.4, procedure I,
EU legislation	EU: in line with Data Act – Regulation (EU) 2023/2854	for details, see user documentation
Environmental conditions		
Temperature range	operating	0 °C to +50 °C in line with EN 60068-2-1, EN 60068-2-2
	storage	–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
Dimensions	W × H × D	250 mm × 52.5 mm × 401 mm (9.84 in × 2.07 in × 15.79 in) 1 HU, ½ 19" rack width
Weight	when fully equipped	4.0 kg (8.82 lb) (nom.)
Calibration interval		
Recommended calibration interval	operation 40 h/week in the full range of the specified environmental conditions	3 years

Ordering information

Designation	Type	Order No.
SGMA upconverter, base unit [6]	R&S®SGU100A	1418.2005.02
Including power cable and quick start guide		
Options		
10 MHz to 20 GHz, CW (without vector modulation)	R&S®SGU-B120	1418.2605.02
10 MHz to 20 GHz, I/Q (with vector modulation)	R&S®SGU-B120V	1418.2657.02
Frequency extension to 40 GHz, CW	R&S®SGU-B140	1418.2870.02
Frequency extension to 40 GHz, I/Q	R&S®SGU-B140V	1418.2928.02
Mechanical step attenuator	R&S®SGU-B26	1418.3401.02
Documentation of calibration values	R&S®DCV-2	0240.2193.18
Recommended extras		
Hardcopy manuals (in English)		1418.2070.02
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
19" rack adapter (for two 1 HU instruments next to each other), suitable for installation of two 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

Warranty and service

Warranty		
Base unit		1 year
All other items		1 year
Service options		
	Service plans	**On demand**
Calibration	up to five years [7]	pay per calibration
Warranty and repair	up to five years [7]	standard price repair
Find out more about our service portfolio under: www.rohde-schwarz.com/service-support/service/overview/service-overview_229461.html		

[6] The base unit must be ordered together with an R&S®SGU-B120 or R&S®SGU-B120V frequency option.

[7] For extended periods, contact your Rohde & Schwarz sales office.

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