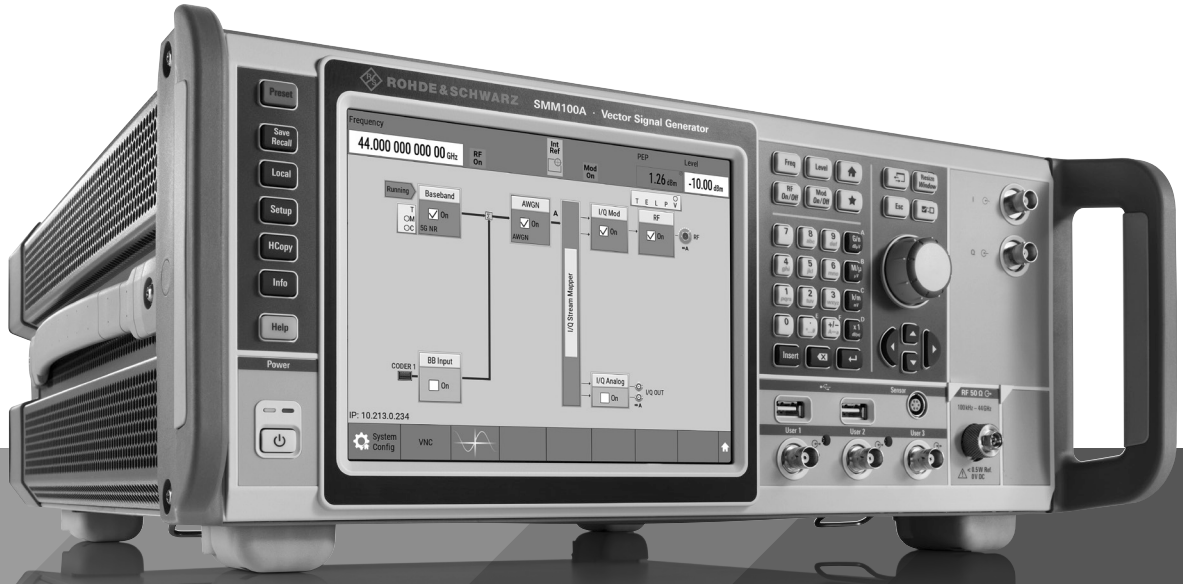
R&S®SMM100A
VECTOR SIGNAL GENERATOR

3 year warranty

Specifications



Data Sheet
Version 13.00

ROHDE&SCHWARZ
Make ideas real

CONTENTS

Key facts

- Frequency range from 100 kHz to 44 GHz
- High output power up to +18 dBm
- Internal RF modulation bandwidth up to 1 GHz
- Excellent modulation frequency response, error vector magnitude (EVM) and adjacent channel power ratio (ACPR)
- 5G NR signal generation for FR1 and FR2
- Ready for future WLAN requirements for RF frequency and modulation bandwidth
- Convenient operation via touchscreen and block diagram

Benefits

Discover excellent signal performance

- Excellent SSB phase noise and EVM performance
- Excellent ACPR/ACLR performance
- Extremely flat frequency response

Discover baseband capabilities

- Internal real-time signal generation
- Arbitrary waveform generator
- Custom digital modulation

Discover scalability

- Frequency options
- Keycode extendable bandwidth and ARB memory
- Timed licenses and waveform packs
- Floating licenses

Discover usability

- Structured and intuitive GUI
- Graphical signal monitoring in real-time
- Automation made easy with context-sensitive help system and SCPI recording
- R&S®SMM-K544 frequency response correction

Discover applications

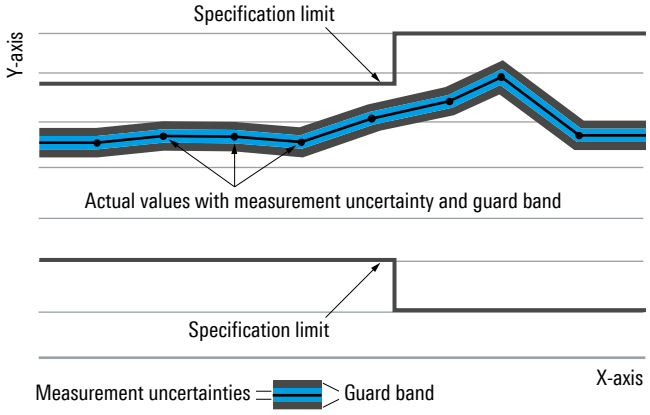
- Mobile communication standards
- Ready for the next Wi-Fi generations
- Envelope tracking
- High rate pulse (HRP) ultrawideband (UWB)

Definitions

General
Product data applies under the following conditions:

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

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



Non-traceable specifications with limits (n. trc.)
Represent product performance that is specified and tested as described under “Specifications with limits” above. However, product performance in this case cannot be warranted due to the lack of measuring equipment traceable to national metrology standards. In this case, measurements are referenced to standards used in the Rohde & Schwarz laboratories.

Specifications without limits
Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

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

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

Measured values (meas.)
Characterize expected product performance by means of measurement results gained from individual samples.

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

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

Non-traceable specifications with limits, typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

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

Frequency and baseband main module options

Frequency options

One of the following frequency options must be installed:

R&S®SMM-B1006	100 kHz to 6 GHz
R&S®SMM-B1007	100 kHz to 7.5 GHz
R&S®SMM-B1012	100 kHz to 12.75 GHz
R&S®SMM-B1020	100 kHz to 20 GHz
R&S®SMM-B1031	100 kHz to 31.8 GHz
R&S®SMM-B1044, R&S®SMM-B1044N	100 kHz to 44 GHz

The R&S®SMM-B1006, R&S®SMM-B1007 and R&S®SMM-B1012 frequency options include an electronically controlled attenuator, whereas the R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044 and R&S®SMM-B1044N options include a mechanically controlled step attenuator.

Baseband hardware

The wideband baseband section enables RF modulation bandwidths up to 1 GHz by the following additional hardware option:

R&S®SMM-B9	baseband generator with ARB (64 Msample, 120 MHz RF bandwidth)

RF characteristics

Frequency

Range	R&S®SMM-B1006	100 kHz to 6 GHz
	R&S®SMM-B1007	100 kHz to 7.5 GHz
	R&S®SMM-B1012	100 kHz to 12.75 GHz
	R&S®SMM-B1020	100 kHz to 20 GHz
	R&S®SMM-B1031	100 kHz to 31.8 GHz
	R&S®SMM-B1044, R&S®SMM-B1044N	100 kHz to 44 GHz
Resolution of setting		0.001 Hz
Resolution of synthesis	f = 1 GHz	0.053 nHz (nom.)
Setting time	to within < $1 \cdot 10^{-7}$ for f > 200 MHz or < 124 Hz for f < 200 MHz, with GUI update stopped, I/Q optimization mode: fast, after IEC/IEEE bus delimiter	
	standard	
	R&S®SMM-B1006	< 1.2 ms, 0.9 ms (typ.)
	R&S®SMM-B1007, R&S®SMM-B1012	< 1.4 ms, 1.0 ms (typ.)
	R&S®SMM-B1031	< 1.5 ms, 1.2 ms (typ.)
	R&S®SMM-B1044, R&S®SMM-B1044N	< 1.5 ms, 1.2 ms (typ.)
Setting time (list mode)	to within < $1 \cdot 10^{-7}$ for f > 200 MHz or < 124 Hz for f < 200 MHz, with GUI update stopped, I/Q optimization mode: fast, after trigger pulse	
	R&S®SMM-B1006	< 0.8 ms, 0.6 ms (typ.)
	R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020	< 1.0 ms, 0.7 ms (typ.)
	R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N	< 1.2 ms, 0.9 ms (typ.)
Resolution of phase offset setting		adjustable in 0.1° steps

Frequency sweep

Operating mode		digital sweep in discrete steps
Trigger modes	execute sweep continuously with internal trigger source	auto
	execute one full sweep	single
	execute one step	step
	sweep start and stop controlled by external trigger signal	start/stop
Trigger source		external trigger signal (INST TRG A at rear), rotary knob, touchpanel, remote control
Sweep range		full frequency range
Sweep shape		sawtooth, triangle
Step size setting resolution	linear	0.001 Hz
	logarithmic	0.01 % to 100 % per step
Dwell time setting range		1 ms to 100 s
Dwell time setting resolution		0.1 ms

Reference frequency

Frequency error	at time of calibration in production	$< 1 \cdot 10^{-8}$
Aging	after 30 days of uninterrupted operation	$\leq 1 \cdot 10^{-9}$/day, $\leq 1 \cdot 10^{-7}$/year
Temperature effect	in temperature range from 0 °C to +45 °C	$\pm 6 \cdot 10^{-8}$
Warm-up time	to nominal thermostat temperature	≤ 10 min (nom.)
Input for external reference frequency		
Connector type	REF in on rear panel	BNC female
Input frequency	standard	10 MHz
	with R&S®SMM-K703 option	10 MHz, 100 MHz
	with R&S®SMM-K704 option	10 MHz, 1 MHz to 100 MHz, variable
Input frequency setting resolution	with R&S®SMM-K704 option	0.1 Hz
Input level range	level limits	0 dBm to 20 dBm
	recommended input level for optimum phase noise performance	7 dBm to 13 dBm
Input impedance		50 Ω (nom.)
Minimum frequency locking range	synchronization bandwidth: wide	$\pm 3 \cdot 10^{-6}$
	synchronization bandwidth: narrow	$\pm 0.3 \cdot 10^{-6}$
Output for internal reference frequency		
Connector type	REF OUT on rear panel	BNC female
Output frequency	standard	sine wave 10 MHz
	with R&S®SMM-K703 option	sine wave 10 MHz, 100 MHz
	with R&S®SMM-K704 option	
	instrument set to internal reference	sine wave 10 MHz
	instrument set to external reference	sine wave 10 MHz, applied external reference frequency
Output level		7 dBm to 14 dBm
Source impedance		50 Ω (nom.)
Wideband noise	with R&S®SMM-K703 option, 100 MHz, internal reference, carrier offset = 10 MHz, measurement bandwidth 1 Hz	< –155 dBc, –159 dBc (typ.)
Ultra low noise 1 GHz reference frequency (R&S®SMM-K703 option)		
Input connector type	1 GHz in on rear panel	SMA female
Input frequency		1 GHz
Input level range	level limits	≥ 6 dBm, ≤ 20 dBm
	recommended input level for optimum phase noise performance	7 dBm to 13 dBm
Input impedance		50 Ω (nom.)
Minimum frequency locking range		$\pm 3 \cdot 10^{-6}$
Output connector type	1 GHz out on rear panel	SMA female
Output frequency		sine wave 1 GHz
Output level		7 dBm to 13 dBm
Source impedance		50 Ω (nom.)

Wideband noise	1 GHz, internal reference, carrier offset = 10 MHz, measurement bandwidth 1 Hz	< –154 dBc, –158 dBc (typ.)
Input for electronic tuning of internal reference frequency		
Connector type	EFC on rear panel	BNC female
Sensitivity	external tuning slope	$1 \cdot 10^{-8}$/V (typ.)
Input voltage		–10 V to +10 V
Input impedance		10 kΩ (nom.)

R&S®SMM-K703 option (100 MHz, 1 GHz reference input/output)
When this option is installed, the user can use the 1 GHz low noise input and output for synchronization.
In WIDE mode, the signal generator will use this signal directly as a reference for the synthesizer.
This option should be used if a very high phase stability between multiple generators is required.
The 100 MHz low noise input and output mode is only available with this option.

R&S®SMM-K704 option (flexible reference input)
When this option is installed, the user can set the reference input frequency in 0.1 Hz steps between 1.0 MHz and 100 MHz.
The signal generator will lock its internal reference oscillator on the input frequency.

Note on choosing the proper reference synchronization bandwidth
The user has the choice to set the synchronization bandwidth either to NARROW or WIDE.

In WIDE mode, the best possible phase stability is achieved.
The phase noise performance close to the carrier depends on the phase noise of the external signal source.
In NARROW mode, the reference PLL acts as a clean-up-loop in which the phase noise is mainly determined by the signal generator's internal reference source.
This mode is recommended when using external reference sources with close-to-carrier phase noise worse than the R&S®SMM100A (i. e. rubidium standards).
Please note that due to the slow synchronization, reference locking can take up to 10 seconds.

Level

Setting range	100 kHz ≤ f < 1 MHz	–145 dBm to +8 dBm
	1 MHz ≤ f < 3 MHz	–145 dBm to +13 dBm
	3 MHz ≤ f ≤ 44 GHz	–145 dBm to +30 dBm
Specified level range	100 kHz ≤ f < 1 MHz	–120 dBm to +3 dBm (PEP) [1]
	1 MHz ≤ f ≤ 3 MHz	–120 dBm to +8 dBm (PEP) [1]
	R&S®SMM-B1006, R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020 frequency options:	
	3 MHz < f ≤ 20 GHz	–120 dBm to +18 dBm (PEP) [1]
	R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N frequency options:	
	3 MHz < f ≤ 3 GHz	–120 dBm to +18 dBm (PEP) [1]
	3 GHz < f ≤ 16 GHz	–120 dBm to +17 dBm (PEP) [1]
	16 GHz < f ≤ 19.5 GHz	
	CW, I/Q modulation, signal bandwidth ≤ 160 MHz	–120 dBm to +15 dBm (PEP) [1]
	I/Q modulation, signal bandwidth > 160 MHz	–120 dBm to +12 dBm (PEP) [1]
	19.5 GHz < f ≤ 29 GHz	–120 dBm to +18 dBm (PEP) [1]
	29 GHz < f ≤ 33 GHz	–120 dBm to +17 dBm (PEP) [1]
	33 GHz < f ≤ 40 GHz	–120 dBm to +15 dBm (PEP) [1]
	40 GHz < f ≤ 42 GHz	–120 dBm to +13 dBm (PEP) [1]
	42 GHz < f ≤ 44 GHz	–120 dBm to +11 dBm (PEP) [1]
Resolution of setting		0.01 dB (nom.)
Level error	level setting characteristic: auto, temperature range from +18 °C to +33 °C	
	100 kHz ≤ f ≤ 3 GHz	< 0.5 dB
	3 GHz < f ≤ 6 GHz	< 0.7 dB
	6 GHz < f ≤ 20 GHz	< 0.9 dB
	R&S®SMM-B1031, 20 GHz < f ≤ 31.8 GHz	< 1.1 dB
	R&S®SMM-B1044, R&S®SMM-B1044N, 20 GHz < f ≤ 44 GHz	< 1.2 dB

[1] PEP = peak envelope power.

Additional level error	I/Q modulation	< 0.3 dB
	pulse modulation	< 0.5 dB
Output impedance VSWR in 50 Ω system	level setting characteristic: auto	
	R&S®SMM-B1006, 100 kHz < f ≤ 6 GHz	< 1.9, < 1.5 (typ.)
	R&S®SMM-B1007, R&S®SMM-B1012, 100 kHz < f ≤ 12.75 GHz	< 2.0, < 1.6 (typ.)
	R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N, 100 kHz < f ≤ 20 GHz	< 2.1, < 1.7 (typ.)
	R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N, step attenuator = 0 dB, 20 GHz < f ≤ 38 GHz	< 2.2, < 1.8 (typ.)
	R&S®SMM-B1044, R&S®SMM-B1044N, step attenuator = 0 dB, 38 GHz < f ≤ 44 GHz	< 2.6. < 2.2 (typ.)
	R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N, step attenuator ≥ 5 dB, 20 GHz < f ≤ 44 GHz	< 2.1, < 1.7 (typ.)
Setting time	to < 0.1 dB deviation from final value, with GUI update stopped, no relay switchover, f > 10 MHz, I/Q optimization mode: fast	
	after IEC/IEEE bus delimiter [2]	< 1 ms, 0.8 ms (typ.)
	with switching of mechanical step attenuator, after IEC/IEEE bus delimiter	< 25 ms
	R&S®SMM-B1044, R&S®SMM-B1044N, with switching of mechanical step attenuator, after IEC/IEEE bus delimiter	< 30 ms
Setting time (list mode)	to < 0.1 dB deviation from final value, with GUI update stopped, no relay switchover, f > 10 MHz, I/Q optimization mode: fast	
	after trigger pulse [2]	< 0.8 ms, 0.55 ms (typ.)
Interruption-free level setting range	level setting characteristic: uninterrupted level setting	> 20 dB
Reverse power (from 50 Ω source)	maximum permissible RF power in output frequency range of RF path with R&S®SMM-B1006 frequency option; Note: the RF path is switched off if the reverse power exceeds a limit (+27 dBm (meas.), depends on RF frequency)	
	1 MHz < f ≤ 3 GHz	50 W
	3 GHz < f ≤ 6 GHz	10 W
	maximum permissible RF power in output frequency range of RF path with R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N frequency options	
	1 MHz < f ≤ 44 GHz	0.5 W
Maximum permissible DC voltage	R&S®SMM-B1006 frequency option	50 V
	R&S®SMM-B1007, R&S®SMM-B1012 frequency options	35 V
	R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N frequency options	0 V

[2] R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N: temperature > +18 °C.

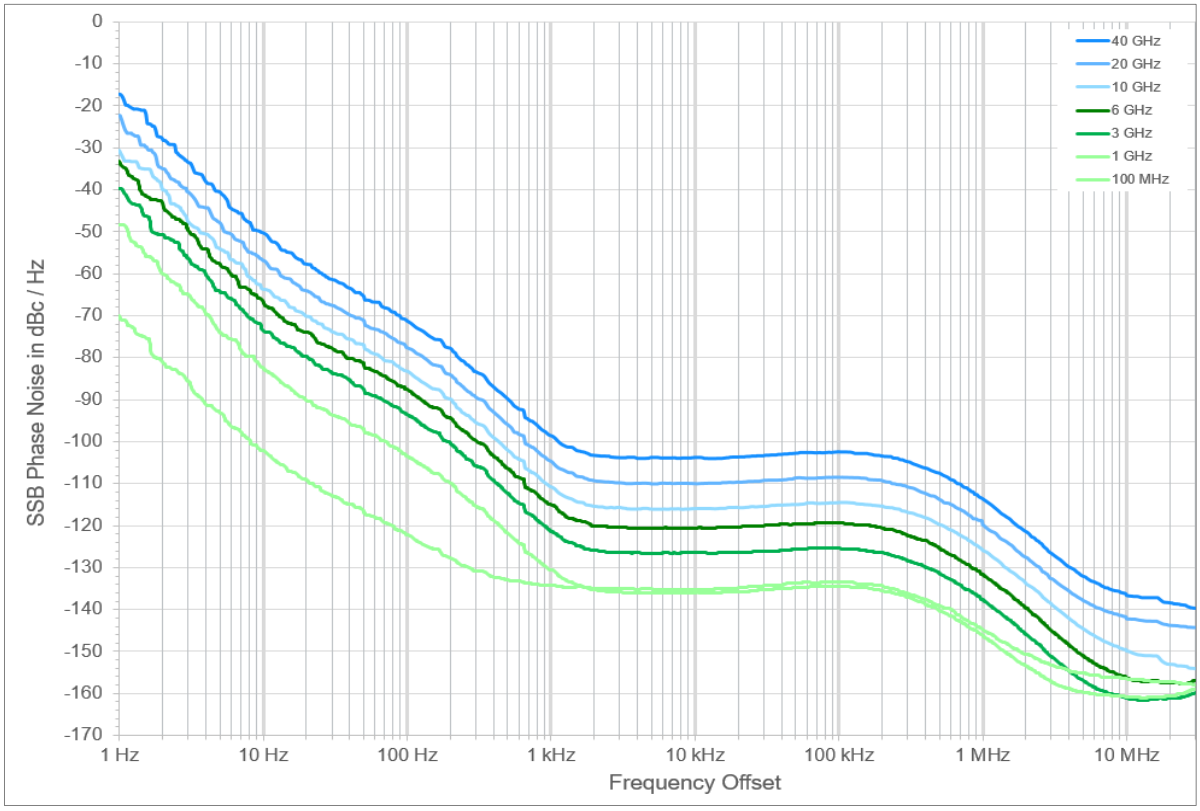
Level sweep

Operating mode		digital sweep in discrete steps
Trigger modes	free run	auto
	execute one full sweep	single
	execute one step	step
	sweep start and stop controlled by external trigger signal	start/stop
Trigger source	internal	external trigger signal (INST TRG A at rear), rotary knob, touchpanel, remote control
Trigger slope	external trigger signal	positive, negative
Sweep range	interruption-free level sweep, level setting characteristic: uninterrupted level setting	0.01 dB to 30 dB
Sweep shape		sawtooth, triangle
Step size setting resolution		0.01 dB
Dwell time setting range		1 ms to 100 s
Dwell time setting resolution		0.1 ms

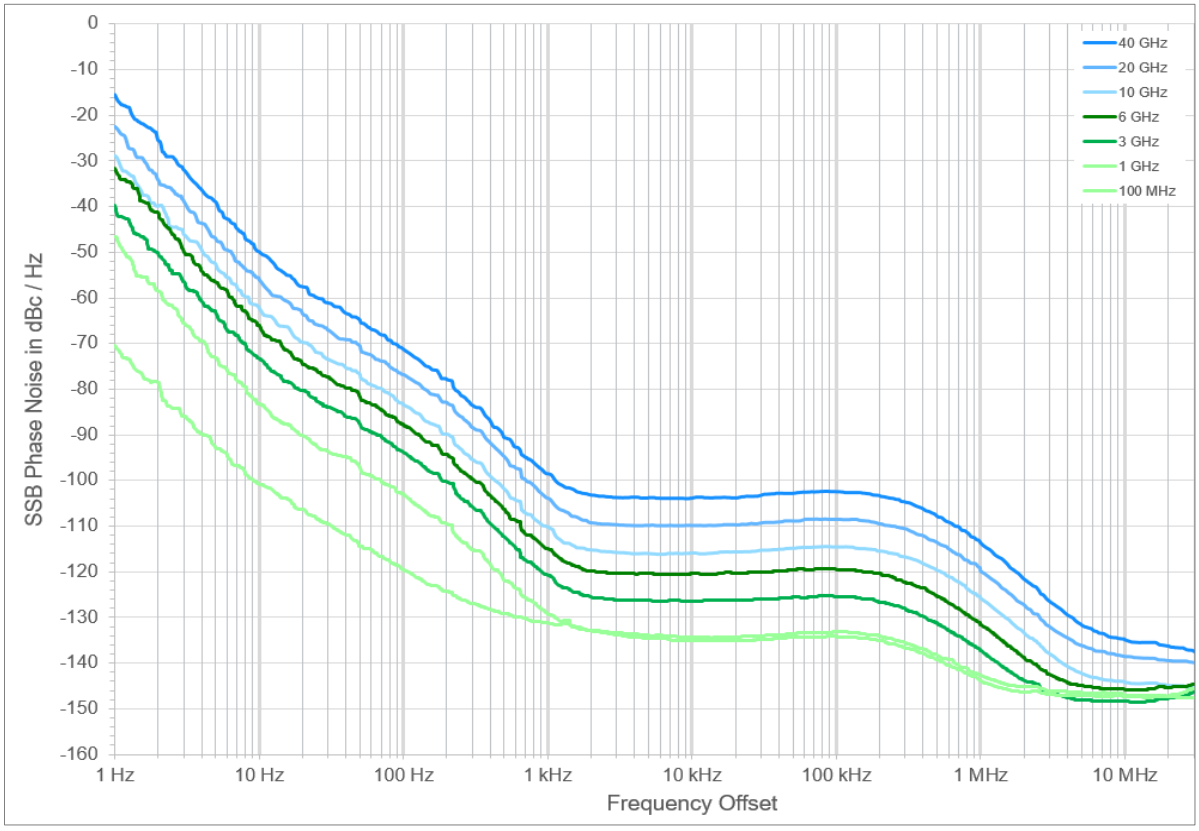
Spectral purity

Harmonics	CW, level < 10 dBm	
	R&S®SMM-B1006, R&S®SMM-B1007, R&S®SMM-B1012 frequency options	< –30 dBc
	R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N frequency options	
	f ≤ 3.5 GHz	< –30 dBc
	f > 3.5 GHz	< –55 dBc
Nonharmonics	CW, I/Q modulation (external wideband I/Q, full-scale DC input), level > –10 dBm, > 10 kHz offset from carrier and outside of the modulation spectrum	
	100 kHz ≤ f ≤ 200 MHz	< –80 dBc
	200 MHz < f ≤ 1500 MHz	< –80 dBc
	1500 MHz < f ≤ 3 GHz	< –79 dBc
	3 GHz < f ≤ 6 GHz	< –73 dBc
	6 GHz < f ≤ 12 GHz	< –67 dBc
	12 GHz < f ≤ 24 GHz	< –61 dBc
	24 GHz < f ≤ 44 GHz	< –55 dBc
Subharmonics	f ≤ 3 GHz	< –85 dBc
	3 GHz < f ≤ 6 GHz	< –74 dBc
	6 GHz < f ≤ 42 GHz	< –60 dBc
	42 GHz < f ≤ 44 GHz	< –50 dBc
Wideband noise	carrier offset > 30 MHz, measurement bandwidth = 1 Hz	
	CW, level = 10 dBm	
	R&S®SMM-B1006 frequency option	
	20 MHz ≤ f ≤ 200 MHz	< –146 dBc, –149 dBc (typ.)
	200 MHz < f ≤ 6 GHz	< –150 dBc, –152 dBc (typ.)
	R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020 frequency options	
	20 MHz ≤ f ≤ 200 MHz	< –146 dBc, –149 dBc (typ.)
	200 MHz < f ≤ 5 GHz	< –150 dBc, –152 dBc (typ.)
	5 GHz < f ≤ 12 GHz	< –147 dBc, –149 dBc (typ.)
	12 GHz < f ≤ 20 GHz	< –144 dBc, –146 dBc (typ.)
	R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N frequency options	
	20 MHz ≤ f ≤ 200 MHz	< –146 dBc, –149 dBc (typ.)
	200 MHz < f ≤ 600 MHz	< –148 dBc, –150 dBc (typ.)
	600 MHz < f ≤ 5 GHz	< –150 dBc, –152 dBc (typ.)
	5 GHz < f ≤ 12 GHz	< –147 dBc, –149 dBc (typ.)
	12 GHz < f ≤ 19.5 GHz	< –144 dBc, –146 dBc (typ.)
	19.5 GHz < f ≤ 30 GHz, carrier offset = 30 MHz	< –135 dBc, –138 dBc (typ.)
	30 GHz < f ≤ 44 GHz, carrier offset = 30 MHz	< –131 dBc, –134 dBc (typ.)

	I/Q modulation with full-scale internal single carrier signal, I/Q input gain = +4 dB, level = 10 dBm	
	20 MHz ≤ f ≤ 200 MHz	< –139 dBc, –142 dBc (typ.)
	200 MHz < f ≤ 1 GHz	< –141 dBc, –144 dBc (typ.)
	1 GHz < f ≤ 3 GHz	< –142 dBc, –145 dBc (typ.)
	3 GHz < f ≤ 12 GHz	< –140 dBc, –143 dBc (typ.)
	R&S®SMM-B1020 frequency option	
	12 GHz < f ≤ 20 GHz	< –138 dBc, –141 dBc (typ.)
	R&S®SMM-B1031 frequency option	
	12 GHz < f ≤ 19.5 GHz	< –138 dBc, –141 dBc (typ.)
	19.5 GHz < f ≤ 30 GHz, carrier offset = 30 MHz	< –133 dBc, –135 dBc (typ.)
	30 GHz < f ≤ 40 GHz, carrier offset = 30 MHz	< –130 dBc, –132 dBc (typ.)
	R&S®SMM-B1044, R&S®SMM-B1044N frequency options	
	12 GHz < f ≤ 19.5 GHz	< –138 dBc, –141 dBc (typ.)
	19.5 GHz < f ≤ 44 GHz, carrier offset = 30 MHz	< –130 dBc, –135 dBc (typ.)
SSB phase noise	CW, standard performance, carrier offset = 20 kHz, measurement bandwidth = 1 Hz, level = 10 dBm or maximum specified output power, whichever is lower	
	20 MHz ≤ f ≤ 200 MHz	< –129 dBc, –134 dBc (typ.)
	f = 1 GHz	< –129 dBc, –134 dBc (typ.)
	f = 2 GHz	< –123 dBc, –128 dBc (typ.)
	f = 3 GHz	< –119 dBc, –124 dBc (typ.)
	f = 4 GHz	< –117 dBc, –122 dBc (typ.)
	f = 6 GHz	< –113 dBc, –118 dBc (typ.)
	f = 10 GHz	< –109 dBc, –114 dBc (typ.)
	f = 20 GHz	< –103 dBc, –108 dBc (typ.)
	f = 30 GHz	< –99 dBc, –104 dBc (typ.)
	f = 40 GHz	< –97 dBc, –102 dBc (typ.)
	f = 44 GHz	< –96 dBc, –101 dBc (typ.)



Measured SSB phase noise performance, standard instrument, CW mode



Measured SSB phase noise performance, standard instrument, I/Q mode

List mode

Frequency and level values can be stored in a list and set in an extremely short amount of time, triggered by an internal timer or an external trigger connector. There are two run modes available:

- learned: faster (see frequency and level data), limited number of steps, cannot be combined with I/Q optimization mode “high quality”
- live: works only for dwell times above 2 ms

Run modes		learned, live
Operating modes	internal trigger, infinite	automatic
	internal trigger, one sweep per trigger event	single
	internal trigger, one step per trigger event	step
	external trigger, one sweep per trigger event	extern single
	external trigger, one step per trigger event	extern step
Maximum number of steps (learned mode)		10000
Dwell time	can be set individually for each step	0.5 ms to 100 s
Resolution		0.1 ms
Setting time	after external trigger	see frequency and level data

Phase coherence (R&S®SMM-B90 option)

It provides phase-coherent RF outputs for two or more instruments.

LO coupling modes	This mode corresponds to internal LO operation. The LO OUT connector can provide the internal LO oscillator signal to enable phase-coherent coupling with other instruments.	internal
	This mode corresponds to external LO operation, provided at the LO IN connector. The LO OUT connector can provide the external LO oscillator signal to enable phase-coherent coupling with additional instruments.	external
REF/LO OUT states	The active LO signal can be routed to the LO OUT connector (in order to couple two or more instruments).	on/off
Input of phase coherence signal		
Connector type	LO IN on rear panel	SMA female
Input impedance		50 Ω (nom.)
Input level range of external LO signal		7 dBm to 13 dBm
Frequency range of external LO signal	for RF setting 200 MHz < f ≤ 6.5 GHz	1.0 · f
	for RF setting 6.5 GHz < f ≤ 13 GHz	0.5 · f
	for RF setting 13 GHz < f ≤ 26 GHz	0.25 · f
	for RF setting 26 GHz < f ≤ 44 GHz	0.125 · f
Output of phase coherence signal		
Connector type	LO OUT on rear panel	SMA female
Output impedance		50 Ω (nom.)
Output level range of internal LO signal		7 dBm to 13 dBm
Frequency range of internal LO signal	for RF setting 200 MHz < f ≤ 6.5 GHz	1.0 · f
	for RF setting 6.5 GHz < f ≤ 13 GHz	0.5 · f
	for RF setting 13 GHz < f ≤ 26 GHz	0.25 · f
	for RF setting 26 GHz < f ≤ 44 GHz	0.125 · f

Simultaneous modulation

	Amplitude modulation	Frequency modulation	Phase modulation	Pulse modulation	I/Q modulation
Amplitude modulation	–	●	●	○	–
Frequency modulation	●		–	●	●
Phase modulation	●	–		●	●
Pulse modulation	○	●	●		○
I/Q modulation	–	●	●	○	

● = compatible, – = incompatible

○ = compatible with limitations (ALC mode = off)

Analog modulation

Amplitude modulation (R&S®SMM-K720 option)

Modulation source		internal, external
External coupling		AC, DC
Modulation depth	modulation is clipped at high levels when maximum PEP is reached	0 % to 100 %
Resolution of setting		0.1 %
AM depth (m) error	f ≤ 30 GHz	
	f_{mod} = 1 kHz and m < 80 %	< (1 % of reading + 1 %)
	30 GHz < f	
	f_{mod} = 1 kHz and m < 80 %	< (2 % of reading + 1 %)
AM distortion	f ≤ 3 GHz, f_{mod} = 1 kHz	
	m = 30 %	< 0.8 %
	m = 80 %	< 1.4 %
	3 GHz < f ≤ 20 GHz, f_{mod} = 1 kHz	
	m = 30 %	< 1 %
	m = 80 %	< 1.6 %
	20 GHz < f, f_{mod} = 1 kHz	
	m = 30 %	< 1.5 %
	m = 80 %	< 2.4 %
Modulation frequency range		DC, 20 Hz to 500 kHz
Modulation frequency response	AC mode, 20 Hz to 500 kHz	< 1 dB
Incidental PM at AM	m = 30 %, f_{mod} = 1 kHz, peak value	< 0.1 rad

Frequency modulation (R&S®SMM-K720 option)

FM multiplier (N) for different frequency ranges	100 kHz ≤ f ≤ 200 MHz	N = 1
	200 MHz < f ≤ 375 MHz	N = 1/4
	375 MHz < f ≤ 750 MHz	N = 1/2
	750 MHz < f ≤ 1500 MHz	N = 1
	1.5 GHz < f ≤ 3 GHz	N = 2
	3 GHz < f ≤ 6 GHz	N = 4
	6 GHz < f ≤ 12 GHz	N = 8
	12 GHz < f ≤ 24 GHz	N = 16
	24 GHz < f ≤ 44 GHz	N = 32
Modulation source		internal, external, internal + external
External coupling		AC, DC
FM modes		normal, low noise
Maximum deviation	FM mode: normal	N · 10 MHz
	FM mode: low noise	N · 100 kHz
Resolution of setting		< 200 ppm, min. N · 0.1 Hz
FM deviation error	f_{mod} = 10 kHz, deviation ≤ half of maximum deviation or 10 MHz, which ever is lower	
	internal	< (1.5 % of reading + 20 Hz)
	external	< (2.0 % of reading + 20 Hz)
FM distortion	f_{mod} = 10 kHz, deviation = N · 1 MHz	< 0.1 %
Modulation frequency response	FM mode: normal (DC/AC coupling), 50 Ω input impedance	
	DC, 10 Hz to 100 kHz	< 0.5 dB
	DC, 10 Hz to 10 MHz, f ≤ 3 GHz DC, 10 Hz to 5 MHz, f > 3 GHz	< 3 dB
	FM mode: low noise (DC/AC coupling), 50 Ω input impedance	
	DC, 10 Hz to 100 kHz	< 3 dB
Synchronous AM with FM	40 kHz deviation, f_{mod} = 1 kHz	
	5 MHz < f ≤ 3 GHz	< 0.1 %
	3 GHz < f ≤ 6 GHz	< 0.2 %
	6 GHz < f ≤ 44 GHz	< 0.2 %
Carrier frequency offset at FM		< 0.2 % of set deviation

Phase modulation (R&S®SMM-K720 option)

PM multiplier (N) for different frequency ranges	100 kHz ≤ f ≤ 200 MHz	N = 1
	200 MHz < f ≤ 375 MHz	N = 1/4
	375 MHz < f ≤ 750 MHz	N = 1/2
	750 MHz < f ≤ 1500 MHz	N = 1
	1.5 GHz < f ≤ 3 GHz	N = 2
	3 GHz < f ≤ 6 GHz	N = 4
	6 GHz < f ≤ 12 GHz	N = 8
	12 GHz < f ≤ 24 GHz	N = 16
	24 GHz < f ≤ 44 GHz	N = 32
Modulation source		internal, external, internal + external
External coupling		AC, DC
PM modes		high deviation, high bandwidth, low noise
Maximum deviation	PM mode: high deviation, f_{mod} ≤ N · 10 MHz / deviation	N · 20.0 rad
	PM mode: high bandwidth	N · 1.0 rad
	PM mode: low noise	N · 0.25 rad
Resolution of setting	PM mode: high deviation	< 200 ppm, min. N · 20 µrad
	PM mode: high bandwidth	< 0.1 %, min. N · 20 µrad
	PM mode: low noise	< 200 ppm, min. N · 20 µrad
PM deviation error	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)
Modulation frequency response	DC/AC coupling, 50 Ω input impedance	
	PM mode: high deviation	
	deviation ≤ N · 5 rad, DC, 10 Hz to 500 kHz	< 1 dB
	deviation > N · 5 rad, DC, 10 Hz to 10 kHz	
	PM mode: high bandwidth	
	DC, 10 Hz to 10 MHz, f ≤ 3 GHz	< 3 dB
	DC, 10 Hz to 5 MHz, f > 3 GHz	
	PM mode: low noise	
	DC, 10 Hz to 100 kHz	< 3 dB

Pulse modulation (R&S®SMM-K22 option)

Modulation source		external, internal
On/off ratio		> 80 dB
Rise/fall time	10 %/90 % of RF amplitude	
	with R&S®SMM-B1006 frequency option	
	transition type = fast	< 10 ns
	transition type = smoothed	< 200 ns
	with R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N frequency options	
	transition type = fast	< 10 ns
	with R&S®SMM-B1044/-B1044N, f > 19.5 GHz	< 15 ns
	transition type = smoothed, only available for: f ≤ 5 GHz, CW; f ≤ 3.5 GHz, I/Q modulation or AM modulation	< 200 ns
Minimum pulse width	50 %/50 % of RF amplitude, transition type = fast	
	with R&S®SMM-B1006, R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044 frequency options	20 ns
	with R&S®SMM-B1044N frequency option	
	f ≤ 19.5 GHz	20 ns
	f > 19.5 GHz	30 ns
Pulse repetition frequency		0 Hz to 10 MHz

Video feedthrough	with R&S®SMM-B1006 frequency option	
	level < 10 dBm	< 10 % of RF
		< 200 mV (V_{pp})
	with R&S®SMM-B1007, R&S®SMM-B1012 frequency options	
	f ≤ 5 GHz: level < 5 dBm	< 10 % of RF
		< 200 mV (V_{pp})
	f > 5 GHz: level < 10 dBm	< 10 % of RF
		< 20 mV (V_{pp})
	R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N, R&S®SMM-B2020 frequency options	
	f ≤ 5 GHz: level < 5 dBm	< 10 % of RF
		< 200 mV (V_{pp})
	f > 5 GHz: level < 10 dBm	< 10 % of RF
		< 2 mV (V_{pp})
Pulse overshoot		< 10 %

Input for external modulation signals

Modulation inputs EXT 1, EXT 2 for AM/FM/PM		
Connector type	EXT 1, EXT 2 on rear panel	BNC female
Input impedance	selectable	100 kΩ or 50 Ω (nom.)
Coupling		AC, DC
Input sensitivity	peak value for set modulation depth or deviation	1 V (nom.)
Bandwidth	analog input bandwidth	0 Hz to 10 MHz
Input damage voltage		±10 V
Modulation input for pulse modulation		
Input		selectable from USER 1, 2, 3 on front panel or USER 4, 5, 6 on rear panel
Connector type	USER 1, 2, 3 on front panel, USER 4, 5, 6 on rear panel	BNC female
Input impedance	selectable	1 kΩ or 50 Ω (nom.)
Threshold voltage		0 V to 2.0 V (nom.)
Input damage voltage		3.3 V (nom.)
Input polarity	selectable	normal, inverse

Modulation sources for analog modulation

Internal modulation generator

Shape		sinusoidal
Frequency range		0.1 Hz to 1 MHz
Resolution of setting		0.1 Hz
Frequency uncertainty		< 0.001 Hz + relative deviation of reference frequency

Multifunction generator (R&S®SMM-K24 option)

The multifunction generator option (R&S®SMM-K24) consists of three function generators that can be set independently. Two of the three signal sources can be added with different weighting. The total voltage is limited by the maximum output voltage.

Sources	LF generator 1 and 2	sine wave, pulse, triangle, trapezoid
	noise generator	noise amplitude distribution: Gaussian, equal
Frequency range	sine wave	0.1 Hz to 10 MHz
	pulse, triangle, trapezoid	0.1 Hz to 1 MHz (displayed value)
	noise bandwidth	100 kHz to 10 MHz
Resolution of setting	sine wave	0.1 Hz
	pulse, triangle, trapezoid	10 ns
	noise bandwidth	100 kHz
Frequency uncertainty		< 0.001 Hz + relative deviation of reference frequency

LF output

Monitoring of resulting modulation signal	for	AM, FM, PM
Source		LF generator 1, LF generator 2, external 1, external 2, noise generator
Output voltage	V_p at LF connector, open circuit voltage EMF	
Setting range		20 mV to 1 V
Setting resolution		1 mV
Setting accuracy	at 1 kHz	< (1 % of reading + 1 mV)
Output impedance		50 Ω
DC offset		–0.2 V to +2.5 V
Frequency response	sine wave, up to 1 MHz	0.05 dB (meas.)
	sine wave, up to 10 MHz	0.1 dB (meas.)
Distortion	f < 100 kHz, at R_L > 50 Ω, level (V_{EMF}) 1 V	< 0.1 %

High-performance pulse generator (R&S®SMM-K23 option)

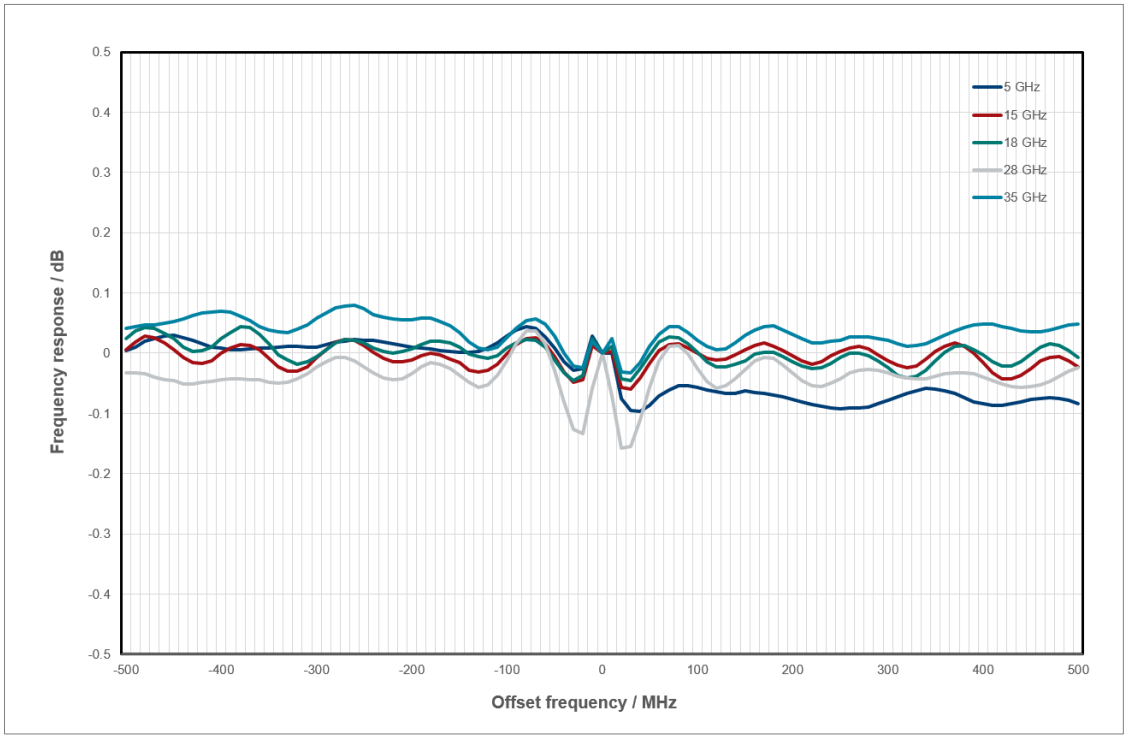
Pulse modes		single pulse, double pulse
Trigger modes	free run, internally triggered	auto
		external trigger
		external gate
Active trigger edge		positive or negative
Pulse period		
Setting range		20 ns to 100 s
Setting resolution		3.333 ns
Pulse width		
Setting range	pulse widths of double pulses are independently settable	3.333 ns to 100 s
Setting resolution		3.333 ns
Pulse delay		
Setting range		0 ns to 100 s
Setting resolution		3.333 ns
Double-pulse delay		
Setting range		20 ns to 1 s
Setting resolution		3.333 ns
Uncertainty for pulse timing	pulse timing generated digitally; ensured by design	relative deviation of reference frequency
External trigger		
Delay	trigger to RF output	50 ns (meas.)
Jitter		< 10 ns (meas.)
PULSE/VIDEO/SYNC output		LVTTL signal (R_L ≥ 50 Ω)

I/Q modulation

I/Q modulation performance

Operating modes		external wideband I/Q
		internal baseband I/Q
RF modulation bandwidth	with external wideband I/Q inputs, I/Q wideband on; with R&S®SMM-B1006, R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044 options	
	1 MHz ≤ f ≤ 300 MHz	±32 % of carrier frequency
	300 MHz < f ≤ 2.5 GHz	±40 % of carrier frequency
	f > 2.5 GHz	±1 GHz
	with external wideband I/Q inputs, I/Q wideband on; with R&S®SMM-B1044N option	
	1 MHz ≤ f ≤ 300 MHz	±32 % of carrier frequency
	300 MHz < f ≤ 2.5 GHz	±40 % of carrier frequency
	2.5 GHz < f ≤ 19.5 GHz	±1 GHz
	f > 19.5 GHz	±275 MHz
	with external wideband I/Q inputs, I/Q wideband on; with R&S®SMM-B1007, R&S®SMM-B1012 options	
	1 MHz ≤ f ≤ 300 MHz	±32 % of carrier frequency
	300 MHz < f ≤ 1.25 GHz	±40 % of carrier frequency
	f > 1.25 GHz	±500 MHz
	with external wideband I/Q inputs, I/Q wideband off	
	f ≤ 1000 MHz	±10 % of carrier frequency
	f > 1000 MHz	±100 MHz
	with internal baseband I/Q, I/Q wideband on; with R&S®SMM-B1006, R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044 options	
	1 MHz ≤ f ≤ 300 MHz	±32 % of carrier frequency
	300 MHz < f ≤ 1.25 GHz	±40 % of carrier frequency
	f > 1.25 GHz	±500 MHz
	with internal baseband I/Q, I/Q wideband on; with R&S®SMM-B1044N option	
	1 MHz ≤ f ≤ 300 MHz	±32 % of carrier frequency
	300 MHz < f ≤ 1.25 GHz	±40 % of carrier frequency
	1.25 GHz < f ≤ 19.5 GHz	±500 MHz
	f > 19.5 GHz	±275 MHz
RF frequency response in specified RF modulation bandwidth	with external wideband I/Q inputs	
	I/Q wideband on	< 9 dB, < 6 dB (meas.)
	I/Q wideband off	< 5 dB, < 3 dB (meas.)
	with internal baseband I/Q, I/Q wideband on, optimization mode: high quality	< 1.0 dB, < 0.4 dB (meas.)

Carrier leakage [3]	mode: internal baseband I/Q, referenced to full-scale input	< –55 dBc
	f > 19.5 GHz with R&S®SMM-B1031 option	< –40 dBc
	f > 19.5 GHz with R&S®SMM-B1044, R&S®SMM-B1044N options	< –30 dBc
Suppression of image sideband for entire instrument in modulation bandwidth [3]	with internal baseband I/Q, optimization mode: high quality	> 40 dB, 50 dB (meas.)
Two-tone IMD (2 carriers)	PEP = 0 dBm, up to 80 MHz carrier spacing	
	f ≤ 3 GHz	< –50 dBc (typ.)
	3 GHz < f ≤ 10 GHz	< –45 dBc (typ.)
	10 GHz < f ≤ 20 GHz	< –40 dBc (typ.)
	20 GHz < f ≤ 30 GHz	< –38 dBc (typ.)
	30 GHz < f ≤ 44 GHz	< –32 dBc (typ.)
I/Q impairments (analog)	These impairments are set within the analog I/Q modulator section. They can be used in external wideband I/Q mode and internal baseband I/Q mode. They cannot be applied to the analog or digital I/Q outputs.	
	I offset, Q offset	
	setting range	–10 % to +10 %
	setting resolution	0.01 %
	gain imbalance	
	setting range	–1.0 dB to +1.0 dB
	setting resolution	0.01 dB
	quadrature offset	
	setting range	–10° to +10°
	setting resolution	0.01°



Measured RF modulation frequency response with internal baseband I/Q

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

Analog I/Q inputs

Analog I/Q input signals are directly applied to the analog I/Q modulation circuit and are not routed through the baseband section of the R&S®SMM100A.

Input mode		single-ended
Connector types	I, Q on front panel	BNC female
Input impedance		50 Ω (nom.)
VSWR	with R&S®SMM-B1006, R&S®SMM-B1007, R&S®SMM-B1012, R&S®SMM-B1020 frequency options	
	up to 200 MHz	< 1.2 (typ.)
	200 MHz to 500 MHz	< 1.35 (typ.)
	500 MHz to 1 GHz	< 1.45 (typ.)
	with R&S®SMM-B1031 frequency option	
	up to 200 MHz, f ≤ 19.5 GHz	< 1.2 (typ.)
	up to 200 MHz, f > 19.5 GHz	< 1.35 (typ.)
	200 MHz to 500 MHz	< 1.35 (typ.)
	500 MHz to 1 GHz	< 1.45 (typ.)
	with R&S®SMM-B1044 frequency option	
	up to 200 MHz, f ≤ 19.5 GHz	< 1.2 (typ.)
	up to 200 MHz, f > 19.5 GHz	< 1.35 (typ.)
	200 MHz to 500 MHz	< 1.35 (typ.)
	500 MHz to 1 GHz	< 1.5 (typ.)
	with R&S®SMM-B1044N frequency option	
	up to 200 MHz, f ≤ 19.5 GHz	< 1.2 (typ.)
	200 MHz to 500 MHz, f ≤ 19.5 GHz	< 1.35 (typ.)
	500 MHz to 1 GHz, f ≤ 19.5 GHz	< 1.5 (typ.)
	up to 275 MHz, f > 19.5 GHz	< 1.35 (typ.)
Nominal input voltage for full-scale input		$\sqrt{V_i^2 + V_q^2} = 0.5\ V$
Damage voltage		±2 V

Baseband characteristics

Internal baseband characteristics

The internal basband provides I/Q paths that can be routed to the installed RF paths or to the analog I/Q outputs.

D/A converter		
Data rate		1200 MHz
Resolution		14 bit
Sample rate		4800 MHz (internal interpolation · 4)
Aliasing filter	with amplitude, group delay and S_i correction	
Bandwidth, rolloff to –0.1 dB		1000 MHz
SFDR overall		> 55 dB
I/Q impairments (digital baseband)	These impairments are set in the digital baseband section of the R&S®SMM100A. They act on the I/Q signal sent to the I/Q modulator/RF section, as well as on the I/Q signals at the analog or digital I/Q outputs (of the respective path).	
Carrier leakage		
Setting range		–10 % to +10 %
Setting resolution		0.01 %
I ≠ Q (imbalance)		
Setting range		–1 dB to +1 dB
Setting resolution		0.01 dB
Quadrature offset		
Setting range		–10° to +10°
Setting resolution		0.01°

Wideband analog 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 100 MHz	0.1 dB (meas.)
	up to 500 MHz	0.2 dB (meas.)
I/Q balance [5]	at R_L = 50 Ω	
Magnitude	up to 100 MHz	0.1 dB (meas.)
	up to 500 MHz	0.1 dB (meas.)
Spectral purity	at R_L = 50 Ω	
SFDR (sine wave)	100 MHz	> 60 dB
	up to 500 MHz	55 dB (meas.)
Wideband noise	10 MHz sine wave at 1 MHz offset	–155 dBc (typ.)

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

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

Wideband differential analog I/Q outputs (R&S®SMM-K17 option)

Output impedance		
Single-ended		50 Ω
Differential		100 Ω
Output voltage (V_{out})	output voltage depends on set modulation signal	
Single-ended	EMF	0.02 V to 1 V (V_p)
Resolution		0.1 mV
Differential	EMF	0.04 V to 2 V (V_{pp})
Resolution		0.1 mV
Bias voltage (single-ended and differential)	EMF	–0.2 V to +2.5 V [6]
Resolution		0.1 mV
Uncertainty		1 % + 2 mV
Offset voltage		
Differential	EMF	(–2 V + V_{out}) to (+2 V – V_{out})
	EMF, RF envelope: on (R&S®SMM-K540 required)	–2 V to +2 V
Resolution		0.1 mV
Uncertainty		1 % + 1 mV
Differential signal balance	at R_L = 50 Ω, output voltage > 0.5 V (V_p)	
Magnitude	up to 100 MHz	0.1 dB (meas.)
	up to 500 MHz	0.15 dB (meas.)
Frequency response [7]	at R_L = 50 Ω, output voltage > 0.5 V (V_p)	
Magnitude	up to 100 MHz	0.1 dB (meas.)
	up to 500 MHz	0.2 dB (meas.)
Wideband noise	10 MHz sine wave at 1 MHz offset	–160 dBc (typ.)

[6] The magnitude of the sum of output voltage and bias voltage must not exceed 4 V.

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

Digital baseband inputs for wideband baseband

Depending on the installed software and hardware options, the R&S®SMM100A is able to receive digital baseband signals. The digital I/Q input can be used for the lossless connection of the R&S®SMM100A to the digital I/Q output of other Rohde & Schwarz instruments.

Minimum required options for digital I/Q inputs		
Interface standard	HS DIG I/Q	1 × R&S®SMM-B9

Input parameters

HS DIQ I/Q interface		
Input level	peak level	
Setting range		–60 dB to +3 dB, referenced to full scale
Setting resolution		0.01 dB
Crest factor		
Setting range		0 dB to +30 dB
Setting resolution		0.01 dB
Adjust level function	automatically determines peak level and crest factor of input signal	
Standard		HS DIG I/Q, in line with R&S®Digital I/Q Interface 40G PAD-R [8] (DIG I/Q 40G), I/Q data and control signals
Level		CML
Connector		QSFP+ / QSFP 28
I/Q sample rate		
Source	the sample rate will be used based on information provided by the transmitting device	HS digital I/Q In
Sample rate	maximum sample rate depends on connected transmitting device and system configuration mode	
40G		up to 1.05 GHz
50G		up to 1.20 GHz
Resolution		0.001 Hz
Frequency uncertainty		< (1 · 10^{-12} + relative deviation of reference frequency) · sample rate (nom.)
I/Q data		
Resolution		16 bit
Logic format		two's complement
Bandwidth (RF)		0.833 · sample rate
Control signals	markers	2

[8] R&S®Digital I/Q Interface 40G PAD-R is a Rohde & Schwarz internal company guideline for the transmission of digital I/Q data. It is supported by a wide range of signal generators, signal analyzers and radio communication testers.

Baseband generator – arbitrary waveform mode (R&S®SMM-B9 option)

The I/Q signals can be assigned a frequency offset.

Waveform length	standard	1 sample to 64 Msample, in one-sample steps
	with R&S®SMM-K511 option	1 sample to 512 Msample, in one-sample steps
	with R&S®SMM-K511 and R&S®SMM-K512 options	1 sample to 1 Gsample, in one-sample steps
	R&S®SMM-K511, R&S®SMM-K512 and R&S®SMM-K513 options	1 sample to 2 Gsample, in one-sample steps
Nonvolatile memory		hard disk
Sample resolution	equivalent to D/A converter	14 bit
Sample rate		400 Hz to 150 MHz
	with R&S®SMM-K523 option	400 Hz to 300 MHz
	with R&S®SMM-K524 option	400 Hz to 600 MHz
	with R&S®SMM-K525 option	400 Hz to 1200 MHz
Sample frequency error	internal clock	< ($1 \cdot 10^{-12}$ + relative deviation of reference frequency) · sample rate (nom.)
Sample clock source		internal
Bandwidth (RF)	at maximum sample rate, rolloff to –0.1 dB	120 MHz
	at reduced sample rate, rolloff to –0.1 dB	0.8 · sample rate
Bandwidth (RF) with R&S®SMM-K523 option	at maximum sample rate, rolloff to –0.1 dB	240 MHz
	at reduced sample rate, rolloff to –0.1 dB	0.8 · sample rate
Bandwidth (RF) with R&S®SMM-K524 option	at maximum sample rate, rolloff to –0.1 dB	500 MHz
	at reduced sample rate, rolloff to –0.1 dB	0.833 · sample rate
Bandwidth (RF) with R&S®SMM-K525 option	at maximum sample rate, rolloff to –0.1 dB	1000 MHz
	at reduced sample rate, rolloff to –0.1 dB	0.833 · sample rate
Frequency offset	Using the frequency offset, the center frequency of the wanted baseband signal can be shifted. The restrictions caused by the modulation bandwidth still apply.	
Frequency offset setting range	standard	–60 MHz to +60 MHz
	with R&S®SMM-K523 option	–120 MHz to +120 MHz
	with R&S®SMM-K524 option	–250 MHz to +250 MHz
	with R&S®SMM-K525 option	–500 MHz to +500 MHz
Frequency offset setting resolution		0.01 Hz
Frequency offset error		< ($9 \cdot 10^{-6}$ Hz + relative deviation of reference frequency) · frequency offset (nom.)
Triggering	A trigger event restarts I/Q generation. The I/Q signal is then synchronous with the trigger (with a specific timing jitter).	
Trigger source	event triggered via GUI or remote command	internal
	event triggered by other baseband generator	internal (baseband A/B)
	event triggered by external trigger signal	external
Trigger modes	The signal is generated continuously.	auto
	The signal is generated continuously. A trigger event causes a restart.	retrig
	The signal is started only when a trigger event occurs. Subsequent trigger events are ignored.	armed auto
	The signal is started only when a trigger event occurs. Every subsequent trigger event causes a restart.	armed retrig
	The signal is started only when a trigger event occurs. The signal is generated once.	single

External trigger input		selectable from USER 1, 2, 3 on front panel
Connector type	USER 1, 2, 3 on front panel	BNC female
Input level		0 V to 3 V (nom.)
Threshold	USER 1, 2, 3	settable between 0.1 V and 2.0 V
Input impedance	selectable	1 kΩ or 50 Ω (nom.)
Trigger jitter		±1.67 ns
External trigger delay		
Setting range		0 sample to $2.147 \cdot 10^9$ sample
Setting resolution		3.3 ns
External trigger inhibit		
Setting range		0 sample to (21.47s · sample rate) sample
Setting resolution		1 sample
External trigger pulse width		> 7.5 ns
Marker signals		
Number of marker signals		3
Operating modes		unchanged, restart, pulse, pattern, ratio
Marker outputs		selectable from USER 1, 2, 3 on front panel
Connector type	USER 1, 2, 3 on front panel	BNC female
Level		LVTTL
Marker delay		
Setting range		0 sample to (waveform length – 1) sample
Setting resolution		1 sample
Marker duration		
Minimum value	sample rate ≤ 300 Msample/s	1 sample
	300 Msample/s < sample rate ≤ 600 Msample/s	2 sample
	600 Msample/s < sample rate ≤ 1200 Msample/s	4 sample
Multisegment waveform mode		
Number of segments		1 to 1024
Changeover modes		GUI, remote control
Extended trigger modes		same segment, next segment, next segment seamless, sequencer
Seamless changeover		output up to end of current segment, followed by changeover to next segment
Sequencer play list length		max. 1024
Sequencer segment repetitions		max. 1048575
Multicarrier waveform mode		
Number of carriers		max. 512
Total RF bandwidth		max. 120 MHz
	with R&S®SMM-K523 option	max. 240 MHz
	with R&S®SMM-K524 option	max. 500 MHz
	with R&S®SMM-K525 option	max. 1000 MHz
Carrier spacing		
Setting range		depends on number of carriers and signal RF bandwidth
Setting resolution		0.01 Hz
Crest factor modes		maximize, minimize, off
Signal period modes		longest file, shortest file, user (max. 1 s)
Single carrier gain		
Setting range		–80 dB to 0 dB
Setting resolution		0.01 dB
Single carrier start phase		
Setting range		0° to 360°
Setting resolution		0.01°
Single carrier delay		
Setting range		0 s to 1 s
Setting resolution		1 ns

I/Q baseband generator – real-time operation (custom digital modulation) (R&S®SMM-K520 option)

Prerequisite: R&S®SMM-B9 must be installed. Their I/Q signals can be assigned a frequency offset.

Types of modulation		
ASK		
Modulation index		0 % to 100 %
Setting resolution		0.1 %
FSK		2FSK, 4FSK, MSK
Deviation		1 Hz to 15 · f_{sym}
Maximum		240 MHz
Setting resolution		0.1 Hz
Variable FSK		4FSK, 8FSK, 16FSK
Deviations		–15 · f_{sym} to +15 · f_{sym}
Maximum		240 MHz
Setting resolution		0.1 Hz
PSK		BPSK, QPSK, QPSK 45° offset, QPSK EDGE, AQPSK, OQPSK, π/4-QPSK, π/2-DBPSK, π/4-DQPSK, π/8-D8PSK, 8PSK, 8PSK EDGE
QAM		16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 1024QAM, 4096QAM, π/4-16QAM, –π/4-32QAM (for EDGE+)
APSK		16APSK, 32APSK
Gamma/gamma1	16APSK	3.15 (DVB-S2 2/3), 2.85 (DVB-S2 3/4), 2.75 (DVB-S2 4/5), 2.70 (DVB-S2 5/6), 2.60 (DVB-S2 8/9), 2.57 (DVB-S2 9/10)
	32APSK	2.84 (DVB-S2 3/4), 2.72 (DVB-S2 4/5), 2.64 (DVB-S2 5/6), 2.54 (DVB-S2 8/9), 2.53 (DVB-S2 9/10)
Symbol rate		
Operating mode		internal
Setting range	standard	
	ASK, PSK, APSK and QAM	50 Hz to 100 MHz
	FSK	50 Hz to 100 MHz
	with R&S®SMM-K523 option	
	ASK, PSK, APSK and QAM	50 Hz to 200 MHz
	FSK	50 Hz to 200 MHz
	with R&S®SMM-K524 option	
	ASK, PSK, APSK and QAM	50 Hz to 300 MHz
	FSK	50 Hz to 300 MHz
	with R&S®SMM-K525 option	
	ASK, PSK, APSK and QAM	50 Hz to 600 MHz
	FSK	50 Hz to 600 MHz
Setting resolution		0.001 Hz
Frequency uncertainty (internal)		< (1.6 · 10^{-11} + relative deviation of reference frequency) · symbol rate (nom.)
Baseband filter	Any filter can be used with any type of modulation. The bandwidth of the modulation signal corresponds to the RF bandwidth; the signal is clipped if the bandwidth is exceeded.	
Maximum bandwidth		120 MHz
	with R&S®SMM-K523 option	240 MHz
	with R&S®SMM-K524 option	500 MHz
	with R&S®SMM-K525 option	1000 MHz
Filter types		cosine, root cosine, Gaussian, cdmaOne, cdmaOne + equalizer, cdmaOne 705 kHz, cdmaOne 705 kHz + equalizer, CDMA2000® 3x, APCO25 C4FM, EDGE narrow pulse, EDGE wide pulse rectangular, split phase, EUtra/LTE

Filter parameter		
Setting range	cosine, root cosine (filter parameter α)	0.05 to 1.00
	Gaussian (filter parameter B × T)	0.15 to 2.50
	split phase (filter parameter B × T)	0.15 to 2.50
Setting resolution		0.01
Coding	Not all coding methods can be used with every type of modulation.	off, differential, diff. + Gray, Gray, NADC, PDC, PHS, TETRA, APCO25 (PSK), APCO25 (8PSK), PWT, TFTS, VDL, EDGE, APCO25(FSK), ICO, CDMA2000®, WCDMA
Data sources		PRBS: 9, 11, 15, 16, 20, 21, 23, All 0, All 1, pattern (length: 1 bit to 64 bit), data lists, external
Data lists		
Output memory		8 bit to 2 Gbit
Nonvolatile memory		hard disk
Predefined settings	modulation, filter, symbol rate and coding in line with standard	
Standards		APCO, Bluetooth®, DECT, ETC, GSM, GSM EDGE, NADC, PDC, PHS, TETRA, WCDMA 3GPP, TD-SCDMA, CDMA2000® forward link, CDMA2000® reverse link, WorldSpace, CW in baseband
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 still apply.	
Setting range		–60 MHz to +60 MHz
	with R&S®SMM-K523 option	–120 MHz to +120 MHz
	with R&S®SMM-K524 option	–250 MHz to +250 MHz
	with R&S®SMM-K525 option	–500 MHz to +500 MHz
Setting resolution		0.01 Hz
Error		< ($9 \cdot 10^{-6}$ Hz + relative deviation of reference frequency) · frequency offset (nom.)
Triggering		
Trigger source	event triggered via GUI or remote command	internal
	event triggered by other baseband generator	internal (baseband A/B)
	event triggered by external trigger signal	external
Trigger modes	The signal is generated continuously.	auto
	The signal is generated continuously. A trigger event causes a restart.	retrig
	The signal is started only when a trigger event occurs. Subsequent trigger events are ignored.	armed auto
	The signal is started only when a trigger event occurs. Every subsequent trigger event causes a restart.	armed retrig
	The signal is started only when a trigger event occurs. The signal is generated once.	single
External trigger input		selectable from USER 1, 2, 3 on front panel
Connector type	USER 1, 2, 3 on front panel	BNC female
Input level		0 V to 3 V (nom.)
Threshold	USER 1, 2, 3	settable between 0.1 V and 2.0 V
Input impedance	selectable	1 kΩ or 50 Ω (nom.)
Trigger jitter		±1.67 ns
External trigger delay		
Setting range		0 symbol to ($2.147 \cdot 10^9$) symbol
Setting resolution		3.3 ns
External trigger inhibit		
Setting range		0 symbol to (21.47 s · symbol rate) symbol
Setting resolution		1 symbol
External trigger pulse width		> 7.5 ns

Marker signals		
Number of marker signals		3
Operating modes		control list, pulse, pattern, ratio
Marker outputs		selectable from USER 1, 2, 3 on front panel
Connector type	USER 1, 2, 3 on front panel, USER 4, 5, 6 on rear panel	BNC female
Level		LVTTL
Marker delay		
Setting range		0 symbol to $(2 \cdot 10^{24} - 1)$ symbol
Setting resolution		1 symbol
Marker duration		
Minimum value	sample rate ≤ 300 Msample/s	1 sample
	300 Msample/s < sample rate ≤ 600 Msample/s	2 sample
	600 Msample/s < sample rate ≤ 1200 Msample/s	4 sample

Baseband enhancements

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

AWGN can be generated with the R&S®SMM-K62 option.

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		> 15 dB
Periodicity		> $3 \cdot 10^{10}$ s
C/N, E_b/N_0		
Setting range	Depends on the set RF level. The PEP of the sum signal (wanted signal + noise) must not exceed the maximum possible PEP of the respective RF path.	–50 dB to +45 dB
Setting resolution		0.01 dB
Uncertainty	for system bandwidth = symbol rate, symbol rate < 4 MHz, –24 dB < C/N < 30 dB and crest factor < 12 dB	< 0.1 dB
System bandwidth	bandwidth for determining noise power	
Setting range		1 kHz to 120 MHz
	with R&S®SMM-K523 option	1 kHz to 240 MHz
	with R&S®SMM-K524 option	1 kHz to 500 MHz
	with R&S®SMM-K525 option	1 kHz to 1000 MHz
Setting resolution		100 Hz

Envelope tracking (R&S®SMM-K540 option)

With this option, the analog I/Q outputs can be used to generate an analog signal corresponding to the envelope of the I/Q signal to test envelope tracking modulators.

For R&S®SMM-K540 option to be installed, the R&S®SMM-K17 option must be installed, and the instrument must be equipped with an R&S®SMM-B9 baseband generator option.

General		
Envelope voltage adaptation		auto normalized, auto power, manual
Output type		single-ended, differential
Bias voltage	see section “Differential analog I/Q outputs” or “Wideband differential analog I/Q outputs”	
Offset voltage	see section “Differential analog I/Q outputs” or “Wideband differential analog I/Q outputs”	
Envelope to RF delay		
Setting range		–1 µs to +1 µs
Setting resolution		1 ps
Shaping		off, linear, from table, polynomial, detroughing
Envelope voltage adaptation modes: auto normalized and auto power		
Power amplifier input power P_{in}		
Setting range		–145.00 dB to +30.00 dB
Setting resolution		0.01 dB
Power amplifier supply voltage V_{CC}	V_{CC} = envelope voltage · DC modulator gain + $V_{CC, Offset}$	
DC modulator gain		–20.00 dB to +20.00 dB
Power amplifier offset voltage V_{CC} offset		0 V to 30 V
Envelope voltage adaptation mode: manual		
Pregain		
Setting range		–20.00 dB to 0.00 dB
Setting resolution		0.01 dB
Postgain		
Setting range		–3.00 dB to +20.00 dB
Setting resolution		0.01 dB
Clipping level	upper and lower limit can be set separately	0 % to 100 %
Maximum output voltage	see "Output voltage" in section "Differential analog I/Q outputs"	

AM/AM, AM/PM predistortion (R&S®SMM-K541 option)

A R&S®SMM-K541 option to be installed requires an R&S®SMM-B9 baseband generator option.

State		on, off
Maximum input power (PEP_{in} max)		
Setting range		–145.00 dB to +30.00 dB
Setting resolution		0.01 dB
Shaping		polynomial, from table

User-defined frequency response correction (R&S®SMM-K544 option)

State		on, off
Scattering parameters		
File format		*.s<n>p (e.g. *.s2p)
Maximum number of points		16384
Number of cascadable datasets		up to 10
Additional frequency response		
File format		*.fres, *.ucor
Number of files		up to 5
Absolute level correction at center frequency	based on S-parameter data	on, off
Minimum compensation bandwidth		100 MHz

Crest factor reduction (R&S®SMM-K548 option)

A R&S®SMM-K548 option requires an R&S®SMM-B9 baseband generator option.

Crest factor reduction can be applied to any waveform loaded in the arbitrary waveform generator.

State		on, off
Algorithm		clipping and filtering
Desired crest factor delta		–20 dB to 0 dB
Maximum iterations		1 to 10
Filter mode “simple”		
Signal bandwidth		0 Hz to input file sample rate
Channel spacing		0 Hz to input file sample rate
Filter mode “enhanced”		
Passband frequency		0 Hz to ½ of input file sample rate
Stopband frequency		0 Hz to ½ of input file sample rate
Maximum filter order		21 to 300

BER measurement (R&S®SMM-K80 option)

An R&S®SMM-B9 baseband generator option must be installed.

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 100 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	4 BNC connectors, selectable from USER 1 to 6	
Clock, data, enable and restart inputs	input impedance	1 kΩ, 50 Ω
	trigger threshold	
	setting range	0.1 V to 2.0 V
	setting resolution	0.1 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®SMM-K80 option)

An R&S®SMM-B9 baseband generator option must be installed.

In BLER measurement mode, arbitrary data can be provided 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 100 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	4 BNC connectors, selectable from USER 1 to 6	
Clock, data, and enable inputs	input impedance	1 kΩ, 50 Ω
	trigger threshold	
	setting range	0.1 V to 2.0 V
	setting resolution	0.1 V
Polarity	data, clock, data enable	normal, inverted
Measurement time	selectable by means of maximum number of received blocks or errors (maximum 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

Digital modulation systems

An R&S®SMM-B9 baseband generator option must be installed.

The specified data applies together with the parameters of the respective standard. The entire frequency range, the filter parameters and the symbol rates can be set by the user.

Internal digital standards

Digital standards that run on the internal baseband generator. The R&S®SMM-K520 option must be installed. The options are described in the “Digital Standards” data sheet (PD 5213.9434.22).

Cellular standards
5G New Radio Release 15 (R&S®SMM-K144 option)
5G New Radio Release 16 (R&S®SMM-K148 option)
LTE (R&S®SMM-K55 option)
LTE Release 9 (R&S®SMM-K84 option, R&S®SMM-K55 required)
LTE Release 10 (R&S®SMM-K85 option, R&S®SMM-K55 required)
LTE Release 11 (R&S®SMM-K112 option, R&S®SMM-K55 required)
LTE Release 12 (R&S®SMM-K113 option, R&S®SMM-K55 required)
LTE Release 13/14/15 (R&S®SMM-K119 option, R&S®SMM-K55 required)
Cellular IoT (R&S®SMM-K115 option)
Cellular IoT Release 14 (R&S®SMM-K143 option)
Cellular IoT Release 15 (R&S®SMM-K146 option)
3GPP FDD (R&S®SMM-K42 option)
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests (R&S®SMM-K83 option, R&S®SMM-K42 required)
GSM/EDGE (R&S®SMM-K40 option)
EDGE Evolution (R&S®SMM-K41 option, R&S®SMM-K40 required)
CDMA2000® (R&S®SMM-K46 option)
1xEV-DO Rev A (R&S®SMM-K47 option)
1xEV-DO Rev B (R&S®SMM-K87 option, R&S®SMM-K47 required)
TD-SCDMA (R&S®SMM-K50 option)
TD-SCDMA enhanced BS/MS tests (R&S®SMM-K51 option, R&S®SMM-K50 required)
Wireless connectivity standards
IEEE 802.11a/b/g/n/j/p (R&S®SMM-K54 option)
IEEE 802.11ac (R&S®SMM-K86 option, R&S®SMM-K54 required)
IEEE 802.11ax (R&S®SMM-K142 option, R&S®SMM-K54 required)
HRP UWB (R&S®SMM-K149 option)
Bluetooth® EDR (R&S®SMM-K60 option)
Bluetooth® 5.x (R&S®SMM-K117 option, R&S®SMM-K60 required)
LoRa® (R&S®SMM-K131 option)
Other standards and modulation systems
OFDM signal generation (R&S®SMM-K114 option)
Multicarrier CW signal generation (R&S®SMM-K61 option)
NFC A/B/F (R&S®SMM-K89 option)

Digital standards with R&S®WinIQSIM2™

These options run on the R&S®SMM-B9 baseband generator option.

R&S®WinIQSIM2™ requires an external PC.

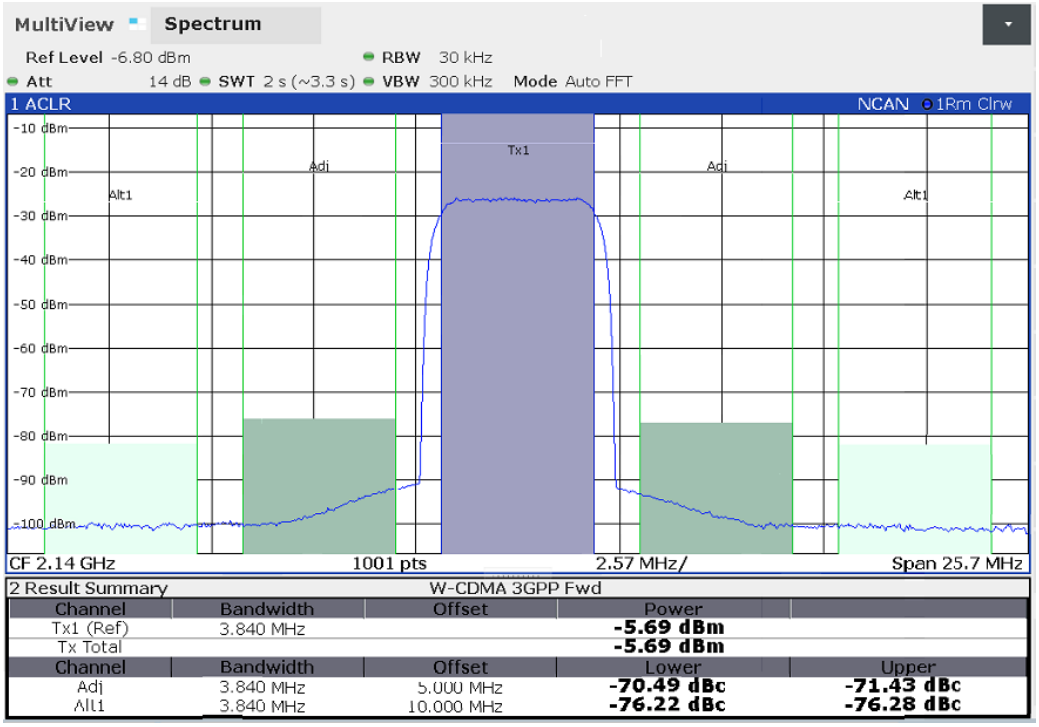
The options are described in the R&S®WinIQSIM2™ data sheet (PD 5213.7460.22).

Cellular standards
5G New Radio (R&S®SMM-K444 option)
LTE (R&S®SMM-K255 option)
LTE Release 9 (R&S®SMM-K284 option, R&S®SMM-K255 required)
LTE Release 10 (R&S®SMM-K285 option, R&S®SMM-K255 required)
LTE Release 11 (R&S®SMM-K412 option, R&S®SMM-K255 required)
LTE Release 12 (R&S®SMM-K413 option, R&S®SMM-K255 required)
LTE Release 13/14/15 (R&S®SMM-K419 option, R&S®SMM-K255 required)
Cellular IoT (R&S®SMM-K415 option)
Cellular IoT Release 14 (R&S®SMM-K443 option)
Cellular IoT Release 15 (R&S®SMM-K446 option)
3GPP FDD (R&S®SMM-K242 option)
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests (R&S®SMM-K283 option, R&S®SMM-K242 required)
GSM/EDGE (R&S®SMM-K240 option)
EDGE Evolution (R&S®SMM-K241 option, R&S®SMM-K240 required)
CDMA2000® (R&S®SMM-K246 option)
1xEV-DO Rev A (R&S®SMM-K247 option)
1xEV-DO Rev B (R&S®SMM-K287 option, R&S®SMM-K247 required)
TD-SCDMA (R&S®SMM-K250 option)
TD-SCDMA enhanced BS/MS tests (R&S®SMM-K251 option, R&S®SMM-K250 required)
Wireless connectivity standards
IEEE 802.11 a/b/g/n/j/p (R&S®SMM-K254 option)
IEEE 802.11 ac (R&S®SMM-K286 option, R&S®SMM-K254 required)
IEEE 802.11 ax (R&S®SMM-K442 option, R&S®SMM-K254 required)
Bluetooth® EDR (R&S®SMM-K260 option)
Bluetooth® 5.x (R&S®SMM-K417 option, R&S®SMM-K260 required)
LoRa® (R&S®SMM-K431 option)
Navigation standards
GPS 1 satellite (R&S®SMM-K244 option)
Modernized GPS 1 satellite (R&S®SMM-K298 option)
Galileo 1 satellite (R&S®SMM-K266 option)
GLONASS 1 satellite (R&S®SMM-K294 option)
BeiDou 1 satellite (R&S®SMM-K407 option)
Modernized BeiDou 1 satellite (R&S®SMM-K432 option)
IRNSS 1 satellite (R&S®SMM-K297 option)
Broadcast standards
DVB-H/DVB-T (R&S®SMM-K252 option)
DVB-S2/DVB-S2X (R&S®SMM-K416 option)
DAB/T-DMB (R&S®SMM-K253 option)
Other standards and modulation systems
OFDM signal generation (R&S®SMM-K414 option)
Multicarrier CW signal generation (R&S®SMM-K261 option)
NFC A/B/F (R&S®SMM-K289 option)

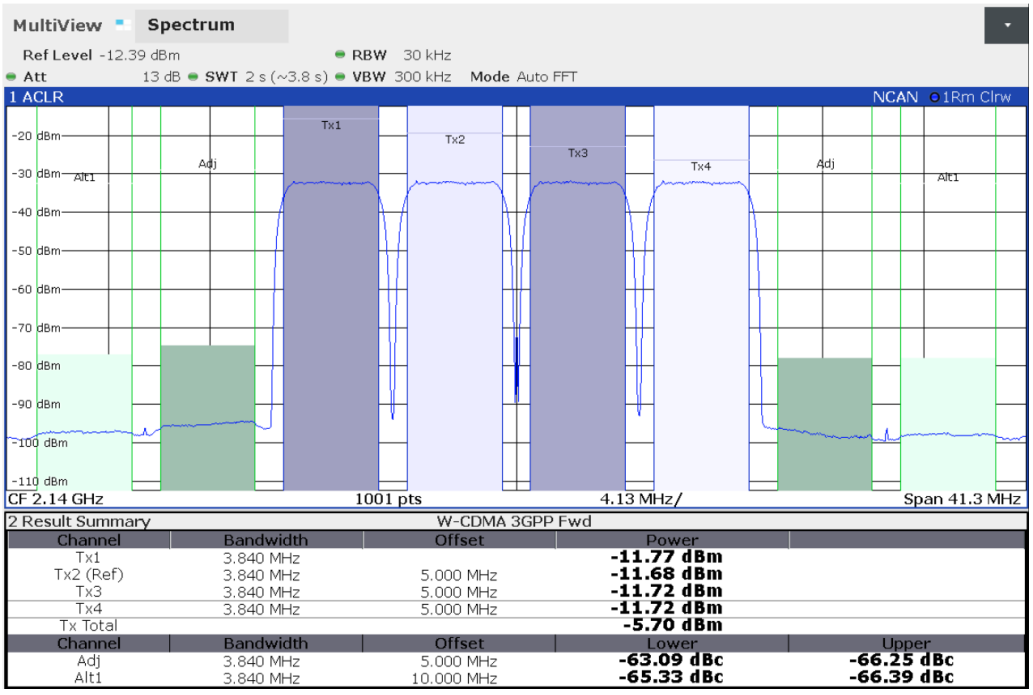
Signal performance for digital standards and modulation systems

3GPP FDD (R&S®SMM-K42 option)

Error vector magnitude	1 DPCH, RMS, frequency = 1800 MHz to 2200 MHz	< 0.8 %, 0.3 % (meas.)
Adjacent channel leakage ratio (ACLR)	test model 1, 64 DPCH, frequency = 1800 MHz to 2200 MHz, average channel power ≤ 3 dBm, with R&S®SMM-B1006 frequency options	
	5 MHz offset	> 70 dB
	10 MHz offset	> 72 dB
	test model 1, 64 DPCH, frequency = 1800 MHz to 2200 MHz, average channel power ≤ 0 dBm, with R&S®SMM-B1007, R&S®SMM-B1012 frequency options	
	5 MHz offset	> 68 dB
	10 MHz offset	> 70 dB
	test model 1, 64 DPCH, frequency = 1800 MHz to 2200 MHz, average channel power ≤ –2 dBm, with R&S®SMM-B1020, R&S®SMM-B1031, R&S®SMM-B1044, R&S®SMM-B1044N frequency options	
	5 MHz offset	> 70 dB
	10 MHz offset	> 72 dB

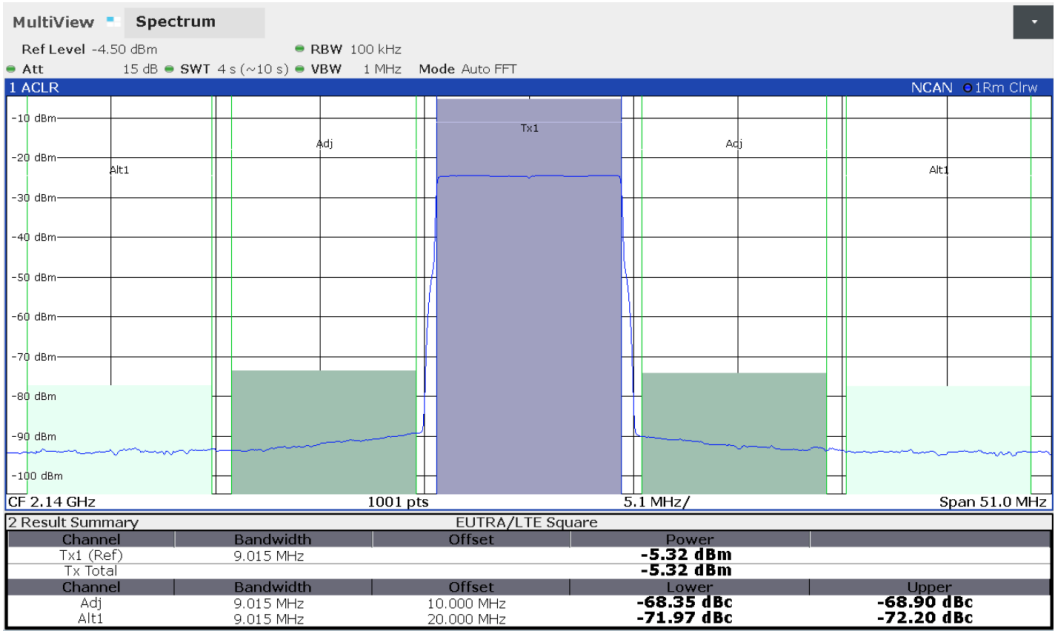


Measured ACPR for 3GPP test model 1, 64 DPCH



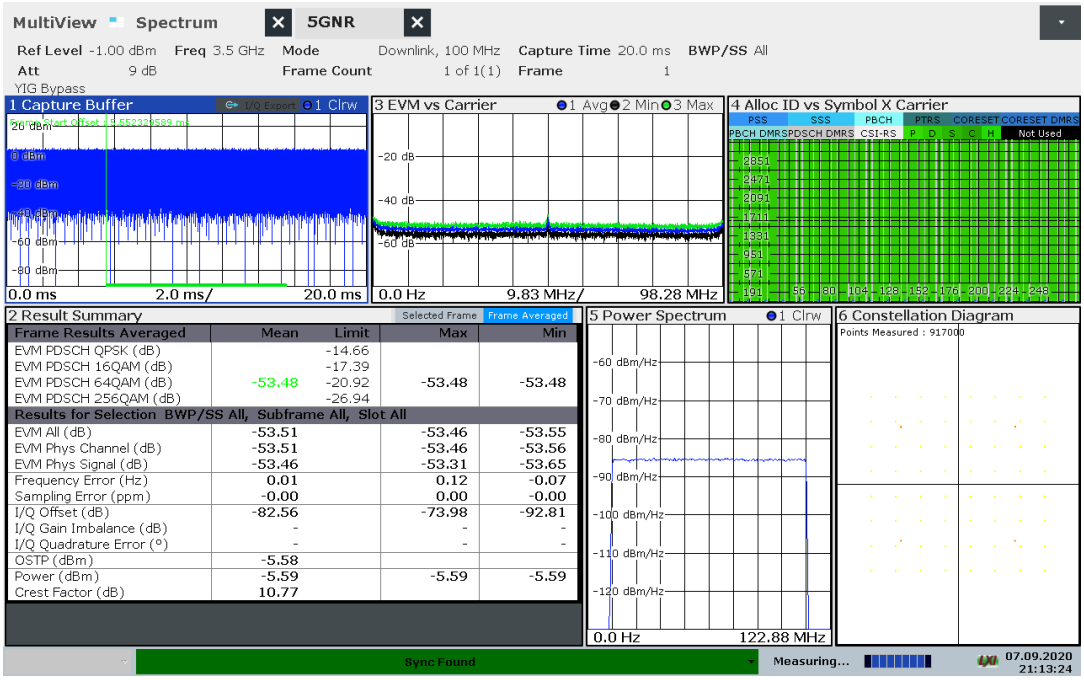
Measured ACPR for a 3GPP four-carrier signal with test model 1, 64 DPCH on each carrier

EUTRA/LTE (R&S®SMM-K55 option)

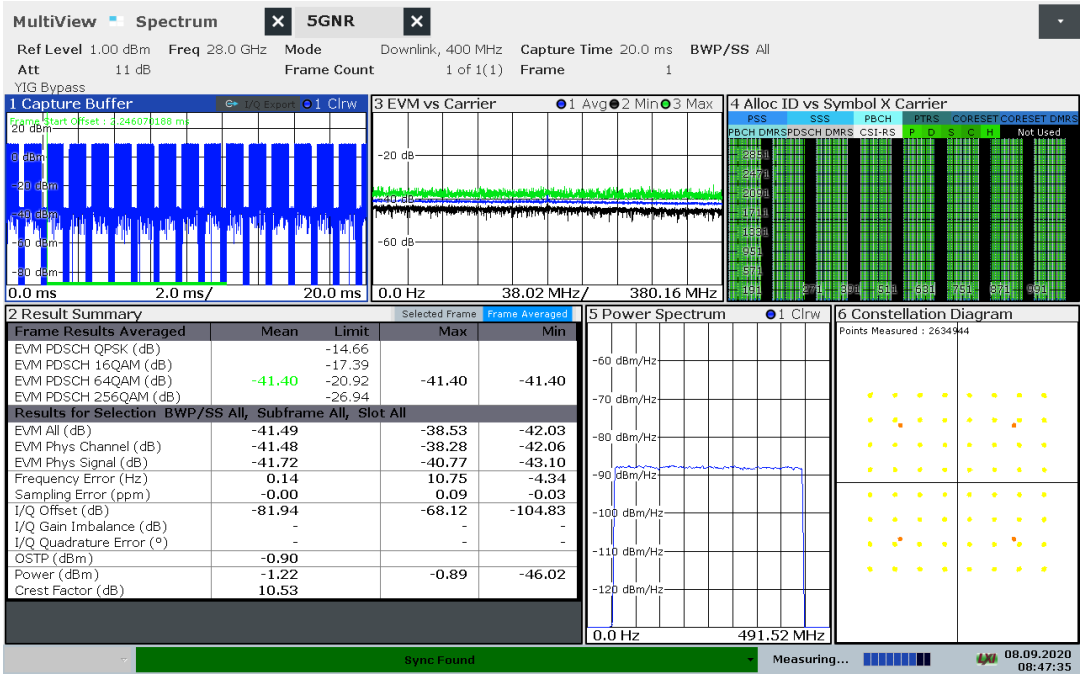


Measured ACPR for a 10 MHz LTE test model E-TM1_1

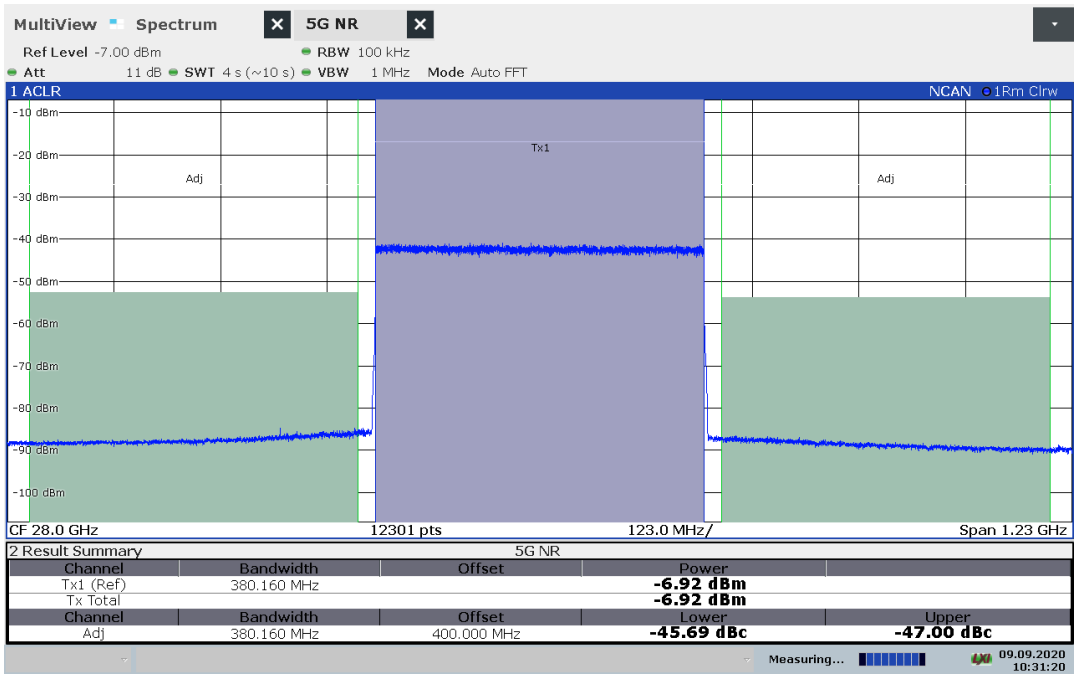
5G NR (R&S®SMM-K144 option)



Measured EVM at 3.5 GHz for a 5G NR test model NR-FR1-TM3.1; FDD, 100 MHz bandwidth, –30 kHz SCS

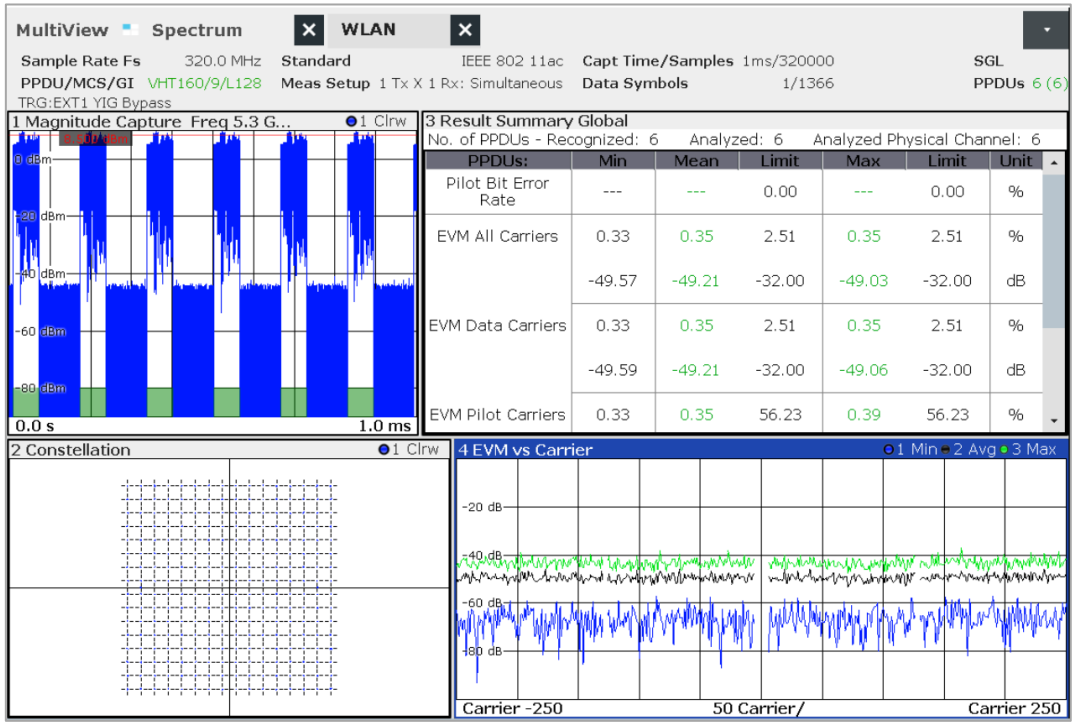


Measured EVM at 28 GHz for a 5G NR test model NR-FR2-TM3.1; TDD 400 MHz bandwidth, –120 kHz SCS



Measured ACPR at 28 GHz for a 5G NR test model NR-FR2-TM3.1; TDD 400 MHz bandwidth, –120 kHz SCS

IEEE 802.11ac (R&S®SMM-K86 option)



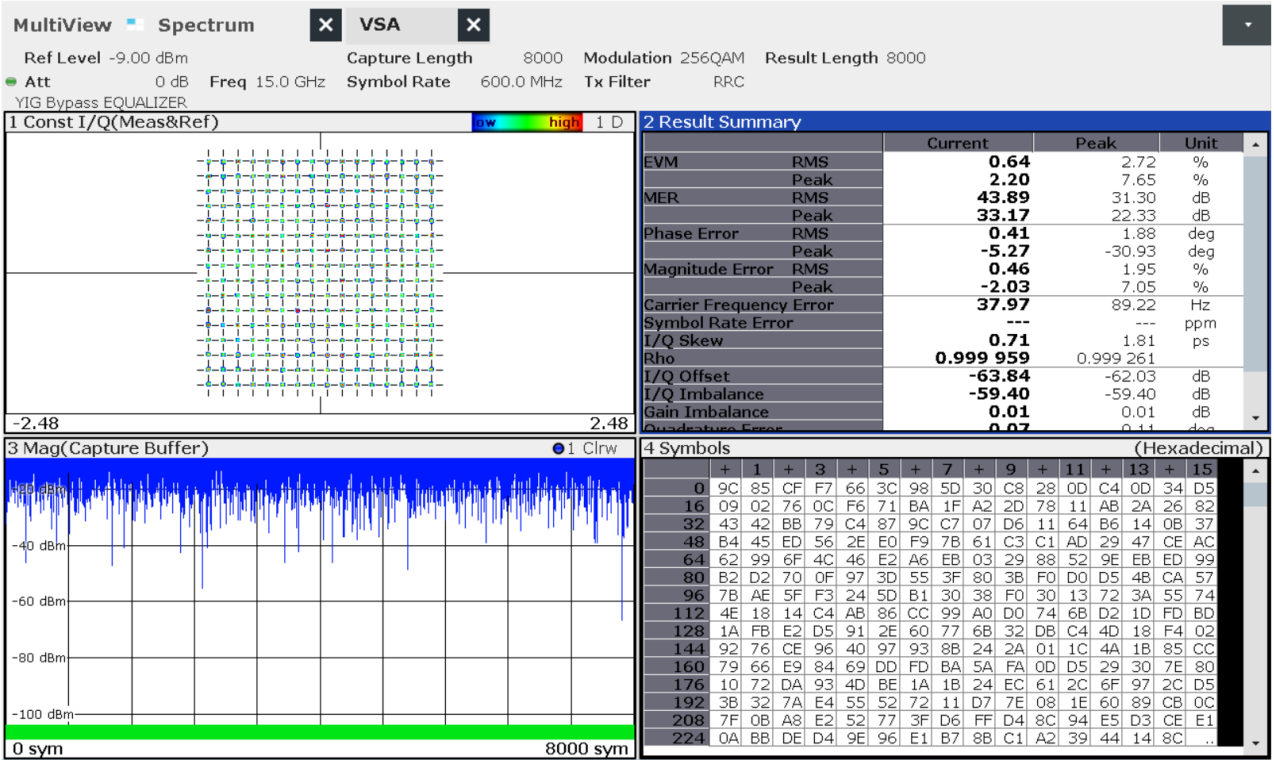
Measured EVM for an IEEE 802.11ac signal with 160 MHz bandwidth

IEEE 802.11ax (R&S®SMM-K142 option)

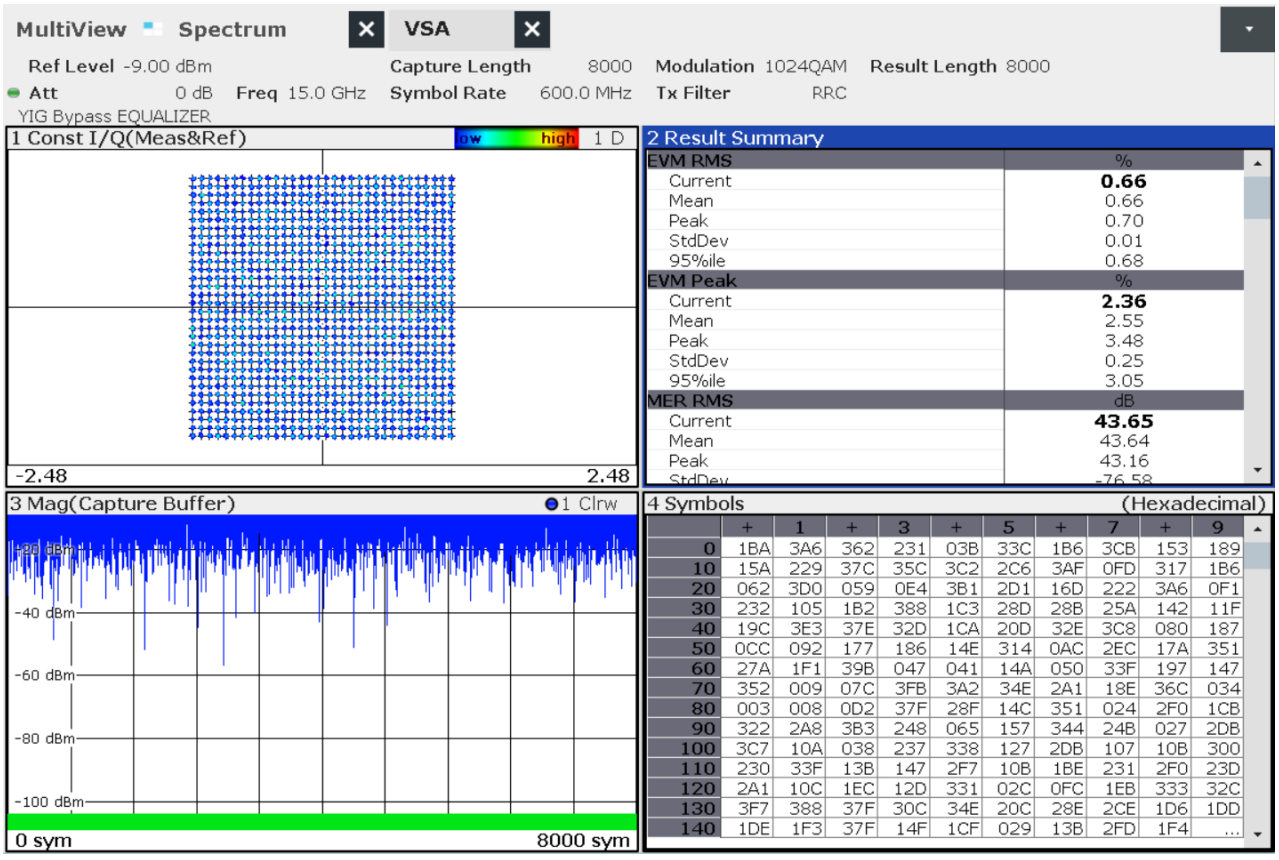
Measured EVM for an IEEE 802.11ax signal with 80 MHz bandwidth

Custom digital modulation (R&S®SMM-B9, real-time mode)

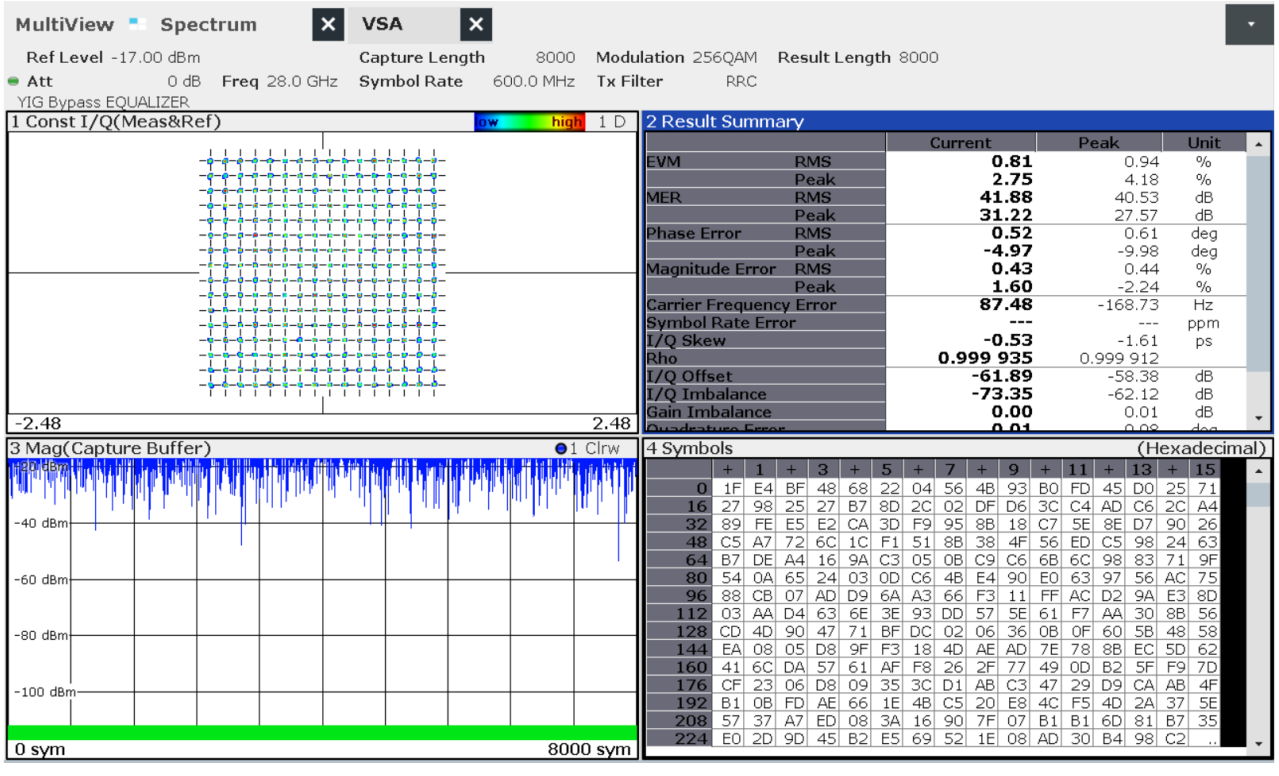
Deviation error with 2FSK, 4FSK	deviation 0.2 to 0.7 · symbol rate	
	Gaussian filter with B × T = 0.2 to 0.7, f = 1 GHz	
	symbol rate up to 2 MHz	0.25 % (meas.)
	symbol rate up to 10 MHz	0.75 % (meas.)
Phase error with MSK	Gaussian filter with B × T = 0.2 to 0.7, f = 1 GHz	
	bit rate up to 2 MHz	0.15° (meas.)
	bit rate up to 10 MHz	0.3° (meas.)
EVM with QPSK, OQPSK, π/4-DQPSK, 8PSK, 16QAM, 32QAM, 64QAM	cosine, root cosine filter with α = 0.2 to 0.7, f = 1 GHz	
	symbol rate up to 5 MHz	0.2 % (meas.)
	symbol rate up to 20 MHz	0.7 % (meas.)



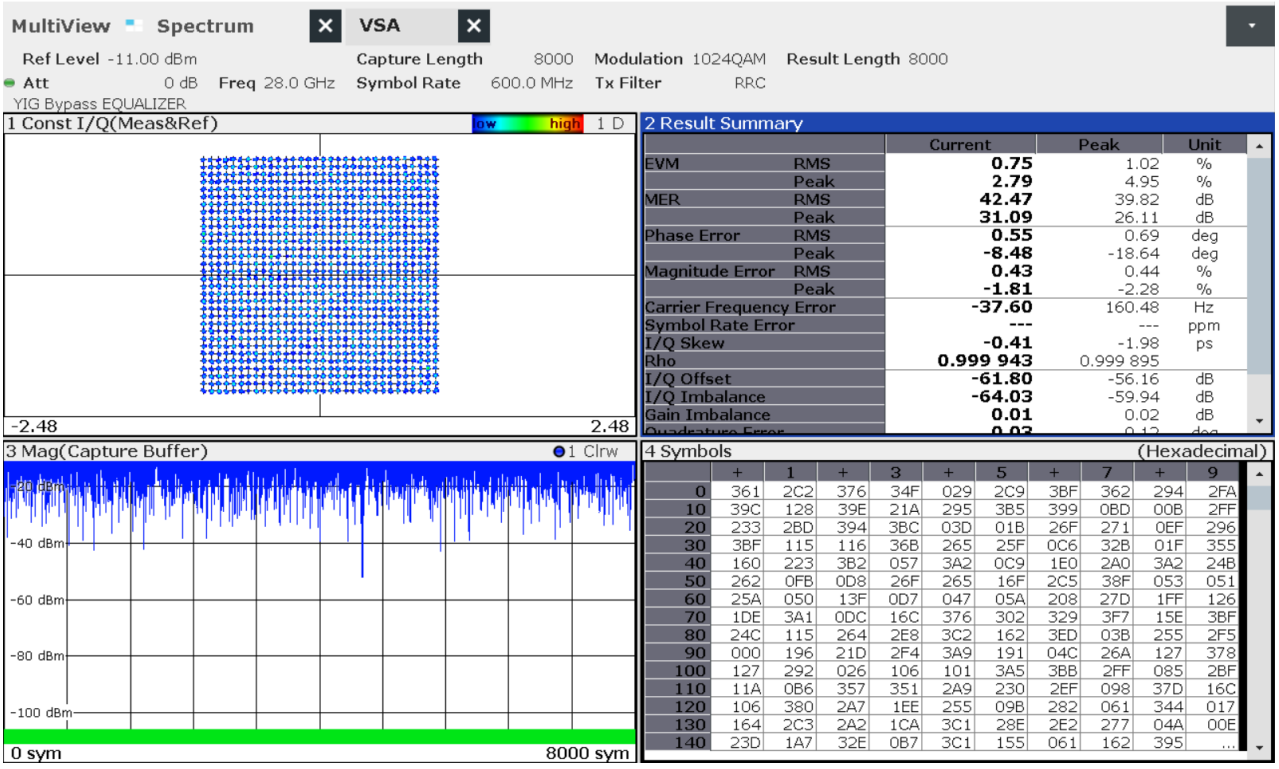
Measured EVM at 15 GHz for a 256QAM signal with 600 MHz symbol rate



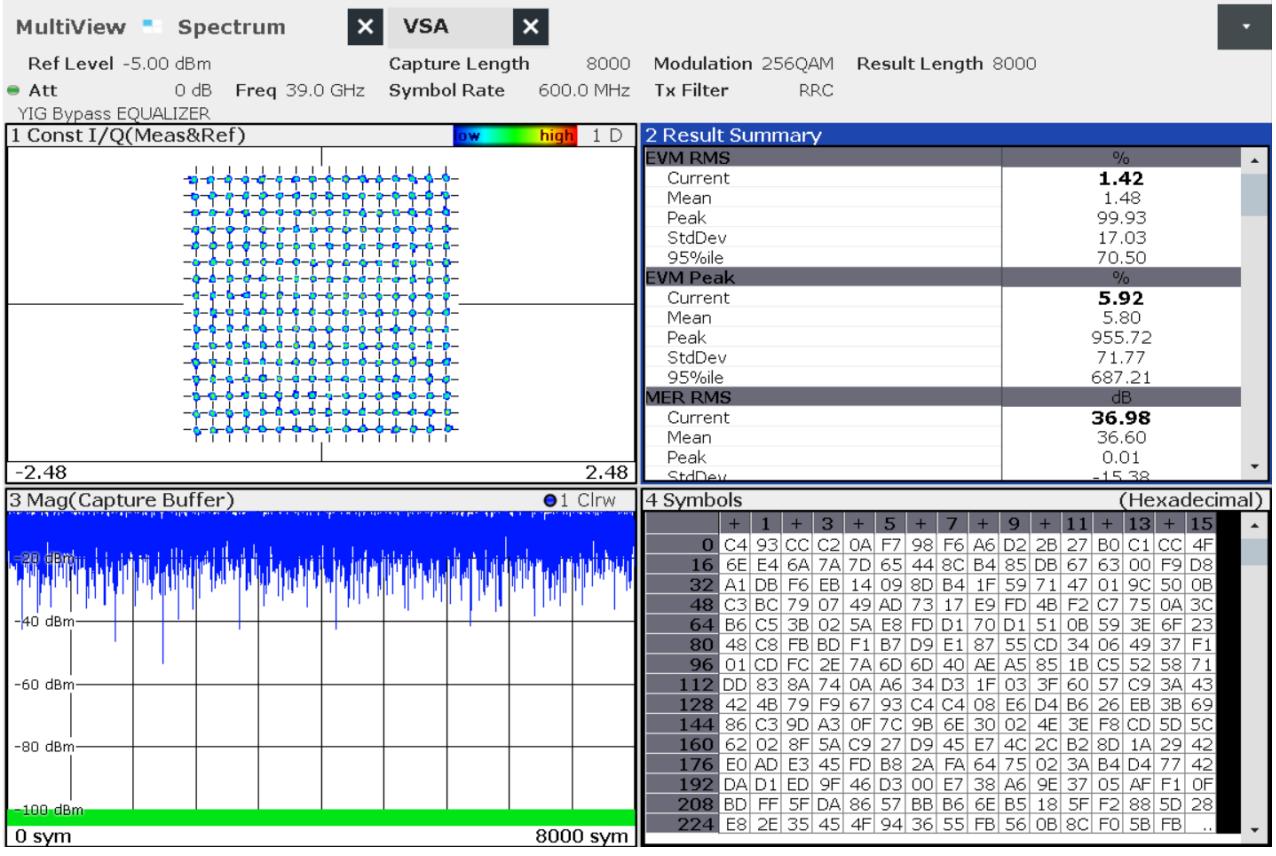
Measured EVM at 15 GHz for a 1024QAM signal with 600 MHz symbol rate



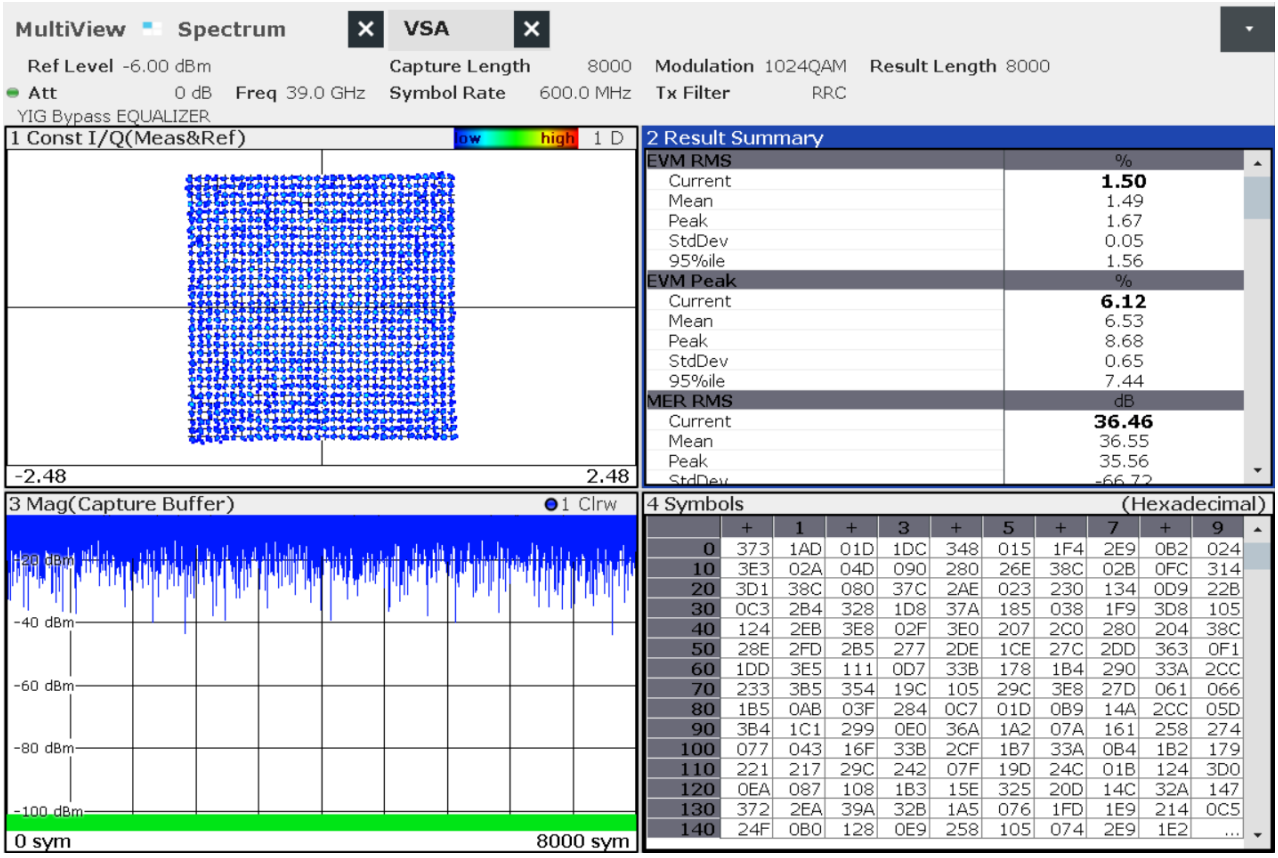
Measured EVM at 28 GHz for a 256QAM signal with 600 MHz symbol rate



Measured EVM at 28 GHz for a 1024QAM signal with 600 MHz symbol rate



Measured EVM at 39 GHz for a 256QAM signal with 600 MHz symbol rate



Measured EVM at 39 GHz for a 1024QAM signal with 600 MHz symbol rate

Remote control

Interfaces	remote control	IEC 60625 (GPIB IEEE-488.2)
	Ethernet/LAN	10/100/1000BASE-T
	USB	2.0 (high speed)
	serial	RS-232 [9]
Command set		SCPI 1999.5 or compatible command sets
IEC/IEEE bus address		0 to 30
Ethernet/LAN protocols and services		• VISA VXI-11 (remote control) • Telnet/RawEthernet (remote control) • VNC (remote operation with web browser) • FTP (file transfer protocol) • SMB (mapping parts of the instrument to a host file system)
Ethernet/LAN addressing		DHCP, static, support of ZeroConf and M-DNS to facilitate direct connection to a system controller
USB protocol		VISA USB-TMC

Connectors

Front panel connectors

The following connectors are located on the front panel of the instrument.

RF 50 Ω	RF output	
	R&S®SMM-B1006, R&S®SMM-B1007	N female
	R&S®SMM-B1012, R&S®SMM-B1020, R&S®SMM-B1031	test port adapter, PC 2.92 mm female (interchangeable port connector system)
	R&S®SMM-B1044, R&S®SMM-B1044N	PC 1.85 mm male (adapter 1.85 mm female to female included as accessory)
I	I modulation input signal	BNC female
Q	Q modulation input signal	BNC female
USER 1, USER 2, USER 3	user-configurable inputs or outputs, e.g. as trigger input or marker output	BNC female
SENSOR	connector for R&S®NRP-Zxx power sensor	6-pin ODU MINI-SNAP® series B
USB	USB 2.0 connector for external USB devices such as: • mouse and keyboard • R&S®NRP-Zxx power sensors (with R&S®NRP-Z4 adapter cable), • memory stick for software update and data exchange • USB serial adapter for RS-232 remote control	USB type A

[9] Requires the R&S®TS-USB1 serial adapter (recommended extra).

Rear panel connectors

REF IN	reference frequency input	BNC female
REF OUT	reference frequency output	BNC female
INST TRG	trigger input for RF, e.g. for frequency or level sweep	BNC female
USER 4, USER 5, USER 6	user-configurable inputs or outputs, e.g. as trigger input or marker output	BNC female
EFC	input for electronic tuning of internal reference frequency	BNC female
LO IN	phase-coherent LO input	SMA female
LO OUT	phase-coherent LO output	SMA female
IEEE 488	remote control of instrument via GPIB	24-pin Amphenol series 57 female
DISPLAY PORT	for future use	
DVI	for future use	
LAN	provides remote control functionality and other services, see section “Remote control”	RJ-45
USB IN	USB 2.0 (high speed), remote control of instrument (USB-TMC)	USB type B
USB DEVICE	USB 3.1 (10 Gbit/s Super-Speed ports) connector for external USB devices such as: • mouse and keyboard for enhanced operation • R&S®NRP-Zxx power sensors (with R&S®NRP-Z4 adapter cable) for external power measurements and level adjustment of instrument • memory stick for software update and data exchange • USB serial adapter for RS-232 remote control	USB type A
LAN	provides remote control functionality and other services, see section “Remote control”	RJ-45
IEEE-488	remote control of instrument via GPIB	24-pin Amphenol series 57 female
EXT 1, EXT 2	inputs for external analog modulation signals	BNC female
Analog I/Q outputs		
I	analog I output	BNC female
	alternative function: LF generator output	
I-bar	analog I-bar output	BNC female
Q	analog Q output	BNC female
	alternative function: LF generator output	
Q-bar	analog Q-bar output	BNC female
Connectors on baseband generator modules		
T/M/C	for future use	BNC female
T/M 2	for future use	BNC female
DIG IQ IN 1	for future use	26-pin MDR
HS DIG IQ IN 1	high-speed digital input connectivity in line with R&S®Digital I/Q Interface	QSFP+/QSFP 28

General data

Power rating		
Rated voltage		100 V to 240 V AC
Rated current		8.9 A to 4.9 A
Rated frequency	100 V to 240 V	50 Hz to 60 Hz
	100 V to 120 V	400 Hz
Rated power	when fully equipped	410 W (meas.)
Environmental conditions		
Temperature range	operating	+5 °C to +45 °C
	operating, with R&S®SMM-B1044, R&S®SMM-B1044N options	+10 °C to +35 °C
	storage	–40 °C to +60 °C temperature gradient < 5 K/hour
Damp heat		+40 °C, 90 % relative humidity, steady state, in line with EN 60068-2-78
Altitude	operating	4600 m
Mechanical resistance		
Vibration	sinusoidal	5 Hz to 55 Hz, 0.15 mm amplitude const., 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 MIL-STD-810E, method no. 516.4, procedure I
Product conformity		
Electromagnetic compatibility	EU: in line with EMC directive (2014/30/EC)	applied harmonized standards: • EN 61326-1 (for use in industrial environment) • EN 61326-2-1 • EN 55011 (class B), EN 55011 (class A) using DIG IQ • EN 61000-3-2 • EN 61000-3-3
Electrical safety	EU: in line with low voltage directive (2014/35/EC)	applied harmonized standard: EN 61010-1
	USA	UL 61010-1
	Canada	CAN/CSA-C22.2 No. 61010-1
International certification	VDE – Association for Electrical, Electronic and Information Technologies	GS mark 40036426
	CSA – Canadian Standard Association	$_{c}CSA_{US}$ mark 2571181
Dimensions and weight		
Dimensions	W × H × D	435 mm × 192 mm × 460 mm (17.1 in × 7.6 in × 18.1 in)
Weight	when fully equipped	20.1 kg (44.4 lb)
Calibration interval		
Recommended calibration interval	operation 40 h/week in full range of specified environmental conditions	3 years

Ordering information

R&S®SMM-Bxxx = hardware option
R&S®SMM-Kxxx = software/key code option

Designation	Type	Order No.
Vector signal generator [10] including power cable and quick start guide	R&S®SMM100A	1440.8002.02
Options		
Frequency options		
100 kHz to 6 GHz	R&S®SMM-B1006	1440.9009.02
100 kHz to 7.5 GHz	R&S®SMM-B1007	1440.9109.02
100 kHz to 12.75 GHz	R&S®SMM-B1012	1440.9209.02
100 kHz to 20 GHz	R&S®SMM-B1020	1440.9309.02
100 kHz to 31.8 GHz	R&S®SMM-B1031	1440.9409.02
100 kHz to 44 GHz	R&S®SMM-B1044	1440.9509.02
100 kHz to 44 GHz, I/Q modulation bandwidth and minimum pulse width limited	R&S®SMM-B1044N	1440.9609.02
Other RF options		
Phase coherence	R&S®SMM-B90	1440.9709.02
Pulse modulator	R&S®SMM-K22	1441.1330.02
Pulse generator	R&S®SMM-K23	1441.1347.02
Multifunction generator	R&S®SMM-K24	1441.1353.02
Frontend control	R&S®SMM-K553	1441.1147.02
100 MHz, 1 GHz ultra low noise reference input/output	R&S®SMM-K703	1441.1301.02
Flexible reference input (1 MHz to 100 MHz)	R&S®SMM-K704	1441.1318.02
AM/FM/PM	R&S®SMM-K720	1441.1324.02
Baseband		
Baseband generator with ARB (64 Msample), 120 MHz RF bandwidth	R&S®SMM-B9	1440.9809.02
Differential analog I/Q outputs	R&S®SMM-K17	1441.2143.02
ARB memory extension to 512 Msample	R&S®SMM-K511	1441.1260.02
ARB memory extension to 1 Gsample	R&S®SMM-K512	1441.1276.02
ARB memory extension to 2 Gsample	R&S®SMM-K513	1441.2120.02
Baseband real-time extension	R&S®SMM-K520	1441.2114.02
Baseband extension to 240 MHz RF bandwidth	R&S®SMM-K523	1441.2108.02
Baseband extension to 500 MHz RF bandwidth	R&S®SMM-K524	1441.2095.02
Baseband extension to 1 GHz RF bandwidth	R&S®SMM-K525	1441.2089.02
Baseband enhancements		
Additive white gaussian noise (AWGN)	R&S®SMM-K62	1441.2072.02
Bit error rate tester	R&S®SMM-K80	1441.2066.02
Envelope tracking	R&S®SMM-K540	1441.2050.02
AM/AM, AM/PM predistortion	R&S®SMM-K541	1441.2043.02
User-defined frequency response correction	R&S®SMM-K544	1441.2037.02
Crest factor reduction	R&S®SMM-K548	1441.1130.02
Digital standards		
GSM/EDGE	R&S®SMM-K40	1441.2020.02
EDGE Evolution	R&S®SMM-K41	1441.2014.02
3GPP FDD	R&S®SMM-K42	1441.2008.02
CDMA2000®	R&S®SMM-K46	1441.1999.02
1xEV-DO Rev A	R&S®SMM-K47	1441.1982.02
TD-SCDMA	R&S®SMM-K50	1441.1960.02
TD-SCDMA enhanced BS/MS tests	R&S®SMM-K51	1441.1953.02
IEEE 802.11 (a/b/g/n/j/p)	R&S®SMM-K54	1441.1930.02
LTE	R&S®SMM-K55	1441.1924.02
Bluetooth® EDR	R&S®SMM-K60	1441.1918.02
Multicarrier CW signal generation	R&S®SMM-K61	1441.1901.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMM-K83	1441.1899.02
LTE Release 9	R&S®SMM-K84	1441.1882.02
LTE Release 10	R&S®SMM-K85	1441.1876.02

[10] The base unit can only be ordered with an R&S®SMM-B10xx frequency option.

Designation	Type	Order No.
IEEE 802.11ac	R&S®SMM-K86	1441.1860.02
1xEV-DO Rev. B	R&S®SMM-K87	1441.1853.02
NFC A/B/F	R&S®SMM-K89	1441.1160.02
LTE Release 11	R&S®SMM-K112	1441.1847.02
LTE Release 12	R&S®SMM-K113	1441.1830.02
OFDM signal generation	R&S®SMM-K114	1441.1824.02
Cellular IoT Release 13	R&S®SMM-K115	1441.1818.02
Bluetooth® 5.x	R&S®SMM-K117	1441.1799.02
LTE Release 13/14/15	R&S®SMM-K119	1441.1776.02
LoRa®	R&S®SMM-K131	1441.1760.02
IEEE 802.11ax	R&S®SMM-K142	1441.1753.02
Cellular IoT Release 14	R&S®SMM-K143	1441.1747.02
5G New Radio Release 15	R&S®SMM-K144	1441.1730.02
Cellular IoT Release 15	R&S®SMM-K146	1441.1247.02
5G New Radio Release 16	R&S®SMM-K148	1441.2166.02
HRP UWB	R&S®SMW-K149	1441.1099.02
Digital standards using R&S®WinIQSIM2™ [11]		
GSM/EDGE	R&S®SMM-K240	1441.1724.02
EDGE Evolution	R&S®SMM-K241	1441.1718.02
3GPP FDD	R&S®SMM-K242	1441.1701.02
GPS 1 satellite	R&S®SMM-K244	1441.1699.02
CDMA2000®	R&S®SMM-K246	1441.1682.02
1xEV-DO Rev A	R&S®SMM-K247	1441.1676.02
TD-SCDMA	R&S®SMM-K250	1441.1653.02
TD-SCDMA enhanced BS/MS tests	R&S®SMM-K251	1441.1647.02
DVB-H/DVB-T	R&S®SMM-K252	1441.1630.02
DAB/T-DMB	R&S®SMM-K253	1441.1624.02
IEEE 802.11a/b/g/n/j/p	R&S®SMM-K254	1441.1618.02
LTE	R&S®SMM-K255	1441.1601.02
Bluetooth® EDR	R&S®SMM-K260	1441.1599.02
Multicarrier CW signal generation	R&S®SMM-K261	1441.1582.02
Additive white gaussian noise (AWGN)	R&S®SMM-K262	1441.1576.02
Galileo 1 satellite	R&S®SMM-K266	1441.1560.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMM-K283	1441.1547.02
LTE Release 9	R&S®SMM-K284	1441.1530.02
LTE Release 10	R&S®SMM-K285	1441.1524.02
IEEE 802.11ac	R&S®SMM-K286	1441.1518.02
1xEV-DO Rev. B	R&S®SMM-K287	1441.1501.02
NFC A/B/F	R&S®SMM-K289	1441.1499.02
GLONASS 1 satellite	R&S®SMM-K294	1441.1482.02
IRNSS 1 satellite	R&S®SMM-K297	1441.1199.02
Modernized GPS 1 satellite	R&S®SMM-K298	1441.1476.02
BeiDou 1 satellite	R&S®SMM-K407	1441.1460.02
LTE Release 11	R&S®SMM-K412	1441.1453.02
LTE Release 12	R&S®SMM-K413	1441.1447.02
OFDM signal generation	R&S®SMM-K414	1441.1430.02
Cellular IoT	R&S®SMM-K415	1441.1424.02
DVB-S2/DVB-S2X	R&S®SMM-K416	1441.1418.02
Bluetooth® 5.x	R&S®SMM-K417	1441.1401.02
LTE Release 13/14/15	R&S®SMM-K419	1441.1382.02
LoRa®	R&S®SMM-K431	1441.1182.02
Modernized BeiDou 1 satellite	R&S®SMM-K432	1441.1176.02
IEEE 802.11ax	R&S®SMM-K442	1441.1376.02
Cellular IoT Release 14	R&S®SMM-K443	1441.1253.02
5G NR	R&S®SMM-K444	1441.1360.02
Cellular IoT Release 15	R&S®SMM-K446	1441.1230.02
Waveform packages for signals from R&S®WinIQSIM2™ [12]		
1 waveform	R&S®SMM-K200	1441.1124.71
5 waveforms	R&S®SMM-K200	1441.1124.72
50 waveforms	R&S®SMM-K200	1441.1124.75

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

[12] Maximum 250 waveforms per instrument can be registered.

Designation	Type	Order No.
Recommended extras		
19" rack adapter	R&S®ZZA-KN4	1175.3033.00
Cable for connecting Rohde & Schwarz digital baseband interfaces	R&S®SMU-Z6	1415.0201.02
Cable for HS digital I/Q interface (optical cable, QSFP+ plug)	R&S®DIGIQ-HS	3641.2948.03
USB serial adapter for RS-232 remote control	R&S®TS-USB1	6124.2531.00
Adapters for instruments with an R&S®SMM-B1012/-B1020/-B2020/-B1031 frequency option		
Test port adapter, 2.92 mm female		1036.4790.00
Test port adapter, 2.92 mm male		1036.4802.00
Test port adapter, N female		1036.4777.00
Test port adapter, N male		1036.4783.00
Adapters for instruments with an R&S®SMM-B1044/-B1044N frequency option		
Coaxial adapter 1.85 mm (f) to 1.85 mm (f)		3588.9654.00
Coaxial adapter 1.85 mm (f) to 2.92 mm (f)		3628.4728.02
Documentation		
Documentation of calibration values	R&S®DCV-2	0240.2193.18
R&S®SMM100A accredited calibration, for instruments with R&S®B1006 6 GHz frequency option	R&S®ACASMM100A	3598.6993.03
R&S®SMM100A accredited calibration, for instruments with R&S®B1007 7.5 GHz frequency option	R&S®ACASMM100A	3598.7019.03
R&S®SMM100A accredited calibration, for instruments with R&S®B1012/-B1020/-B1031/-B1044/ -B1044N 12.75 GHz/20 GHz/31.8 GHz/44 GHz frequency options	R&S®ACASMM100A	3598.7002.03

Warranty		
Base unit		3 years
All other items [13]		1 year
Options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde & Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

Extended warranty with a term of one and two years (WE1 and WE2)
Repairs carried out during the contract term are free of charge [14]. Necessary calibration and adjustments carried out during repairs are also covered.

Extended warranty with calibration coverage (CW1 and CW2)
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 [14] and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

Extended warranty with accredited calibration (AW1 and AW2)
Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated (with accreditation), inspected and maintained during the term of the contract. It includes all repairs [14] and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

[13] For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

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

Service that adds value

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

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