R&S®SMW200A
Vector Signal Generator
Specifications

ROHDE&SCHWARZ

Test & Measurement

Data Sheet | 04.02

CONTENTS

Key features

For all your needs

- Frequency range from 100 kHz to 3/6/12.75/20/31.8/40 GHz
- Optional second RF path with 100 kHz up to 3/6/12.75/20 GHz
- Versatile configuration: from single-path vector signal generator to multichannel MIMO receiver tester
- Ideal for MIMO, MSR or LTE-Advanced applications thanks to up to eight signal sources and up to 16 fading channels
- Modular architecture for optimal adaptation to the application at hand

Simplify your setup

- Easy generation of complex signals
- Max. eight baseband generators on two internal baseband modules with realtime coder and ARB
- Internal digital adding of baseband signals, even with frequency and level offset
- Wideband baseband and vector signal generator in one box
- Support of all important digital standards such as 5G air interface candidates, LTE (up to Release 12), 3GPP FDD/HSPA/HSPA+, GSM/EDGE/EDGE Evolution, CDMA2000®/1xEV-DO, WLAN IEEE 802.11a/b/g/n/j/p/ac/ad
- No separate PC software required for digital standards
- Generation of radar signal scenarios for module, receiver and DFS tests
- LTE and 3GPP test case wizards for easy base station conformance testing in line with 3GPP TS 25.141 or 3GPP TS 36.141
- Envelope tracking and AM/AM, AM/φM predistortion options enable full test and verification of ET modulator chipsets

Bring reality to your lab

- Optional integrated fading section for channel emulation with up to 160 MHz bandwidth
- All important fading scenarios available as presets
- Installation of up to four fading modules, providing as many as 32 "logical" faders
- Implementation of all key MIMO fading scenarios such as 2x2, 3x3, 4x4, 8x4, 4x8 and 2x4x4 using a single instrument
- Support of complex applications such as dual-carrier HSPA, LTE carrier aggregation and multi-user LTE
- Connection of R&S®SGT100A signal generator modules to provide up to eight RF paths

Make your device even better

- Excellent signal quality for high accuracy in spectral and modulation measurements
- Up to 2 GHz I/Q modulation bandwidth (in RF) with internal baseband
- Exceptional modulation frequency response of < 0.4 dB (meas.) over 2 GHz bandwidth
- High-end pulse modulation with on/off ratio > 80 dB and rise/fall time < 10 ns
- Excellent spectral purity (SSB phase noise –139 dBc (typ.) at 1 GHz, 20 kHz offset)
- 3 GHz, 6 GHz and 12.75 GHz RF paths with electronic attenuator
- Phase coherence option, e.g. for beamforming applications

Speed up your development

- Intuitive operating concept and clever help functions for quick success
- Block diagram as key operating element to visualize signal flow
- Adaptive GUI for overview of both simple and complex scenarios
- Graphical signal monitoring at practically every point in the signal flow
- Context-sensitive online help system with complete user documentation
- SCPI macro recorder and code generator for generating executable remote control code from manual operating steps (for MATLAB®, CVI, etc.)

Grows with your needs

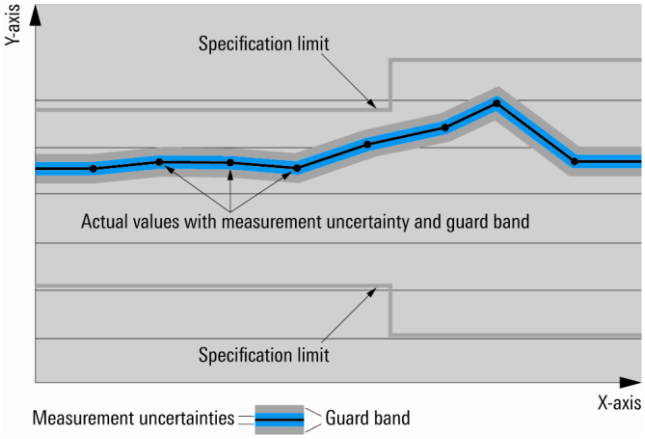
- Customizing of instrument to accommodate virtually every application
- Advanced plug-in system for retrofitting baseband modules without instrument recalibration
- Software upgrades possible at any time, simple and quick activation via key codes

Definitions

General
Product data applies under the following conditions:

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

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



Specifications without limits
Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (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 indicated as follows: “parameter: value”.

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

In line with the 3GPP/3GPP2 standard, chip rates are specified in Mcps (million chips per second), whereas bit rates and symbol rates are specified in Mbps (million bits per second), kbps (thousand bits per second) or ksps (thousand symbols per second), and sample rates are specified in Msample/s (million samples per second). Mcps, 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 in RF path A:

R&S®SMW-B103	100 kHz to 3 GHz
R&S®SMW-B106	100 kHz to 6 GHz
R&S®SMW-B112	100 kHz to 12.75 GHz
R&S®SMW-B120	100 kHz to 20 GHz
R&S®SMW-B131	100 kHz to 31.8 GHz
R&S®SMW-B140, R&S®SMW-B140N	100 kHz to 40 GHz

In addition, one of the following frequency options can be installed in RF path B:

R&S®SMW-B203	100 kHz to 3 GHz
R&S®SMW-B206	100 kHz to 6 GHz
R&S®SMW-B212	100 kHz to 12.75 GHz
R&S®SMW-B220	100 kHz to 20 GHz

The R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206, R&S®SMW-B112 and R&S®SMW-B212 options include an electronic attenuator, whereas the R&S®SMW-B120, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N and R&S®SMW-B220 options include a mechanical step attenuator.

For possible RF path combinations, see section "RF enhancement options and RF path combinations" below.

Signal routing and baseband main module options

One of the following options must be installed:

R&S®SMW-B13	one I/Q path to RF section
R&S®SMW-B13T	two I/Q paths to RF section
R&S®SMW-B13XT	wideband, two I/Q paths to RF section

If RF path B is equipped (or is planned to be retrofitted) with an R&S®SMW-B2xx frequency option, an R&S®SMW-B13T or R&S®SMW-B13XT option must be installed as the baseband main module.

Baseband hardware overview

To select between two different baseband sections, simply choose the appropriate baseband main module.

To select the standard baseband section, choose the R&S®SMW-B13 or R&S®SMW-B13T option as the baseband main module. The standard baseband section enables RF modulation bandwidths up to 160 MHz and allows further options for fading and MIMO to be installed. It provides the following additional hardware options:

R&S®SMW-B10	standard baseband generator
R&S®SMW-B14	fading simulator

To select the wideband baseband section, choose the R&S®SMW-B13XT option as the baseband main module.
The wideband baseband section enables RF modulation bandwidths up to 2000 MHz. It provides the following additional hardware options:

R&S®SMW-B9	wideband baseband generator

RF enhancement options and RF path combinations

In addition to frequency options, the following RF enhancement options (hardware) can be installed (an R&S®SMW-B13T or R&S®SMW-B13XT option must be installed as the baseband main module):

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

The following combinations of frequency and enhancement options are possible:

			3 GHz			6 GHz			12.75 GHz	20 GHz
	Path B / **Path A**	(path B not equipped)	R&S®SMW-B203	R&S®SMW-B203 and R&S®SMW-B20	R&S®SMW-B203 and R&S®SMW-B22	R&S®SMW-B206	R&S®SMW-B206 and R&S®SMW-B20	R&S®SMW-B206 and R&S®SMW-B22	R&S®SMW-B212	R&S®SMW-B220
3 GHz	R&S®SMW-B103	●	●	–	–	●	–	–	●	●
	R&S®SMW-B103 and R&S®SMW-B20	●	●	●	–	●	●	–	●	●
	R&S®SMW-B103 and R&S®SMW-B22	●	●	●	●	●	●	●	●	●
6 GHz	R&S®SMW-B106	●	●	–	–	●	–	–	●	●
	R&S®SMW-B106 and R&S®SMW-B20	●	●	●	–	●	●	–	●	●
	R&S®SMW-B106 and R&S®SMW-B22	●	●	●	●	●	●	●	●	●
12.75 GHz	R&S®SMW-B112	●	●	–	–	●	–	–	–	–
	R&S®SMW-B112 and R&S®SMW-B20	●	●	–	–	●	–	–	–	–
	R&S®SMW-B112 and R&S®SMW-B22	●	●	–	–	●	–	–	–	–
20 GHz	R&S®SMW-B120	●	●	–	–	●	–	–	–	●
	R&S®SMW-B120 and R&S®SMW-B20	●	●	–	–	●	–	–	–	–
	R&S®SMW-B120 and R&S®SMW-B22	●	●	–	–	●	–	–	–	–
31.8 GHz	R&S®SMW-B131	●	–	–	–	–	–	–	–	–
	R&S®SMW-B131 and R&S®SMW-B20	●	–	–	–	–	–	–	–	–
	R&S®SMW-B131 and R&S®SMW-B22	●	–	–	–	–	–	–	–	–
40 GHz	R&S®SMW-B140, R&S®SMW-B140N	●	–	–	–	–	–	–	–	–
	R&S®SMW-B140(N) and R&S®SMW-B20	●	–	–	–	–	–	–	–	–
	R&S®SMW-B140(N) and R&S®SMW-B22	●	–	–	–	–	–	–	–	–

● = possible, – = not possible

The following option can be installed once, but can be used with all installed RF paths:

R&S®SMW-B90	phase coherence

RF characteristics

Frequency

Range	R&S®SMW-B103, R&S®SMW-B203	100 kHz to 3 GHz
	R&S®SMW-B106, R&S®SMW-B206	100 kHz to 6 GHz
	R&S®SMW-B112, R&S®SMW-B212	100 kHz to 12.75 GHz
	R&S®SMW-B120, R&S®SMW-B220	100 kHz to 20 GHz
	R&S®SMW-B131	100 kHz to 31.8 GHz
	R&S®SMW-B140, R&S®SMW-B140N	100 kHz to 40 GHz
Resolution of setting		0.001 Hz
Resolution of synthesis	fundamental frequency range = 750 MHz to 1500 MHz	
	standard	5 µHz (nom.)
	with R&S®SMW-B22 option	0.2 µHz (nom.)
Setting time	to within < 1×10^{-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	
	R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206	< 1.2 ms, 0.6 ms (typ.)
	R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220	< 1.4 ms, 0.9 ms (typ.)
	R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N	< 1.5 ms, 1.1 ms (typ.)
Setting time (list mode)	to within < 1×10^{-7} for f > 200 MHz or < 124 Hz for f < 200 MHz, with GUI update stopped	
	after trigger pulse	
	R&S®SMW-B103, R&S®SMW-B203	< 0.6 ms, 0.4 ms (typ.)
	R&S®SMW-B106, R&S®SMW-B206	< 0.8 ms, 0.5 ms (typ.)
	R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220	< 1.0 ms, 0.7 ms (typ.)
	R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N	< 1.2 ms, 0.9 ms (typ.)
Resolution of phase offset setting		0.1°

Frequency 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		external trigger signal (INST TRG A or B at rear), rotary knob, touchpanel, remote control
Sweep range		full frequency range
Sweep shape		sawtooth, triangle
Step size	linear	full frequency range
	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	
	standard	< 1×10^{-8}
	with R&S®SMW-B22 option	< 5×10^{-9}
Aging	after 30 days of uninterrupted operation	
	standard	1×10^{-9}/day, 1×10^{-7}/year
	with R&S®SMW-B22 option	5×10^{-10}/day, 3×10^{-8}/year
Temperature effect	in temperature range from 0 °C to +50 °C	
	standard	6×10^{-8}
	with R&S®SMW-B22 option	6×10^{-9}
Warm-up time	to nominal thermostat temperature	≤ 10 min

Output for internal reference frequency		
Connector type	REF OUT on rear panel	BNC female
Output frequency	sine wave	10 MHz or external input frequency
Output level		2 dBm to 9 dBm, 5 dBm to 8 dBm (typ.)
Source impedance		50 Ω (nom.)
Input for external reference frequency		
Connector type	REF IN on rear panel	BNC female
Input frequency		1 MHz to 100 MHz
Min. frequency locking range	standard	$\pm 0.5 \times 10^{-6}$
	with R&S®SMW-B22 option	$\pm 1.5 \times 10^{-7}$
Input level range	level limits	≥ –6 dBm, ≤ 19 dBm
	recommended input level	0 dBm to 19 dBm
Input impedance		50 Ω (nom.)
Input for electronic tuning of internal reference frequency		
Connector type	EFC on rear panel	BNC female
Sensitivity	standard	0.5×10^{-9}/V to 3×10^{-8}/V, 1×10^{-8}/V to 2×10^{-8}/V (typ.)
	with R&S®SMW-B22 option	5×10^{-9}/V to 2×10^{-8}/V, 8×10^{-9}/V to 9.5×10^{-9}/V (typ.)
Input voltage		–10 V to +10 V
Input impedance	standard	10 kΩ (nom.)
	with R&S®SMW-B22 option	5 kΩ (nom.)

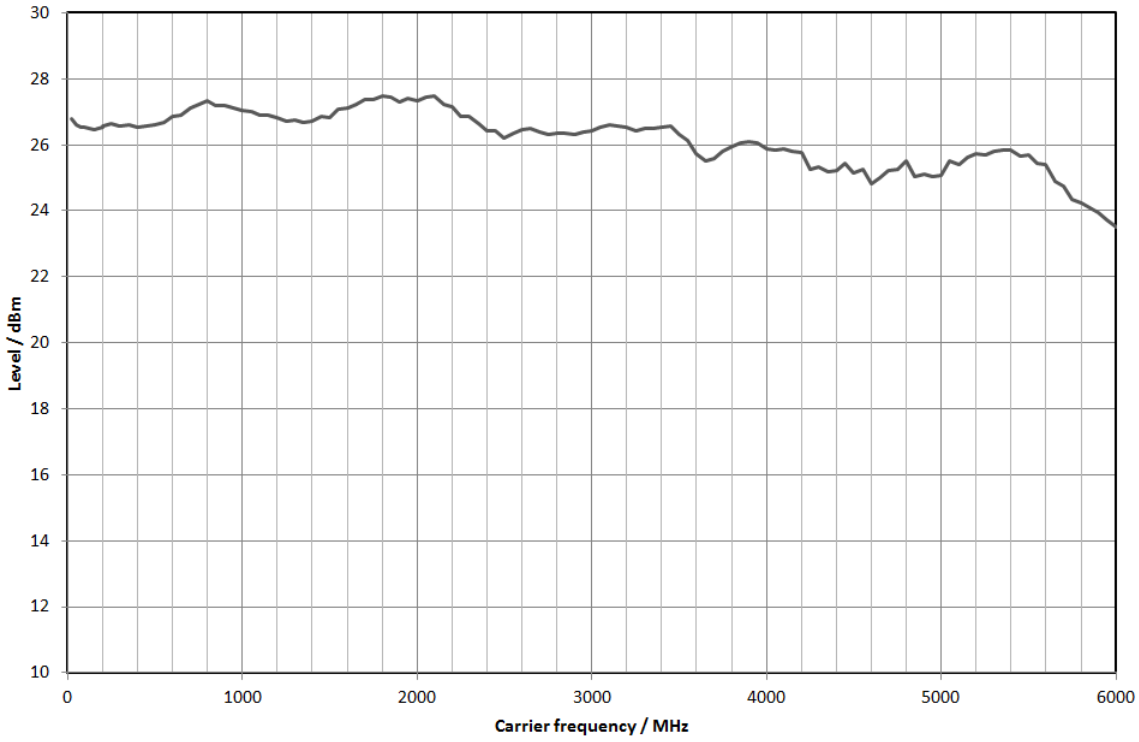
Level

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 ≤ 40 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®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206, R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220 frequency options:	
	3 MHz < f ≤ 20 GHz	–120 dBm to +18 dBm (PEP) [1]
	R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N 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	–120 dBm to +15 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]
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
	20 GHz < f ≤ 40 GHz	< 1.1 dB
Additional level error	I/Q modulation	< 0.3 dB
	pulse modulation	< 0.5 dB

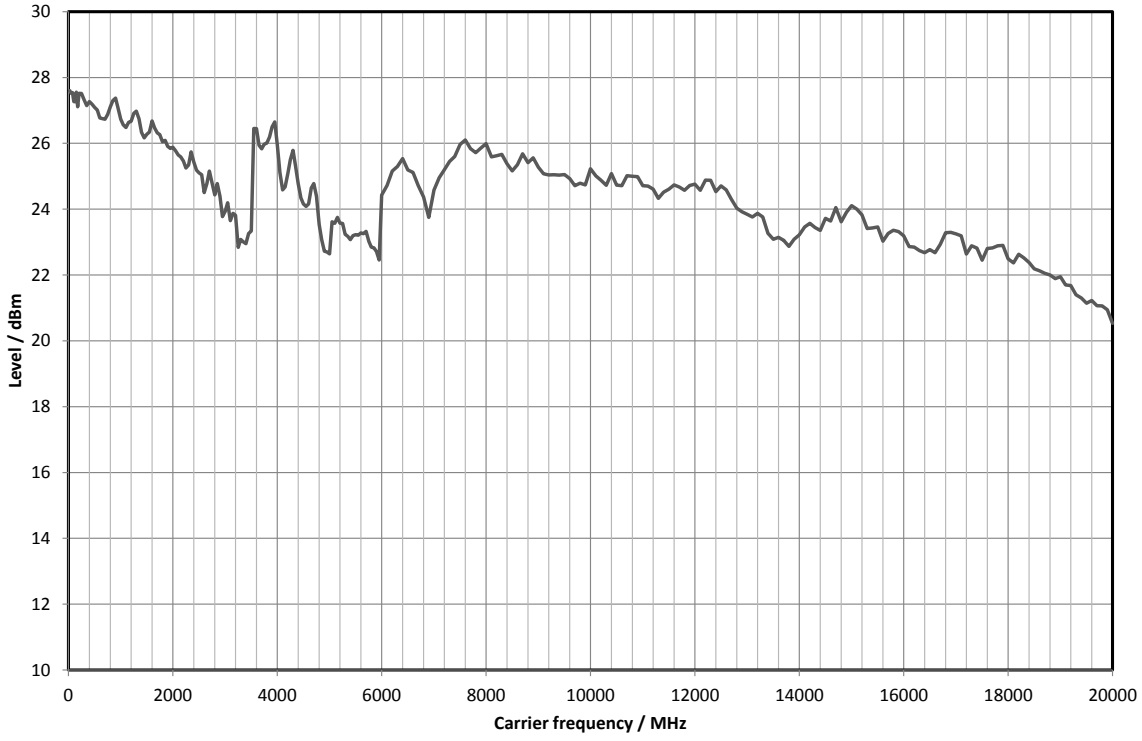
[1] PEP = peak envelope power.

Output impedance VSWR in 50 Ω system	level setting characteristic: auto	
	R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206 100 kHz < f ≤ 6 GHz	< 1.6
	R&S®SMW-B112, R&S®SMW-B212 100 kHz < f ≤ 12.75 GHz	< 2.0
	R&S®SMW-B120, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N, R&S®SMW-B220, 100 kHz < f ≤ 20 GHz	< 1.7
	R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N, step attenuator = 0 dB 20 GHz < f ≤ 38 GHz	< 2.0
	R&S®SMW-B140, R&S®SMW-B140N, step attenuator = 0 dB 38 GHz < f ≤ 40 GHz	< 2.4
	R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N, step attenuator ≥ 5 dB 20 GHz < f ≤ 40 GHz	< 1.9
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, 0.6 ms (typ.)
	with switching of mechanical step attenuator, after IEC/IEEE bus delimiter	< 25 ms
Setting time (list mode)	to < 0.1 dB deviation from final value, with GUI update stopped, no relay switchover, f > 10 MHz	
	after trigger pulse [2]	< 0.8 ms, 0.4 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®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206 frequency options Note: The RF path is switched off if the reverse power exceeds a limit (+27 dBm (meas.), depending 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®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N frequency options	
	1 MHz < f ≤ 40 GHz	0.5 W
Maximum permissible DC voltage	R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206 frequency options	50 V
	R&S®SMW-B112, R&S®SMW-B212 frequency options	35 V
	R&S®SMW-B120, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N, R&S®SMW-B220 frequency options	0 V

[2] R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N: temperature > +18 °C.



Measured maximum available output level versus frequency with R&S®SMW-B106, R&S®SMW-B206 frequency options.



Measured maximum available output level versus frequency with R&S®SMW-B120, R&S®SMW-B220 frequency options.

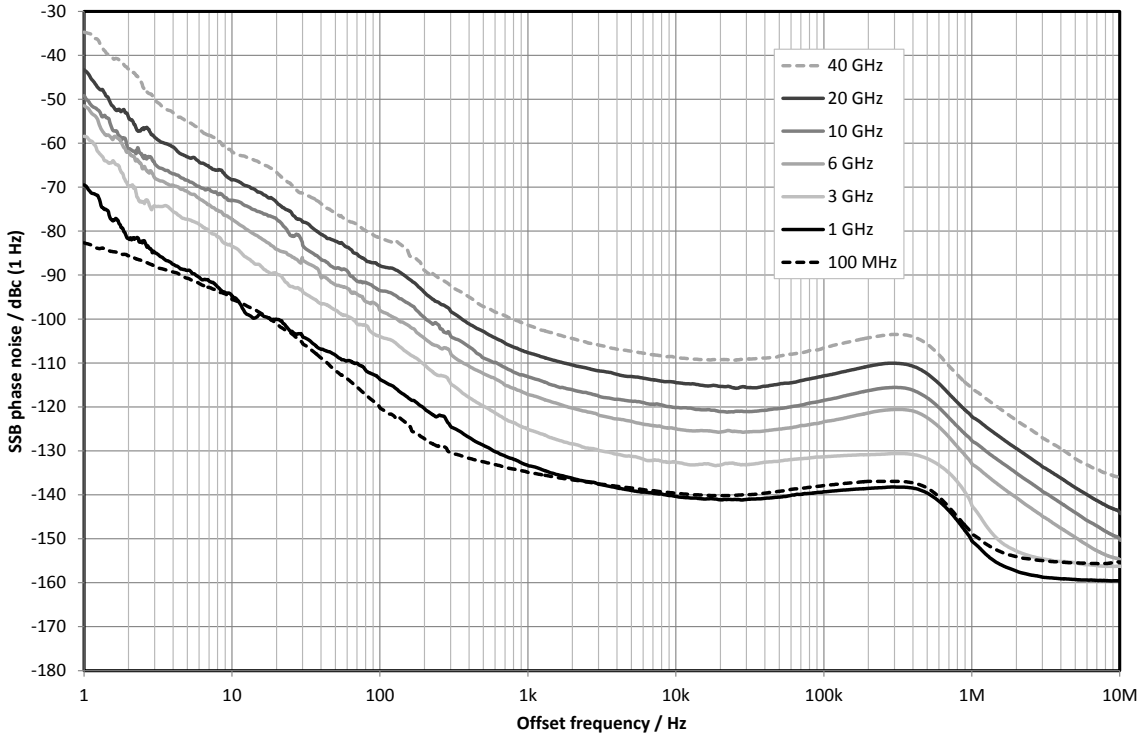
Level sweep

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 or B 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

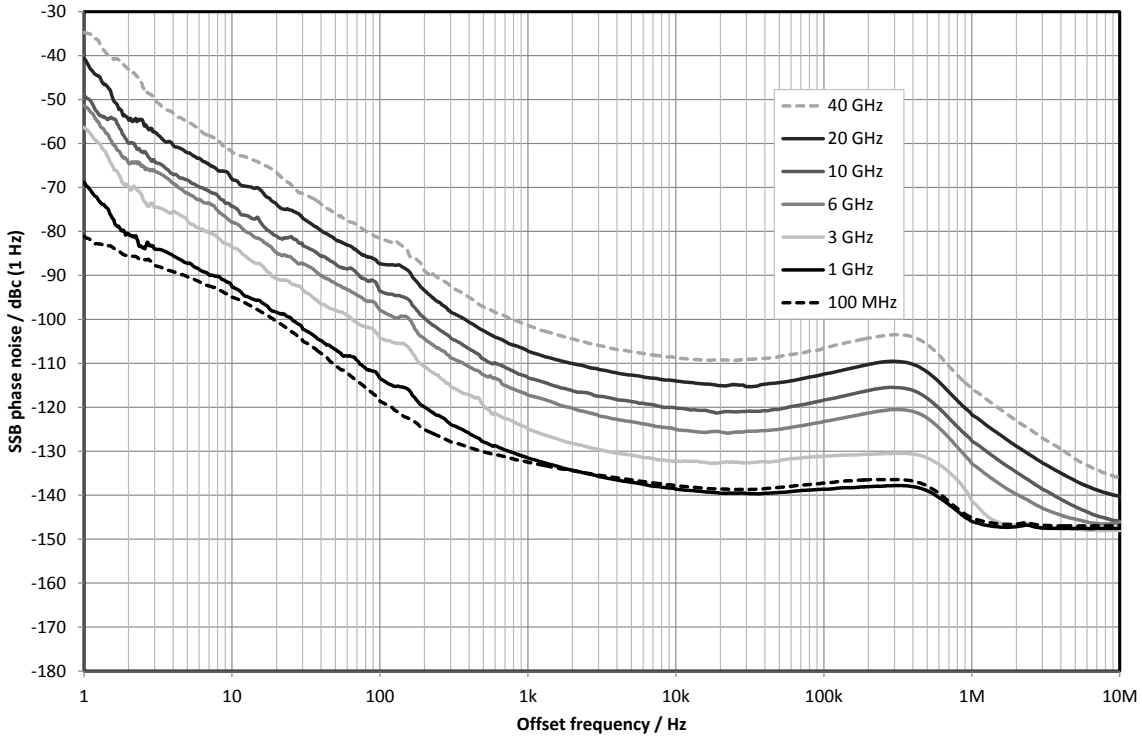
Spectral purity

Harmonics	CW, level < 10 dBm	
	R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206, R&S®SMW-B112, R&S®SMW-B212 frequency options	< –30 dBc
	R&S®SMW-B120, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N, R&S®SMW-B220 frequency options	
	f ≤ 3.5 GHz	< –30 dBc
	f > 3.5 GHz	< –55 dBc
Nonharmonics	CW, I/Q modulation (full-scale DC input), level > –10 dBm, > 10 kHz offset from carrier and outside the modulation spectrum	
	100 kHz ≤ f ≤ 200 MHz	< –77 dBc
	200 MHz < f ≤ 1500 MHz	< –80 dBc
	1500 MHz < f ≤ 3 GHz	< –74 dBc
	3 GHz < f ≤ 6 GHz	< –68 dBc
	6 GHz < f ≤ 12 GHz	< –62 dBc
	12 GHz < f ≤ 24 GHz	< –56 dBc
	24 GHz < f ≤ 40 GHz	< –50 dBc
	CW, I/Q modulation (full-scale DC input), level > –10 dBm, > 850 kHz offset from carrier and outside the modulation spectrum	
	100 kHz ≤ f ≤ 200 MHz	< –77 dBc
	200 MHz < f ≤ 1500 MHz	
	with R&S®SMW-B13/-B13T options	< –86 dBc
	with R&S®SMW-B13XT option	< –80 dBc
	1500 MHz < f ≤ 3 GHz	< –80 dBc
	3 GHz < f ≤ 6 GHz	< –74 dBc
Nonharmonics with R&S®SMW-B22 option	CW, I/Q modulation (full-scale DC input), level > –10 dBm, > 10 kHz offset from carrier and outside the modulation spectrum	
	100 kHz ≤ f ≤ 200 MHz	< –77 dBc, –87 dBc (typ.)
	200 MHz < f ≤ 1500 MHz	
	with R&S®SMW-B13/-B13T options	< –90 dBc
	with R&S®SMW-B13XT option	< –80 dBc
	1500 MHz < f ≤ 3 GHz	
	with R&S®SMW-B13/-B13T options	< –84 dBc
	with R&S®SMW-B13XT option	< –80 dBc
	3 GHz < f ≤ 6 GHz	< –78 dBc
	6 GHz < f ≤ 12 GHz	< –72 dBc
	12 GHz < f ≤ 24 GHz	< –66 dBc
	24 GHz < f ≤ 40 GHz	< –60 dBc
Power supply and mechanically related nonharmonics	at RF = 1 GHz, 50 Hz to 10 kHz from carrier	< –80 dBc
	with R&S SMW-B13XT option, temperature 25°C	< –80 dBc (typ.)
Subharmonics	1.5 GHz < f ≤ 6 GHz	< –74 dBc
	6 GHz < f ≤ 40 GHz	< –60 dBc

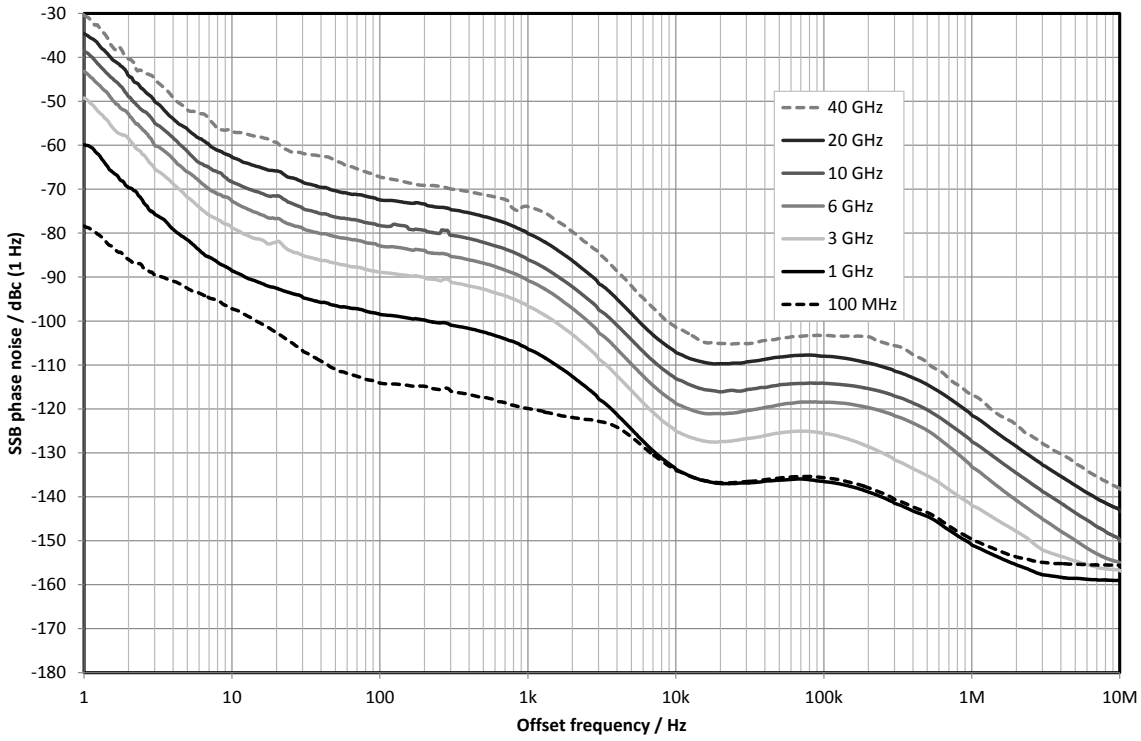
Wideband noise	carrier offset > 30 MHz, measurement bandwidth = 1 Hz	
	CW, level = 10 dBm	
	R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206 frequency options	
	20 MHz ≤ f ≤ 200 MHz	< –146 dBc, –149 dBc (typ.)
	200 MHz < f ≤ 6 GHz	< –150 dBc, –152 dBc (typ.)
	R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220 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 ≤ 13 GHz	< –147 dBc, –149 dBc (typ.)
	13 GHz < f ≤ 20 GHz	< –144 dBc, –146 dBc (typ.)
	R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N 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 ≤ 13 GHz	< –147 dBc, –149 dBc (typ.)
	13 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 ≤ 40 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 ≤ 13 GHz	< –140 dBc, –143 dBc (typ.)
	R&S®SMW-B120, R&S®SMW-B220 frequency options	
	13 GHz < f ≤ 20 GHz	< –138 dBc, –141 dBc (typ.)
	R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N frequency option	
	13 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.)
SSB phase noise	CW, carrier offset = 20 kHz, measurement bandwidth = 1 Hz	
	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.)
	f = 10 GHz	< –111 dBc, –115 dBc (typ.)
	f = 20 GHz	< –105 dBc, –109 dBc (typ.)
	f = 30 GHz	< –101 dBc, –105 dBc (typ.)
	f = 40 GHz	< –99 dBc, –103 dBc (typ.)
SSB phase noise with R&S®SMW-B22 option	CW, carrier offset = 20 kHz, measurement bandwidth = 1 Hz	
	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.)
	f = 10 GHz	< –116 dBc, –119 dBc (typ.)
	f = 20 GHz	< –110 dBc, –113 dBc (typ.)
	f = 30 GHz	< –106 dBc, –109 dBc (typ.)
	f = 40 GHz	< –104 dBc, –107 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 (20 Hz to 23 kHz)	< 0.02 %



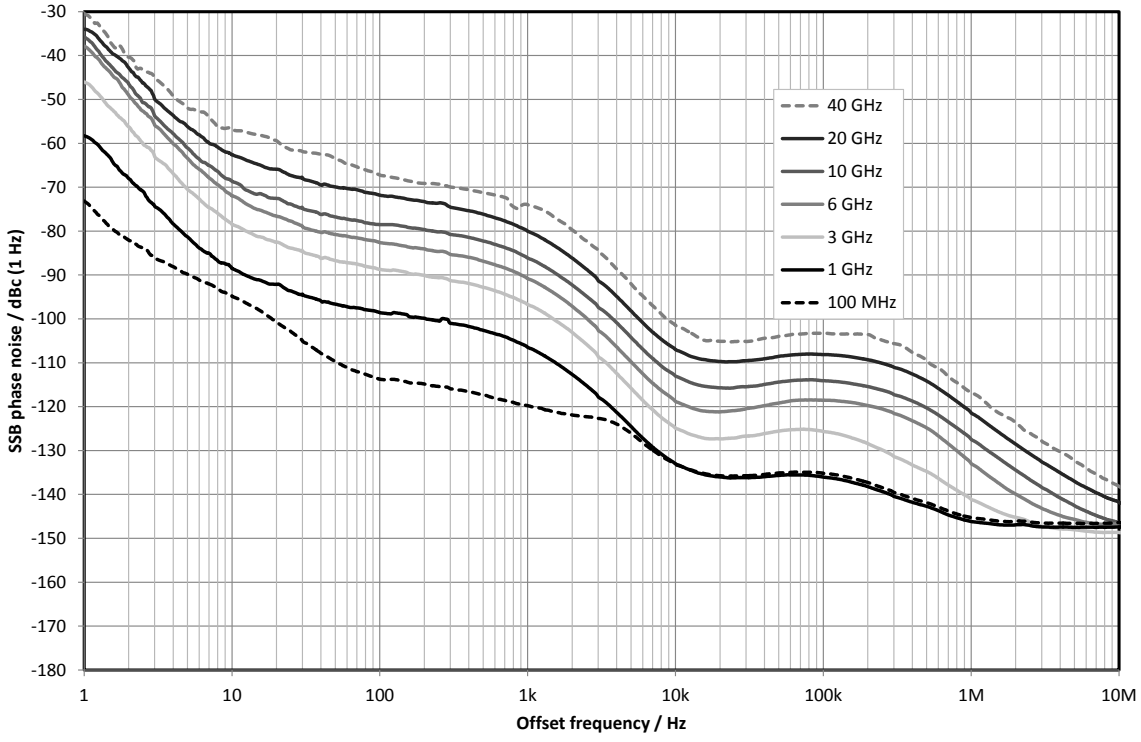
Measured SSB phase noise performance with R&S®SMW-B22 option, CW mode.



Measured SSB phase noise performance with R&S®SMW-B22 option, I/Q mode.



Measured SSB phase noise performance, standard instrument, CW mode.



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

Phase coherence (R&S®SMW-B90 option)

The R&S®SMW-B90 option provides phase-coherent RF outputs for the two RF paths or two or more instruments.

LO coupling modes	This mode corresponds to internal LO operation in path A and path B.	A, B internal
	This mode corresponds to internal LO operation in path A, and LO of path B is coupled to path A.	A internal, A → B coupled
	This mode corresponds to external LO operation at the LO IN connector in path A and internal LO operation in path B.	A external, B internal
	This mode corresponds to external LO operation at the REF/LO IN connector in path A and path B.	A external, A → B coupled
REF/LO OUT states	The active LO signal of path B 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 ≤ 40 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 ≤ 40 GHz	0.125 × f

Simultaneous modulation

In the same RF path.

	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)

Two-path instruments: Frequency modulation and phase modulation are not compatible with I/Q modulation in the other RF path.

For simultaneous I/Q and frequency modulation, or simultaneous I/Q and phase modulation, the instrument must be equipped with a two-path signal routing and baseband main module (R&S®SMW-B13T or R&S®SMW-B13XT option).

Analog modulation

Amplitude modulation

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 φM at AM	m = 30 %, f_{mod} = 1 kHz, peak value	< 0.1 rad

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

R&S®SMW-B13T or R&S®SMW-B13XT must be installed.

FM multiplier (rm) for different frequency ranges	100 kHz ≤ 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
	1.5 GHz < f ≤ 3 GHz	rm = 2
	3 GHz < f ≤ 6 GHz	rm = 4
	6 GHz < f ≤ 12 GHz	rm = 8
	12 GHz < f ≤ 24 GHz	rm = 16
	24 GHz < f ≤ 40 GHz	rm = 32
Modulation source		internal, external, internal + external
External coupling		AC, DC
Operating modes	with R&S®SMW-B20 option	FM mode: normal
	with R&S®SMW-B22 option	FM mode : normal, FM mode : low noise
Maximum deviation	FM mode: normal	rm × 10 MHz
	FM mode: low noise	rm × 100 kHz
Resolution of setting		< 200 ppm, min. rm × 0.1 Hz
FM deviation error	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, deviation = rm × 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 8 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 ≤ 40 GHz	< 0.2 %
Carrier frequency offset at FM		< 0.2 % of set deviation

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

R&S®SMW-B13T or R&S®SMW-B13XT must be installed.

Operating mode		internal, external, internal + external, AC/DC, high bandwidth, high deviation, low noise (with R&S®SMW-B22 option only)
φM multiplier (rm) for different frequency ranges	100 kHz ≤ 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
	1.5 GHz < f ≤ 3 GHz	rm = 2
	3 GHz < f ≤ 6 GHz	rm = 4
	6 GHz < f ≤ 12 GHz	rm = 8
	12 GHz < f ≤ 24 GHz	rm = 16
	24 GHz < f ≤ 40 GHz	rm = 32
Modulation source		internal, external, internal + external
External coupling		AC, DC
Operating modes	with R&S®SMW-B20 option	φM mode: high deviation, φM mode: high bandwidth
	with R&S®SMW-B22 option	φM mode: high deviation, φM mode: high bandwidth, φM mode: low noise
Maximum deviation	φM mode: high deviation fmod ≤ rm × 10 MHz/deviation	rm × 20.0 rad
	φM mode: high bandwidth	rm × 1.0 rad
	φM mode: low noise	rm × 0.25 rad
Resolution of setting	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
φM 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)
φM distortion	f_{mod} = 10 kHz, half of maximum deviation	< 0.2 %, 0.1 % (typ.)
Modulation frequency response	DC/AC coupling, 50 Ω input impedance	
	high deviation, DC, 10 Hz to 500 kHz	< 1 dB
	high bandwidth, DC, 10 Hz to 10 MHz for f ≤ 3 GHz DC, 10 Hz to 8 MHz for f > 3 GHz	< 3 dB
	low noise, DC, 10 Hz to 100 kHz	< 3 dB

Pulse modulation (R&S®SMW-K22 option)

If two RF paths are installed (signal paths A and B), pulse modulation can be used either on signal path A or B with one R&S®SMW-K22 option. For pulse modulation to be used on signal paths A and B simultaneously, two R&S®SMW-K22 must be installed.

Modulation source		external, internal
On/off ratio		> 80 dB
Rise/fall time	10 %/90 % of RF amplitude	
	with R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206 frequency options	
	transition type = fast	< 10 ns
	transition type = smoothed	< 200 ns
	with R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N, R&S®SMW-B220 frequency options	
	transition type = fast	< 10 ns
	transition type = smoothed, only available for f ≤ 5 GHz, CW; f ≤ 3.5 GHz, I/Q- or AM-modulation	< 200 ns
Minimum pulse width	50 %/50 % of RF amplitude, transition type = fast	
	with R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206, R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220, R&S®SMW-B131, R&S®SMW-B140 frequency options	20 ns
	with R&S®SMW-B140N 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®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206 frequency options	
	level < 10 dBm	< 10 % of RF
		< 200 mV (V_{pp})
	with R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N, R&S®SMW-B220 frequency options	
	f ≤ 5 GHz: level < 5 dBm	< 10 % of RF
	f > 5 GHz: level < 10 dBm	< 200 mV (V_{pp})
Pulse overshoot		< 10 %

Input for external modulation signals

Modulation inputs EXT 1, EXT 2 for AM/FM/φM		
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		sine
Frequency range		0.1 Hz to 1 MHz
Resolution of setting		0.1 Hz
Frequency uncertainty		< 0.001 Hz + relative deviation of reference frequency
Frequency response	up to 1 MHz	0.05 dB (meas.)
Distortion	f < 100 kHz, at R_L > 50 Ω, level (V_{EMF}) < 1 V	< 0.1 %

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

If two RF paths are installed (signal paths A and B), the multifunction generator can be used either on signal path A or B with one R&S®SMW-K24 option. For the multifunction generator to be used on signal paths A and B simultaneously, two R&S®SMW-K24 must be installed.

The multifunction generator option (R&S®SMW-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 1/2	sine, pulse, triangle, trapezoid
	noise generator	noise amplitude distribution : Gaussian, equal
Frequency range	sine	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	0.1 Hz
	pulse, triangle, trapezoid	10 ns
	noise bandwidth	100 kHz
Frequency uncertainty		< 0.001 Hz + relative deviation of reference frequency
Frequency response	sine, up to 1 MHz	0.05 dB (meas.)
	sine, up to 10 MHz	0.1 dB (meas.)
Distortion	f < 100 kHz, at R_L > 50 Ω, level (V_{EMF}) 1 V	< 0.1 %

LF output

Monitoring of resulting modulation signal for		AM, FM, φM
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

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

If two RF paths are installed (signal paths A and B), the high-performance pulse generator can be used either on signal path A or B with one R&S®SMW-K23 option. For the high-performance pulse generator to be used on signal paths A and B simultaneously, two R&S®SMW-K23 must be installed.

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	with R&S®SMW-B13XT option	3.333 ns
	with R&S®SMW-B13, R&S®SMW-B13T options	5 ns
Pulse width		
Setting range	pulse widths of double pulses are independently settable	
	with R&S®SMW-B13XT option	3.333 ns to 100 s
	with R&S®SMW-B13, R&S®SMW-B13T options	5 ns to 100 ns
Setting resolution	with R&S®SMW-B13XT option	3.333 ns
	with R&S®SMW-B13, R&S®SMW-B13T options	5 ns
Pulse delay		
Setting range		0 ns to 100 s
Setting resolution	with R&S®SMW-B13XT option	3.3333 ns
	with R&S®SMW-B13, R&S®SMW-B13T options	5 ns
Double-pulse delay		
Setting range		20 ns to 1 s
Setting resolution	with R&S®SMW-B13XT option	3.333 ns
	with R&S®SMW-B13, R&S®SMW-B13T options	5 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 ($R_L \geq 50\ \Omega$)

I/Q modulation

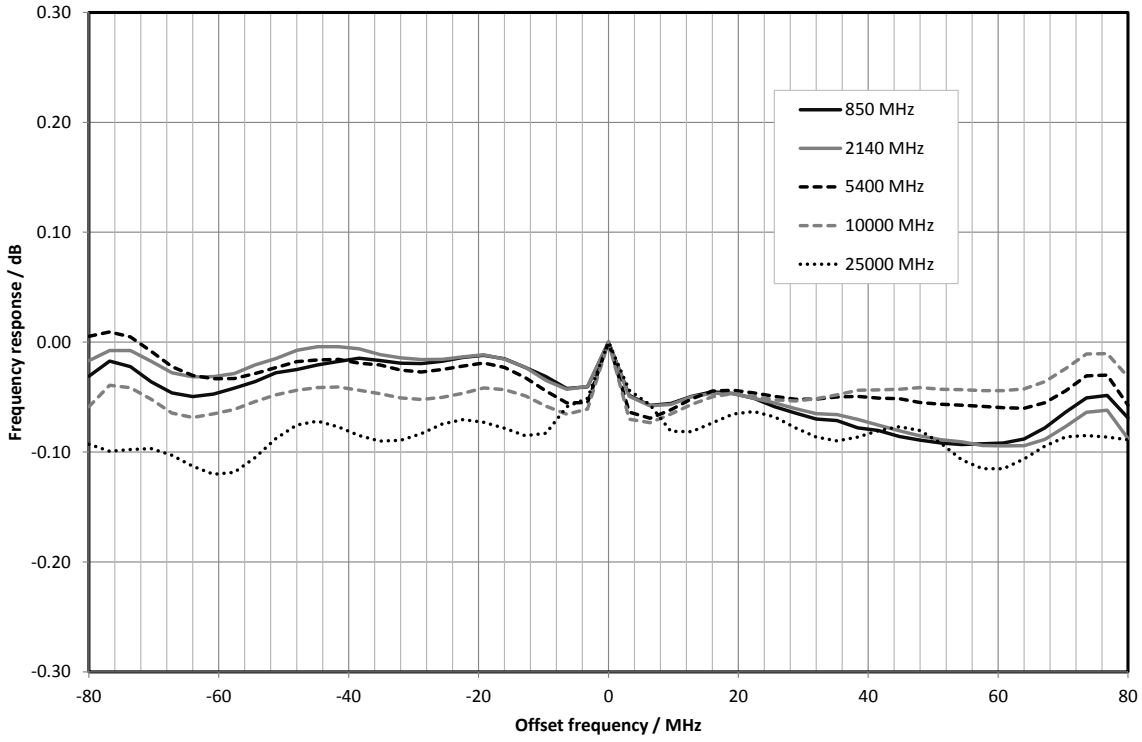
I/Q modulation performance

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®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206, R&S®SMW-B120, R&S®SMW-B220, R&S®SMW-B131, R&S®SMW-B140	
	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®SMW-B140N	
	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®SMW-B112, R&S®SMW-B212	
	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, standard baseband (R&S®SMW-B13 or -B13T), I/Q wideband on	
	1 MHz < f ≤ 250 MHz	±32 % of carrier frequency
	f > 250 MHz	±80 MHz
	with internal baseband I/Q, wideband baseband (R&S®SMW-B13XT), I/Q wideband on; with R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206, R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220, R&S®SMW-B131, R&S®SMW-B140	
	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 internal baseband I/Q, wideband baseband (R&S®SMW-B13XT), I/Q wideband on; with R&S®SMW-B140N	
	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
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, standard baseband (R&S®SMW-B13 or -B13T), I/Q wideband on, optimization mode: high quality	< 1.0 dB, < 0.3 dB (meas.)
	with internal baseband I/Q, wideband baseband (R&S®SMW-B13XT), 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®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N	< –40 dBc

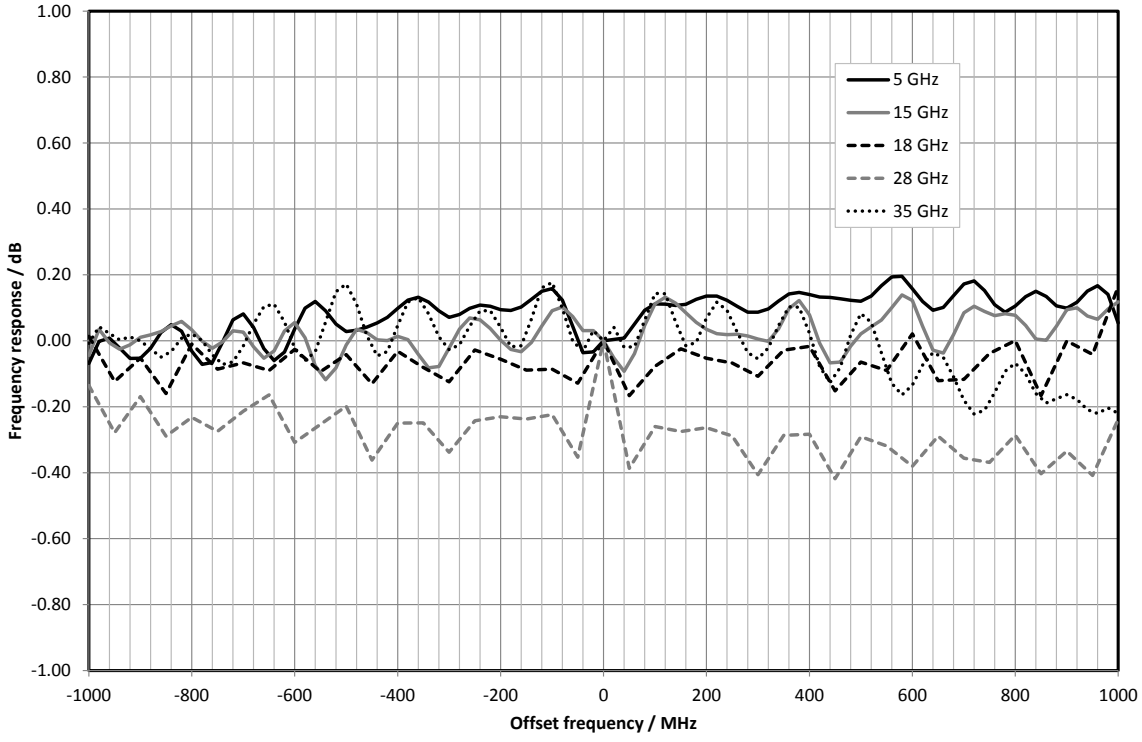
[3] Value applies after 1 hour warm-up time and recalibration for 4 hours of operation and temperature variations of less than +5 °C.

Suppression of image sideband for entire instrument in modulation bandwidth [4]	with internal baseband I/Q, standard baseband (R&S®SMW-B13 or -B13T), optimization mode: high quality, up to 160 MHz RF modulation bandwidth	> 50 dB, 60 dB (typ.)
	with internal baseband I/Q, wideband baseband (R&S®SMW-B13XT), optimization mode: high quality	
	RF modulation bandwidth ≤ 1600 MHz	> 40 dB, 50 dB (typ.)
	1600 MHz < RF modulation bandwidth ≤ 2000 MHz	> 37 dB, 47 dB (typ.)
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 ≤ 40 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 %
	resolution	0.01 %
	gain imbalance	
	setting range	–1.0 dB to +1.0 dB
	resolution	0.01 dB
	quadrature offset	
	setting range	–10° to +10°
	resolution	0.01°

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



Measured RF modulation frequency response with internal baseband I/Q, standard baseband.



Measured RF modulation frequency response with internal baseband I/Q, wideband baseband

Analog I/Q inputs

For each installed RF path A or B, one pair of I and Q inputs is available on the front panel (single-ended input mode). With the R&S®SMW-K739 option installed, the input mode for RF path A can also be switched to differential. In this mode, all four available connectors are used for RF path A.

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®SMW200A.

Input mode		single-ended
	with R&S®SMW-K739 option, for RF path A	
	R&S®SMW-B103, R&S®SMW-B106, R&S®SMW-B112, R&S®SMW-B120	single-ended or differential
	R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N	
	f ≤ 19.5 GHz	single-ended or differential
	f > 19.5 GHz	single-ended
Connector types	I, Q on front panel (for each installed RF path A or B)	BNC female
Input impedance		50 Ω (nom.)
VSWR with frequency options R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206, R&S®SMW-B112, R&S®SMW-B212, R&S®SMW-B120, R&S®SMW-B220	up to 200 MHz	< 1.2
	200 MHz to 500 MHz	< 1.35
	500 MHz to 1 GHz	< 1.45
VSWR with frequency options R&S®SMW-B131, R&S®SMW-B140	up to 200 MHz, f ≤ 19.5 GHz	< 1.2
	up to 200 MHz, f > 19.5 GHz	< 1.35
	200 MHz to 500 MHz	< 1.35
	500 MHz to 1 GHz	< 1.45
VSWR with R&S®SMW-B140N frequency option	up to 200 MHz, f ≤ 19.5 GHz	< 1.2
	200 MHz to 500 MHz, f ≤ 19.5 GHz	< 1.35
	500 MHz to 1 GHz, f ≤ 19.5 GHz	< 1.45
	up to 275 MHz, f > 19.5 GHz	< 1.35
Nominal input voltage for full-scale input		$\sqrt{V_i^2 + V_q^2} = 0.5\ V$
Damage voltage		±2 V

Standard baseband characteristics

Internal baseband characteristics (R&S®SMW-B13 or R&S®SMW-B13T option)

The R&S®SMW-B13 option provides one I/Q path to the RF section (to RF path A) as well as one analog I/Q output (i.e. one I and one Q output connector). The R&S®SMW-B13T option provides two I/Q paths to the RF section (if two RF paths are installed) as well as two analog I/Q outputs. With two RF paths, R&S®SMW-B13T is required.

Either R&S®SMW-B13 or R&S®SMW-B13T must be installed on the instrument.

D/A converter		
Data rate		200 MHz
Resolution		16 bit
Sampling rate		800 MHz (internal interpolation × 4)
Aliasing filter	with amplitude, group delay and S_i correction	
Bandwidth, rolloff to –0.1 dB		80 MHz
D/A converter interpolation spectra	up to 10 MHz	< –80 dBc
	up to 80 MHz	< –73 dBc
I/Q impairments (digital baseband)	These impairments are set in the digital baseband section of the R&S®SMW200A. 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 %
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°

Analog I/Q outputs (R&S®SMW-B13 or R&S®SMW-B13T option)

Number of I/Q outputs	with R&S®SMW-B13 option	1
	with R&S®SMW-B13T option	2
Output impedance		50 Ω
Output voltage	EMF (output voltage depends on set modulation signal)	1 V (V_p)
Offset	EMF	< 1 mV
Frequency response [5]	at R_L = 50 Ω	
Magnitude	up to 10 MHz	0.02 dB (meas.)
	up to 80 MHz	0.03 dB (meas.)
I/Q balance [6]	at R_L = 50 Ω	
Magnitude	up to 10 MHz	0.01 dB (meas.)
	up to 80 MHz	0.02 dB (meas.)
Spectral purity	at R_L = 50 Ω	
SFDR (sine)	up to 2 MHz	> 70 dB
	up to 20 MHz	60 dB (meas.)
Wideband noise	10 MHz sine wave at 1 MHz offset	–155 dBc (typ.)

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

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

Differential analog I/Q outputs (R&S®SMW-K16 option)

This option can be installed once if the instrument is equipped with the R&S®SMW-B13 option. If the instrument is equipped with the R&S®SMW-B13T option, differential analog I/Q outputs can be used either on signal path A or B with one R&S®SMW-K16 option. For differential analog I/Q outputs to be used on signal paths A and B simultaneously, two R&S®SMW-K16 must be installed.

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 [7]
Resolution		2 mV
Uncertainty		1 % + 4 mV
Offset voltage		
Differential	EMF	–300 mV to +300 mV
Resolution		0.1 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 (meas.)
	up to 80 MHz	0.2 dB (meas.)
Frequency response [8]	at R_L = 50 Ω, output voltage > 0.5 V (V_p)	
Magnitude	up to 10 MHz	0.02 dB (meas.)
	up to 80 MHz	0.03 dB (meas.)

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

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

Envelope tracking (R&S®SMW-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.

This option can be installed once if the instrument is equipped with the R&S®SMW-B13 option. If the instrument is equipped with the R&S®SMW-B13T option, envelope tracking can be used either on signal path A or B with one R&S®SMW-K540 option. For envelope tracking to be used on signal paths A and B simultaneously, two R&S®SMW-K540 must be installed.

For each R&S®SMW-K540 option to be installed, an R&S®SMW-K16 option must be installed, and the instrument must be equipped with at least one baseband generator (R&S®SMW-B10 option)

General		
Envelope voltage adaptation		auto normalized, auto power, manual
Output type		single-ended, differential
Bias voltage	see section "Differential analog I/Q outputs"	
Offset voltage	see section "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/φM predistortion (R&S®SMW-K541 option)

At least one standard baseband generator (R&S®SMW-B10 option) must be installed. If the instrument is equipped with two R&S®SMW-B10 options, predistortion can be used either on signal path A or B with one R&S®SMW-K541 option. For AM/AM, AM/φM predistortion to be used on signal paths A and B simultaneously, two R&S®SMW-K541 must be installed.

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

Digital baseband inputs/outputs

Depending on the installed software and hardware options, the R&S®SMW200A is able to receive digital baseband signals and to output digital baseband signals. The digital I/Q input/output can be used for the lossless connection of the R&S®SMW200A to the digital I/Q input/output of other Rohde & Schwarz instruments (for example the R&S®CMW500 wideband radio communication tester in fading applications).

Digital baseband outputs: At least one R&S®SMW-K18 option must be installed. This option can be installed once if the instrument is equipped with the R&S®SMW-B13 option. If the instrument is equipped with the R&S®SMW-B13T option, digital baseband outputs can be used either on signal path A or B with one R&S®SMW-K18 option. For digital baseband outputs to be used on signal paths A and B simultaneously, two R&S®SMW-K18 must be installed. Furthermore, to enable two or more digital baseband outputs in MIMO modes, two R&S®SMW-K18 must be installed.

The following table gives an overview of which software and hardware options are required for which digital I/Q connectivity:

Minimum required R&S®SMW200A options	**Digital I/Q inputs**	**Digital I/Q outputs**
R&S®SMW-B13 + 1 × R&S®SMW-K18	–	1
R&S®SMW-B13T + 2 × R&S®SMW-K18	–	2
1 × R&S®SMW-B10	1	–
1 × R&S®SMW-B10 + R&S®SMW-B13 + 1 × R&S®SMW-K18	1	1
1 × R&S®SMW-B10 + R&S®SMW-B13T + 2 × R&S®SMW-K18	1	2
2 × R&S®SMW-B10	2	–
2 × R&S®SMW-B10 + R&S®SMW-B13 + 1 × R&S®SMW-K18	2	1
2 × R&S®SMW-B10 + R&S®SMW-B13T + 2 × R&S®SMW-K18	2	2
2 × R&S®SMW-B10 + 4 × R&S®SMW-B14 + R&S®SMW-B13T + 2 × R&S®SMW-K18	depending on selected system configuration (for required additional options for specific system configurations, see section "Multichannel, MIMO, fading and noise", specifications for R&S®SMW-K74, -K75, -K76 options)	
3x1	3	1
3x2	3	2
3x3	3	3
1x3	1	3
2x3	2	3
4x1	4	1
4x2	4	2
4x3	4	3
4x4	4	4
1x4	1	4
2x4	2	4
3x4	3	4
8x1	-	1
8x2	-	2
8x4	-	4
1x8	1	6
2x8	2	6
4x8	2	6
3x1x1	3	3
4x1x1	4	4
5x1x1	–	3
6x1x1	–	4
7x1x1	–	5
8x1x1	–	6
2x1x2	2	4
2x2x1	4	2
2x2x2	4	4
2x1x3, 2x2x3	2	5
2x1x4, 2x2x4	2	6
2x3x1, 2x4x1	2	2
2x3x2, 2x4x2	2	4
2x3x3, 2x4x3	–	5
2x3x4, 2x4x4	–	6
3x2x1	2	3

3x1x2, 3x2x2	2	4
4x2x1	2	4
4x1x2, 4x2x2	2	6

Output parameters

Interface		
Standard		in line with R&S®Digital I/Q Interface [9], I/Q data and control signals, data and interface clock
Level		LVDS
Connector		26-pin MDR
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’, the sample rate will be estimated on the basis of the applied I/Q data clock.	
Source		user-defined, digital I/Q out
Sample rate	max. sample rate depending on connected receiving device	400 Hz to 200 MHz
Resolution (user-defined)		0.001 Hz
Frequency uncertainty (user-defined)		< (5 × 10^{-14} + relative deviation of reference frequency) × sample rate (nom.)
I/Q data		
Resolution		up to 18 bit
Logic format		two’s complement
Physical signal level		
Setting range		0 to –60 dBFS
Resolution		0.01 dBFS
Bandwidth (RF)	sample rate = 200 MHz (no interpolation, user-defined)	160 MHz
	sample rate < 200 MHz (interpolation)	0.8 × sample rate
Control signals	markers	3

Input parameters

Input level	peak level	
Peak level		
Setting range		–60 dB to +3 dB, referenced to full scale
Resolution		0.01 dB
Crest factor		
Setting range		0 dB to +30 dB
Resolution		0.01 dB
Adjust level function	automatically determines peak level and crest factor of input signal	
I/Q swap	I and Q signals swapped	on/off
Interface		
Standard		in line with R&S®Digital I/Q Interface PAD-R [9], I/Q data and control signals, data and interface clock
Level		LVDS
Connector		26-pin MDR
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 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	max. sample rate depending on connected transmitting device	400 Hz to 200 MHz
Resolution (user-defined)		0.001 Hz
Frequency uncertainty (user-defined)		< (5 × 10^{-14} + relative deviation of reference frequency) × sample rate (nom.)

[9] R&S®Digital I/Q Interface 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.

I/Q data		
Resolution		18 bit
Logic format		two's complement
Bandwidth	sample rate = 200 MHz (no interpolation, user-defined)	160 MHz
	sample rate < 200 MHz (interpolation)	0.8 × sample rate
Control signals	markers	3

Standard baseband generator (R&S®SMW-B10 option) – arbitrary waveform mode

One or two R&S®SMW-B10 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.

Prerequisite: Either R&S®SMW-B13 or R&S®SMW-B13T must be installed.

Waveform length		1 sample to 64 Msample in one-sample steps
	with R&S®SMW-K511 option (memory extension)	1 sample to 512 Msample in one-sample steps
	with R&S®SMW-K512 option (memory extension)	1 sample to 1 Gsample in one-sample steps
Nonvolatile memory		hard disk
Sample resolution	equivalent to D/A converter	16 bit
Sample rate		400 Hz to 150 MHz
	with R&S®SMW-K522 option	400 Hz to 200 MHz
Sample frequency error	internal clock	< (5×10^{-14} + relative deviation of reference frequency) × sample rate (nom.)
Sample clock source		internal, external
Bandwidth (RF)	using the maximum sample rate, rolloff to –0.1 dB	120 MHz
	using a reduced sample rate, rolloff to –0.1 dB (The waveform is automatically interpolated to the internal sample rate of 150 MHz.)	0.8 × sample rate
Bandwidth (RF) with R&S®SMW-K522 option	using the maximum sample rate, rolloff to –0.1 dB	160 MHz
	using a reduced sample rate, rolloff to –0.1 dB (The waveform is automatically interpolated to the internal sample rate of 200 MHz.)	0.8 × sample rate
Frequency offset	With the aid of 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		–60 MHz to +60 MHz
	with R&S®SMW-K522 option	–80 MHz to +80 MHz
Frequency offset setting resolution		0.01 Hz
Frequency offset error		< 7×10^{-7} 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 or T/M/C 1, T/M 2, T/M 3 of respective baseband generator on rear panel
Connector type	USER 1, 2, 3 on front panel, T/M/C 1, T/M 2, T/M 3 of respective baseband generator on rear 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
	T/M/C 1, T/M 2, T/M 3	settable between 0.3 V and 2.0 V
Input impedance	selectable	1 kΩ or 50 Ω (nom.)
Trigger jitter		±2.5 ns
External trigger delay		
Setting range		0 sample to (2^{16} – 1) sample
Setting resolution	without R&S®SMW-B14 option	5 ns
	with R&S®SMW-B14 option	1/fading clockrate (= 5 ns or 10 ns)
External trigger inhibit		
Setting range		0 sample to (2^{26} – 1) 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 or T/M/C 1, T/M 2, T/M 3 of respective baseband generator on rear panel
Connector type	USER 1, 2, 3 on front panel, T/M/C 1, T/M 2, T/M 3 of respective baseband generator on rear panel	BNC female
Level		LVTTL
Marker delay		
Setting range		0 sample to (waveform length – 1) sample
	without recalculation	0 sample to 2000 sample
Setting resolution		1 sample
Multisegment waveform mode		
Number of segments		1 to 1024
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	20 µs (meas.)
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®SMW-K522 option	max. 160 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

Extended sequencing (R&S®SMW-K501 option)

The R&S®SMW-K501 option enables multisegment waveform sequencing with user-defined XML-based lists. Up to 5 levels of nested loops are possible.

At least one R&S®SMW-B10 option (standard baseband generator) must be installed. If two R&S®SMW-B10 options are installed (signal paths A and B), extended sequencing can be used either on signal path A or B with one R&S®SMW-K501 option. For extended sequencing to be used simultaneously on signal paths A and B, two R&S®SMW-K501 options must be installed.

General settings		
Mode	sequencing via user-defined XML lists	user
List types	Sequencing lists define an arbitrary number of entries that represent either a waveform or a sublist with further entries.	sequencing list
	Time lists store a list of different off times between waveform segments. They can be referenced in sequence entries.	time list
	Attenuation lists define the power level of the output signal over time.	attenuation list
	Hopping lists define frequency offsets of the output signal over time.	hopping list
Sequence		link to a sequencing list XML file
Attenuation over time		link to a attenuation list XML file
Hopping		link to a hopping list XML file
Clock		see section “Standard baseband generator (R&S®SMW-B10 option) – arbitrary waveform mode”
Triggering		see section “Standard baseband generator (R&S®SMW-B10 option) – arbitrary waveform mode”
Marker signals		
Number of marker signals		3
Operating modes	marker at every start of sequence	restart
	marker 1 embedded in waveform	unchanged
	XML-defined marker for each entry	entry
Marker outputs		see section “Standard baseband generator (R&S®SMW-B10 option) – arbitrary waveform mode”
Marker delay		see section “Standard baseband generator (R&S®SMW-B10 option) – arbitrary waveform mode”

Standard baseband generator (R&S®SMW-B10 option) – realtime operation (custom digital modulation)

One or two R&S®SMW-B10 can be installed. The I/Q signals can be assigned a frequency offset and/or be added in the digital domain with settable level ratio.

Prerequisite: Either R&S®SMW-B13 or R&S®SMW-B13T must be installed.

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		40 MHz
Resolution		0.1 Hz
Variable FSK		4FSK, 8FSK, 16FSK
Deviations		–1.5 × f_{sym} to +1.5 × f_{sym}
Maximum		40 MHz
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+)
Symbol rate	If an external clock is used, the applied data rate may deviate from the set clock rate by ±2 %.	
Operating mode		internal, external
Setting range	ASK, PSK and QAM	50 Hz to 100 MHz
	FSK	50 Hz to 100 MHz
Resolution		0.001 Hz
Frequency uncertainty (internal)		< (5 × 10^{-14} + relative deviation of reference frequency) × symbol rate (nom.)
External clock		symbol
External clock rate		max. 200 MHz
External clock input		selectable from USER 1, 2, 3 on front panel or T/M/C 1 of respective baseband generator on rear panel
Connector type	USER 1, 2, 3 on front panel T/M/C 1 of respective baseband generator on rear panel	BNC female
Input level		0 V to 3 V (nom.)
Threshold		settable between 10 mV and 1.9 V
Input impedance	selectable	1 kΩ or 50 Ω (nom.)
Baseband filter	Any filter can be used with any type of modulation. The bandwidth of the modulation signal is max. 50 MHz; the signal is clipped if the bandwidth is exceeded.	
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. phase, diff. + Gray, Gray, GSM, NADC, PDC, PHS, TETRA, APCO25 (PSK), APCO25 (8PSK), PWT, TFTS, INMARSAT, 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	standard	8 bit to 2 Gbit
	with R&S®SMW-K511 option (memory extension)	8 bit to 16 Gbit
	with R&S®SMW-K512 option (memory extension)	8 bit to 32 Gbit
Nonvolatile memory		hard disk
External data		
Data bit rate		50 bps to 100 Mbps
Symbol clock slope		positive or negative
Bit clock slope		positive or negative
Bit order		LSB first or MSB first
External data input		T/M 2 of respective baseband generator on rear panel
Connector type	T/M 2 of respective baseband generator on rear panel	BNC female
Input level		0 V to 3 V (nom.)
Threshold		settable between 0.3 V and 2.0 V
Input impedance	selectable	1 kΩ or 50 Ω (nom.)
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, CDMA2000® Reverse, Worldspace
Frequency offset	With the aid of 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		–60 MHz to +60 MHz
	with R&S®SMW-K522 option	–80 MHz to +80 MHz
Frequency offset setting resolution		0.01 Hz
Frequency offset error		< 7 × 10^{-7} 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 or T/M/C 1, T/M 2, T/M 3 of respective baseband generator on rear panel
Connector type	USER 1, 2, 3 on front panel, T/M/C 1, T/M 2, T/M 3 of respective baseband generator on rear 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
	T/M/C 1, T/M 2, T/M 3	settable between 0.3 V and 2.0 V
Input impedance	selectable	1 kΩ or 50 Ω (nom.)
Trigger jitter		±2.5 ns

External trigger delay		
Setting range		0 symbol to (2^{16} – 1) symbol
Setting resolution	without R&S®SMW-B14 option	5 ns
	with R&S®SMW-B14 option	1/fading clockrate (=5 ns or 10 ns)
External trigger inhibit		
Setting range		0 symbol to (2^{26} – 1) 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 or T/M/C 1, T/M 2, T/M 3 of respective baseband generator on rear panel
Connector type	USER 1, 2, 3 on front panel, T/M/C 1, T/M 2, T/M 3 of respective baseband generator on rear panel	BNC female
Level		LVTTL
Marker delay		
Setting range		0 symbol to (2^{24} – 1) symbol
	without recalculation	0 symbol to 2000 symbol
Setting resolution		1 symbol

Slow I/Q (R&S®SMW-K551 option)

At least one R&S®SMW-B10 option (standard baseband generator) and one R&S®SMW-K18 option (digital baseband output) must be installed.

In slow I/Q mode, the generated signal's clock rate can be reduced (e.g. a 20 MHz LTE signal is generated with a clock rate of 240 kHz instead of the original 30.72 MHz). This feature can be used to run tests on hardware emulation platforms that are not yet capable of full-speed signal processing. The signal and fading characteristics are comparable to those of a system running at full speed. The actual clock rate of the generated signal is controlled by the device connected to the digital I/Q output connectors of the R&S®SMW200A.

Note: All digital I/Q outputs need to run at the same clock rate.

Note: The minimum clock rate is limited by the external controlling device only (e.g. R&S®EX-IQ-Box).

Note: The R&S®SMW200A can handle varying clock rates.

Signal outputs		analog and digital, digital only
	with 2 × R&S®SMW-K18 installed	analog and digital, digital only, digital only multiplexed
Digital only	The instrument runs at reduced speed, depending on the device connected to the digital I/Q output (slow I/Q). The streams are output via the digital I/Q outputs only; analog I/Q outputs and RF outputs are not available. Note: System configurations with more than 4 streams are not available in this mode.	
Digital only multiplexed	The instrument runs at reduced speed, depending on the device connected to the digital I/Q output (slow I/Q). The streams are output via BBMM1 and BBMM2 in multiplexed mode, i.e. up to 4 streams are output via a single digital output. Analog I/Q outputs and RF outputs are not available. Note: All system configurations available on the instrument are available in this mode.	
Analog & digital	The instrument runs in regular operating mode, both analog and digital outputs are available, slow I/Q is not possible.	
Number of digital outputs		according to selected system configuration (see section "Digital baseband inputs/outputs")
Number of streams per digital output	digital only	1
	digital only multiplexed	1 to 4
Bandwidth	general	according to selected system configuration (see section "Multichannel, MIMO, fading and noise", specifications for R&S®SMW-K74, -K75, -K76 options)
	4 streams mapped to one digital output	40 MHz

Note: In digital only/digital only multiplexed mode, marker signals are only available via the digital I/Q interface, but not via USER or T/M/C connectors.

Note: In digital only/digital only multiplexed mode, no digital baseband inputs are available.

Wideband baseband characteristics

Internal baseband characteristics (R&S®SMW-B13XT option)

The R&S®SMW-B13XT provides I/Q paths that can be routed to the installed RF paths or to the analog I/Q outputs. Up to two signals can be output at the same time, for example:

- Signal A is routed to RF path A, signal B to RF path B
- Signal A is routed to RF path A, signal B to analog I/Q out 1

D/A converter		
Data rate		2400 MHz
Resolution		14 bit
Sampling rate		4800 MHz (internal interpolation × 2)
Aliasing filter	with amplitude, group delay and S_i correction	
Bandwidth, rolloff to –0.1 dB		1000 MHz
SFDR overall		< –55 dBc
I/Q impairments (digital baseband)	These impairments are set in the digital baseband section of the R&S®SMW200A. 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 %
Resolution		0.01 %
I ≠ Q (imbalance)		
Setting range		–1 dB to +1 dB
Resolution		0.01 dB
Quadrature offset		
Setting range		–10° to +10°
Resolution		0.01°

Analog I/Q outputs (R&S®SMW-B13XT option)

Number of I/Q outputs	single-ended	2
Output impedance		50 Ω
Output voltage	EMF (output voltage depends on set modulation signal)	1 V (V_p)
Offset	EMF	< 1 mV
Frequency response [10]	at R_L = 50 Ω	
Magnitude	up to 100 MHz	0.1 dB (meas.)
	up to 1000 MHz	0.2 dB (meas.)
I/Q balance [11]	at R_L = 50 Ω	
Magnitude	up to 100 MHz	0.1 dB (meas.)
	up to 1000 MHz	0.1 dB (meas.)
Spectral purity	at R_L = 50 Ω	
SFDR (sine)	100 MHz	<70 dBc
	up to 1000 MHz	−55 dBc (meas.)
Wideband noise	10 MHz sine wave at 1 MHz offset	–155 dBc (typ.)

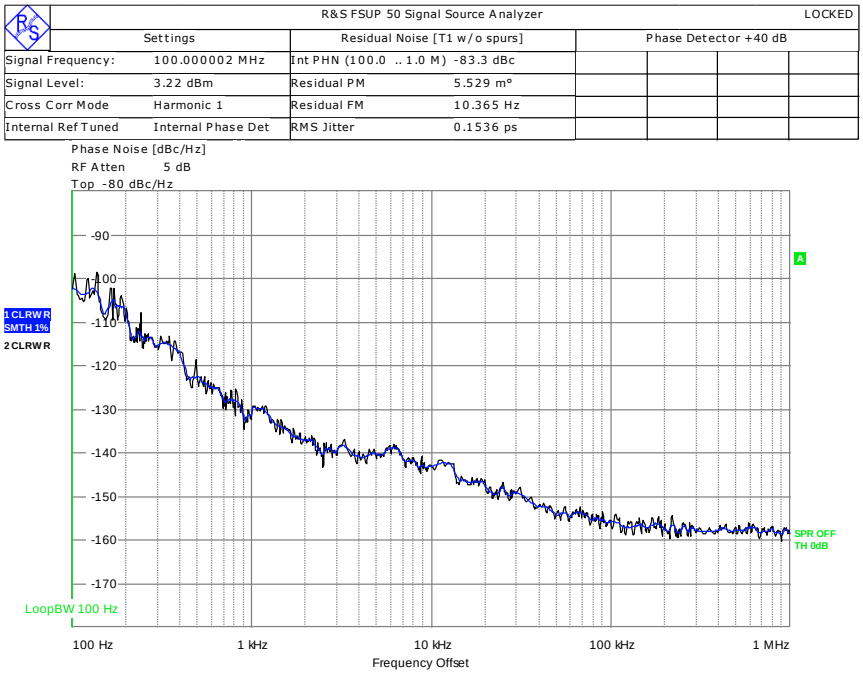
[10] "Optimize internal I/Q impairments for RF output" switched off.

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

Differential analog I/Q outputs (R&S®SMW-K17 option)

This option can be installed once if the instrument is equipped with the R&S®SMW-B13XT option. Differential analog I/Q outputs can be used on signal path A only. If the differential output mode is activated, analog I/Q outputs for signal path B are not available.

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 1 V (V_p)
Resolution		0.1 mV
Differential	EMF	0.04 V to 4 V (V_{pp})
Resolution		0.1 mV
Bias voltage (single-ended and differential)	EMF	–0.2 V to +2.5 V [12]
Resolution		0.1 mV
Uncertainty		1 % + 1 mV
Offset voltage		
Differential	EMF	–200 mV to +200 mV
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.)
	up to 1000 MHz	0.2 dB (meas.)
Frequency response [13]	at R_L = 50 Ω, output voltage > 0.5 V (V_p)	
Magnitude	up to 100 MHz	0.1 dB (meas.)
	up to 1000 MHz	0.2 dB (meas.)
Wideband noise	10 MHz sine wave at 1 MHz offset	–160 dBc (typ.)

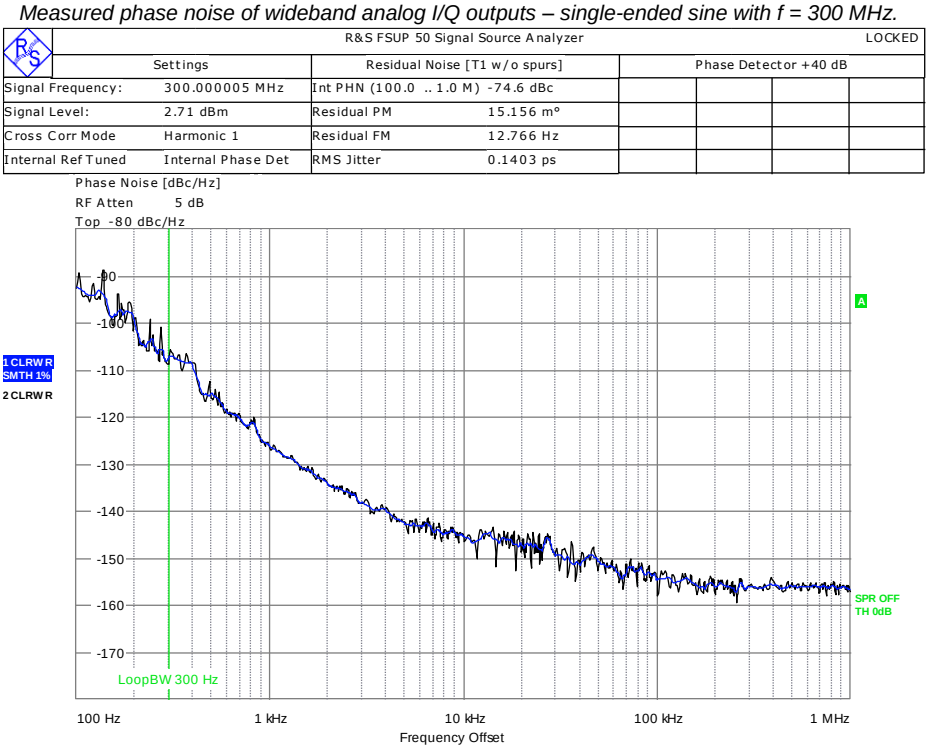


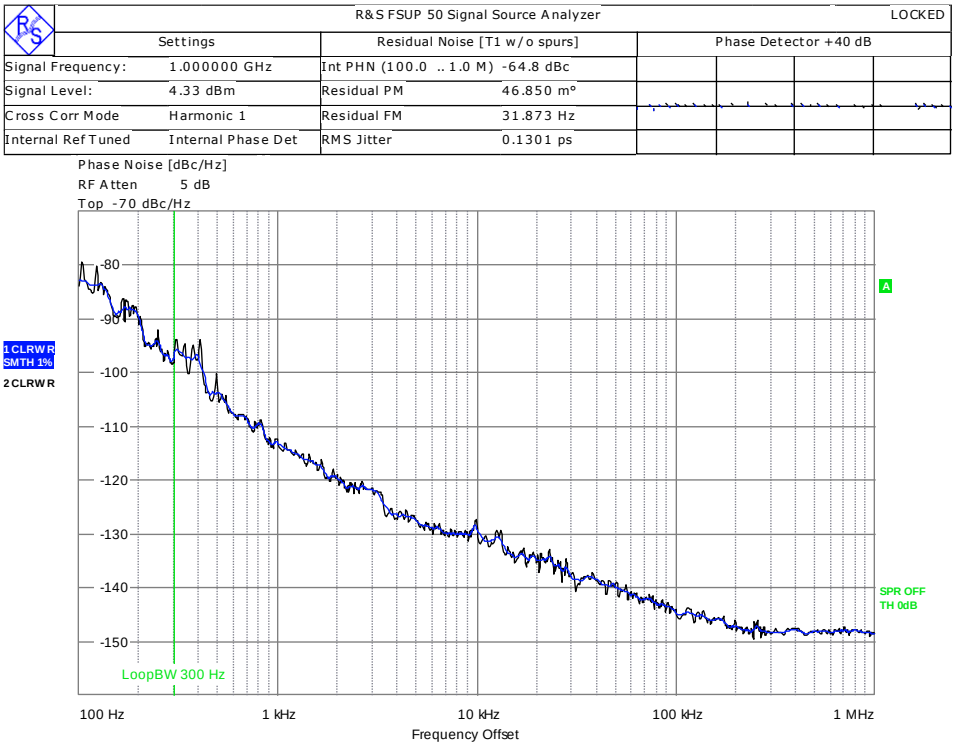
Measured phase noise of wideband analog I/Q outputs – single-ended sine with f = 100 MHz.

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

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

Measured phase noise of wideband analog I/Q outputs – single-ended sine with f = 300 MHz.





Measured phase noise of wideband analog I/Q outputs – single-ended sine with f = 1GHz

Wideband baseband generator (R&S®SMW-B9 option) – arbitrary waveform mode

One or two R&S®SMW-B9 can be installed. Their I/Q signals can be assigned a frequency offset.

Prerequisite: R&S®SMW-B13XT must be installed.

Waveform length		1 sample to 256 Msample in one-sample steps
	with R&S®SMW-K515 option (memory extension)	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 600 MHz
	with R&S®SMW-K526 option	400 Hz to 2400 MHz
Sample frequency error	internal clock	< (1 × 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	500 MHz
	at reduced sample rate, rolloff to –0.1 dB (The waveform is automatically interpolated to the internal sample rate of 600 MHz.)	0.833 × sample rate
Bandwidth (RF) with R&S®SMW-K526 option	at maximum sample rate, rolloff to –0.1 dB	2000 MHz
	at reduced sample rate, rolloff to –0.1 dB (The waveform is automatically interpolated to the internal sample rate of 2400 MHz.)	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		–250 MHz to +250 MHz
	with R&S®SMW-K526 option	–1000 MHz to +1000 MHz
Frequency offset setting resolution		0.01 Hz
Frequency offset error		< 9 × 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^{16} – 1) sample
Setting resolution		3.3 ns
External trigger inhibit		
Setting range		0 sample to (2^{26} – 1) 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
	without recalculation	0 sample to 2000 sample
Setting resolution		1 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. 500 MHz
	with R&S®SMW-K526 option	max. 2000 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

Digital modulation systems

At least one standard baseband generator (R&S®SMW-B10 option) or wideband baseband generator (R&S®SMW-B9 option) must be installed. If two baseband generators are installed and two signals of the same standard (e.g. LTE) are to be output simultaneously, two corresponding software options must also be installed (in this case R&S®SMW-K55). If only one R&S®SMW-K55 is installed and LTE is selected in one baseband generator, the other baseband generator is disabled for LTE. However, a software option is not tied to a specific baseband generator.

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 with standard baseband

Digital standards that run on the standard baseband generator (R&S®SMW-B10 option).

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

Cellular standards
5G air interface candidates (R&S®SMW-K114 option)
EUTRA/LTE (R&S®SMW-K55 option)
EUTRA/LTE closed-loop BS test (R&S®SMW-K69 option, R&S®SMW-K55 required)
EUTRA/LTE log file generation (R&S®SMW-K81 option, R&S®SMW-K55 required)
EUTRA/LTE Release 9 and enhanced features (R&S®SMW-K84 option, R&S®SMW-K55 required)
EUTRA/LTE Release 10/LTE-Advanced (R&S®SMW-K85 option, R&S®SMW-K55 required)
LTE Release 11 and enhanced features (R&S®SMW-K112 option, R&S®SMW-K55 required)
EUTRA/LTE Release 12 (R&S®SMW-K113 option, R&S®SMW-K55 required)
3GPP FDD (R&S®SMW-K42 option)
3GPP FDD/HSPA/HSPA+, enhanced BS/MS tests (R&S®SMW-K83 option, R&S®SMW-K42 required)
GSM/EDGE (R&S®SMW-K40 option)
EDGE EVOLUTION (R&S®SMW-K41 option, R&S®SMW-K40 required)
CDMA2000® (R&S®SMW-K46 option)
1xEV-DO (R&S®SMW-K47 option)
1xEV-DO Rev. B (R&S®SMW-K87 option, R&S®SMW-K47 required)
TD-SCDMA (3GPP TDD LCR) (R&S®SMW-K50 option)
TD-SCDMA (3GPP TDD LCR) enhanced BS/MS test including HSDPA (R&S®SMW-K51 option, R&S®SMW-K50 required)
TETRA Release 2 (R&S®SMW-K68 option)
Wireless connectivity standards
IEEE 802.11 a/b/g/n/j/p (R&S®SMW-K54 option)
IEEE 802.11 ac (R&S®SMW-K86 option, R&S®SMW-K54 required)
IEEE 802.16 (R&S®SMW-K49 option)
Bluetooth® EDR/low energy (R&S®SMW-K60 option)
Broadcast standards
DVB-H/DVB-T (R&S®SMW-K52 option)
Other standards and modulation systems
Multicarrier CW signal generation (R&S®SMW-K61 option)
NFC A/B/F (R&S®SMW-K89 option)
Baseband power sweep (R&S®SMW-K542 option)

Internal digital standards with wideband baseband

Digital standards that run on the wideband baseband generator (R&S®SMW-B9 option).

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

Cellular standards
5G air interface candidates (R&S®SMW-K114 option)
EUTRA/LTE (R&S®SMW-K55 option)
EUTRA/LTE Release 9 and enhanced features (R&S®SMW-K84 option, R&S®SMW-K55 required)
EUTRA/LTE Release 10/LTE-Advanced (R&S®SMW-K85 option, R&S®SMW-K55 required)
LTE Release 11 and enhanced features (R&S®SMW-K112 option, R&S®SMW-K55 required)
EUTRA/LTE Release 12 (R&S®SMW-K113 option, R&S®SMW-K55 required)
Wireless connectivity standards
IEEE 802.11 ad (R&S®SMW-K141 option)
Other standards and modulation systems
Multicarrier CW signal generation (R&S®SMW-K61 option)
Baseband power sweep (R&S®SMW-K542 option)

Digital standards with R&S®WinIQSIM2™

These options run on the standard baseband generator (R&S®SMW-B10 option) as well as on the wideband baseband generator (R&S®SMW-B9 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
EUTRA/LTE (R&S®SMW-K255 option)
EUTRA/LTE Release 9 and enhanced features (R&S®SMW-K284 option, R&S®SMW-K255 required)
EUTRA/LTE Release 10/LTE-Advanced (R&S®SMW-K285 option, R&S®SMW-K255 required)
LTE Release 11 and enhanced features (R&S®SMW-K412 option, R&S®SMW-K255 required)
3GPP FDD (R&S®SMW-K242 option)
3GPP FDD/HSPA/HSPA+, enhanced BS/MS tests (R&S®SMW-K283 option, R&S®SMW-K242 required)
GSM/EDGE (R&S®SMW-K240 option)
EDGE EVOLUTION (R&S®SMW-K241 option, R&S®SMW-K240 required)
CDMA2000® (R&S®SMW-K246 option)
1xEV-DO (R&S®SMW-K247 option)
1xEV-DO Rev. B (R&S®SMW-K287 option, R&S®SMW-K247 required)
TD-SCDMA (3GPP TDD LCR) (R&S®SMW-K250 option)
TD-SCDMA (3GPP TDD LCR) enhanced BS/MS test including HSDPA (R&S®SMW-K251 option, R&S®SMW-K250 required)
TETRA Release 2 (R&S®SMW-K268 option)
Wireless connectivity standards
IEEE 802.11 a/b/g/n (R&S®SMW-K254 option)
IEEE 802.11 ac (R&S®SMW-K286 option, R&S®SMW-K254 required)
IEEE 802.16 (R&S®SMW-K249 option)
Bluetooth® EDR/low energy (R&S®SMW-K260 option)
Navigation standards
GPS 1 satellite (R&S®SMW-K244 option)
Galileo 1 satellite (R&S®SMW-K266 option)
Glonass 1 satellite (R&S®SMW-K294 option)
Beidou 1 satellite (R&S®SMW-K407 option)

Broadcast standards
DVB-H/DVB-T (R&S®SMW-K252 option)
DAB/T-DMB (R&S®SMW-K253 option)
Other standards and modulation systems
Multicarrier CW signal generation (R&S®SMW-K261 option)
Additional white Gaussian noise (AWGN) (R&S®SMW-K262 option)
NFC A/B/F (R&S®SMW-K289 option)

Options with external R&S®Pulse Sequencer software or R&S®Pulse Sequencer (DFS) software

These options run on the standard baseband generator (R&S®SMW-B10 option) as well as on the wideband baseband generator (R&S®SMW-B9 option), except where indicated.

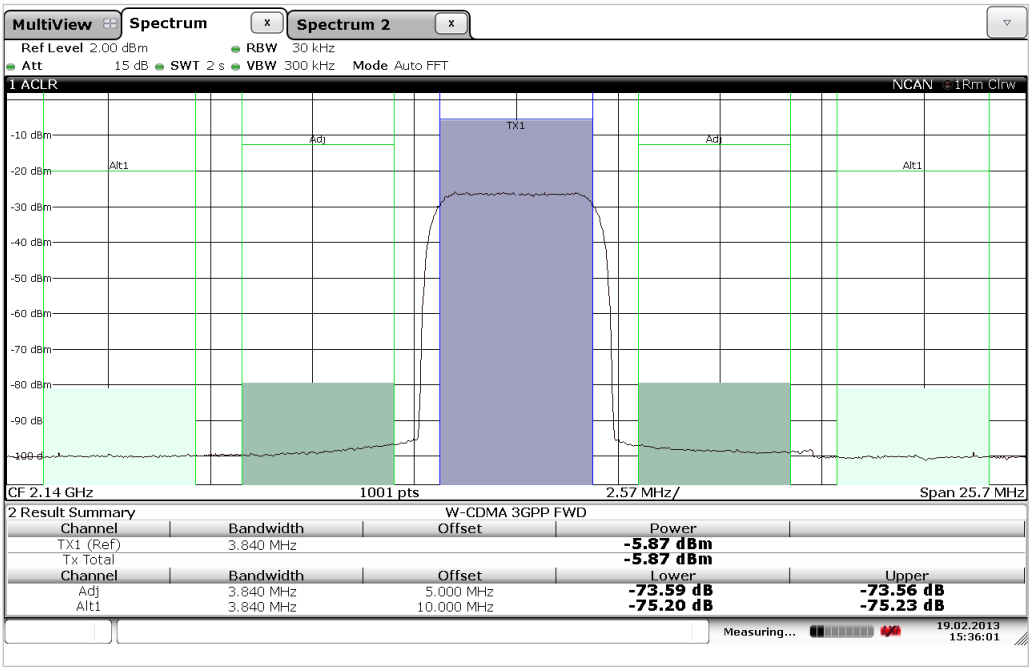
The options are described in the pulse sequencer options data sheet (PD 3607.1388.22).

Pulse sequencing (R&S®SMW-K300 option)
Enhanced pulse sequencing (R&S®SMW-K301 option)
Direction finding (R&S®SMW-K308 option, with R&S®SMW-B10 only)
DFS signal generation (R&S®SMW-K350 option, with R&S®SMW-B10 only)

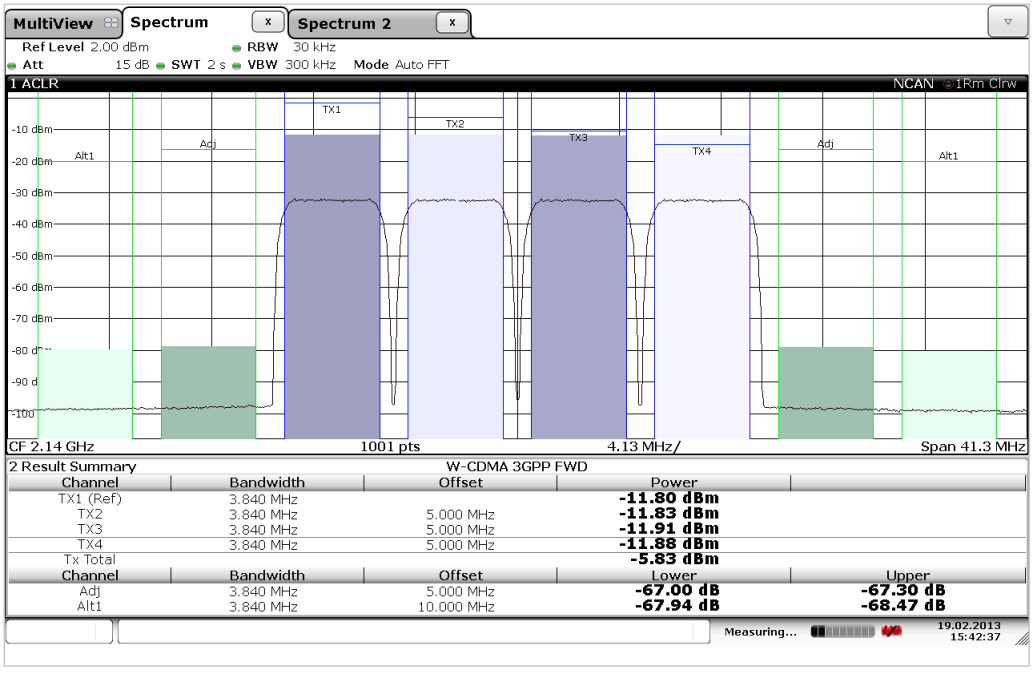
Signal performance for digital standards and modulation systems

3GPP FDD (with R&S®SMW-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 ≤ 5 dBm, with R&S®SMW-B103, R&S®SMW-B203, R&S®SMW-B106, R&S®SMW-B206 frequency options, with R&S®SMW-B13/-B13T 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®SMW-B112, R&S®SMW-B212 frequency options, with R&S®SMW-B13/-B13T 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 ≤ 0 dBm, with R&S®SMW-B120, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N, R&S®SMW-B220 frequency options, with R&S®SMW-B13/-B13T options	
	5 MHz offset	> 70 dB
	10 MHz offset	> 72 dB

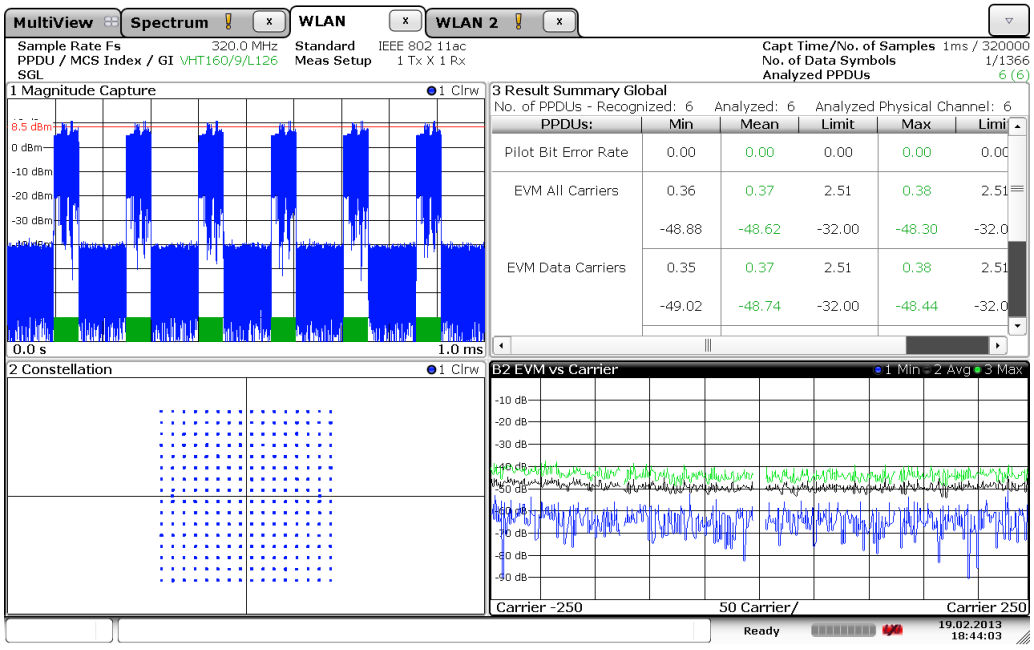


Measured ACPR for 3GPP test model 1, 64 DPCH.



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

IEEE 802.11ac (with R&S®SMW-K86 option)



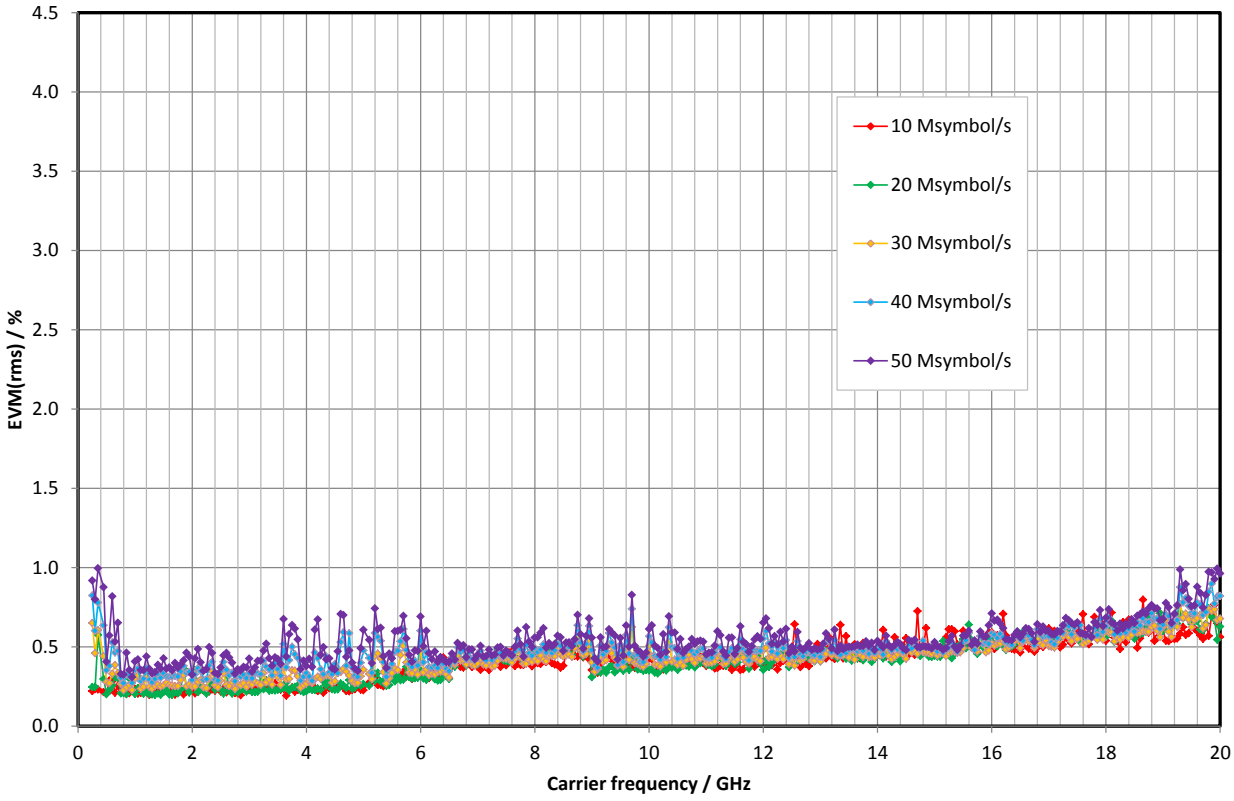
Measured EVM for an IEEE 802.11ac signal with 160 MHz bandwidth.

IEEE 802.11ad (with R&S®SMW-K141 option)

Measured EVM for an IEEE 802.11ad signal with 1.76 GHz bandwidth (MCS12, at 15 GHz IF).

Custom digital modulation (with R&S®SMW-B10 option, realtime 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 versus carrier frequency for 16QAM.

Multichannel, MIMO, fading and noise

The options described here require the standard baseband section, i.e. either R&S®SMW-B13 or R&S®SMW-B13XT must be installed.

Fading simulator (R&S®SMW-B14 option)

At least one R&S®SMW-B10 standard baseband generator must be installed.

All frequency and time settings are coupled to the internal reference frequency.

Number of installable fading simulator modules		1, 2 or 4
Number of available fading channels ("logical" faders)	one R&S®SMW-B14 installed	1
	two or four R&S®SMW-B14 installed	2
	with R&S®SMW-K74 option, two R&S®SMW-B14 installed	up to 4 (see R&S®SMW-K74 specifications)
	with R&S®SMW-K74 option, four R&S®SMW-B14 installed	up to 16 (see R&S®SMW-K74 specifications)
	with R&S®SMW-K74 and R&S®SMW-K75 options, four R&S®SMW-B14 installed	up to 16 (see R&S®SMW-K75 specifications)
Number of fading paths (per logical fader)		20
Bandwidth		up to 160 MHz
Start seed		0 to 9
Fading profiles		static path, pure Doppler, Rayleigh, Rice, constant phase, bell shape TGn indoor, bell shape TGn moving vehicle
Fading profile parameter		
Rayleigh	pseudo-noise interval	> 1 year
Constant phase	phase	0° to 360°
	phase resolution	0.1°
Pure Doppler	maximum resulting Doppler shift	frequency ratio × current Doppler frequency
	frequency ratio	–1 to +1
	resolution	0.01
Rician	combination of Rayleigh and pure Doppler	
	power ratio	–30 dB to +30 dB
Fading path loss	setting range	0 dB to 50 dB
	setting resolution	0.01 dB
	accuracy	< 0.01 dB
Fading path delay	The 20 fading paths are divided in 4 path groups. Each group consists of 3 fine delay and 2 standard delay paths. A basic delay can be set per path group and an additional delay per path. The total delay per path is the sum of the basic delay of the respective group and of the additional delay of the path.	
Basic delay per group		
Group 1	fixed value	0 s
Setting range for group 2, 3, 4		0 s to 0.5 s
Setting resolution	scenarios with 1 to 8 fading channels	5 ns
	scenarios with 9 to 16 fading channels	10 ns
Additional delay per path		
Setting range		0 µs to 20 µs
Fine delay path resolution	scenarios with 1 to 8 fading channels	2.5 ps
	scenarios with 9 to 16 fading channels	5 ps
Standard delay path resolution	scenarios with 1 to 8 fading channels	5 ns
	scenarios with 9 to 16 fading channels	10 ns
Speed range	at f = 1 GHz	0 km/h to 4320 km/h
	accuracy	< 0.1 %
Doppler frequency	setting range	0 Hz to 4000 Hz
	accuracy ($f_D \geq 0.05$ Hz)	< 0.1 %
Restart	standard	auto
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 %
	setting resolution	0.1 %
	correlation phase	
	setting range	0° to 360°
	setting resolution	0.05°
Lognormal	standard deviation	0 dB to 12 dB
	resolution	1 dB
	local constant at f = 1 GHz	20 m to 200 m
Predefined settings	standard	LTE (CQI, EPA, EVA, ETU, MBFSN), GSM, CDMA2000®, 1xEV-DO, IEEE 802.11 SISO, WiMAX™ ITU, NADC, PCN, TETRA
	with R&S®SMW-K71 option	3GPP FDD WCDMA, LTE (HST, moving propagation)
	with R&S®SMW-K72 option	WiMAX™ SUI, DAB, 3GPP TR 37.977 SCME channel models, C2C-CC channel models
	with R&S®SMW-K74 option	LTE MIMO (EPA, EVA, ETU), IEEE 802.11n MIMO, IEEE 802.11ac MIMO, WiMAX™ MIMO
	with R&S®SMW-K74 and R&S®SMW-K71 option	LTE MIMO (HST)

Dynamic fading (R&S®SMW-K71 option)

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

Moving delay mode		
Number of fading paths		2 per signal path
Fading profiles		none
Basic delay	in steps of 5 ns	0 s to 0.5 s
Delay variation	peak to peak	0.3 µs to 40 µs
	variation period	10 s to 500 s
	variation speed	0 µs/s to 5 µs/s
Delay step size		5 ps
Birth-death mode		
System bandwidth		160 MHz
Number of fading paths		2 per signal path
Fading profiles		pure Doppler
Delay range		0 s to 40 µs
Delay grid		0 s to 20 µs [14]
Positions		3 to 50 [14]
Hopping dwell		100 ms to 5 s
Start offset	separately settable for each signal path	1 ms to 200 ms
Delay resolution		10 ns
High-speed train		
Fading profiles		static path, pure Doppler, Rayleigh
Speed	at f = 1 GHz	0 km/h to 4320 km/h
D (min)		1 m to 100 m
D (s)		20 m to 2000 m
Two-channel interferer		
Number of fading paths		2 per signal path
Fading profiles		static path, pure Doppler, Rayleigh
Fading profile parameter		
Rayleigh	pseudo-noise interval	> 1 year
	phase resolution	1°
Pure Doppler	maximum resulting Doppler shift	frequency ratio × current Doppler frequency
	frequency ratio	–1 to +1
	resolution	0.01
Fading path loss	setting range	0 dB to 50 dB
	resolution	0.01 dB
	accuracy	< 0.01 dB
Speed range	at f = 1 GHz	0 km/h to 4320 km/h
	accuracy	< 0.1 %
Min. delay	path 1	0 µs to 1638 µs
	path 2	0 µs to 999.9 µs
Max. delay	path 1	n.a.
	path 2	0.1 µs to 1000 µs
Moving mode	path 1	n.a.
	path 2	sliding, hopping
Period/dwell		0.1 s to 10 s

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

Enhanced fading models (R&S®SMW-K72 option)

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

Fading profiles		
Gauss I, Gauss II	sum of two Gaussian distributions	in line with DAB standard
Gauss DAB 1	Gaussian distribution, shifted in frequency	in line with DAB standard
Gauss Doppler	sum of Gaussian distribution and pure Doppler	
Gauss (0.08 fd)	Gaussian distribution, std. dev. 0.08 f_d	
Gauss (0.1 fd)	Gaussian distribution, std. dev. 0.1 f_d	
Gauss Watterson	sum of two Gaussian distributions	in line with Watterson channel model
WiMAX™ Doppler	rounded Doppler PSD model	in line with IEEE 802.16a-03-01
WiMAX™ Rice	same as WiMAX™ Doppler plus pure Doppler	in line with IEEE 802.16a-03-01
Customized fading profiles		
Modified Rayleigh	spectrum shape can be modified within the maximum Doppler frequency range	customizable bandwidth, frequency offset, lower cutoff frequency, upper cutoff frequency
Modified flat		
Predefined settings	SUI1 to SUI6	in line with IEEE 802.16a-03-01
	ITU OIP-A, ITU OIP-B, ITU V-A	in line with 3GPP TS34.121-1, annex D.2.2, table D.2.2.1A
	DAB-RA, DAB-TU, DAB-SFN	in line with EN 50248-2001
	Watterson I1, Watterson I2, Watterson I3	in line with "Experimental Confirmation of an HF Channel Model", Watterson, et al., IEEE transactions on communication technology, vol. com-18, no. 6, Dec. 1970"
	Rural LOS, Urban Approaching LOS, Urban Crossing LOS, Highway LOS, Highway NLOS	in line with C2C-CC channel models for 802.11p
	with R&S®SMW-K74 option: SCME Uma3, SCME Uma30, SCME Umi3, SCME Umi30	in line with 3GPP TR 37.977

OTA-MIMO fading enhancements (R&S®SMW-K73 option)

Two or four R&S®SMW-B14 must be installed (signal paths A and B); one R&S®SMW -K74 option and two R&S®SMW-K72 options are additionally required.

MIMO-OTA settings		
Antenna polarization mode		single antenna pattern with slant angle; separate antenna patterns for each polarization component
Calculation mode		considering antenna spacing or antenna relative phase
Inverse channel matrix	only for 2x2 MIMO	for radiated tests to counteract the channel matrix of the anechoic chamber

MIMO fading/routing (R&S®SMW-K74 option)

The R&S®SMW-K74 option allows up to 16 fading channels to be simulated as is required for 4x4 MIMO receiver tests. At least two R&S®SMW-B14 options must be installed (signal paths A and B), and two baseband sources (R&S®SMW-B10) and the R&S®SMW-B13T option must be present.

Supported scenarios with two R&S®SMW-B14 options

Cells with gray background: up to 160 MHz bandwidth supported for this scenario

Cells with white background: up to 80 MHz bandwidth supported for this scenario

Entities (users, cells, carriers)	TX antennas	RX antennas	1	2
1	1		●	●
	2		●	●
2	1		●	●
	2		–	–

Supported scenarios with four R&S®SMW-B14 options

Cells with gray background: up to 160 MHz bandwidth supported for this scenario

Cells with white background: up to 80 MHz bandwidth supported for this scenario

Entities (users, cells, carriers)	TX antennas	RX antennas	1	2	3	4	8
1	1		●	●	●	●	●
	2		●	●	●	●	●
	3		●	●	●	●	–
	4		●	●	●	●	–
	8		●	●	–	–	–
2	1		●	●	–	–	–
	2		●	●	–	–	–
	3		–	–	–	–	–
	4		–	–	–	–	–
	8		–	–	–	–	–

Note: For scenarios with more than two output signals (number of entities × number of RX antennas > 2), the following functions are not available: analog modulation, modulation sources for analog modulation, envelope tracking, AM/AM, AM/φM predistortion.

Parameters common to all scenarios		
Number of fading paths per fading channel		20 paths, see R&S®SMW-B14
Steering matrix	can be set by setting the diagonal elements of the correlation matrix	
Correlation	Correlation between corresponding fading paths of all TX/RX 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 1
	setting resolution	0.0001
	correlation phase	
	setting range	0° to 360°
	setting resolution	0.02°
Correlation matrix setting		individually or with Kronecker assumption (RX and TX antenna correlation with automatic calculation of matrix) or by AoA/AoD parameterization
	with R&S®SMW-K72 option	SCME/WINNER
Matrix representation		(real, imaginary) or (magnitude, phase)
Additional SCME/WINNER parameters		
Number of clusters		up to 20
Number of subclusters		up to 3 per cluster

Higher-order MIMO (R&S®SMW-K75 option)

Four R&S®SMW-B14 options and the R&S®SMW-K74 option must be installed.

The R&S®SMW-K75 option enhances the R&S®SMW-K74 option to support higher-order MIMO modes. A common application is LTE carrier aggregation with each carrier using a 4x2 or 2x4 MIMO system (2x4x4, 2x4x2 or 2x2x4) within one box.

For scenarios with more than four baseband signals, only the "coupled sources" baseband configuration is available, i.e. all generated baseband signals belong to the same digital standard. "Coupled sources" is supported by the LTE (R&S®SMW-K55 option and enhancement options) and WLAN (R&S®SMW-K54/-K86 options) digital standards and by the arbitrary waveform mode of the standard baseband generator (R&S®SMW-B10 option). Please note that not all scenarios are supported by all digital standards.

Supported scenarios with R&S®SMW-K75

Cells with grey background: up to 80 MHz bandwidth supported for this scenario

Cells with white background: up to 40 MHz bandwidth supported for this scenario

Entities (users, cells, carriers)	TX antennas	RX antennas	1	2	3	4	8
1	4						●
	8					●	
2	1		–	–	●	●	
	2		–	–	●	●	
	3		●	●	●	●	
	4		●	●	●	●	

Note: For R&S®SMW-K75 scenarios , the following functions are not available: analog modulation, modulation sources for analog modulation, envelope tracking, AM/AM, AM/φM predistortion.

Multiple entities (R&S®SMW-K76 option)

Two R&S®SMW-B10 options and the R&S®SMW-B13T option must be installed.

The R&S®SMW-K76 option allows the generation of scenarios with up to 8 baseband signals. Common applications are multistandard radio with 8 SISO systems (8x1x1) or LTE carrier aggregation with each carrier using a 2x2 MIMO system (4x2x2) within one box.

For scenarios with more than 4 baseband signals, only the "coupled sources" baseband configuration is available, i.e. all generated baseband signals belong to the same digital standard. "Coupled sources" is supported by the LTE (R&S®SMW-K55 option and enhancement options) and WLAN (R&S®SMW-K54/-K86 options) digital standards and by the arbitrary waveform mode of the standard baseband generator (R&S®SMW-B10 option). Please note that not all scenarios are supported by all digital standards.

Note: If the R&S®SMW200A is equipped with one fading simulator module (R&S®SMW-B14 option), the functionality of the R&S®SMW-K76 is limited to the generation of 2 baseband signals only. Therefore, we strongly recommend that you install the R&S®SMW-K76 option only on instruments with either 0 or 2 or 4 R&S®SMW-B14 options.

Supported scenarios with R&S®SMW-K76

Cells with gray background: up to 160 MHz bandwidth supported for this scenario (depending on installed R&S®SMW-K522 bandwidth extension options)

Cells with white background: up to 80 MHz bandwidth supported for this scenario

Entities (users, cells, carriers)	TX antennas	RX antennas	1
3	1		●
4	1		●
5	1		●
6	1		●
7	1		●
8	1		●

Additional supported scenarios with R&S®SMW-K76 in combination with an R&S®SMW-K74 option and four R&S®SMW-B14 options

Cells with gray background: up to 160 MHz bandwidth supported for this scenario (depending on installed R&S®SMW-K522 bandwidth extension options)

Cells with white background: up to 80 MHz bandwidth supported for this scenario

Entities (users, cells, carriers)	TX antennas	RX antennas	1	2
3	1		●	●
	2		●	●
4	1		●	●
	2		●	●

Note: For scenarios with more than 2 output signals (number of entities × number of RX antennas > 2), the following functions are not available: analog modulation, modulation sources for analog modulation, envelope tracking, AM/AM, AM/φM predistortion.

Fading capabilties in R&S®SMW-K76 scenarios

Individual fading can be applied to each entity depending on the available fading options:

4 × R&S®SMW-B14	individual fading can be applied to all entities for system configurations 3x1x1 to 8x1x1 (SISO only)
4 × R&S®SMW-B14 + R&S®SMW-K74	individual fading can be applied to all entities (MIMO and SISO)
4 × R&S®SMW-B14 + R&S®SMW-K74 + R&S®SMW-K75	individual fading can be applied to all entities (MIMO and SISO)
Other configurations	no fading can be applied to R&S®SMW-K76 scenarios

Stream extender (R&S®SMW-K550 option)

Two R&S®SMW-B10 options (standard baseband generator) and the R&S®SMW-K76 option (multiple entities) must be installed.

The stream extender option enables the R&S®SMW200A to duplicate generated baseband signals (streams) for specific system configurations. As a result, four baseband streams with realtime data sources can be generated in parallel as required for test cases such as the GSM AM suppression test specified in 3GPP TS 51.021.

The duplicated baseband streams have an identical content, but appear to the receiver under test as different signals if shifted in frequency.

Note: None of the digital I/Q inputs and outputs are available in this mode.

System configuration	system configurations where the duplication of streams is available	3x1x1, 4x1x1
Duplicate streams	streams after baseband / fading block are duplicated and can be treated as individual streams, which allows adding AWGN (if R&S®SMW-K62 is available), shifting in frequency and mapping to outputs	on, off
Supported bandwidth		up to 80 MHz

Radar echo generation (R&S®SMW-K78 option)

At least one R&S®SMW-B14 option must be installed (signal path A), and one standard baseband generator (R&S®SMW-B10) and the R&S®SMW-B13 or R&S®SMW-B13T option must be present.

If two or four R&S®SMW-B14 are installed, one or two R&S®SMW-K78 options can be installed.

The R&S®SMW-K78 option allows the echo generation of independent virtual static or moving radar objects at the same time. The echoes are generated regarding the object's individual velocity, range (variation) and RCS.

Note: R&S®SMW-K78 radar echo generation and R&S®SMW-B14 fading simulation modes cannot be used at the same time.

Supported transmit signal modes and bandwidth with R&S®SMW-K78

Mode	Further requirements	Bandwidth
R&S®SMW-B10 only	–	up to 160 MHz (with R&S®SMW-K522)
External baseband via R&S®FSW + R&S®SMW-B10	R&S®FSW incl. R&S®FSW-B17, R&S®FSW-B80/B160/B320/B500 Note: An external attenuator may be required to protect the input stage of the R&S®FSW.	up to 160 MHz (may be limited by R&S®FSW)

General parameters		
Number of available radar objects	one R&S®SMW-K78 option one or two R&S®SMW-B14 installed	path A: up to 6
	one R&S®SMW-K78 option four R&S®SMW-B14 installed	path A: up to 12
	two R&S®SMW-K78 options two R&S®SMW-B14 installed	path A: up to 6 path B: up to 6
	two R&S®SMW-K78 options four R&S®SMW-B14 installed	path A: up to 12 path B: up to 12
Bandwidth		up to 160 MHz
Test setups	radar under test (RUT) is directly connected to the R&S®SMW200A (+ R&S®FSW) via cable	conducted test
	RUT and R&S®SMW200A (+ R&S®FSW) are equipped with antennas and connected via air interface	over-the-air (OTA) test
Radar RX power setting	calculation of power received by RUT regarding two-way radar equation	radar equation
	power received by RUT is set manually	manual

Radar setup	availability of parameters depends on transmit signal mode, test setup and radar RX power setting	
Radar TX power		
Setting range	may be limited by setting range of reference level of R&S®FSW	–50 dBm to +60 dBm
Setting resolution		0.001 dBm
Radar antenna TX gain		
Setting range	may be limited by setting range of reference level of R&S®FSW	0 dBi to 100 dBi
Setting resolution		0.001 dBi
Radar antenna RX gain		
Setting range		0 dBi to 100 dBi
Setting resolution		0.001 dBi
System loss		
Setting range		0 dB to 100 dB
Setting resolution		0.001 dB
REG antenna RX gain		
Setting range	may be limited by setting range of reference level of R&S®FSW	0 dBi to 100 dBi
Setting resolution		0.001 dBi
REG antenna TX gain		
Setting range		0 dBi to 100 dBi
Setting resolution		0.001 dBi
OTA range offset		
Setting range	may be limited by setting range of reference level of R&S®FSW	0.01 m to 5000 m
Setting resolution		0.01 m
External attenuator (analyzer)		
Setting range	maybe limited by setting range of reference level of R&S®FSW	–58 dB to +318 dB
Setting resolution		0.001 dB
Simulation setup		
System latency calibration	R&S®SMW-K78 measures the internal system (R&S®FSW + R&S®SMW200A) latency automatically (only available in transmit signal mode: external baseband via R&S®FSW + R&S®SMW-B10)	automatic
	user measures internal latency with external equipment (e.g. scope)	manual
System latency	system latency calibration: manual	
Setting range		0 m to 3 000 m
Setting resolution		0.01 m
Correction value	system latency calibration: automatic	
Setting range		–100 m to +100 m
Setting resolution		0.01 m
Maximum uncertainty		±2.5 m
Use radar range ambiguity to reduce min. range	all pulses per object are delayed so that a minimal range of 0.1 m is virtually possible (only for constant PRF)	on
	all pulses per object are delayed with regard to set range	off
Pulse repetition frequency (PRF)		
Setting range		0.001 kHz to 1 000 kHz
Setting resolution		0.001 kHz
Object configuration		
Object type	arbitrary object types can run at the same time	
	echo is not generated	off
	echo for objects with variable range and constant velocity > 0 m/s is generated	moving
	echo for objects with constant range and no velocity is generated	static
	echo for objects with constant range and constant velocity > 0 m/s is generated	static + moving

Parameters common to all object types		
Object name		define 15-digit name
Range		
Setting range	use radar range ambiguity to reduce min. range: off	2.1 km to 10 000 km
	use radar range ambiguity to reduce min. range: on	0.0001 km to 10 000 km
Setting resolution		0.1 m
Phase offset		
Setting range		0.0° to 359.9°
Setting resolution		0.1°
RCS	power setting: radar equation	
Model		Swerling 0
Setting range		–60 dBsm to +100 dBsm
Setting resolution		0.1 dBsm
Radar RX power of start /end range	power setting: radar equation	
Setting range	may be limited by maximum output level of R&S®SMW200A	calculated with radar equation
Setting resolution		0.1 dBm
Radar RX power	power setting: manual	
Setting range	may be limited by maximum output level of R&S®SMW200A	–145 dBm to +30 dBm
Setting resolution		0.001 dBm
Parameters for moving objects		
Simulation mode	object moves back to start position with set velocity after reaching its end position	round trip
Object velocity		
Setting range	the maximum Doppler shift of 190 kHz must not be exceeded	0.001 ms to v_{max} v_{max} = 750 m/s or (190 kHz / 2f) × c, whichever is lower
Setting resolution		0.001 m/s
Parameters for static + moving objects		
Object velocity		
Setting range	the maximum Doppler shift of 190 kHz must not be exceeded	0.001 ms to v_{max} v_{max} = (190 kHz / 2f) × c, i.e. v_{max} = 9493 m/s for f = 3 GHz v_{max} = 1424 m/s for f = 20 GHz v_{max} = 712 m/s for f = 40 GHz
Setting resolution		0.001 m/s
Direction	object flies toward RUT	approaching
	object flies away from RUT	departing
Simulation quantization (moving)		
Update delay increment	object velocity ≥ 75 m/s	500 ps
	object velocity < 75 m/s	50 ps
Update rate delay	depending on object velocity	max. 2 MHz
Update rate power	depending on object velocity	max. 10 kHz

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

AWGN can be generated either on path A or B with one R&S®SMW-K62 option. For AWGN to be generated on paths A and B simultaneously, two R&S®SMW-K62 must be installed, and the R&S®SMW200A must be equipped with the R&S®SMW-B13T 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		> (2^{800} – 1)/200 MHz
C/N, E_b/N_0		
Setting range	Depending 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		0.1 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 160 MHz
Setting resolution		100 Hz

Remote control

Interfaces	remote control	IEC 60625 (GPIB IEEE-488.2)
	Ethernet/LAN	10/100/1000BaseT
	USB	2.0 (high speed)
	serial	RS-232 [15]
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

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

Connectors

Front panel connectors

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

RF 50 Ω (path A)	RF output path A	
	R&S®SMW-B103, R&S®SMW-B106	N female
	R&S®SMW-B112, R&S®SMW-B120, R&S®SMW-B131, R&S®SMW-B140, R&S®SMW-B140N	test port adapter, PC 2.92 mm female (interchangeable port connector system)
RF 50 Ω (path B)	RF output path B	
	R&S®SMW-B203, R&S®SMW-B206	N female
	R&S®SMW-B212, R&S®SMW-B220	test port adapter, PC 2.92 mm female (interchangeable port connector system)
I (path A)	I modulation input signal, path A	BNC female
Q (path A)	Q modulation input signal, path A	BNC female
I (path B)	I modulation input signal, path B	BNC female
Q (path B)	Q modulation input signal, path B	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, keyboard, R&S®NRP-Zxx power sensors (with R&S®NRP-Z4 adapter cable), memory stick for software update and data exchange, or USB serial adapter for RS-232 remote control	USB type A

Rear panel connectors

REF IN	reference frequency input	BNC female
REF OUT	reference frequency output	BNC female
INST TRG A	trigger input for RF path A, e.g. for frequency or level sweep	BNC female
INST TRG B	trigger input for RF path B, 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 2.0 (high speed) 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
DIG I/Q OUT 1, DIG I/Q OUT 2	digital output connectivity in line with R&S®Digital I/Q Interface to connect to the R&S®EX-IQ-Box, for example	26-pin MDR
Analog I/Q outputs		
I/LF OUT 1	analog I output	BNC female
	alternative function: LF generator output	
I-bar 1	analog I-bar output	BNC female
Q/LF OUT 2	analog Q output	BNC female
	alternative function: LF generator output	
Q-bar 1	analog Q-bar output	BNC female
$I, \overline{I}, Q, \overline{Q}$	second set of analog I, I-bar, Q, Q-bar outputs	BNC female
Connectors on standard baseband generator and fading simulator modules		
T/M/C 1, T/M/C 4	multipurpose input/output connectors; configurable as trigger input, marker output or clock input or output	BNC female
T/M 2, T/M 3, T/M 5, T/M 6	multipurpose input/output connectors; configurable as trigger input or marker output	BNC female
DIG IQ IN/OUT 1, DIG IQ IN/OUT 2	digital input or output connectivity in line with R&S®Digital I/Q Interface	26-pin MDR
Connectors on wideband baseband generator modules		
T/M/C 1, T/M/C 3	for future use	BNC female
T/M 2, T/M 4	for future use	BNC female
DIG IQ IN/OUT 1, DIG IQ IN/OUT 2	for future use	26-pin MDR

General data

Power supply		
AC input voltage range		100 V to 240 V
AC input current range		max. 7.3 A to 4.6 A
AC supply frequency		50 Hz to 60 Hz, 400 Hz
Power consumption	when fully equipped	550 W (meas.)
Environmental conditions		
Temperature range	operating	5 °C to +45 °C
	operating, with R&S®SMW-B93 option	0 °C to +45 °C
	storage	–40 °C to +60 °C temperature gradient < 5 K/hour
Climatic resistance		+40 °C/90 % rel. humidity, cyclically in line with EN 60068-2-30
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		
EMC	in line with EMC directive of EU (2004/108/EC)	applied harmonized standards: EN 61326-1 (for use in industrial environment), EN 61326-2-1, EN 55011 (class B), EN 61000-3-2, EN 61000-3-3
Electrical safety	in line with low voltage directive of EU (2006/95/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	$_{c}CSA_{UL}$ 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	21 kg (46.3 lb)
Calibration interval		
Recommended calibration interval	operation 40 h/week in full range of specified environmental conditions	3 years

Ordering information

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

Designation	Type	Order No.
Vector Signal Generator [16] including power cable, quick start guide and CD-ROM (with operating and service manual)	R&S®SMW200A	1412.0000.02
Options		
Frequency options, RF path A		
100 kHz to 3 GHz	R&S®SMW-B103	1413.0004.02
100 kHz to 6 GHz	R&S®SMW-B106	1413.0104.02
100 kHz to 12.75 GHz	R&S®SMW-B112	1413.0204.03
100 kHz to 20 GHz	R&S®SMW-B120	1413.0404.02
100 kHz to 31.8 GHz	R&S®SMW-B131	1413.8605.02
100 kHz to 40 GHz	R&S®SMW-B140	1413.0604.02
100 kHz to 40 GHz, I/Q modulation bandwidth and minimum pulse width limited	R&S®SMW-B140N	1414.1633.02
Baseband main modules		
Signal Routing and Baseband Main Module, one I/Q path to RF	R&S®SMW-B13	1413.2807.02
Signal Routing and Baseband Main Module, two I/Q paths to RF	R&S®SMW-B13T	1413.3003.02
Wideband Baseband Main Module, two I/Q paths to RF	R&S®SMW-B13XT	1413.8005.02
Frequency Options, RF path B		
100 kHz to 3 GHz	R&S®SMW-B203	1413.0804.02
100 kHz to 6 GHz	R&S®SMW-B206	1413.0904.02
100 kHz to 12.75 GHz	R&S®SMW-B212	1413.1000.03
100 kHz to 20 GHz	R&S®SMW-B220	1413.1100.02
Other RF options		
FM/φM Modulator	R&S®SMW-B20	1413.1600.02
Enhanced Phase Noise Performance and FM/φM Modulator	R&S®SMW-B22	1413.2207.02
Phase Coherence	R&S®SMW-B90	1413.5841.02
Pulse Modulator	R&S®SMW-K22	1413.3249.02
Pulse Generator	R&S®SMW-K23	1413.3284.02
Multifunction Generator	R&S®SMW-K24	1413.3332.02
Differential Analog I/Q Inputs	R&S®SMW-K739	1413.7167.02
Standard baseband		
Baseband Generator with ARB (64 Msample) and Digital Modulation (realtime), 120 MHz RF bandwidth	R&S®SMW-B10	1413.1200.02
Differential Analog I/Q Outputs	R&S®SMW-K16	1413.3384.02
Digital Baseband Output	R&S®SMW-K18	1413.3432.02
Extended Sequencing	R&S®SMW-K501	1413.9218.02
ARB Memory Extension to 512 Msample	R&S®SMW-K511	1413.6860.02
ARB Memory Extension to 1 Gsample	R&S®SMW-K512	1413.6919.02
Baseband Extension to 160 MHz RF bandwidth	R&S®SMW-K522	1413.6960.02
Envelope Tracking	R&S®SMW-K540	1413.7215.02
AM/AM, AM/φM Predistortion	R&S®SMW-K541	1413.7267.02
Slow I/Q	R&S®SMW-K551	1413.9724.02
Wideband baseband		
Wideband Baseband Generator with ARB (256 Msample), 500 MHz RF bandwidth	R&S®SMW-B9	1413.7350.02
Wideband Differential Analog I/Q Outputs	R&S®SMW-K17	1414.2346.02
ARB Memory Extension to 2 Gsample	R&S®SMW-K515	1413.9360.02
Baseband Extension to 2000 MHz RF bandwidth	R&S®SMW-K526	1413.9318.02

[16] The base unit can only be ordered with an R&S®SMW-B1xx frequency option and an R&S®SMW-B13 or R&S®SMW-B13T or R&S®SMW-B13XT signal routing and baseband main module.

Designation	Type	Order No.
Multichannel, MIMO, fading and noise		
Fading Simulator	R&S®SMW-B14	1413.1500.02
Additive White Gaussian Noise (AWGN)	R&S®SMW-K62	1413.3484.02
Dynamic Fading	R&S®SMW-K71	1413.3532.02
Enhanced Fading Models	R&S®SMW-K72	1413.3584.02
OTA-MIMO Fading Enhancements	R&S®SMW-K73	1414.2300.02
MIMO Fading/Routing	R&S®SMW-K74	1413.3632.02
Higher-Order MIMO	R&S®SMW-K75	1413.9576.02
Multiple Entities	R&S®SMW-K76	1413.9624.02
Radar Echo Generation	R&S®SMW-K78	1414.1833.02
Stream Extender	R&S®SMW-K550	1413.7315.02
Digital standards		
GSM/EDGE	R&S®SMW-K40	1413.3684.02
EDGE Evolution	R&S®SMW-K41	1413.3732.02
3GPP FDD	R&S®SMW-K42	1413.3784.02
CDMA2000®	R&S®SMW-K46	1413.3884.02
1xEV-DO	R&S®SMW-K47	1413.3932.02
IEEE 802.16	R&S®SMW-K49	1413.3984.02
TD-SCDMA	R&S®SMW-K50	1413.4039.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMW-K51	1413.4080.02
DVB-H/DVB-T	R&S®SMW-K52	1413.6090.02
IEEE 802.11 (a/b/g/n)	R&S®SMW-K54	1413.4139.02
EUTRA/LTE	R&S®SMW-K55	1413.4180.02
Bluetooth® EDR	R&S®SMW-K60	1413.4239.02
Multicarrier CW Signal Generation	R&S®SMW-K61	1413.4280.02
TETRA Release 2	R&S®SMW-K68	1413.4439.02
LTE Closed-Loop BS Test	R&S®SMW-K69	1413.4480.02
LTE Log File Generation	R&S®SMW-K81	1413.4539.02
3GPP FDD HSPA/HSPA+, Enhanced BS/MS Tests	R&S®SMW-K83	1413.4580.02
EUTRA/LTE Release 9 and Enhanced Features	R&S®SMW-K84	1413.5435.02
EUTRA/LTE Release 10 (LTE-Advanced)	R&S®SMW-K85	1413.5487.02
IEEE 802.11ac	R&S®SMW-K86	1413.5635.02
1xEV-DO Rev. B	R&S®SMW-K87	1413.6519.02
NFC A/B/F	R&S®SMW-K89	1413.6619.02
LTE Release 11 and Enhanced Features	R&S®SMW-K112	1413.8505.02
LTE Release 12	R&S®SMW-K113	1414.1933.02
5G Air Interface Candidates	R&S®SMW-K114	1414.1985.02
IEEE 802.11ad	R&S®SMW-K141	1414.1333.02
Baseband Power Sweep	R&S®SMW-K542	1413.9876.02
Digital standards using R&S®WinIQSIM2™ [17]		
GSM/EDGE	R&S®SMW-K240	1413.4739.02
EDGE Evolution	R&S®SMW-K241	1413.4780.02
3GPP FDD	R&S®SMW-K242	1413.4839.02
GPS 1 Satellite	R&S®SMW-K244	1413.4880.02
CDMA2000®	R&S®SMW-K246	1413.4939.02
1xEV-DO	R&S®SMW-K247	1413.4980.02
IEEE 802.16	R&S®SMW-K249	1413.5035.02
TD-SCDMA	R&S®SMW-K250	1413.5087.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMW-K251	1413.5135.02
DVB-H/DVB-T	R&S®SMW-K252	1413.6190.02
DAB/T-DMB	R&S®SMW-K253	1413.6248.02
IEEE 802.11n	R&S®SMW-K254	1413.5187.02
EUTRA/LTE	R&S®SMW-K255	1413.5235.02
Bluetooth® EDR	R&S®SMW-K260	1413.5287.02
Multicarrier CW Signal Generation	R&S®SMW-K261	1413.5335.02
Additive White Gaussian Noise (AWGN)	R&S®SMW-K262	1413.6460.02
Galileo 1 Satellite	R&S®SMW-K266	1413.7015.02
TETRA Release 2	R&S®SMW-K268	1413.5387.02
3GPP FDD HSPA/HSPA+, Enhanced BS/MS Tests	R&S®SMW-K283	1413.6290.02
EUTRA/LTE Release 9 and Enhanced Features	R&S®SMW-K284	1413.5535.02
EUTRA/LTE Release 10 (LTE-Advanced)	R&S®SMW-K285	1413.5587.02

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

Designation	Type	Order No.
IEEE 802.11ac	R&S®SMW-K286	1413.5687.02
1xEV-DO Rev. B	R&S®SMW-K287	1413.6560.02
NFC A/B/F	R&S®SMW-K289	1413.6654.02
Glonass 1 Satellite	R&S®SMW-K294	1413.7067.02
Beidou 1 Satellite	R&S®SMW-K407	1413.7115.02
LTE Release 11 and Enhanced Features	R&S®SMW-K412	1413.8557.02
Options with external R&S®Pulse Sequencer software or R&S®Pulse Sequencer (DFS) software		
Pulse Sequencing	R&S®SMW-K300	1413.8805.02
Enhanced Pulse Sequencing	R&S®SMW-K301	1413.9776.02
Direction Finding	R&S®SMW-K308	1414.1433.02
DFS Signal Generation	R&S®SMW-K350	1413.9160.02
Other options		
Rear Panel Connectors for RF path A (3/6 GHz) and I/Q	R&S®SMW-B81	1413.5893.02
Rear Panel Connectors for RF path B (3/6 GHz)	R&S®SMW-B82	1413.5941.02
Rear Panel Connectors for RF path A (20/31.8/40 GHz) and I/Q	R&S®SMW-B83	1414.0937.02
Rear Panel Connectors for RF path B (20 GHz)	R&S®SMW-B84	1414.1033.02
Solid State Drive	R&S®SMW-B93	1414.1885.02
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
USB Serial Adapter for RS-232 remote control	R&S®TS-USB1	6124.2531.00
Adapters for instruments with an R&S®SMW-B112/-B212/-B120/-B220/-B131/-B140/-B140N 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
Documentation		
Documentation of Calibration Values	R&S®DCV-2	0240.2193.18
R&S®SMW200A DAkkS Calibration (ISO 17025, ISO 9000)	R&S®SMW200ADKD	1413.6690.02

Warranty		
Base unit		3 years
All other items		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 a term of one and two years (WE1 and WE2)
Repairs carried out during the contract term are free of charge [18]. 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 [18]and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

For product brochure, see PD 3606.8037.12 and www.rohde-schwarz.com/product/smw200a

[18] 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

About Rohde&Schwarz

The Rohde&Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, radiomonitoring and radiolocation. Founded more than 80 years ago, this independent company has an extensive sales and service network and is present in more than 70 countries. The electronics group is among the world market leaders in its established business fields. The company is headquartered in Munich, Germany. It also has regional headquarters in Singapore and Columbia, Maryland, USA, to manage its operations in these regions.

Sustainable product design

- Environmental compatibility and eco-footprint
- Energy efficiency and low emissions
- Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

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