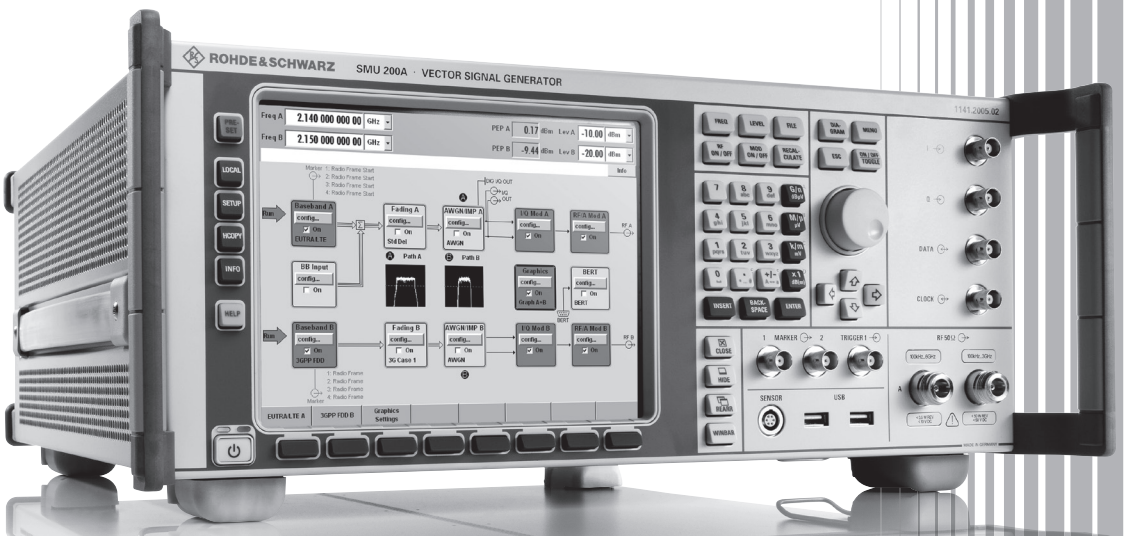
R&S®SMU200A
Vector Signal Generator
Specifications



ROHDE&SCHWARZ

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Specifications apply under the following conditions: 30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and all internal adjustments performed. Data designated “overrange” or “underrange” and data without tolerance limits is not binding.

EMC specifications are tested with sufficiently shielded cables and accessories (e.g. mouse and keypad). To prevent degradation of these specifications, it is the user's responsibility to use appropriate equipment.

In compliance with the 3GPP standard, chip rates are specified in Mcps (million chips per second), whereas bit rates and symbol rates are specified in kbps (thousand bits per second) or ksps (thousand symbols per second). Mcps, kbps and ksps are not SI units.

Device settings and GUI parameters are designated with the format "parameter: value".

This document contains the specifications of the R&S®SMU200A, including RF characteristics, analog modulation, I/Q modulation, performance of the I/Q baseband generator, fading and noise. The functional specifications of the digital standards (R&S®SMU-K40 to -K61 options) and the digital standards with external PC software (R&S®SMU-K6) are described in the Digital Standards data sheet (PD 5213.9434.22). The digital standards with R&S®WinIQSIM2™ are described in the R&S®WinIQSIM2™ data sheet (PD 5213.7460.22).

Introduction

The R&S®SMU200A vector signal generator has been designed to meet all requirements encountered in the research and development as well as production of modern communications systems. The R&S®SMU200A not only combines up to two independent signal generators in one cabinet of only four height units, but also offers unrivaled RF and baseband characteristics.

Due to its modular design, the R&S®SMU200A can be optimally adapted to the requirements of different applications. The first RF path can be equipped with one of the four available frequency options. The upper frequency limit of 2.2 GHz, 3 GHz, 4 GHz or 6 GHz is user-selectable. In addition, a second RF path can be installed with an upper frequency limit of 2.2 GHz or 3 GHz. The lower frequency limit of all frequency options is 100 kHz.

Two generators can also be installed in the baseband section. They generate complex signals in realtime and are equipped with an arbitrary waveform generator with 16 Msample, 64 Msample or 128 Msample memory. The signals generated in the different basebands can be added, even with frequency offset.

Featuring a dual-path concept and an optional integrated multichannel fading simulator, the R&S®SMU200A is ideal for tests on MIMO receivers as 2x2 MIMO systems can be tested using a single instrument. For larger systems up to 2x4 or 4x2 MIMO, two instruments can be combined.

The modern, intuitive concept of the R&S®SMU200A ensures fast and easy operation.

Key features

Two signal generators in one

- Frequency options from 100 kHz to 2.2/3/4/6 GHz for the first RF path
- Optional second RF path up to 2.2 GHz or 3 GHz
- Up to two complete baseband paths
- Lossless combination of baseband signals in the digital domain (e.g. for testing multistandard base stations)

Intuitive operation

- Color display with 800 × 600 pixel (SVGA format)
- Intuitive user interface with graphical display of signal flow (block diagram)
- Graphical display of baseband signals through built-in transient recorder
- Context-sensitive help system

Outstanding signal quality

- I/Q modulator with 200 MHz RF bandwidth
- Very low SSB phase noise of –135 dBc (typ.) (f = 1 GHz, 20 kHz carrier offset, 1 Hz measurement bandwidth), –139 dBc (typ.) with the enhanced phase noise performance option
- Wideband noise of –153 dBc (typ.) (CW, f = 1 GHz, > 10 MHz carrier offset, 1 Hz measurement bandwidth)
- Excellent ACLR performance of +70 dB (typ.) with 3GPP FDD (test model 1, 64 DPCH)
- Very high level repeatability of 0.05 dB
- High output power of up to +19 dBm (PEP), overrange +26 dBm
- Option for phase-coherent RF outputs
- High-stability reference oscillator as standard

Unrivaled flexibility

- 2x2 MIMO with realtime fading possible; two instruments can be combined for 2x4 or 4x2 MIMO
- Optional fading simulator with up to 40 fading paths
- Support of EUTRA/LTE FDD and TDD signal generation, including Release 9 and Release 10
- Realtime processing of LTE HARQ feedback commands and timing adjustment commands for closed-loop base station tests
- Four code channels in realtime for 3GPP FDD, support of HSPA and HSPA+
- HSUPA fixed reference channels with channel coding and HARQ feedback simulation
- Support of WLAN IEEE 802.11a, b, g, n, ac
- Baseband generator with universal coder for realtime signal generation
- Arbitrary waveform generator with 16 Msample, 64 Msample or 128 Msample
- Arbitrary waveform generator supported by R&S®WinIQSIM2™ simulation software

Ideal for production

- Very short frequency and level setting times (< 2 ms); only 450 µs in list mode
- Electronic attenuator with overvoltage protection up to 6 GHz over full level range
- Flexible high speed measurements with RF list mode and multisegment waveforms
- Minimum space required as two complete generators are accommodated in one instrument of only four height units

Connectivity

- Optional digital I/Q input and output; support of R&S®EX-IQ-Box for flexible data formats and clock generation
- Support of R&S®NRP-Zxx power sensors
- Remote control via LAN (Gigabit Ethernet, VXI11) and GPIB
- Remote operation via Windows Remote Desktop or VNC
- User-selectable trigger and marker signals
- USB connectors for keyboard, mouse and memory stick
- LXI class C compliance

Frequency and enhancement options

Frequency options

One of the following frequency options must be installed in RF path A:

R&S®SMU-B102	100 kHz to 2.2 GHz
R&S®SMU-B103	100 kHz to 3 GHz
R&S®SMU-B104	100 kHz to 4 GHz
R&S®SMU-B106	100 kHz to 6 GHz

One of the following frequency options can be installed in RF path B:

(If R&S®SMU-B104 or R&S®SMU-B106 and one of the R&S®SMU-B20 or R&S®SMU-B22 options are installed in RF path A, no options can be installed in RF path B.)

R&S®SMU-B202	100 kHz to 2.2 GHz
R&S®SMU-B203	100 kHz to 3 GHz

Enhancement options

Enhanced phase noise performance and FM/φM modulator

One of the following options can be installed in RF path A:

R&S®SMU-B20	FM/φM modulator
R&S®SMU-B22	FM/φM modulator and enhanced phase noise performance

These options cannot be installed in RF path B.

High-power output

The following options can be installed

R&S®SMU-B31	High-power output (RF path A)
R&S®SMU-B36	High-power output (RF path B)

Phase coherence

R&S®SMU-B90	Phase coherence

This option can be installed once. It provides phase-coherent RF outputs of two or more RF paths for one or more instruments.

Modulation

Possible modulation types

RF path A
Amplitude modulation, frequency/phase modulation (optional), vector modulation, digital modulation via internal baseband section (optional), vector modulation via baseband inputs (optional), pulse modulation, wideband amplitude modulation

RF path B
Amplitude modulation, digital modulation via internal baseband section (optional), vector modulation via baseband inputs (optional), pulse modulation

Simultaneous modulation

In the same RF path

	AM	FM	φM	PM	WB-AM	I/Q	DM	ARB
Amplitude modulation (AM)	/	●	●	●	–	–	–	–
Frequency modulation (FM)	●	/	–	●	●	●	●	●
Phase modulation (φM)	●	–	/	●	●	●	●	●
Pulse modulation (PM)	●	●	●	/	●	●	●	●
Wideband AM (WB-AM)	–	●	●	●	/	–	–	–
Vector modulation (I/Q)	–	●	●	●	–	/	–	–
Digital modulation (DM)	–	●	●	●	–	–	/	–
ARB	–	●	●	●	–	–	–	/

● = compatible, – = not compatible, switch off each other

RF characteristics

Frequency

Frequency range	underrange	100 kHz to < 300 kHz
	R&S®SMU-B102, R&S®SMU-B202	up to 2.2 GHz
	R&S®SMU-B103, R&S®SMU-B203	up to 3 GHz
	R&S®SMU-B104	up to 4 GHz
	R&S®SMU-B106	up to 6 GHz
Resolution of setting		0.01 Hz
Resolution of synthesis	standard, fundamental frequency range = 750 MHz to 1500 MHz	5 µHz
	with R&S®SMU-B22 option	0.2 µHz
Setting time [1]	to within < 1×10^{-7} for f > 200 MHz or < 124 Hz for f < 200 MHz, with GUI update stopped, after IEC/IEEE bus delimiter	< 2 ms, 1.5 ms (typ.)
	ALC state: off (sample & hold)	< 4 ms, 2.5 ms (typ.)
	after trigger pulse in list mode	< 450 µs, 300 µs (typ.)
Phase offset		adjustable in 0.1° steps

Frequency sweep

Operating modes	digital sweep in discrete steps	automatic, step, single, external single, external step, manual or external trigger, linear or logarithmic spacing
Sweep range		full frequency range
Step width	linear	full frequency range
	logarithmic	0.01 % to 100 % per step
Dwell time	range	10 ms to 10 s
	resolution	0.1 ms

Reference frequency

Aging	after 30 days of uninterrupted operation	< 1×10^{-9}/day, < 1×10^{-7}/year
	with R&S®SMU-B22 option	< 5×10^{-10}/day, < 3×10^{-8}/year
Maximum temperature effect	in operating temperature range	±6×10^{-8}
	with R&S®SMU-B22 option	±6×10^{-9}
Warm-up time	to nominal thermostat temperature	≤ 10 min
Output for internal reference signal	frequency (approx. sine wave)	10 MHz or external input frequency
	level	5 dBm (typ.)
	source impedance	50 Ω
Input for external reference	frequency	5 MHz, 10 MHz or 13 MHz
	maximum deviation	3×10^{-6}
	input level, limits	≥ –6 dBm, ≤ 19 dBm
	recommended	0 dBm to 19 dBm
	input impedance	50 Ω
Electronic tuning from input AUX I/O	sensitivity	1×10^{-8}/V to 3×10^{-8}/V (typ.)
	with R&S®SMU-B22 option	4×10^{-9}/V to 1.2×10^{-8}/V (typ.)
	input voltage	–10 V to +10 V
	input impedance	10 kΩ

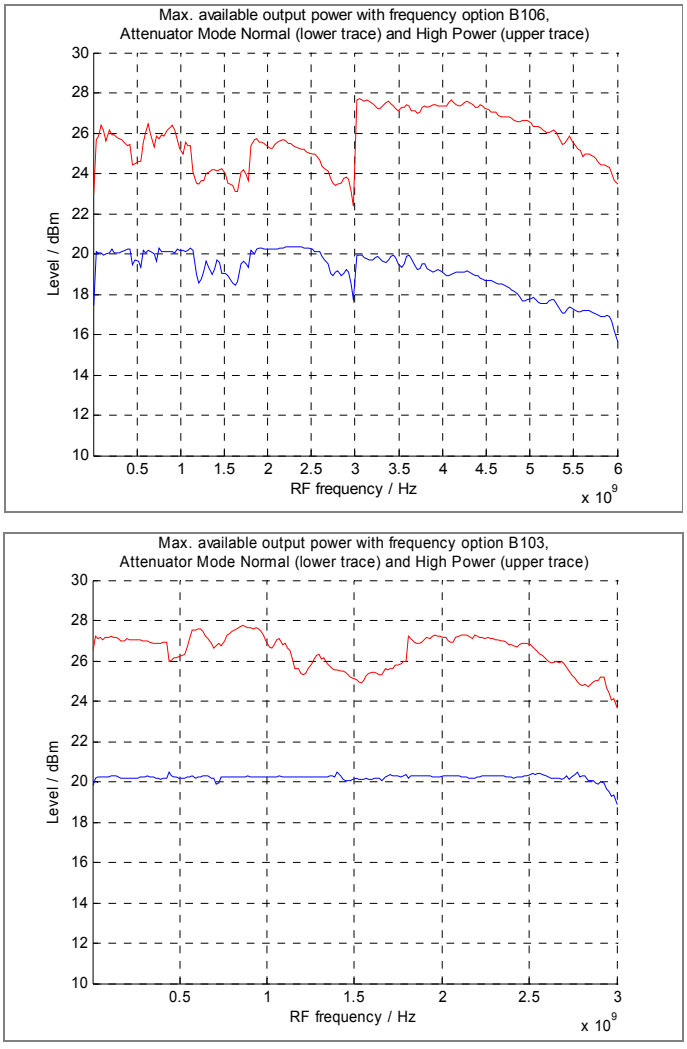
[1] Installation of software that is not authorized by Rohde & Schwarz for use on the R&S®SMU200A or installation of antivirus software can deteriorate the setting time performance.

Level

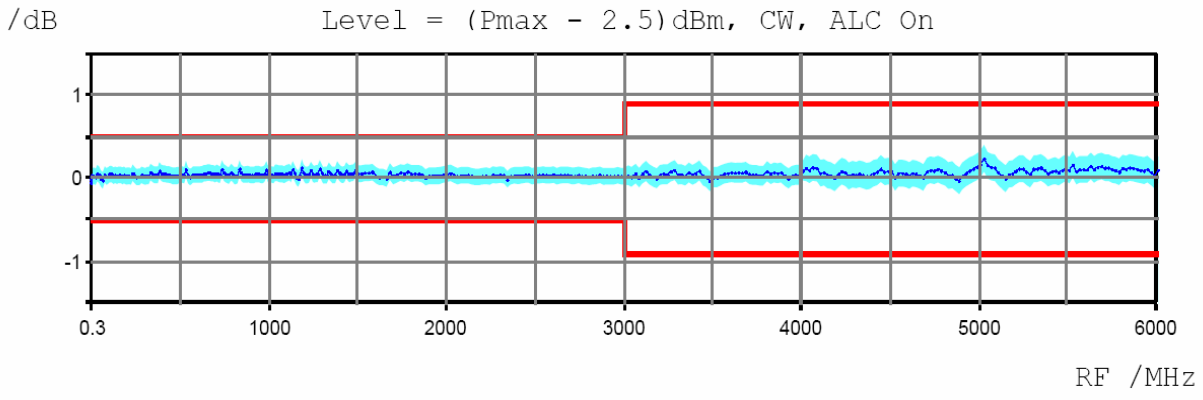
Setting range	standard	–145 dBm to +20 dBm
	with R&S®SMU-B31 or R&S®SMU-B36 option	to +30 dBm
Maximum level	standard	
	f ≤ 3 GHz	+13 dBm (PEP) [2]
	f > 3 GHz	+11 dBm (PEP)
	with R&S®SMU-B31 or R&S®SMU-B36 option	
	f ≤ 3 GHz	+19 dBm (PEP)
	f > 3 GHz	+17 dBm (PEP)
Resolution		0.01 dB
Level uncertainty	for levels > –120 dBm, attenuator mode: auto, temperature range = +18 °C to +28 °C	
	1 MHz ≤ f ≤ 3 GHz	< 0.5 dB
	f > 3 GHz	< 0.9 dB
Additional uncertainty with ALC state: off (sample & hold)	This function is needed only for some special applications.	< 0.2 dB
Output impedance VSWR in 50 Ω system	standard, ALC state: on	
	f ≤ 3 GHz	< 1.6, < 1.4 (typ.)
	f > 3 GHz	< 1.85, < 1.6 (typ.)
	with R&S®SMU-B31 or R&S®SMU-B36 option, ALC state: on	
	attenuator mode: normal	
	f ≤ 3 GHz	< 1.65, < 1.45 (typ.)
	f > 3 GHz	< 1.9, < 1.65 (typ.)
	attenuator mode: high power	
	f ≤ 3 GHz	< 1.7, < 1.5 (typ.)
	f > 3 GHz	< 1.9, < 1.65 (typ.)
Setting time [1]	after IEC/IEEE bus delimiter, to < 0.1 dB deviation from final value, with GUI update stopped, temperature range = +18 °C to +28 °C	
	ALC state: on	< 2 ms, 1.5 ms (typ.)
	ALC state: off	< 4 ms, 2.5 ms (typ.)
	in list mode after trigger impulse to 0.3 dB deviation from final value	< 450 µs, 300 µs (typ.)
	range switchover with R&S®SMU-B31 or R&S®SMU-B36 option	< 10 ms
Uninterrupted level setting	attenuator mode: fixed, ALC state: on	
	setting range	> 20 dB
Back-feed (from ≥ 50 Ω source)	maximum permissible RF power in output frequency range for f > 1 MHz	
	1 MHz ≤ f ≤ 3 GHz	50 W
	f > 3 GHz	10 W
	maximum permissible DC voltage	50 V

[2] PEP = peak envelope power.

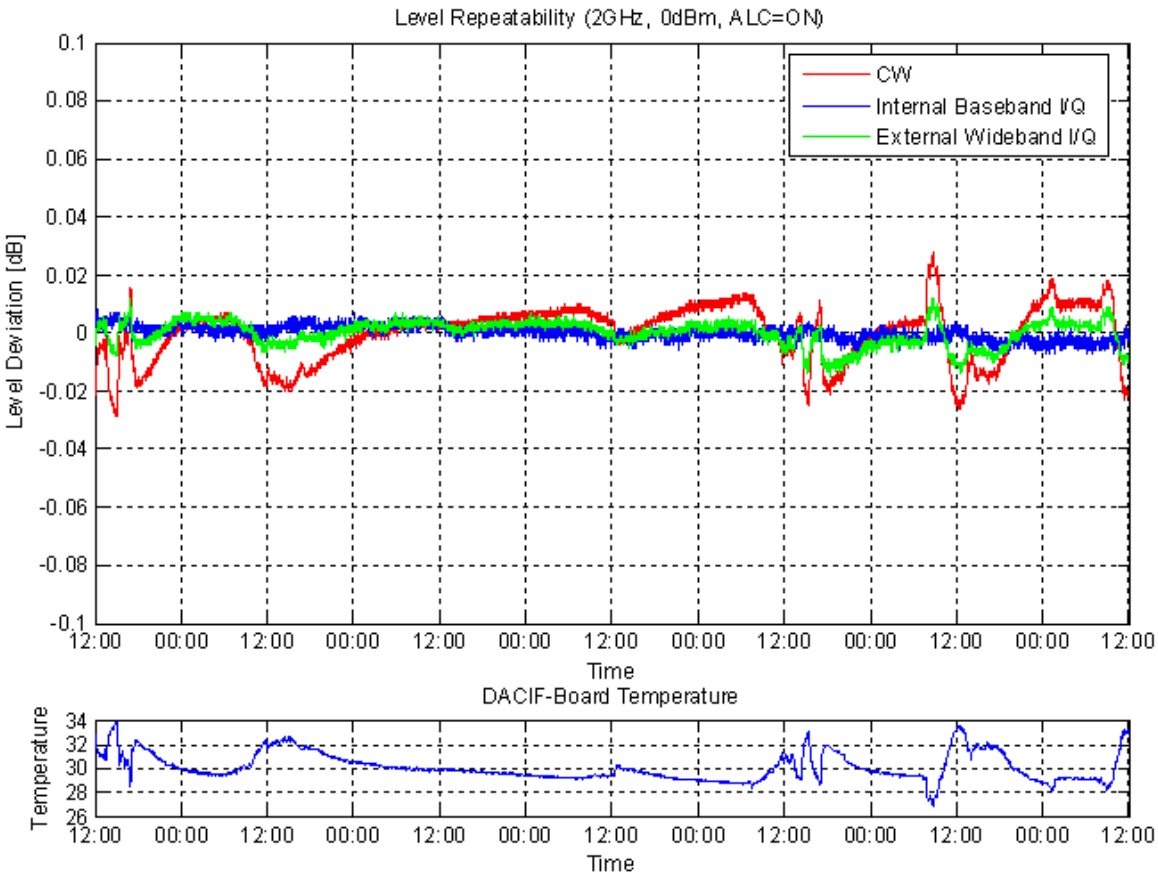
Measured level data



Measured maximum available output level versus frequency.



Measured level uncertainty versus frequency.



Measured level repeatability over 6 days with random settings between measurements
(DACIF board temperature: internal temperature test point, variations caused by changes of ambient temperature).

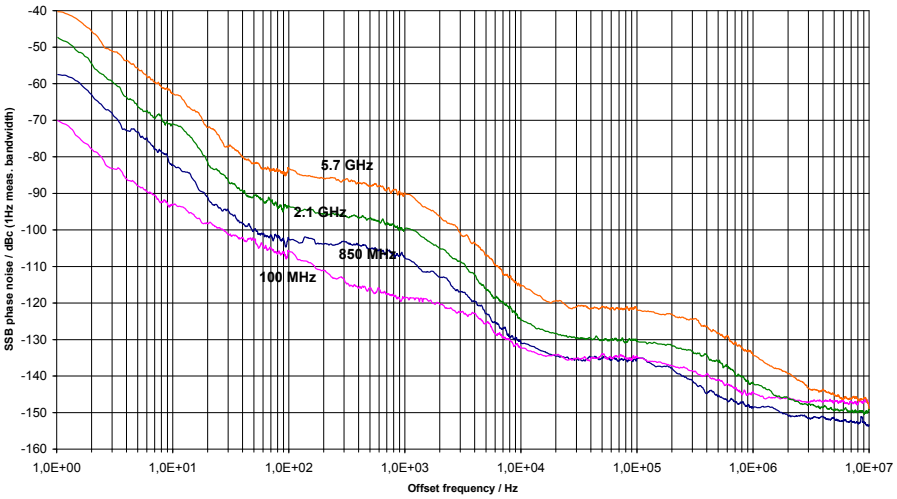
Level sweep

Operating modes	digital sweep in discrete steps	auto, single, step, external single, external step, manual or external trigger
Sweep range		level range of attenuator modes normal or high power
Step width	logarithmic	0.1 dB to 20 dB per step
Dwell time	range	10 ms to 10 s
	resolution	0.1 ms

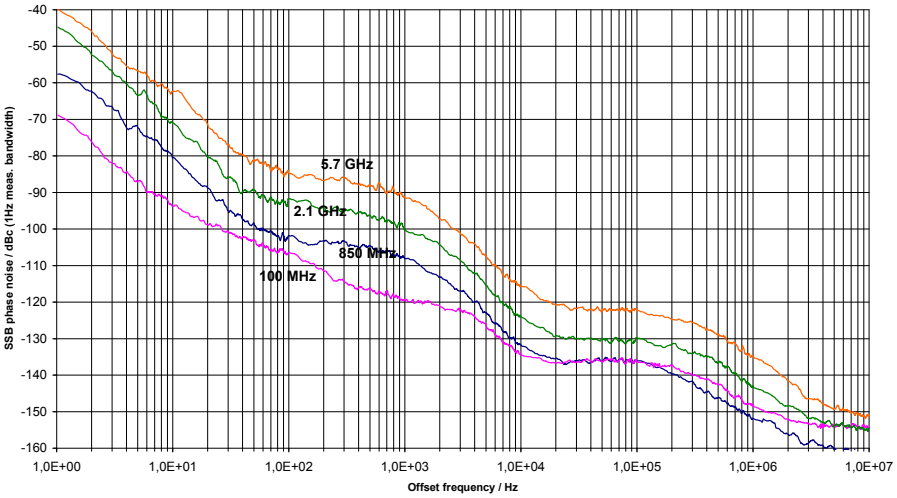
Spectral purity

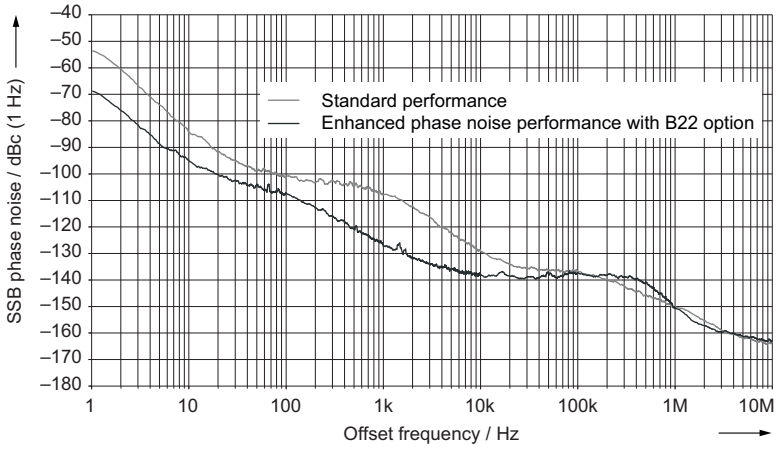
Harmonics	standard, unmodulated	
	level < 8 dBm	< –30 dBc
	level < 13 dBm	< –30 dBc (typ.)
	with R&S®SMU-B31 or R&S®SMU-B36 option, level < 12 dBm	< –30 dBc
Nonharmonics	level > –50 dBm, CW, vector modulation (full-scale DC input), > 10 kHz offset from carrier and outside the modulation spectrum	
	0.3 MHz ≤ f ≤ 200 MHz	< –77 dBc
	200 MHz < f ≤ 1500 MHz	< –80 dBc
	1500 MHz < f ≤ 3000 MHz	< –74 dBc
	f > 3000 MHz	< –68 dBc
	> 850 kHz offset from carrier and outside the modulation spectrum	
	0.3 MHz ≤ f ≤ 200 MHz	< –77 dBc
	200 MHz < f ≤ 1500 MHz	< –86 dBc
	1500 MHz < f ≤ 3000 MHz	< –80 dBc
	f > 3000 MHz	< –74 dBc
Nonharmonics with R&S®SMU-B22 option	level > –50 dBm, CW, vector modulation (full-scale DC input), > 10 kHz offset from carrier and outside the modulation spectrum	
	0.3 MHz ≤ f ≤ 200 MHz	< –77 dBc (–87 dBc (typ.))
	200 MHz < f ≤ 1500 MHz	< –90 dBc
	1500 MHz < f ≤ 3000 MHz	< –84 dBc
	f > 3000 MHz	< –78 dBc
Power supply and mechanically related nonharmonics	at RF = 1 GHz, 50 Hz to 10 kHz from carrier	< –70 dBc
Subharmonics	1500 MHz < f ≤ 3000 MHz	< –74 dBc
	f > 3000 MHz	< –50 dBc
Wideband noise	> 10 MHz carrier offset, 1 Hz measurement bandwidth, CW	
	20 MHz ≤ f ≤ 200 MHz	< –146 dBc (–149 dBc (typ.))
	200 MHz < f ≤ 1500 MHz	< –150 dBc (–153 dBc (typ.))
	1.5 GHz < f ≤ 3 GHz	< –148 dBc (–151 dBc (typ.))
	f > 3 GHz	< –146 dBc (–149 dBc (typ.))
	vector modulation with full-scale DC input, 3 dB I/Q input gain	
	20 MHz ≤ f ≤ 200 MHz	< –143 dBc (–146 dBc (typ.))
	200 MHz < f ≤ 1500 MHz	< –146 dBc (–149 dBc (typ.))
	1.5 GHz < f ≤ 3 GHz	< –145 dBc (–148 dBc (typ.))
	f > 3 GHz	< –143 dBc (–146 dBc (typ.))
SSB phase noise	20 kHz carrier offset, 1 Hz measurement bandwidth, CW	
	20 MHz ≤ f ≤ 200 MHz	< –128 dBc (–132 dBc (typ.))
	f = 1 GHz	< –131 dBc (–135 dBc (typ.))
	f = 2 GHz	< –125 dBc (–129 dBc (typ.))
	f = 3 GHz	< –121 dBc (–125 dBc (typ.))
	f = 4 GHz	< –119 dBc (–123 dBc (typ.))
	f = 6 GHz	< –115 dBc (–119 dBc (typ.))
SSB phase noise with R&S®SMU-B22 option	20 kHz carrier offset, 1 Hz measurement bandwidth, CW	
	20 MHz ≤ f ≤ 200 MHz	< –135 dBc (–138 dBc (typ.))
	f = 1 GHz	< –136 dBc (–139 dBc (typ.))
	f = 2 GHz	< –130 dBc (–133 dBc (typ.))
	f = 3 GHz	< –126 dBc (–129 dBc (typ.))
	f = 4 GHz	< –124 dBc (–127 dBc (typ.))
	f = 6 GHz	< –120 dBc (–123 dBc (typ.))
Residual FM	RMS value at f = 1 GHz	
	300 Hz to 3 kHz	< 1 Hz
	20 Hz to 23 kHz	< 4 Hz
Residual AM	RMS value from 20 Hz to 23 kHz	< 0.02 %

Measured SSB phase noise, I/Q modulated



Measured SSB phase noise, unmodulated





Measured SSB phase noise, f = 1 GHz, comparison of standard performance and performance with R&S®SMU-B22 option.

List mode

Frequency and level values can be stored in a list and set in an extremely short amount of time.		
Operating modes		automatic, single sweep, manual or external trigger, fast hopping with immediate and external trigger
Max. number of channels		10000
Dwell time		1 ms to 1 s
Resolution		0.1 ms
Setting time	after external trigger	see frequency and level data
	additional trigger delay in two-path units, both paths operated in list mode	< 200 µs

Phase coherence (R&S®SMU-B90 option)

The R&S®SMU-B90 provides phase-coherent RF outputs of two or more RF paths for one or more instruments with I/Q modulation.

The R&S®SMU-B90 option can be installed in any R&S®SMU200A with serial number 103001 or higher.

Coupling modes	internal	This mode corresponds to normal operation. Each RF path uses its internal local oscillator.
	external	An external signal is used for path A. With a two-path instrument, the internal local oscillator signal is used for path B.
	coupled A –> B	The local oscillator signal of path A is also used for path B (only for two-path instruments).
	externally coupled A –> B	An external signal is input at the LO IN connector and used for the coupled paths A and B (only for two-path instruments).
LO out state	The internal local oscillator signal used with path A is also available on the LO OUT connector (in order to couple two instruments).	on
	The LO OUT signal is switched off.	off
Frequency range	internal mode (no LO coupling)	
	underrange	100 kHz to < 300 kHz
	R&S®SMU-B102, R&S®SMU-B202	up to 2 GHz
	R&S®SMU-B103, R&S®SMU-B203,	up to 3 GHz
	R&S®SMU-B104	up to 4 GHz
	R&S®SMU-B106	up to 6 GHz
	external modes, coupled A –> B, externally coupled A –> B	
	R&S© SMU-B102 and R&S© SMU-B202	200 MHz to 2 GHz
	R&S© SMU-B103 and R&S© SMU-B203	200 MHz to 3 GHz
	other configurations	Coupling is possible within the smallest common frequency range of all RF paths to be coupled.
Levels of external local oscillator signals	LO IN	10 dBm to 16 dBm (nom.)
	LO OUT	13 dBm (nom.)

Phase	drift	
	versus temperature	0.1° (nom.) when ambient temperature changes by 1 °C
	versus time	0.02°/h (nom.)
	versus level	2°/dB (nom.)
	setting range (with baseband phase offset)	0.00° to 359.99°
	setting resolution	0.01°

Analog modulation

Internal modulation generator

Frequency range		0.1 Hz to 1 MHz
Resolution of setting		0.1 Hz
Frequency uncertainty		< 0.012 Hz + relative deviation of reference frequency
Frequency response	up to 100 kHz	< 0.1 dB
	up to 1 MHz	< 1 dB
Distortion	up to 100 kHz at R_L > 200 Ω, level = 1 V (V_p)	< 0.1 %
Output voltage	V_p at LF connector, R_L > 200 Ω	1 mV to 3 V
	resolution	1 mV
	setting uncertainty at 1 kHz	< (1 % of reading + 1 mV)
Output impedance		16 Ω
Frequency setting time	to within < 1 × 10^{-7}, with GUI update stopped, after IEC/IEEE bus delimiter	< 3 ms
Sweep	digital sweep in discrete steps	
	operating modes	automatic, step, single, external single, external step, manual or external trigger, linear or logarithmic spacing
	sweep range	entire frequency range
	linear step width	entire frequency range
	logarithmic step width	0.01 % to 100 % per step

Input for external modulation signals

Modulation input EXT MOD	input impedance	high (> 100 kΩ), switchable to 50 Ω with R&S®SMU-B20 or R&S®SMU-B22 option
	input sensitivity (peak value for set modulation depth or deviation)	1 V
	maximum permissible input voltage	±10 V

Amplitude modulation

Operating modes			internal, external AC/DC
Modulation depth	modulation is clipped at high levels if maximum PEP is reached		0 % to 100 %
Resolution			0.1 %
Setting uncertainty	attenuator mode: auto, f_{mod} = 1 kHz and m < 80 %		< (1 % of reading + 1 %)
AM distortion	PEP in specified range, attenuator mode: auto		
	f ≤ 3 GHz, at f_{mod} = 1 kHz,	m = 30 %	< 0.5 %
		m = 80 %	< 0.8 %
	f > 3 GHz, at f_{mod} = 1 kHz,	m = 30 %	< 1 %
		m = 80 %	< 1.6 %
Modulation frequency range			DC, 20 Hz to 500 kHz
Modulation frequency response	AC mode, 20 Hz to 500 kHz		< 1 dB
Synchronous φM at AM	m = 30 %, f_{mod} = 1 kHz, peak value		< 0.1 rad

Wideband amplitude modulation

Operating modes	modulation input I	external DC
Modulation frequency response	as with I/Q modulation – external wideband I/Q	
Input impedance		50 Ω
Input sensitivity	peak voltage for 100 % AM	0.25 V

Pulse modulation

Operating modes		external, internal (duty cycle approx. 1:1)
On/off ratio		> 70 dB
Rise/fall time	10 %/90 % of RF amplitude	1 µs (typ.)
Pulse repetition frequency		0 Hz to 100 kHz
Video crosstalk	spectral line of fundamental of 100 kHz square-wave modulation	< –30 dBc
Modulation input EXT MOD A/B	input level	rising 1.7 V, falling 1.1 V (typ.)
	input impedance	> 10 kΩ
	polarity	selectable

Frequency modulation (R&S®SMU-B20 or R&S®SMU-B22 option)

Operating modes		internal, external, internal + external, AC/DC, normal, low noise (with R&S®SMU-B22 only)
FM/φM range multiplier	0.3 MHz ≤ f ≤ 200 MHz	rm = 1
	200 MHz < f ≤ 375 MHz	rm = 0.25
	375 MHz < f ≤ 750 MHz	rm = 0.5
	750 MHz < f ≤ 1500 MHz	rm = 1
	1500 MHz < f ≤ 3000 MHz	rm = 2
	f > 3000 MHz	rm = 4
Maximum deviation	FM mode: normal	rm × 10 MHz
	FM mode: low noise	rm × 100 kHz
Resolution		< 200 ppm, min. rm × 0.1 Hz
Setting uncertainty	f_{mod} = 10 kHz, deviation ≤ half of maximum deviation	
	internal	< (1.5 % of reading + 20 Hz)
	external	< (2.0 % of reading + 20 Hz)
FM distortion	f_{mod} = 10 kHz and 1 MHz deviation	< 0.1 %
Modulation frequency response	FM mode: normal	
	10 Hz to 100 kHz	< 0.5 dB
	10 Hz to 10 MHz	< 3 dB
	FM mode: low noise	
	10 Hz to 100 kHz	< 3 dB
Synchronous AM	40 kHz deviation, f_{mod} = 1 kHz, f > 5 MHz	< 0.1 %
	f > 3 GHz	< 0.2 %
Carrier frequency offset at FM		< 0.2 % of set deviation

Phase modulation (R&S®SMU-B20 or R&S®SMU-B22 option)

Operating mode		internal, external, internal + external, AC/DC, high bandwidth, high deviation, low noise (with R&S®SMU-B22 only)
Maximum deviation	φM mode: high deviation	rm × 20.0 rad
	φM mode: high bandwidth	rm × 1.0 rad
	φM mode: low noise	rm × 0.25 rad
Resolution	φM mode: high deviation	< 200 ppm, min. rm × 20 µrad
	φM mode: high bandwidth	< 0.1 %, min. rm × 20 µrad
	φM mode: low noise	< 200 ppm, min. rm × 20 µrad
Setting uncertainty	f_{mod} = 10 kHz, deviation ≤ half of maximum deviation	
	internal	< (1.5 % of reading + 0.01 rad)
	external	< (2.0 % of reading + 0.01 rad)
φM distortion	f_{mod} = 10 kHz, half of maximum deviation	< 0.2 %, 0.1 % (typ.)
Modulation frequency response	10 Hz to 500 kHz, φM mode: high deviation	< 1 dB
	10 Hz to 10 MHz, φM mode: high bandwidth	< 3 dB
	10 Hz to 100 kHz, φM mode: low noise	< 3 dB

I/Q modulation

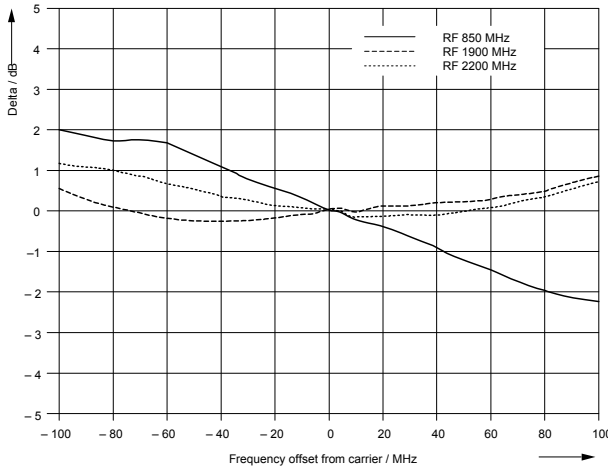
I/Q modulator

Operating modes		external wideband I/Q, internal baseband I/Q
I/Q impairments	I offset, Q offset	
	setting range	–10 % to +10 %
	resolution	0.01 %
	gain imbalance	
	setting range	–1.0 dB to +1.0 dB
	resolution	0.001 dB
	quadrature offset	
	setting range	–10° to +10°
	resolution	0.01°
I/Q swap	I and Q signals swapped	on/off

External wideband I/Q

This type of modulation is possible only in path A.

I/Q inputs	input impedance	50 Ω
	VSWR up to 50 MHz	< 1.2
	input voltage for full-scale input	$\sqrt{V_i^2 + V_q^2} = 0.5$ V
	minimum input voltage for ALC state: on	0.1 V
Modulation frequency range	I/Q wideband: on	100 MHz
RF frequency response for entire instrument in modulation bandwidth	I/Q wideband: on	
	up to 50 MHz	< 6 dB (typ.)
	up to 5 MHz	< 1.0 dB (typ.)
Carrier leakage	without input signal, referenced to full-scale input [3]	< –55 dBc, < –65 dBc (typ.)
Error vector	measured with 16QAM, root cosine filter, α = 0.5, symbol rate 10 kHz	
	RMS value	
	f ≤ 200 MHz	< 0.3 %
	f > 200 MHz	< (0.2 % + 0.1 % × f/GHz)
	peak value	
	f ≤ 200 MHz	< 0.6 %
	f > 200 MHz	< (0.4 % + 0.2 % × f/GHz)



Measured frequency response of external wideband I/Q modulation.

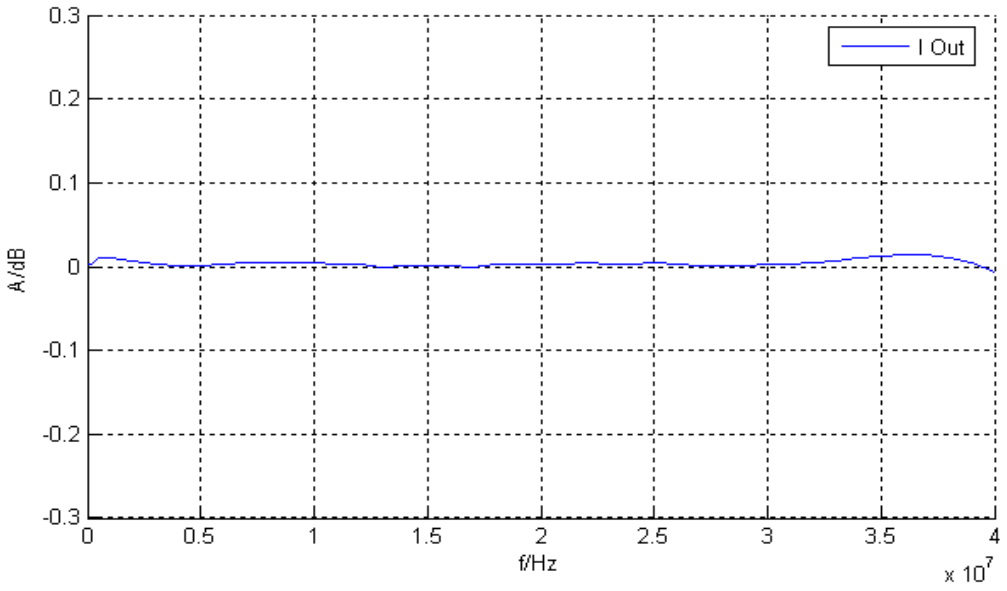
[3] Value applies after 1 hour warm-up time and recalibration for 4 hours of operation and temperature variations of less than +5 °C.

Internal baseband I/Q (with R&S®SMU-B13 option)

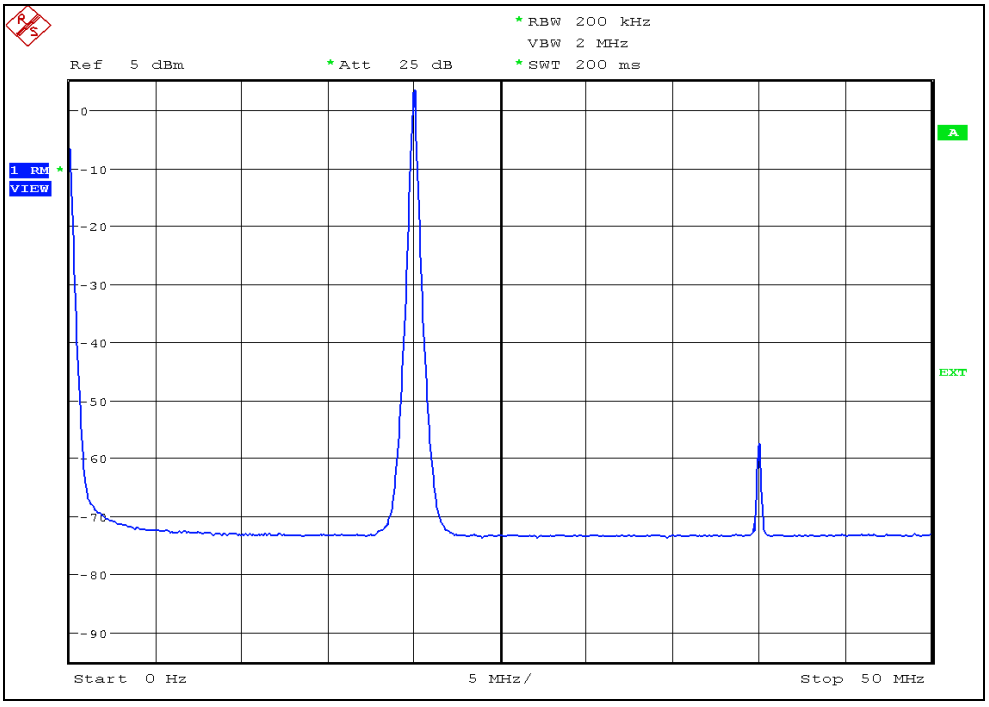
The R&S®SMU-B13 option converts the internal digital baseband signals of the R&S®SMU-B9/-B10/-B11 into analog signals for driving the I/Q modulator. It also generates the analog I/Q output signals. One or two R&S®SMU-B13 can be installed.
The first R&S®SMU-B13 drives RF path A, the second RF path B. The I/Q output signals are available either for path A or B.

D/A converter	data rate	100 MHz
	resolution	16 bit
	sample rate	400 MHz (internal interpolation × 4)
Aliasing filter	with amplitude, group delay and S_i correction	
	bandwidth, roll-off to –0.1 dB	40 MHz
	D/A converter interpolation spectra	
	up to 10 MHz	< –80 dBc
	up to 40 MHz	< –73 dBc
I/Q impairment	carrier leakage	
	setting range	–10 % to +10 %
	resolution	0.01 %
	I ≠ Q (imbalance)	
	setting range	–1 dB to +1 dB
	resolution	0.001 dB
	quadrature offset	
	setting range	–10° to +10°
	resolution	0.01°
RF frequency response for entire instrument in modulation bandwidth	f > 100 MHz, –20 dBm ≤ level ≤ 10 dBm, I/Q wideband: on, optimize internal I/Q impairments for RF output: on, optimization mode: high quality	
	up to 10 MHz	< 0.5 dB, 0.1 dB (typ.)
	up to 40 MHz	< 2.0 dB, 0.3 dB (typ.)
Suppression of image sideband for entire instrument in modulation bandwidth [3]	up to 10 MHz	> 50 dB, 56 dB (typ.)
	up to 40 MHz	> 40 dB, 50 dB (typ.)
Carrier leakage [3]	referenced to full-scale input	< –55 dBc, < –65 dBc (typ.)
Additional level uncertainty referenced to CW	measured at 0 dBm with 16QAM, root cosine filter, α = 0.5, 10 kHz symbol rate	< 0.2 dB
I/Q outputs		
Output impedance		50 Ω
Output voltage	EMF (output voltage depends on set modulation signal)	1 V (V_p)
Offset	EMF	< 1 mV
Frequency response [4]	at R_L = 50 Ω	
	magnitude	
	up to 10 MHz	0.02 dB (typ.)
	up to 40 MHz	0.03 dB (typ.)
	nonlinear phase	
	up to 10 MHz	0.1° (typ.)
	up to 30 MHz	0.2° (typ.)
I/Q balance [4]	at R_L = 50 Ω	
	magnitude	
	up to 10 MHz	0.01 dB (typ.)
	up to 40 MHz	0.02 dB (typ.)
	nonlinear phase	
	up to 10 MHz	0.1° (typ.)
	up to 30 MHz	0.2° (typ.)
Spectral purity	at R_L = 50 Ω	
	SFDR (sine)	
	up to 2 MHz	> 70 dB
	up to 20 MHz	60 dB (typ.)
	phase noise	
	10 MHz sine wave at 20 kHz offset	–150 dBc (typ.)
	wideband noise	
	10 MHz sine wave at 1 MHz offset	–155 dBc (typ.)

[4] Optimize internal I/Q impairments for RF output switched off.



Measured frequency response of I/Q outputs.



Measured SFDR of I/Q outputs.

Differential I/Q output (R&S®SMU-B16 option)

One R&S®SMU-B16 option can be installed; the I/Q output signals are available either for path A or B.
This option is not compatible with rear-panel outputs (R&S®SMU-B81 and R&S®SMU-B82 options).

Additional specifications for I/Q outputs with R&S®SMU-B16 option		
Output impedance		
Single-ended		50 Ω
Differential		100 Ω
Output voltage	output voltage depends on set modulation signal	
Single-ended	EMF	0.02 V to 2 V (V_p)
Resolution		1 mV
Differential	EMF	0.04 V to 4 V (V_{pp})
Resolution		2 mV
Bias voltage (single-ended and differential)	EMF	–3.6 V to +3.6 V
Resolution		2 mV
Uncertainty		1 % + 4 mV
Offset voltage		
Differential	EMF	–300 mV to +300 mV
Resolution		0.2 mV
Uncertainty		1 % + 0.1 % × bias voltage + 1 mV
Differential signal balance	at R_L = 50 Ω, output voltage > 0.5 V (V_p)	
	magnitude	
	up to 10 MHz	< 0.2 dB, 0.05 dB (typ.)
	up to 40 MHz	0.2 dB (typ.)
Frequency response [5]	at R_L = 50 Ω, output voltage > 0.5 V (V_p)	
	magnitude	
	up to 10 MHz	0.02 dB (typ.)
	up to 40 MHz	0.03 dB (typ.)
	nonlinear phase	
	up to 10 MHz	0.1° (typ.)
	up to 30 MHz	0.2° (typ.)

Digital baseband output (R&S®SMU-B18 option)

The R&S®SMU-B18 option makes digital I/Q signals available on the rear panel of the instrument. The digital I/Q output can be used for the lossless connection of the R&S®SMU200A to the digital I/Q input of other Rohde & Schwarz instruments (e.g. R&S®AMU200A baseband signal generator and fading simulator). One R&S®SMU-B18 can be installed.

Interface	standard	in line with Rohde & Schwarz TVR290, I/Q data and control signals, data and interface clock
	level	LVDS
	connector	26-pin MDR
	data rate	30 MHz to 100 MHz with 1 MHz resolution, 81.6 MHz
I/Q sample rate	With source ‘user-defined’, the sample rate must be entered via the parameter ‘sample rate’, no I/Q data clock being necessary. With source ‘digital I/Q out’ or ‘digital I/Q in’, the sample rate will be estimated on the basis of the applied I/Q data clock.	
	source	user-defined, digital I/Q out, digital I/Q in
	sample rate	400 Hz to 100 MHz
		max. sample rate limited by actual interface data rate
	resolution (user-defined)	0.001 Hz
	frequency uncertainty (user-defined)	< 5 × 10^{-14}

[5] Optimize internal I/Q impairments for RF output switched off.

I/Q data	resolution	18 bit
	logic format	two's complement
	physical signal level	
	setting range	0 to –60 dBFS
	resolution	0.01 dBFS
	bandwidth	
	sample rate = 100 MHz (no interpolation, user-defined)	40 MHz
	sample rate < 100 MHz (interpolation)	0.31 × sample rate
Control signals	markers	4
	data valid	valid samples marked in data stream

Baseband input (analog/digital) (R&S®SMU-B17 option)

At least one R&S®SMU-B13 baseband main module and at least one R&S®SMU-B9/-B10/-B11 I/Q baseband generator must be installed. The R&S®SMU-B17 option makes it possible to feed external analog or digital signals to the baseband section of the R&S®SMU200A. The frequency of the signals can be shifted, and the signals can be added to the internally generated signal with settable level ratio. If the R&S®SMU200A is equipped with a fading simulator, the input signals can also be faded.

Mode	see also simultaneous modulation	analog input, digital input
Input level	peak level	
	setting range	–10 dB to 0 dB referenced to full scale
	resolution	0.01 dB
	crest factor	
	setting range	0 dB to 30 dB
	resolution	0.01 dB
	The adjust level function automatically determines the peak level and crest factor of the input signal.	
Frequency offset	The frequency offset can be used to shift the center frequency of the input signal in the baseband. The restrictions caused by the modulation bandwidth apply.	
	setting range	–40 MHz to +40 MHz
	resolution	0.01 Hz
	frequency accuracy	< 5 × 10 – 10 × frequency offset + reference frequency error
I/Q swap	I and Q signals swapped	on/off
Analog I/Q inputs All specifications apply to a peak level of 0 dB.		
I/Q inputs	input impedance	50 Ω
	VSWR up to 30 MHz	< 1.1, 1.03 (typ.)
	input voltage for full-scale input	$\sqrt{V_i^2 + V_q^2} = 0.5\ V$
I/Q impairment	carrier leakage I, Q	
	setting range	–10 % to +10 %
	resolution	0.01 %
	I ≠ Q (imbalance)	
	setting range	–3 dB to +3 dB
	resolution	0.001 dB
	I/Q skew	
	setting range	–1 ns to +1 ns
	resolution	1 ps
A/D converter	sample rate	100 MHz
	resolution	14 bit
Aliasing filter	with amplitude and group delay correction	
	bandwidth, roll-off to –0.1 dB	30 MHz
	stopband rejection, f ≥ 70 MHz	80 dB (typ.)
RF frequency response for entire instrument in modulation bandwidth	I/Q wideband: on, optimize internal I/Q impairments for RF output: on	
	up to 10 MHz	0.2 dB (typ.)
	up to 30 MHz	0.4 dB (typ.)

Carrier leakage	referenced to full scale	< –55 dBc, < –65 dBc (typ.)
Suppression of image sideband for entire instrument in modulation bandwidth	up to 10 MHz	56 dB (typ.)
	up to 30 MHz	50 dB (typ.)
RF spectral purity	wideband noise, with full-scale DC input	
	20 MHz ≤ f ≤ 200 MHz	–145 dBc (typ.)
	200 MHz < f ≤ 1.5 GHz	–148 dBc (typ.)
	1.5 GHz < f ≤ 3 GHz	–148 dBc (typ.)
	f > 1.5 GHz	–145 dBc (typ.)
	ACLR with an ideal input signal, 3GPP test model 1, 64 DPCH	
	level ≤ 10.5 dBm PEP, ≤ 16.5 dBm PEP with R&S®SMU-B31, R&S®SMU-B36 options	
	frequency = 1800 MHz to 2200 MHz	
	5 MHz offset (baseband gain: 3 dB)	70 dB (typ.)
	10 MHz offset (baseband gain: 6 dB)	73 dB (typ.)
Digital I/Q inputs		
Interface	standard	in line with Rohde & Schwarz TVR290, I/Q data and control signals, data and interface clock
	level	LVDS
	connector	26-pin MDR
	data rate	66 MHz to 100 MHz
I/Q sample rate (max. sample rate depends on interface data rate) With source ‘user-defined’, the sample rate must be entered via the parameter ‘sample rate’, no I/Q data clock being necessary. With source ‘digital I/Q in’, the sample rate will be estimated on the basis of the applied I/Q data clock.	source	user-defined, digital I/Q in
	sample rate	400 Hz to 100 MHz
	resolution (user-defined)	0.001 Hz
	frequency uncertainty (user-defined)	$< 5 \times 10^{-14}$
I/Q data	resolution	18 bit
	logic format	two’s complement
	bandwidth	
	sample rate = 100 MHz (no interpolation, user-defined)	40 MHz
	sample rate < 100 MHz (interpolation)	0.31 × sample rate
Control signals	markers	4
	data valid	valid samples marked in data stream

I/Q baseband generator (R&S®SMU-B9/-B10/-B11 option) – arbitrary waveform mode

At least one R&S®SMU-B13 baseband main module must be installed. One or two R&S®SMU-B9/-B10/-B11 options can be installed. Their I/Q signals can be assigned a frequency offset and/or be added in the digital domain with settable level ratio.

Waveform memory	output memory	
	waveform length with R&S®SMU-B9 option	128 sample to 128 Msample in one-sample steps
	waveform length with R&S®SMU-B10 option	128 sample to 64 Msample in one-sample steps
	waveform length with R&S®SMU-B11 option	128 sample to 16 Msample in one-sample steps
	resolution	16 bit
	loading time 10 Msample	15 s
	nonvolatile memory	hard disk
Multisegment waveform	number of segments	max. 1024 segments
	changeover modes	GUI, remote control, external trigger
	extended trigger modes	same segment, next segment, next segment seamless, sequencer
	changeover time at 50 MHz clock rate (external trigger, without clock change)	5 µs (meas.)
	seamless changeover	output up to end of current segment, followed by changeover to next segment
	sequencer play list length	max. 96
	sequencer segment repetitions	max. 65535
Multicarrier waveform	number of carriers	max. 32
	total RF bandwidth	max. 80 MHz
	crest factor modes	maximize, minimize, off
	signal period modes	longest file, shortest file, user (max. 1 s)
	single carrier gain	–80 dB to 0 dB
	single carrier start phase	0° to 360°
	single carrier delay	0 s to 1 s
Clock generation	clock rate	400 Hz to 100 MHz
	resolution	0.001 Hz
	operating mode	internal, external
	frequency uncertainty (internal)	$< 5 \times 10^{-14}$ × clock rate + uncertainty of reference frequency
Interpolation	The sample rate of the waveform is automatically interpolated to the internal 100 MHz data rate.	
	bandwidth	
	clock rate = 100 MHz (no interpolation), roll-off to –0.1 dB	40 MHz
	clock rate ≤ 100 MHz, drop to –0.1 dB	0.31 × clock rate
Frequency offset	The frequency offset can be used to shift the center frequency of the wanted baseband signal. The restrictions caused by the modulation bandwidth apply.	
	range	–40 MHz to +40 MHz
	resolution	0.01 Hz
	frequency uncertainty	< 5 × 10 – 10 × frequency offset + reference frequency error

Triggering	In internal clock mode, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In external clock mode, the trigger event is synchronized to the symbol clock.	
	operating mode	internal, external
	modes	auto, retrig, armed auto, armed retrig
	setting uncertainty for clock phase related to trigger in internal clock mode	< 18 ns
	external trigger delay	
	setting range	0 sample to (2^{16} – 1) sample
	resolution	
	internal clock mode	0.01 sample
	external clock mode	1 sample
	setting uncertainty	< 5 ns
	external trigger inhibit	
	setting range	0 sample to (2^{26} – 1) sample
	resolution	1 sample
	external trigger pulse width	> 15 ns
	external trigger frequency	< 0.02 × sample rate
Marker outputs	number	4
	level	LVTTL
	operating modes	unchanged, restart, pulse, pattern, ratio
	marker delay	
	setting range	0 sample to (waveform length – 1) sample
	setting range without recalculation	0 sample to 2000 sample
	resolution of setting	0.001 sample
	setting uncertainty	< 10 ns
Operation with R&S®WinIQSIM2™: As of version 1.00, the software supports I/Q data download and control of the R&S®SMU-B9/-B10/-B11 options.		

I/Q baseband generator (R&S®SMU-B9/-B10/-B11 option) – realtime operation

At least one R&S®SMU-B13 baseband main module must be installed. One or two R&S®SMU-B9/-B10/-B11 options can be installed. Their I/Q signals can be assigned a frequency offset and/or be added in the digital domain with settable level ratio.

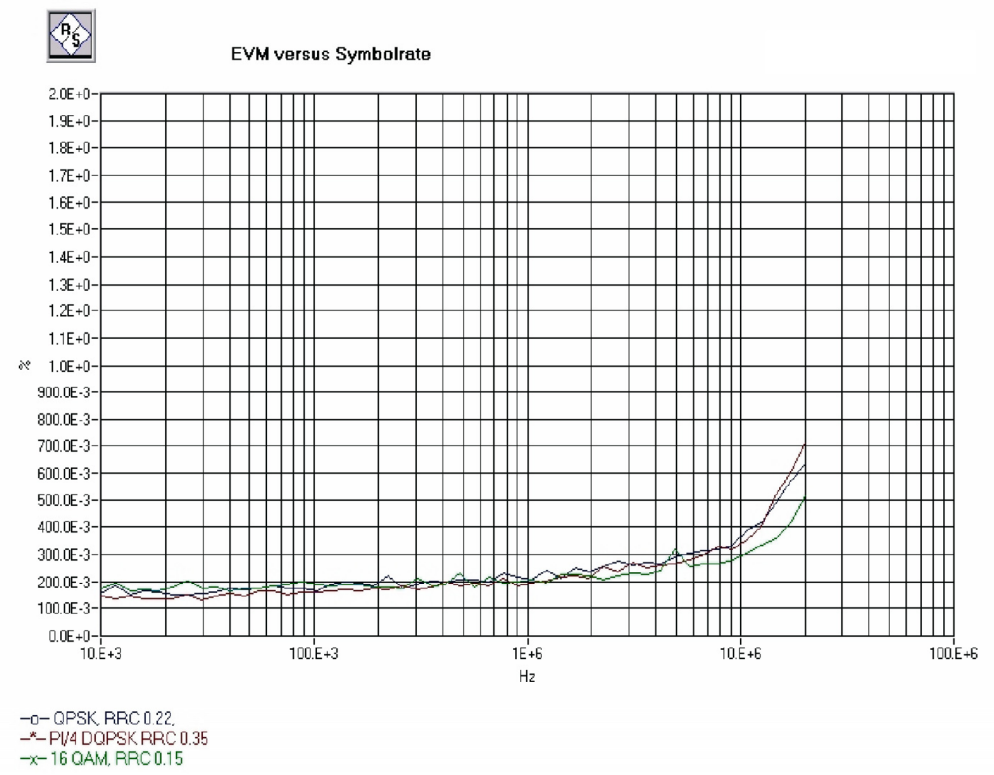
Types of modulation	ASK	
	modulation index	0 % to 100 %
	resolution	0.1 %
	FSK	2FSK, 4FSK, MSK
	deviation	0.1 to 1.5 × f_{sym}
	maximum	10 MHz
	resolution	< 0.1 Hz
	setting uncertainty	< 0.5 %
	variable FSK	4FSK, 8FSK, 16FSK
	deviations	–1.5 × f_{sym} to +1.5 × f_{sym}
	maximum	10 MHz
	resolution	< 0.1 Hz
	PSK	BPSK, QPSK, QPSK 45° offset, OQPSK, π/4-QPSK, π/2-DBPSK, π/4-DQPSK, π/8-D8PSK, 8PSK, 8PSK EDGE
	QAM	16QAM, 32QAM, 64QAM, 256QAM, 1024QAM
Coding	Not all coding methods can be used with every type of modulation.	off, differential, diff. phase, diff. + Gray, Gray, GSM, NADC, PDC, PHS, TETRA, APCO25 (PSK), PWT, TFTS, INMARSAT, VDL, EDGE, APCO25(FSK), ICO, CDMA2000® [6], WCDMA
Baseband filter	Any filter can be used with any type of modulation. The bandwidth of the modulation signal is max. 25 MHz; the signal is clipped if the bandwidth is exceeded.	
	cosine, root cosine	
	filter parameter α	0.05 to 1.00
	Gaussian	
	filter parameter B × T	0.15 to 2.50
	cdmaOne, cdmaOne + equalizer	
	cdmaOne 705 kHz,	
	cdmaOne 705 kHz + equalizer	
	CDMA2000® 3x	
	APCO25 C4FM	
	rectangular	
	split phase	
	filter parameter B × T	0.15 to 2.5
	resolution of filter parameter	0.01
Symbol rate	If an external clock is used, the applied data rate may deviate from the set clock rate by ±2 %. The external clock can be used for internal and external data.	
	operating mode	internal, external
	setting range	
	ASK, PSK, QAM	400 Hz to 25 MHz
	FSK	400 Hz to 15 MHz
	resolution	0.001 Hz
	frequency uncertainty (internal)	< 5 × 10^{-14} × symbol rate + reference frequency uncertainty
	external clock	symbol, K × symbol, bit clock
	clock divider K	1 to 64
	external clock rate	max. 100 MHz

[6] CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA - USA).

Frequency offset	The frequency offset can be used to shift the center frequency of the modulation signal in the baseband. The restrictions caused by the modulation bandwidth apply.	
	setting range	–40 MHz to +40 MHz
	resolution	0.01 Hz
	frequency uncertainty	< 5 × 10 – 10 × frequency offset + reference frequency error
Data sources	**internal**	
	All 0, All 1	
	PRBS	
	sequence length	9, 11, 15, 16, 20, 21, 23
	pattern	
	length	1 bit to 64 bit
	data lists	
	R&S®SMU-B9 output memory	8 bit to 4 Gbit
	R&S®SMU-B10 output memory	8 bit to 2 Gbit
	R&S®SMU-B11 output memory	8 bit to 512 Mbit
	nonvolatile memory	hard disk
	external	
	In the case of serial transmission, the symbol strobe marks the LSB of the symbol, and the maximum symbol rate is limited by the data rate of the interface.	
	serial	
	word width	1 bit to 10 bit
	bit rate	max. 60 MHz
	parallel	
	word width	1 bit to 10 bit
	symbol rate	max. 25 MHz
Triggering	In internal clock mode, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In external clock mode, the trigger event is synchronized to the symbol clock.	
	operating mode	internal, external
	modes	auto, retrig, armed auto, armed retrig
	setting uncertainty for clock phase related to trigger in internal clock mode	< 18 ns
	external trigger delay	
	setting range	0 sample to (2^{16} – 1) sample
	resolution	
	internal clock mode	0.01 sample
	external clock mode	1 sample
	setting uncertainty	< 5 ns
	external trigger inhibit	
	setting range	0 sample to (2^{26} – 1) sample
	resolution	1 sample
	external trigger pulse width	> 15 ns
	external trigger frequency	< 0.02 × sample rate

Marker outputs	number	4
	level	LVTTL
	operating modes	control list, restart, pulse, pattern, ratio
	marker delay (in sample)	
	setting range	0 to 2^{24} – 1
	setting range without recalculation	0 to 2000
	resolution of setting	0.001
	setting uncertainty	< 10 ns
Level reduction	Internal or external via LEVATT input. The signal switches between nominal and reduced level (without edge shaping). If an internal LEVATT signal is used, the connector is used as an output.	
	setting range	0 dB to 60 dB
	additional level error in case of reduction	
	up to 30 dB	< 1 dB
	up to 50 dB	< 3 dB
Burst	Internal or external via BURST input. The signal triggers the beginning of a power ramp. The positive edge starts power ramping from blank to full level, the negative edge ramping in the opposite direction from full level to blanking. If an internal BURST GATE signal is applied, the connector is used as an output.	
	operating range	max. 5 MHz
	rise/fall time	
	setting range	0.5 symbol to 16 symbol
	resolution	0.1 symbol
	ramp shape	cosine, linear
Trigger/clock/data inputs	The input impedance and trigger threshold can be set separately for the trigger and the clock/data inputs.	
	input impedance	1 kΩ, 50 Ω
	trigger threshold	
	setting range	0.00 V to 2.50 V
	resolution	0.01 V
Clock/data outputs	level	LVTTL

Predefined settings	modulation, filter, symbol rate and coding in line with standard	
	standards	Bluetooth® [7], DECT, ETC, GSM, GSM EDGE, NADC, PDC, PHS, TETRA, WCDMA 3GPP, TD-SCDMA, CDMA2000® Forward, CDMA2000® Reverse, Worldspace
Modulation errors		
Deviation error with 2FSK, 4FSK	deviation 0.2 to 0.7 × symbol rate	
	Gaussian filter with B × T = 0.2 to 0.7	
	symbol rate up to 2 MHz	< 1.2 %, 0.25 % (typ.)
	symbol rate up to 10 MHz	0.75 % (typ.)
Phase error with MSK	Gaussian filter with B × T = 0.2 to 0.7	
	bit rate up to 2 MHz	< 0.4°, 0.15° (typ.)
	bit rate up to 10 MHz	0.3° (typ.)
EVM with QPSK, OQPSK, π/4-DQPSK, 8PSK, 16QAM, 32QAM, 64QAM	cosine, root cosine filter with α = 0.2 to 0.7	
	symbol rate up to 5 MHz	< 0.8 %, 0.2 % (typ.)
	symbol rate up to 20 MHz	0.7 % (typ.)



Measured EVM versus symbol rate.

[7] The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Rohde & Schwarz is under license.

Modulation uncertainty for main standards

Typical values

Standard	GSM	EDGE	WCDMA 3GPP (1DPCH)	cdmaOne Reverse	DECT	TETRA	NADC	PDC	IEEE 802.11a
Frequency in MHz	400 to 2000	400 to 2000	1800 to 2200	800 to 900	1880 to 1990	380 to 480	824 to 894	810 to 956	2400 to 2485
				1850 to 2000			1850 to 2000	1429 to 1501	5150 to 5825
EVM in %	–	0.2	0.3	0.2	–	0.2	0.2	0.2	0.4
Phase error in °	0.15	–	–	–	–	–	–	–	–
Deviation error in kHz	–	–	–	–	0.5	–	–	–	–
Channel spacing	200 kHz	200 kHz	5 MHz	1.25 MHz	1.728 MHz	25 kHz	30 kHz	25 kHz	–
Adjacent channel power ratio (ACPR) in dB [8]									
In adjacent channel	–37	–38	–72 [9]	–85 [10]	–	–74 [11]	–34	–74	–42 at 11 MHz
In alternate channel	–71	–71	–78 [12]	–89 [13]	–	–77 [11]	–80	–82	–64 at 20 MHz
In 2nd alternate channel	–85	–85	–	–95 [14]	–	–	–	–	–66 at 30 MHz

Signal performance for digital standards

GSM/EDGE	with R&S®SMU-K40 option	
Burst on/off ratio		> 100 dB
Phase error	MSK, Gaussian filter B × T = 0.3	
	RMS	< 0.4°, 0.15° (typ.)
	peak	< 1.2°, 0.4° (typ.)
Error vector magnitude	8PSK EDGE, Gaussian linearized filter, RMS	< 0.5 %, 0.2 % (typ.)
Power density spectrum	values measured with 30 kHz resolution bandwidth, referenced to level in band center without power ramping	
	level ≤ 10.5 dBm, ≤ 16.5 dBm with R&S®SMU-B31, R&S®SMU-B36 options	
	200 kHz offset	< –34 dB, –37 dB (typ.)
	400 kHz offset	< –68 dB, –71 dB (typ.)
	600 kHz offset	< –80 dB, –85 dB (typ.)

[8] Level restricted, see specifications.

[9] 0 dB baseband gain (standard).

[10] 885 kHz offset and 30 kHz bandwidth.

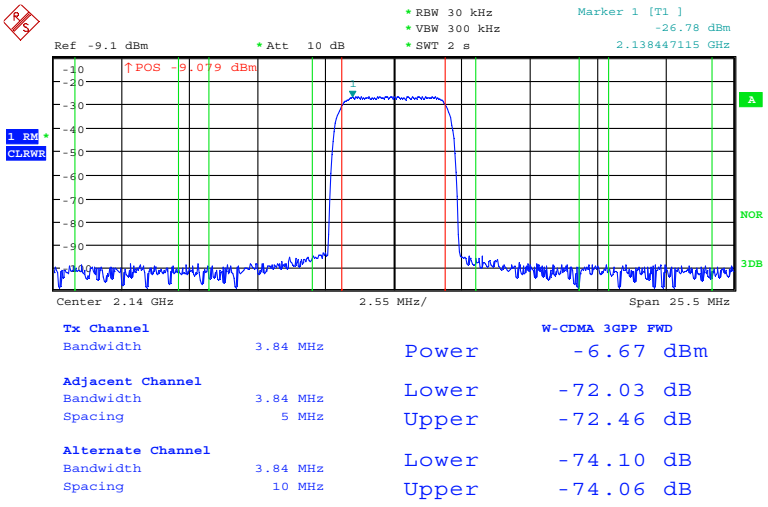
[11] Measured with root cosine filter.

[12] 6 dB baseband gain (low noise).

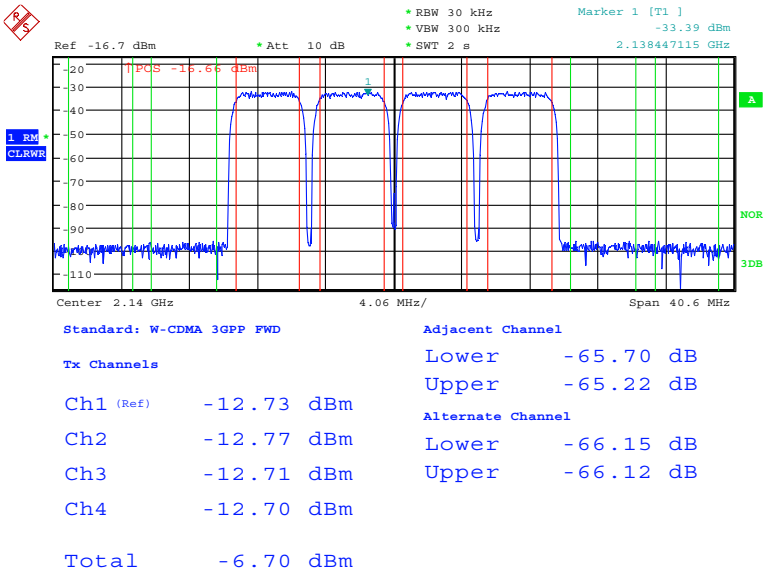
[13] 1.25 MHz offset and 30 kHz bandwidth.

[14] 1.98 MHz offset and 30 kHz bandwidth.

3GPP FDD	with R&S®SMU-K42 option	
Error vector magnitude	1 DPCH, RMS	< 0.8 %, 0.3 % (typ.)
Adjacent channel leakage ratio (ACLR)	test model 1, 64 DPCH	
	level ≤ 10.5 dBm PEP, ≤ 16.5 dBm PEP with R&S®SMU-B31, R&S®SMU-B36 options	
	frequency = 1800 MHz to 2200 MHz	
	5 MHz offset (baseband gain: 3 dB)	> 67 dB, 71 dB (typ.)
	10 MHz offset (baseband gain: 6 dB)	> 72 dB, 74 dB (typ.)

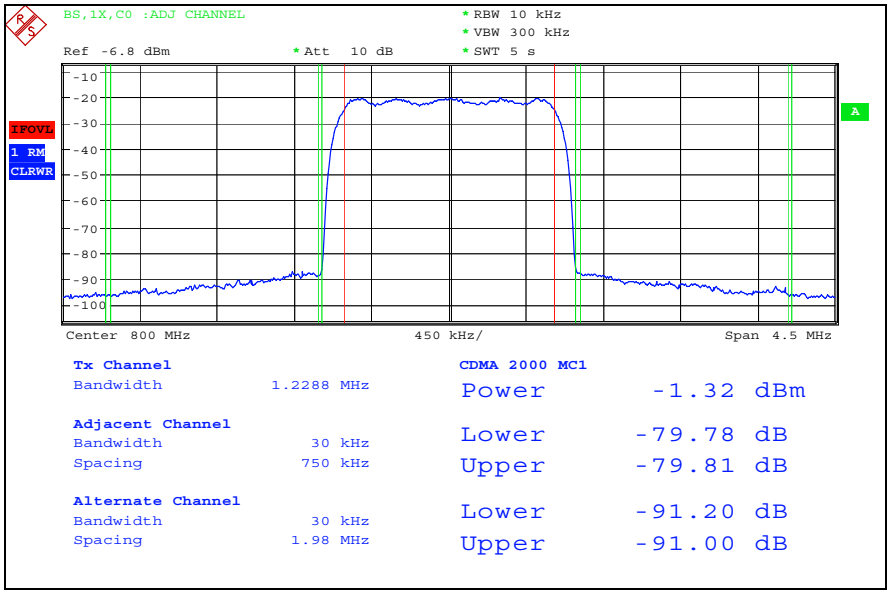


Measured ACPR for 3GPP test model 1, 64 DPCH (baseband gain: +3 dB).



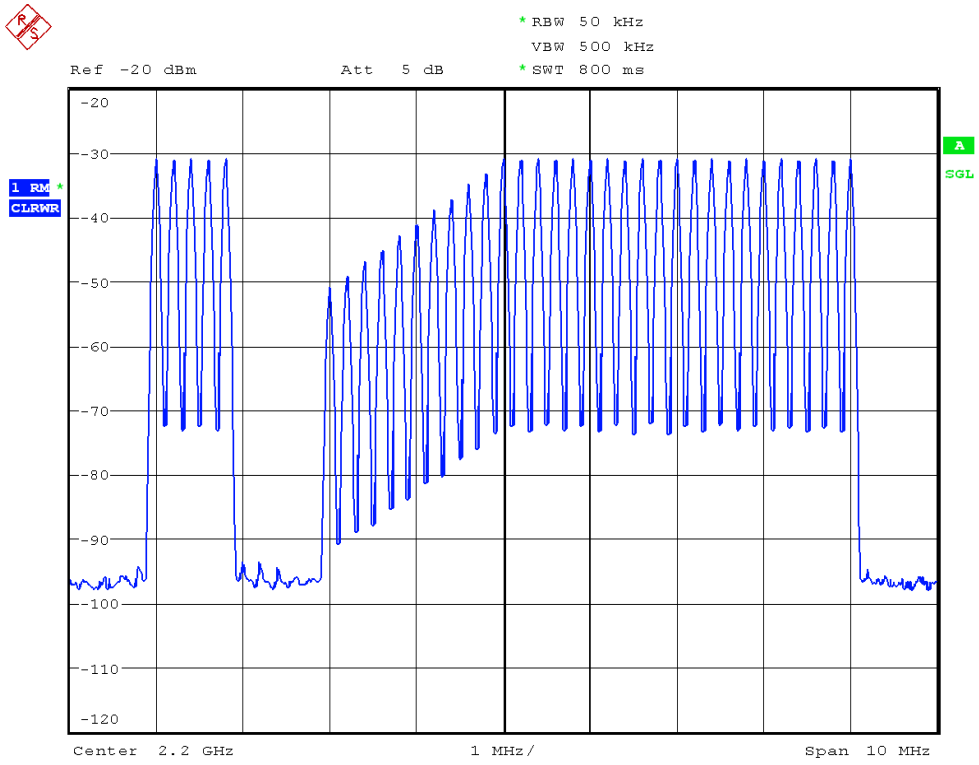
Measured ACPR for a 3GPP four-carrier signal with test model 1, 64 DPCH on each carrier (baseband gain: +3 dB).

CDMA2000®	with R&S®SMU-K46 option	
Error vector magnitude (EVM)	F-PICH, F-SYNC and one F-FCH, RMS	< 0.8 %, 0.3 % (typ.)
Adjacent channel leakage ratio (ACLR)	F-PICH, F-SYNC and one F-FCH	
	level ≤ 10.5 dBm PEP, ≤ 16.5 dBm PEP with R&S®SMU-B31, R&S®SMU-B36 options	
	800 MHz carrier frequency	
	0.75 MHz channel spacing (30 kHz bandwidth)	79 dB (typ.)
	1.98 MHz channel spacing (30 kHz bandwidth)	91 dB (typ.)



Measured ACPR for a CDMA2000® 1x signal consisting of F-PICH, F-SYNC and one F-FCH.

Multicarrier CW	with R&S®SMU-K61 option	
RF frequency response	up to 10 MHz	< 1.5 dB, 0.7 dB (typ.)
	up to 40 MHz	< 4.5 dB, 2.0 dB (typ.)
Suppression of unwanted carriers	up to 10 MHz	> 50 dB, 56 dB (typ.)
	up to 40 MHz	> 40 dB, 50 dB (typ.)



Example of multicarrier CW, with different carrier powers and some carriers switched off in the left half of the spectrum.

Digital standards (for the R&S®SMU-B9/-B10/-B11 options)

At least one I/Q baseband generator (R&S®SMU-B9/-B10/-B11 options) must be installed. If two I/Q baseband generators are installed and two signals of the same standard (e.g. GSM/EDGE) are to be output simultaneously, two corresponding software options must also be installed (in this case R&S®SMU-K40). If only one R&S®SMU-K40 is installed and GSM/EDGE is selected in one I/Q baseband generator, the other I/Q baseband generator is disabled for GSM/EDGE. However, a software option is not tied to a specific I/Q baseband generator.

GSM/EDGE	R&S®SMU-K40 option
EDGE Evolution	R&S®SMU-K41 option
3GPP FDD	R&S®SMU-K42 option
3GPP FDD enhanced BS/MS tests including HSDPA	R&S®SMU-K43 option
GPS	R&S®SMU-K44 option
3GPP FDD HSUPA	R&S®SMU-K45 option
CDMA2000®	R&S®SMU-K46 option
1xEV-DO	R&S®SMU-K47 option
IEEE 802.11a/b/g	R&S®SMU-K48 option
IEEE 802.16 WiMAX™	R&S®SMU-K49 option
TD-SCDMA (3GPP TDD LCR)	R&S®SMU-K50 option
TD-SCDMA (3GPP TDD LCR) enhanced BS/MS tests including HSDPA	R&S®SMU-K51 option
DVB-H/DVB-T	R&S®SMU-K52 option
DAB/T-DMB	R&S®SMU-K53 option
IEEE 802.11n	R&S®SMU-K54 option
EUTRA/LTE	R&S®SMU-K55 option
XM Radio	R&S®SMU-K56 option
FM stereo modulation	R&S®SMU-K57 option
Sirius Radio	R&S®SMU-K58 option
3GPP FDD HSPA+	R&S®SMU-K59 option
Bluetooth® EDR	R&S®SMU-K60 option
Multicarrier CW signal generation	R&S®SMU-K61 option
Assisted GPS	R&S®SMU-K65 option
TETRA Release 2	R&S®SMU-K68 option
EUTRA/LTE closed-loop BS test	R&S®SMU-K69 option
EUTRA/LTE log file generation	R&S®SMU-K81 option
EUTRA/LTE Release 9 and enhanced features	R&S®SMU-K84 option
EUTRA/LTE Release 10 (LTE-Advanced)	R&S®SMU-K85 option
IEEE 802.11ac	R&S®SMU-K86 option

The options are described in the Digital Standards data sheet (PD 5213.9434.22).

Digital standards with external PC software or waveforms (for the R&S®SMU-B9/-B10/-B11 options)

At least one I/Q baseband generator (R&S®SMU-B9/-B10/-B11 options) must be installed. If two I/Q baseband generators are installed and two signals of the same standard are to be output simultaneously, two corresponding software options must also be installed. If only one software option is installed and the standard is selected in one I/Q baseband generator, the other I/Q baseband generator is disabled for this standard. However, a software option is not tied to a specific I/Q baseband generator.

Pulse sequencer (external PC software)	R&S®SMU-K6 option
XM Radio waveforms	R&S®SMU-K256 option
HD Radio™ [15] waveforms	R&S®SMU-K352 option

The options are described in the Digital Standards data sheet (PD 5213.9434.22).

[15] HD Radio™ is a proprietary trademark of iBiquity Digital Corporation.

Digital standards with R&S®WinIQSIM2™ (for the R&S®SMU-B9/-B10/-B11 ARB)

At least one I/Q baseband generator (R&S®SMU-B9/-B10/-B11 options) must be installed. If two I/Q baseband generators are installed and two waveforms of the same standard (e.g. GSM/EDGE) are to be output simultaneously, two corresponding software options must also be installed (in this case R&S®SMU-K240). If only one R&S®SMU-K240 is installed and GSM/EDGE waveforms are played in one I/Q baseband generator, the other I/Q baseband generator is disabled for GSM/EDGE waveforms. However, a software option is not tied to a specific I/Q baseband generator.

R&S®WinIQSIM2™ requires an external PC.

GSM/EDGE	R&S®SMU-K240 option
EDGE Evolution	R&S®SMU-K241 option
3GPP FDD	R&S®SMU-K242 option
3GPP FDD enhanced BS/MS tests including HSDPA	R&S®SMU-K243 option
GPS	R&S®SMU-K244 option
3GPP FDD HSUPA	R&S®SMU-K245 option
CDMA2000®	R&S®SMU-K246 option
1xEV-DO	R&S®SMU-K247 option
IEEE 802.11a/b/g	R&S®SMU-K248 option
IEEE 802.16 WiMAX™	R&S®SMU-K249 option
TD-SCDMA (3GPP TDD LCR)	R&S®SMU-K250 option
TD-SCDMA (3GPP TDD LCR) enhanced BS/MS tests including HSDPA	R&S®SMU-K251 option
DVB-H/DVB-T	R&S®SMU-K252 option
DAB/T-DMB	R&S®SMU-K253 option
IEEE 802.11n	R&S®SMU-K254 option
EUTRA/LTE	R&S®SMU-K255 option
HSPA+	R&S®SMU-K259 option
Bluetooth® EDR	R&S®SMU-K260 option
Multicarrier CW signal generation	R&S®SMU-K261 option
Additive white Gaussian noise (AWGN)	R&S®SMU-K262 option
TETRA Release 2	R&S®SMU-K268 option
EUTRA/LTE Release 9 and enhanced features	R&S®SMU-K284 option
EUTRA/LTE Release 10 (LTE-Advanced)	R&S®SMU-K285 option
IEEE 802.11ac	R&S®SMU-K286 option

The options are described in the R&S®WinIQSIM2™ data sheet (PD 5213.7460.22).

Fading and noise

Fading simulator (R&S®SMU-B14 option) and fading simulator extension (R&S®SMU-B15 option)

The R&S®SMU-B9/-B10/-B11 or R&S®SMU-B17 option is required to generate input signals for the fading simulator.
All frequency and time settings are coupled to the internal reference frequency.

Number of signal paths	with R&S®SMU-B14	1
	with R&S®SMU-B14 and R&S®SMU-B15	1 or 2
Signal routing	only possible with R&S®SMU-B14 and R&S®SMU-B15	
	input	both signal paths split or combined
	output	split, one signal path only or sum of both signal paths
Number of fading paths	depending on options and signal routing, see table on next page	
Fading path loss	setting range	0 dB to 50 dB
	resolution	0.01 dB
	accuracy	< 0.01 dB
Fading path delay	setting range	0 ms to 2.56 ms
	resolution	10 ns
	with R&S®SMU-K71 option	0.01 ns
Delay groups		max. 4 per signal path
	permitted delay differences within one group	< 40 µs
Speed range	at f = 1 GHz	0 km/h to 1725 km/h
	accuracy	< 0.128 %
Doppler frequency	setting range	0 Hz to 1600 Hz
	accuracy	< 0.1 %
Restart	standard	auto
	with R&S®SMU-B9/-B10/-B11 options installed	auto, internal from baseband A or B, external
Total insertion loss	automatic or user-definable, with clipping indicator	0 dB to 18 dB
Correlation	fading paths in signal path A pairwise with fading paths in signal path B	
	correlation coefficient	
	setting range	0 % to 100 %
	resolution	5 %
	correlation phase	
	setting range	0° to 360°
	resolution	1°
Fading profiles		
Rayleigh	pseudo-noise interval	> 93 h
Pure Doppler	frequency ratio	(–1 to +1) × current Doppler frequency
	resolution	0.01 × current Doppler frequency
Rician	combination of Rayleigh and pure Doppler	
	power ratio	–30 dB to +30 dB
Lognormal	standard deviation	0 dB to 12 dB
	resolution	1 dB
	local constant at f = 1 GHz	12 m to 200 m
Static, constant phase	path loss	0 dB to 50 dB
	phase	0° to 360°
	resolution	1°

Number of fading paths, RF bandwidth and timing resolution

	With R&S®SMU-K71 only

With R&S®SMU-B14			
Signal paths	Fading paths	RF bandwidth	Timing resolution
1	20	80 MHz	10 ns
1	12	30 MHz	0.01 ns
1	8	50 MHz	0.01 ns

With R&S®SMU-B14 and R&S®SMU-B15			
Signal paths	Fading paths	RF bandwidth	Timing resolution
1	40	80 MHz	10 ns
1	24	30 MHz	0.01 ns
1	16	50 MHz	0.01 ns
2	20	80 MHz	10 ns
2	12	30 MHz	0.01 ns
2	8	50 MHz	0.01 ns

Dynamic fading and enhanced resolution (R&S®SMU-K71 option)

At least one R&S®SMU-B14 fading simulator must be installed. If both the R&S®SMU-B14 and the R&S®SMU-B15 are installed (signal paths A and B), dynamic fading and enhanced resolution can be used either on signal path A or B with one R&S®SMU-K71 option. For dynamic fading and enhanced resolution to be used on signal paths A and B simultaneously, two R&S®SMU-K71 must be installed.

Moving delay mode		
System bandwidth		50 MHz
Number of fading paths		2 per signal path
Fading profiles		none
Basic delay	in steps of 10 ns	0 ms to 2.56 ms
Delay variation	peak to peak	0.3 µs to 40 µs
Variation period	peak to peak	10 s to 500 s
Variation speed	peak to peak	0 µs/s to 500 µs/s
Delay step size		< 10 ps
Birth-death mode		
System bandwidth		50 MHz
Number of fading paths		2 per signal path
Fading profiles		pure Doppler
Delay range		0 µs to 40 µs
Delay grid		0 µs to 20 µs [16]
Positions		3 to 50 [16]
Hopping dwell		100 ms to 5 s
Start offset	separately settable for each signal path	1 ms to 200 ms
Delay resolution		10 ns

[16] The maximum delay range of 40 µs cannot be exceeded.

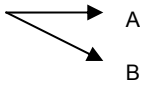
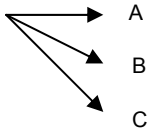
Extended statistic functions (R&S®SMU-K72 option)

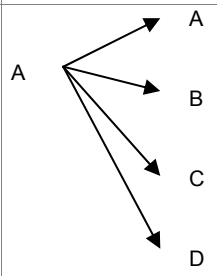
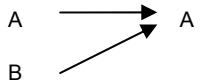
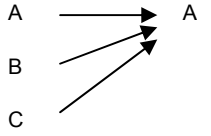
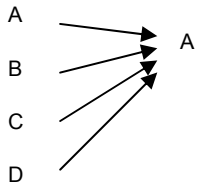
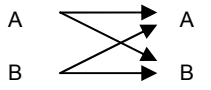
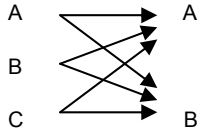
At least one R&S®SMU-B14 fading simulator must be installed. If both the R&S®SMU-B14 and the R&S®SMU-B15 are installed (signal paths A and B), extended statistic functions can be used either on signal path A or B with one R&S®SMU-K72 option. For extended statistic functions to be used on signal paths A and B simultaneously, two R&S®SMU-K72 must be installed.

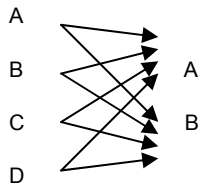
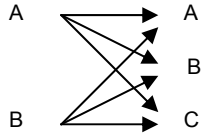
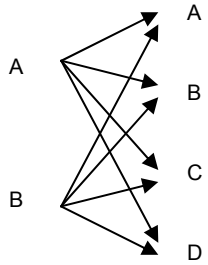
Fading profiles		
Gauss I, Gauss II	sum of two Gaussian distributions	in line with DAB standard
Gauss DAB 1, Gauss DAB 2	Gaussian distribution, shifted in frequency	in line with DAB standard
WiMAX™ Doppler	rounded Doppler PSD model	in line with IEEE 802.16a-03-01
WiMAX™ Rice	like WiMAX™ Doppler plus pure Doppler	in line with IEEE 802.16a-03-01
Predefined settings	SUI1 to SUI6	in line with IEEE 802.16a-03-01
	DAB-RA, DAB-TU, DAB-SFN	in line with EN 50248-2001

MIMO fading (R&S®SMU-K74 option)

The R&S®SMU-K74 option allows four fading channels to be simulated as is required for 1x2, 2x1 and 2x2 MIMO receiver tests. Both the R&S®SMU-B14 and the R&S®SMU-B15 options must be installed (signal paths A and B) and two baseband sources (R&S®SMU-B9, -B10 or -B11) must be present. By combining two instruments, it is possible to simulate receiver test scenarios for 1x3, 1x4, 2x3, 2x4, 3x1, 4x1, 3x2 and 4x2 MIMO.

Number of fading paths in each channel	standard, 80 MHz RF bandwidth, 10 ns timing resolution	10
	with R&S®SMU-K71 option, 50 MHz RF bandwidth, 0.01 ns timing resolution	4
	with R&S®SMU-K71 option, 30 MHz RF bandwidth, 0.01 ns timing resolution	6
Steering matrix	The steering matrix can be set by setting the diagonal elements of the correlation matrix.	
Correlation	The correlation between corresponding fading paths of the signal paths can be set in a correlation matrix. For each fading path index, an individual matrix can be set.	
	correlation coefficient	
	setting range	0 % to 100 %
	resolution	1 %
	correlation phase	
	setting range	0° to 360°
	resolution	1°
Correlation matrix setting		individually or with Kronecker assumption (RX and TX antenna correlation with automatic calculation of matrix)
Matrix representation		(real, imaginary) or (magnitude, phase)
Start seed		settable
1x2 MIMO		
Number of signal paths	with R&S®SMU-B14 and R&S®SMU-B15	2
Signal routing	1x2 MIMO, simulating fading channels between one TX and two RX antennas	
1x3 MIMO		
Number of signal paths	with two R&S®SMU200A, both with R&S®SMU-B14 and R&S®SMU-B15	3
Signal routing	1x3 MIMO, simulating fading channels between one TX and three RX antennas	

1x4 MIMO		
Number of signal paths	with two R&S®SMU200A, both with R&S®SMU-B14 and R&S®SMU-B15	4
Signal routing	1x4 MIMO, simulating fading channels between one TX and four RX antennas	
2x1 MIMO		
Number of signal paths	with R&S®SMU-B14 and R&S®SMU-B15	2
Signal routing	2x1 MIMO, simulating fading channels between two TX and one RX antennas	
3x1 MIMO		
Number of signal paths	with two R&S®SMU200A, both with R&S®SMU-B14 and R&S®SMU-B15; external signal combiner required (either baseband or RF combiner)	3
Signal routing	3x1 MIMO, simulating fading channels between three TX and one RX antennas	
4x1 MIMO		
Number of signal paths	with two R&S®SMU200A, both with R&S®SMU-B14 and R&S®SMU-B15; external signal combiner required (either baseband or RF combiner)	4
Signal routing	4x1 MIMO, simulating fading channels between four TX and one RX antennas	
2x2 MIMO		
Number of signal paths	with R&S®SMU-B14 and R&S®SMU-B15	4
Signal routing	2x2 MIMO, simulating fading channels between two TX and two RX antennas	
3x2 MIMO		
Number of signal paths	with two R&S®SMU200A, both with R&S®SMU-B14 and R&S®SMU-B15; external signal combiner required (either baseband or RF combiner)	6
Signal routing	3x2 MIMO, simulating fading channels between three TX and two RX antennas	

4x2 MIMO		
Number of signal paths	with two R&S®SMU200A, both with R&S®SMU-B14 and R&S®SMU-B15; external signal combiner required (either baseband or RF combiner)	8
Signal routing	4x2 MIMO, simulating fading channels between four TX and two RX antennas	
2x3 MIMO		
Number of signal paths	with two R&S®SMU200A, both with R&S®SMU-B14 and R&S®SMU-B15	6
Signal routing	2x3 MIMO, simulating fading channels between two TX and three RX antennas	
2x4 MIMO		
Number of signal paths	with two R&S®SMU200A, both with R&S®SMU-B14 and R&S®SMU-B15	8
Signal routing	2x4 MIMO, simulating fading channels between two TX and four RX antennas	

Dynamic scenario simulation (R&S®SMU-K77 option)

At least one R&S®SMU-B14 fading simulator must be installed. If both the R&S®SMU-B14 and the R&S®SMU-B15 are installed (signal paths A and B), dynamic scenario simulation can be used either on signal path A or B with one R&S®SMU-K77 option. For dynamic scenario simulation to be used on signal paths A and B simultaneously, two R&S®SMU-K77 must be installed.

Scenarios		
Predefined	ship to ship	simulation of the signal transmission from one object to another, each moving on a straight line of definable direction
	tower to aircraft	simulation of the signal transmission between a tower and an aircraft; the aircraft takes off, flies a circuit and lands again
User-defined	simulation of two moving objects	trajectories and type of object (and their limits) are fully customizable
A trajectory viewer visualizes the generated trajectories and displays the position of the objects in realtime. The display shows an x-y and x-z view. The viewer is available for both predefined and user-defined scenarios.		
Basic figures		
System bandwidth		50 MHz
Number of fading paths		1 LOS per signal path
Fading profiles		pure Doppler
Delay resolution		0.5 ns
Propagation delay		0 µs to 160 µs (corresponds to a range difference of 0 km to 47.967 km)
Minimum position dwell time		0.1 ms
Maximum Doppler frequency shift		3 kHz
Number of simulated objects		2
Import interfaces		
Trajectory description file	proprietary file format (see manual)	waypoints (ENU, geodetic), velocity, time
TPA file	proprietary file format (see manual)	time, propagation delay, attenuation
Ephemeris file	AGI STK file format	position (Cartesian), time, velocity
Export interfaces		
Ephemeris file	AGI STK file format	position (Cartesian), time, velocity

Additive white Gaussian noise (AWGN, R&S®SMU-K62 option)

At least one R&S®SMU-B13 baseband main module must be installed. If two R&S®SMU-B13 are installed (paths A and B), AWGN can be generated either on path A or B with one R&S®SMU-K62 option. For AWGN to be generated on paths A and B simultaneously, two R&S®SMU-K62 must be installed.

Addition of an AWGN signal of settable bandwidth and settable C/N ratio or E_b/N_0 to a wanted signal. If the noise generator is used, a frequency offset cannot be added to the wanted signal.

Noise	distribution density	Gaussian, statistical, separate for I and Q
	crest factor	> 18 dB
	periodicity	> 48 h
C/N, E_b/N_0	setting range	–30 dB to +30 dB
	resolution	0.1 dB
	uncertainty for system bandwidth = symbol rate, –24 dB < C/N < 30 dB and crest factor < 12 dB	< 0.1 dB
System bandwidth	bandwidth for determining noise power	
	range	1 kHz to 80 MHz
	resolution	100 Hz

Other options

BER measurement (R&S®SMU-K80 option)

The data supplied by the DUT is compared with a reference pseudo-random bit sequence.

Clock		supplied by DUT; a clock pulse is required for each valid bit
Clock rate		100 Hz to 60 MHz
Data	PRBS	
	sequence length	9, 11, 15, 16, 20, 21, 23
	pattern ignore	off, All 0, All 1
	data enable	external
	modes	off, high, low
	restart	external
	modes	on/off
Synchronization time		28 clock cycles
Interface	9-pin D-Sub connector, D-Sub/BNC cable supplied with option	
Clock, data, enable and restart inputs	input impedance	1 kΩ, 50 Ω
	trigger threshold	
	setting range	0.00 V to 2.50 V
	resolution	0.01 V
Polarity	data, clock, data enable	normal, inverted
Measurement time		selectable by means of maximum number of data bits or bit errors (max. 2^{31} bit each), continuous measurement
Measurement result	if selected number of data bits or bit errors is attained	BER in ppm, % or decade values
Status displays		not synchronized, no clock, no data

BLER measurement (R&S®SMU-K80 option)

In BLER measurement mode, arbitrary data can be supplied by the DUT. A signal marking the block's CRC has to be provided on the data enable connector of the BER/BLER option.

Clock		supplied by DUT; a clock pulse is required for each valid bit
Clock rate		100 Hz to 60 MHz
Data	input data	arbitrary
	data enable (marking the block's CRC)	external
	modes	high, low
CRC	CRC type	CCITT CRC16 ($x^{16} + x^{12} + x^5 + 1$)
	CRC bit order	MSB first, LSB first
Synchronization time		1 block
Interface	9-pin D-Sub connector, D-Sub/BNC cable supplied with option	
Clock, data and enable inputs	input impedance	1 kΩ, 50 Ω
	trigger threshold	
	setting range	0 V to 2.50 V
	resolution	0.01 V
Polarity	data, clock, data enable	normal, inverted
Measurement time	selectable by means of maximum number of received blocks or errors (max. 2^{31} blocks each), continuous measurement	
Measurement result	if selected number of received blocks or errors is attained	BLER in ppm, % or decade values
Status displays		not synchronized, no clock, no data

General data

Remote control

Systems		IEC/IEEE bus, IEC 60625 (IEEE 488) Ethernet
Command set		SCPI 1999.5
Connector		
IEC/IEEE		24-contact Amphenol
Ethernet		Western
IEC/IEEE bus address		0 to 30
Interface functions		IEC: SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0

Operating data

Power supply	input voltage range, AC, nominal	100 V to 240 V
	AC supply frequency	47 Hz to 63 Hz
	input current	5.0 A to 1.6 A
	power factor correction	in line with EN 61000-3-2
EMC		in line with EN 55011 class B, EN 61326
	with activated digital I/Q output	in line with EMC directive of EU (2004/108/EC), applied standard: EN 61326 (immunity for industrial environment; class A emissions) [17]
Immunity to interfering field strength		up to 10 V/m
Environmental conditions	operating temperature range	+5 °C to +45 °C, in line with EN 60068-2-1, EN 60068-2-2
	storage temperature range	–20 °C to +60 °C
	climatic resistance	+40 °C/90 % rel. humidity, in line with EN 60068-2-3
Mechanical resistance		
Vibration	sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const., 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 EN 60068-2-27, MIL-STD-810E
Electrical safety		in line with EN 61010-1
Dimensions	W × H × D	435 mm × 192 mm × 460 mm (17.1 in × 7.6 in × 18.1 in)
Weight	if fully equipped	25 kg (55.1 lb)
Recommended calibration interval		3 years

License information

The firmware of this device contains open source software. Details and license agreements can be found in release notes and operating manual.

[17] The instrument complies with the emission requirements stipulated by EN 55011 class A. This means that the instrument is suitable for use in industrial environments. In line with EN 61000-6-4, operation in residential, commercial and business areas or in small-size companies is not covered. The instrument may not be operated in residential, commercial and business areas or in small-size companies, unless additional measures are taken to ensure that EN 610000-6-3 is complied with.

Ordering information

Designation	Type	Order No.
Vector Signal Generator [18] including power cable, quick start guide and CD-ROM (with operating and service manual)	R&S®SMU200A	1141.2005.02
Options		
RF Path A		
100 kHz to 2.2 GHz	R&S®SMU-B102	1141.8503.02
100 kHz to 3 GHz	R&S®SMU-B103	1141.8603.02
100 kHz to 4 GHz	R&S®SMU-B104	1141.8703.02
100 kHz to 6 GHz	R&S®SMU-B106	1141.8803.02
FM/φM Modulator	R&S®SMU-B20	1142.0006.02
FM/φM Modulator and Enhanced Phase Noise Performance	R&S®SMU-B22	1160.5006.02
High-Power Output	R&S®SMU-B31	1159.8011.04
RF Path B		
100 kHz to 2.2 GHz	R&S®SMU-B202	1141.9400.02
100 kHz to 3 GHz	R&S®SMU-B203	1141.9500.02
High-Power Output	R&S®SMU-B36	1160.1000.04
Additional RF options		
Phase Coherence	R&S®SMU-B90	1409.8604.02
Baseband		
Baseband Generator with ARB (128 Msample) and Digital Modulation (realtime)	R&S®SMU-B9	1161.0766.02
Baseband Generator with ARB (64 Msample) and Digital Modulation (realtime)	R&S®SMU-B10	1141.7007.02
Baseband Generator with ARB (16 Msample) and Digital Modulation (realtime)	R&S®SMU-B11	1159.8411.02
Baseband Main Module	R&S®SMU-B13	1141.8003.04
Differential I/Q Output	R&S®SMU-B16	1161.0066.02
Baseband Input (analog/digital)	R&S®SMU-B17	1142.2880.02
Digital Baseband Output	R&S®SMU-B18	1159.6954.02
Digital standards		
GSM/EDGE	R&S®SMU-K40	1160.7609.02
EDGE Evolution	R&S®SMU-K41	1408.7810.02
3GPP FDD	R&S®SMU-K42	1160.7909.02
3GPP Enhanced BS/MS Tests incl. HSDPA	R&S®SMU-K43	1160.9660.02
GPS	R&S®SMU-K44	1161.0566.02
3GPP FDD HSUPA	R&S®SMU-K45	1161.0666.02
CDMA2000®	R&S®SMU-K46	1160.9876.02
1xEV-DO	R&S®SMU-K47	1408.7410.02
IEEE 802.11 (a/b/g)	R&S®SMU-K48	1161.0266.02
IEEE 802.16	R&S®SMU-K49	1161.0366.02
TD-SCDMA	R&S®SMU-K50	1161.0966.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMU-K51	1161.1062.02
DVB-H	R&S®SMU-K52	1408.7010.02
DAB/T-DMB	R&S®SMU-K53	1400.6209.02
IEEE 802.11n	R&S®SMU-K54	1408.7562.02
EUTRA/LTE	R&S®SMU-K55	1408.7310.02
XM Radio	R&S®SMU-K56	1161.1162.02
FM Stereo Modulation	R&S®SMU-K57	1400.6250.02
Sirius Radio	R&S®SMU-K58	1408.7910.02
3GPP FDD HSPA+	R&S®SMU-K59	1415.0053.02
Bluetooth® EDR	R&S®SMU-K60	1408.7962.02
Multicarrier CW Signal Generation	R&S®SMU-K61	1160.8505.02
Assisted GPS	R&S®SMU-K65	1415.0053.02
TETRA Release 2	R&S®SMU-K68	1408.8217.02

[18] The base unit can only be ordered with an R&S®SMU-B10x frequency option.

EUTRA/LTE Closed-Loop BS Test	R&S®SMU-K69	1408.8117.02
EUTRA/LTE Log File Generation	R&S®SMU-K81	1408.8169.02
EUTRA/LTE Release 9 and Enhanced Features	R&S®SMU-K84	1408.8475.02
EUTRA/LTE Release 10 (LTE-Advanced)	R&S®SMU-K85	1408.8498.02
IEEE 802.11ac	R&S®SMU-K86	1408.8552.02
Digital standards using R&S®WinIQSIM2™ [19]		
GSM/EDGE	R&S®SMU-K240	1408.5518.02
EDGE Evolution	R&S®SMU-K241	1408.7862.02
3GPP FDD	R&S®SMU-K242	1408.5618.02
3GPP Enhanced BS/MS Tests incl. HSDPA	R&S®SMU-K243	1408.5718.02
GPS	R&S®SMU-K244	1408.5818.02
3GPP FDD HSUPA	R&S®SMU-K245	1408.5918.02
CDMA2000® incl. 1xEV-DV	R&S®SMU-K246	1408.6014.02
1xEV-DO	R&S®SMU-K247	1408.7462.02
IEEE 802.11 (a/b/g)	R&S®SMU-K248	1408.6114.02
IEEE 802.16	R&S®SMU-K249	1408.6214.02
TD-SCDMA	R&S®SMU-K250	1408.6314.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMU-K251	1408.6414.02
DVB-H/DVB-T	R&S®SMU-K252	1408.7510.02
DAB/T-DMB	R&S®SMU-K253	1408.8317.02
IEEE 802.11n	R&S®SMU-K254	1408.7610.02
EUTRA/LTE	R&S®SMU-K255	1408.7362.02
3GPP FDD HSPA+	R&S®SMU-K259	1415.0101.02
Bluetooth® EDR	R&S®SMU-K260	1408.8017.02
Multicarrier CW Signal Generation	R&S®SMU-K261	1408.6514.02
Additive White Gaussian Noise (AWGN)	R&S®SMU-K262	1400.6609.02
TETRA Release 2	R&S®SMU-K268	1408.8269.02
EUTRA/LTE Release 9 and Enhanced Features	R&S®SMU-K284	1408.8517.02
EUTRA/LTE Release 10 (LTE-Advanced)	R&S®SMU-K285	1408.8530.02
IEEE 802.11ac	R&S®SMU-K286	1408.8575.02
Digital standards using an external PC software or waveforms		
Pulse Sequencer	R&S®SMU-K6	1408.7662.02
Playback of XM Radio Waveforms	R&S®SMU-K256	1161.1240.02
Playback of HD Radio™ Waveforms	R&S®SMU-K352	1408.8069.02
MIMO, fading and noise		
Fading Simulator	R&S®SMU-B14	1160.1800.02
Fading Simulator Extension	R&S®SMU-B15	1160.2288.02
Additive White Gaussian Noise (AWGN)	R&S®SMU-K62	1159.8511.02
Dynamic Fading and Enhanced Resolution	R&S®SMU-K71	1160.9201.02
Extended Statistic Functions	R&S®SMU-K72	1408.7062.02
MIMO Fading	R&S®SMU-K74	1408.7762.02
Dynamic Scenario Simulation	R&S®SMU-K77	1408.8598.02
Other options		
BER/BLER Measurement	R&S®SMU-K80	1159.8770.02
Rear Panel Connectors for 1st RF Path	R&S®SMU-B81	1159.9001.02
Rear Panel Connectors for 2nd RF Path	R&S®SMU-B82	1159.9501.02
Documentation of Calibration Values	R&S®DCV-2	0240.2193.18
DAkks (formerly DKD) Calibration in line with ISO 17025 and ISO 9000 (can only be ordered with the device)	R&S®SMU200DKD	1161.3536.02
Recommended extras		
Hardcopy manuals (in German)		1007.9845.31
Hardcopy manuals (in English, UK)		1007.9845.32
Hardcopy manuals (in English, USA)		1007.9845.39
19" Rack Adapter	R&S®ZZA-411	1096.3283.00
Adapter for Telescopic Sliders	R&S®ZZA-T45	1109.3774.00
BNC Adapter for AUX I/O Connector	R&S®SMU-Z5	1160.4545.02
Cable for connecting digital baseband interfaces	R&S®SMU-Z6	1415.0201.02
Keyboard with USB Interface (US assignment)	R&S®PSL-Z2	1157.6870.04
Mouse with USB Interface, optical	R&S®PSL-Z10	1157.7060.03
External USB CD-RW Drive	R&S®PSP-B6	1134.8201.22

[19] R&S®WinIQSIM2™ requires an external PC.

Service options		
Extended Warranty, one year	R&S®WE1SMU200A	Please contact your local Rohde & Schwarz sales office.
Extended Warranty, two years	R&S®WE2SMU200A	
Extended Warranty, three years	R&S®WE3SMU200A	
Extended Warranty, four years	R&S®WE4SMU200A	
Extended Warranty with Calibration Coverage, one year	R&S®CW1SMU200A	
Extended Warranty with Calibration Coverage, two years	R&S®CW2SMU200A	
Extended Warranty with Calibration Coverage, three years	R&S®CW3SMU200A	
Extended Warranty with Calibration Coverage, four years	R&S®CW4SMU200A	

Extended warranty with a term of one to four years (WE1 to WE4)
Repairs carried out during the contract term are free of charge [20]. 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 [20] and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

For product brochure, see PD 0758.0197.12 and www.rohde-schwarz.com

[20] Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.

Service you can rely on

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

About Rohde&Schwarz

Rohde&Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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