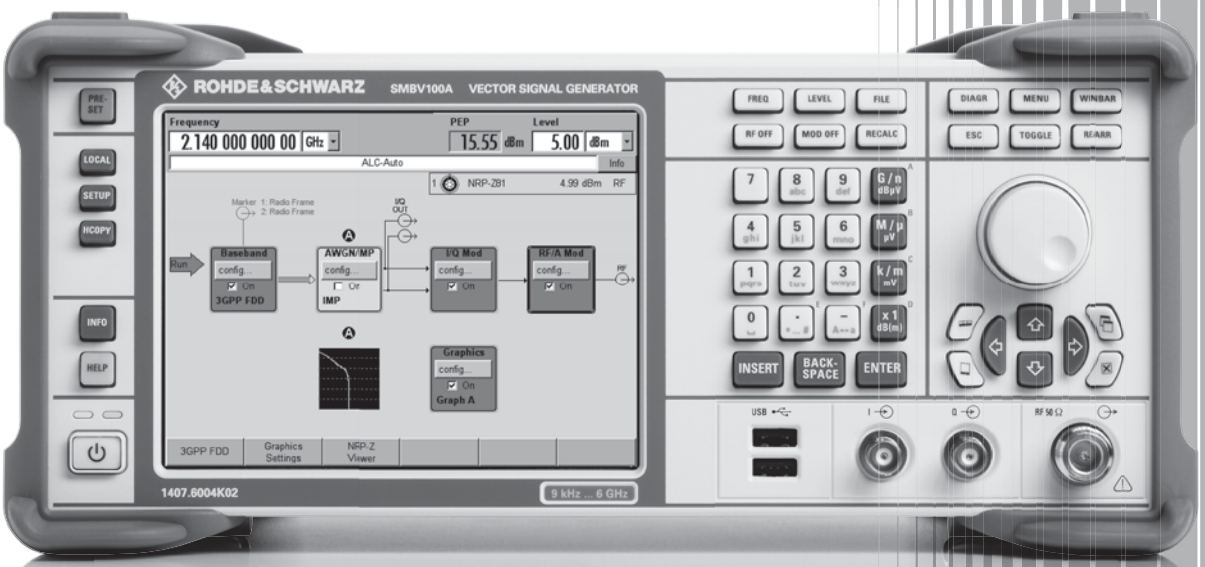
R&S®SMBV100A
Vector Signal Generator
Specifications



70 Years of Driving Innovation

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CONTENTS

Key features

Ready for future applications today

- Future-proof hardware concept
- RF section with high output level up to 6 GHz
- Wide RF signal bandwidth of up to 120 MHz during internal signal generation
- Maximum RF bandwidth of I/Q modulator exceeds 500 MHz
- Always up-to-date with software upgrades

Customized internal signal generation with optional baseband

- Baseband coder with realtime capabilities for direct signal generation
- Integrated ARB for playback of precalculated waveforms
- Availability of ARB-only versions with different bandwidths
- Memory depth of up to 256 Msample for long test sequences

Support of all important state-of-the-art digital standards

- Straightforward signal configuration due to easy-to-use GUI
- 2G/3G/LTE mobile radio standards
- Wireless standards incl. mobile WiMAX and WLAN IEEE 802.11n

High-performance RF for all kind of applications

- Excellent phase noise ensures low EVM with digital signals
- High output level compensates for losses in the test/system setup
- Fast settling time for quicker measurements
- Analog modulation for basic measurements

Flexible signal processing and baseband connectivity

- CW interference and AWGN simulation
- Analog and digital baseband outputs
- Support for R&S®EX-IQ-Box digital interface adapter[1]

Low cost of ownership due to service concept

- Fast on-site servicing
- Long calibration interval (three years) minimizes service costs
- Straightforward modular design for short repair times

Allrounder and specialist at the same time

- Optimized for high production throughput
  - Multisegment waveform mode for fast switchover between test sequences
  - High level repeatability ensures stable test conditions
- Prepared for aerospace and defense applications
  - Versatile capabilities for generating unmodulated as well as complex modulated pulses
  - Coupling of multiple instruments for phase coherent RF generation

[1] Available in January 2009.

Specifications

Specifications apply under the following conditions: 30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and all internal automatic adjustments performed. "Typical values" are designated with the abbreviation "typ." These values are verified during the final test but are not assured by Rohde & Schwarz. "Nominal values" are design parameters that are not assured by Rohde & Schwarz. These values are verified during product development but are not specifically tested during production.

RF characteristics

Frequency

Range	R&S®SMBV-B103	
	CW mode	9 kHz to 3.2 GHz
	I/Q mode	1 MHz to 3.2 GHz
	R&S®SMBV-B106	
	CW mode	9 kHz to 6 GHz
	I/Q mode	1 MHz to 6 GHz
Resolution of setting		0.001 Hz
Resolution of synthesis	f = 1 GHz	0.44 µHz
Setting time	to within <1 × 10^{-7} for f > 200 MHz or <20 Hz for f ≤ 200 MHz after IEC/IEEE bus delimiter	
	ALC state ON	
	CW mode	<3 ms
	I/Q mode	<5 ms
	ALC state Table	<2 ms
	ALC state S&H	<7 ms
	after trigger pulse in List mode[2]	<1 ms
Phase offset		adjustable in 0.1° steps

Frequency sweep

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

Reference frequency

Aging	after 30 days of uninterrupted operation	<1 × 10^{-6}/year
	with R&S®SMBV-B1 option	<1 × 10^{-9}/day, <1 × 10^{-7}/year
Temperature effect	in temperature range 0 °C to 50 °C	<2 × 10^{-6}
	with R&S®SMBV-B1 option	<1 × 10^{-7}
Warm-up time	to nominal thermostat temperature (only with R&S®SMBV-B1 option)	≤10 min
Output for internal reference signal	frequency (approx. sinewave)	10 MHz
	level	typ. 10 dBm
	source impedance	nominal 50 Ω
Input for external reference	frequency	10 MHz
	maximum deviation	3 × 10^{-6}
	input level, recommended	≥0 dBm, ≤16 dBm
	input impedance	nominal 50 Ω

[2] ALC state Sample & Hold or ALC state Table.

Level

The R&S®SMBV100A has two different attenuator modes for level setting:

AUTO MODE: In this mode, the attenuator is switched automatically. The output level is specified over the entire range from –120 dBm to +13/+18 dBm.

FIXED MODE: The level is set without switching the attenuator. The attenuator is fixed to the current setting. If the ALC state is ON, level changes are performed without interruption. The maximum attenuation range is limited. With higher attenuation, the spectral purity of the output signal decreases.

The R&S®SMBV100A has four different automatic level control (ALC) modes:

ALC STATE AUTO: The best suited ALC mode is set automatically.

ALC STATE ON: The level control loop is closed. This mode is suitable for CW, AM and modulation signals with constant envelope.

ALC STATE SAMPLE & HOLD: At every frequency and level change, the level control loop is closed for about 1 ms and the level control voltage is sampled. The level control voltage is then clamped. This mode is used internally while in ALC state Auto for I/Q and pulse modulation.

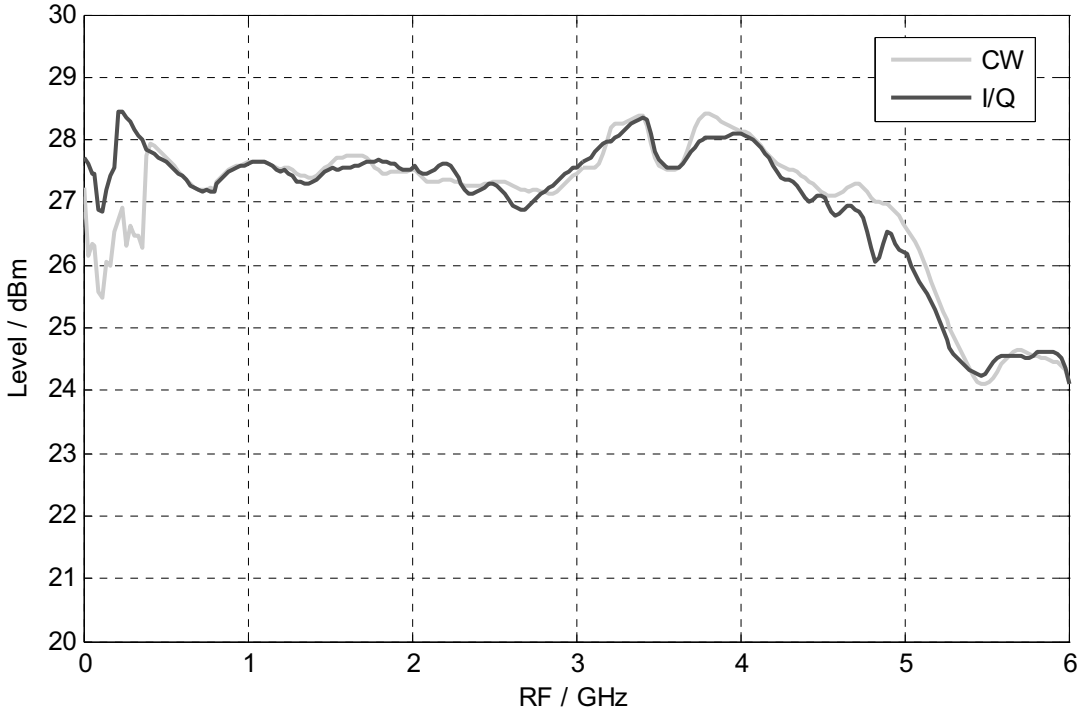
ALC STATE TABLE: The level control voltage is obtained during a learning cycle as a function of level and frequency at discrete points. At normal operation the level control voltage is interpolated between the obtained values and set. This mode is suitable for I/Q and pulse modulation. The setting times are significantly faster than in the Sample & Hold mode, but the absolute level accuracy is slightly inferior due to the interpolation error and temperature changes after the learning cycle.

Setting range		–145 dBm to +30 dBm
Specified level range	1 MHz ≤ f ≤ 6 GHz	–120 dBm to +18 dBm (PEP) [3]
	200 kHz ≤ f < 1 MHz	–120 dBm to +13 dBm (PEP)
Resolution		0.01 dB
Absolute level error	ALC state ON, Auto mode temperature range 18 °C to 33 °C	
	200 kHz ≤ f ≤ 3 GHz	<0.5 dB
	f > 3 GHz	<0.9 dB
Additional level error	ALC state Sample & Hold ALC state Table	<0.25 dB <0.5 dB
Output impedance VSWR in 50 Ω system	200 kHz ≤ f ≤ 6 GHz	<1.8
Setting time	after IEC/IEEE bus delimiter, with GUI update stopped, Auto mode, temperature range 18 °C to 33 °C, to <0.1 dB deviation from final value (unless otherwise stated)	
	ALC state ON	
	CW mode	<2.5 ms
	I/Q mode	<5 ms
	ALC state Table	
	CW mode	<2 ms
	I/Q mode[4]	<2 ms
	ALC state S&H	<7 ms
	in List mode after trigger pulse	
	CW mode	<1 ms
	I/Q mode[5]	<1 ms
Uninterrupted level setting	Fixed mode, ALC state ON	
	setting range	>20 dB
Reverse power (from ≥50 Ω source)	maximum permissible RF power in output frequency range of RF path for f ≥ 1 MHz	
	1 MHz ≤ f ≤ 1 GHz	50 W
	1 GHz < f ≤ 2 GHz	25 W
	2 GHz < f ≤ 6 GHz	10 W
	maximum permissible DC voltage	50 V

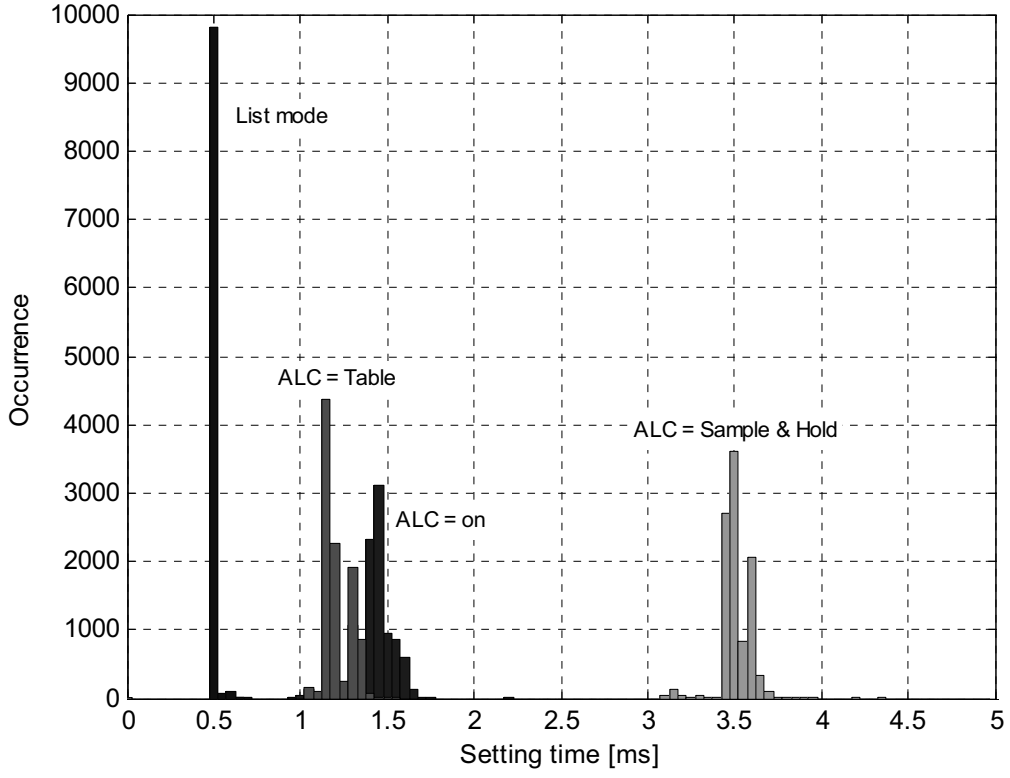
[3] PEP = peak envelope power.

[4] To <0.2 dB deviation from final value for frequencies <500 MHz and levels >+10 dBm.

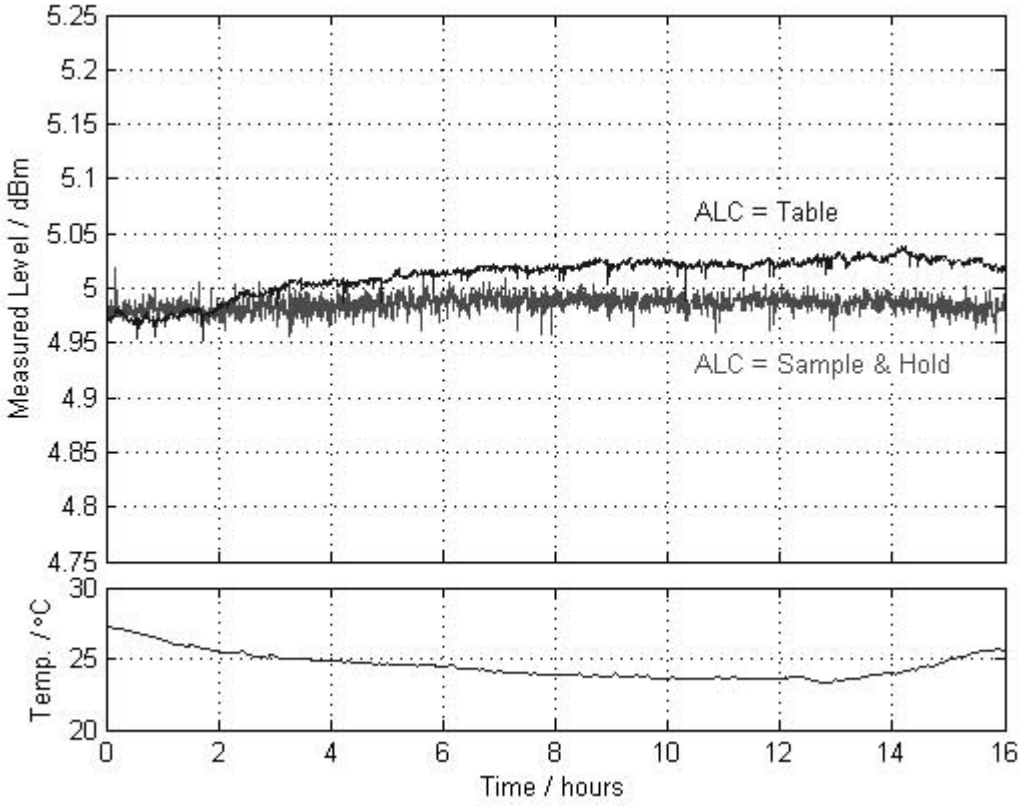
[5] ALC state Sample & Hold or ALC state Table; to <0.2 dB deviation from final value for frequencies <500 MHz and levels >+10 dBm.



Measured maximum output power versus frequency



Histogram of measured level setting times in I/Q mode for different ALC states and List mode



Measured level repeatability 3GPP Test Model 1-64 at 2.16 GHz, 5 dBm, ALC=Table and ALC=Sample & Hold

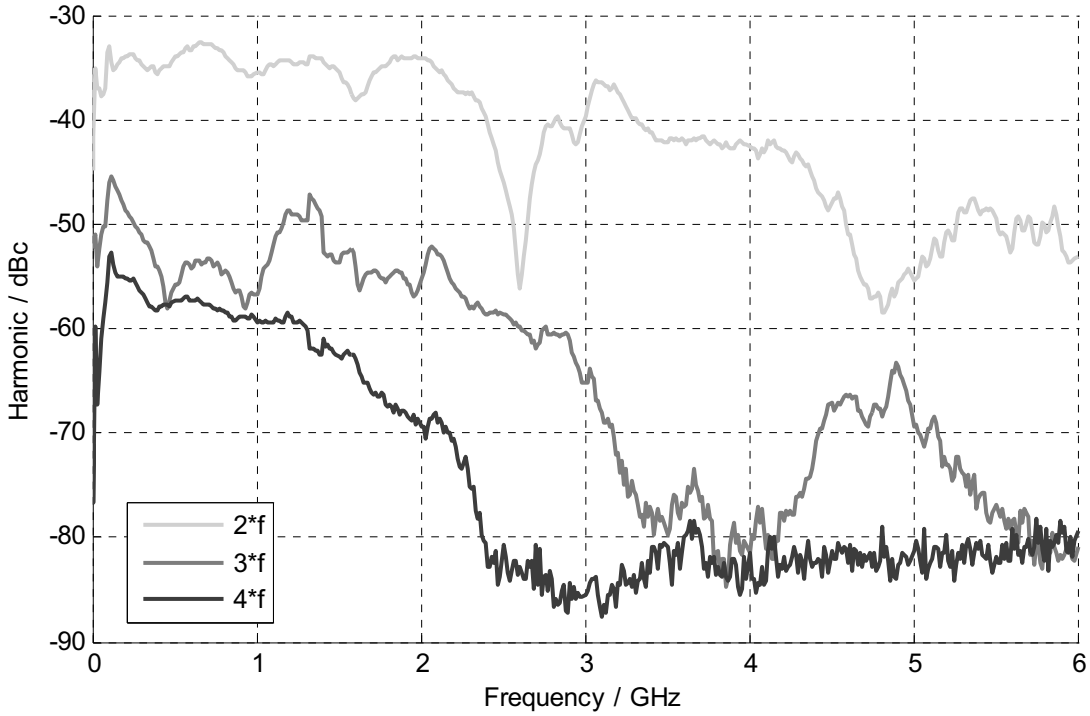
Level sweep

Operating modes	digital sweep in discrete steps	automatic, step, single sweep, external single, external step, manual or external trigger, linear spacing
Sweep range		entire level range
	uninterrupted	0.1 dB to 20 dB
Step width		0.1 dB to 20 dB
Dwell time	setting range	10 ms to 10 s
	resolution	0.1 ms

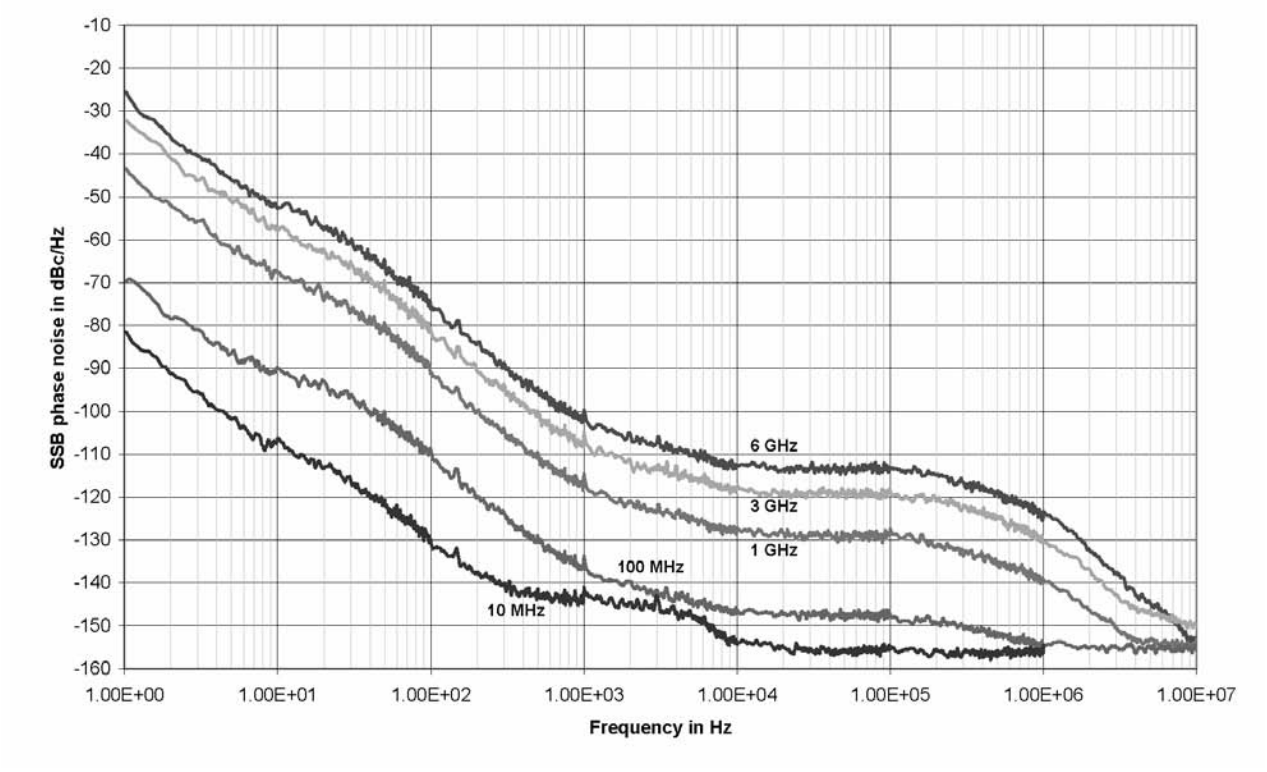
Spectral purity

Harmonics	f > 1 MHz	
	level ≤ 8 dBm	<–30 dBc [6]
Nonharmonics	level >–10 dBm, >10 kHz carrier offset CW, I/Q mode (full-scale DC input)	
	f ≤ 1500 MHz	<–70 dBc (typ. <–85 dBc)
	1500 MHz < f ≤ 3 GHz	<–64 dBc (typ. <–79 dBc)
	f > 3 GHz	<–58 dBc (typ. <–73 dBc)
Wideband noise	attenuator mode Auto for level > 5 dBm >10 MHz carrier offset 1 Hz measurement bandwidth, CW	<–142 dBc (typ. –152 dBc)
SSB phase noise	20 kHz carrier offset, 1 Hz measurement bandwidth	
	f = 100 MHz	
	CW mode	<–141 dBc (typ. –147 dBc)
	I/Q mode	<–121 dBc (typ. –126 dBc)
	f = 1 GHz	<–122 dBc (typ. –128 dBc)
	f = 2 GHz	<–116 dBc (typ. –122 dBc)
	f = 3 GHz	<–112 dBc (typ. –118 dBc)
	f = 4 GHz	<–110 dBc (typ. –116 dBc)
	f = 6 GHz	<–106 dBc (typ. –112 dBc)
RMS jitter	f = 1 GHz, BW = 1 Hz to 10 MHz, CW with R&S®SMBV-B1 option	nominal 1.1 ps (1.1 mUI)
	f = 1 GHz, BW = 1 Hz to 10 MHz, CW	nominal 3.9 ps (3.9 mUI)
	f = 155 MHz, BW = 100 Hz to 1.5 MHz, CW	nominal 83 fs (12.9 µUI)
	f = 622 MHz, BW = 1 kHz to 5 MHz, CW	nominal 63 fs (39.2 µUI)
	f = 2.488 GHz, BW = 5 kHz to 15 MHz, CW	nominal 55 fs (137 µUI)
Residual FM	RMS value at f = 1 GHz, CW	
	0.3 kHz to 3 kHz, weighted (ITU-T)	<4 Hz
	0.03 kHz to 23 kHz	<10 Hz
Residual AM	RMS value (0.03 kHz to 20 kHz), CW	<0.02 %

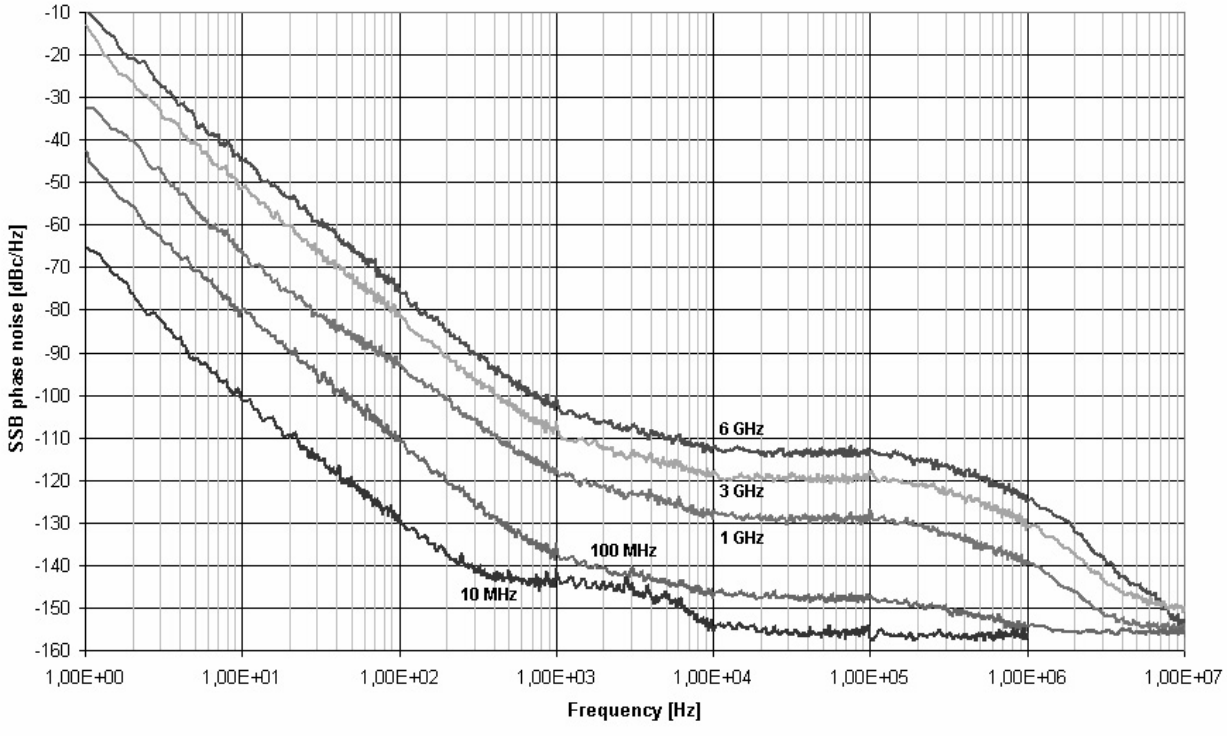
[6] Not valid in I/Q wideband mode.



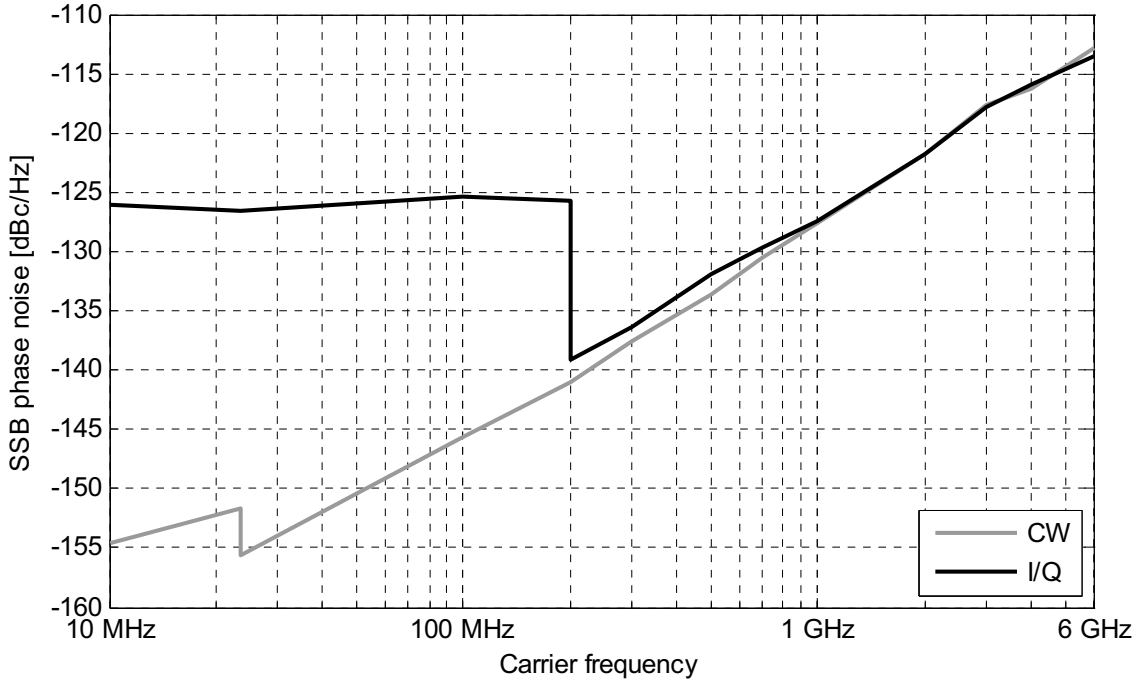
Measured harmonics at +18 dBm versus frequency



Measured SSB phase noise with internal OCXO (R&S®SMBV-B1 option)



Measured SSB phase noise



Measured SSB phase noise at 20 kHz offset versus frequency with internal OCXO

List mode

Frequency and level values can be stored in a list and set in an extremely short amount of time.		
Operating modes		automatic, single sweep, manual or external trigger
Max. number of stored settings		2000
Dwell time		1 ms to 1 s
Resolution		0.1 ms
Setting time	after external triggering	see frequency and level data

Phase coherence (R&S®SMBV-B90 option)

The R&S®SMBV-B90 option enables phase coherent RF outputs of two or more instruments in I/Q mode.

Coupling modes	internal	This mode corresponds to a normal operation, the internal local oscillator is used.
	external	An external local oscillator signal is used.
LO OUT state	The internally used local oscillator signal can be routed to the LO OUT connector (in order to couple two or more instruments).	ON/OFF
Frequency range	internal mode	entire range of frequency options
	external mode (LO coupling)	
	R&S®SMBV-B103	200 MHz to 3.2 GHz
	R&S®SMBV-B106	200 MHz to 6 GHz
Levels of external local oscillator signals	LO IN, recommended	7 dBm to 13 dBm
	LO OUT	typ. 7 dBm to 13 dBm
Phase	drift	
	over temperature	nominal <0.3° when changing ambient temperature by 1 °C
	over time	nominal <0.02°/h
	over level (attenuator mode Fixed)	nominal <0.2°/dB
	setting range when using the baseband phase offset (not available for analog wideband I/Q input)	0.00° to 359.99°
	setting resolution	0.01°

Analog modulation

Possible modulation types

I/Q modulation, amplitude modulation, frequency modulation, phase modulation, pulse modulation

Simultaneous modulation

	Amplitude modulation	Frequency modulation	Phase modulation	Pulse modulation	I/Q modulation
Amplitude modulation		+	+	(+)	–
Frequency modulation	+		–	+	+
Phase modulation	+	–		+	+
Pulse modulation	(+)	+	+		+
I/Q modulation	–	+	+	+	

+ = compatible, – = incompatible, (+) = compatible with reduced AM modulation performance

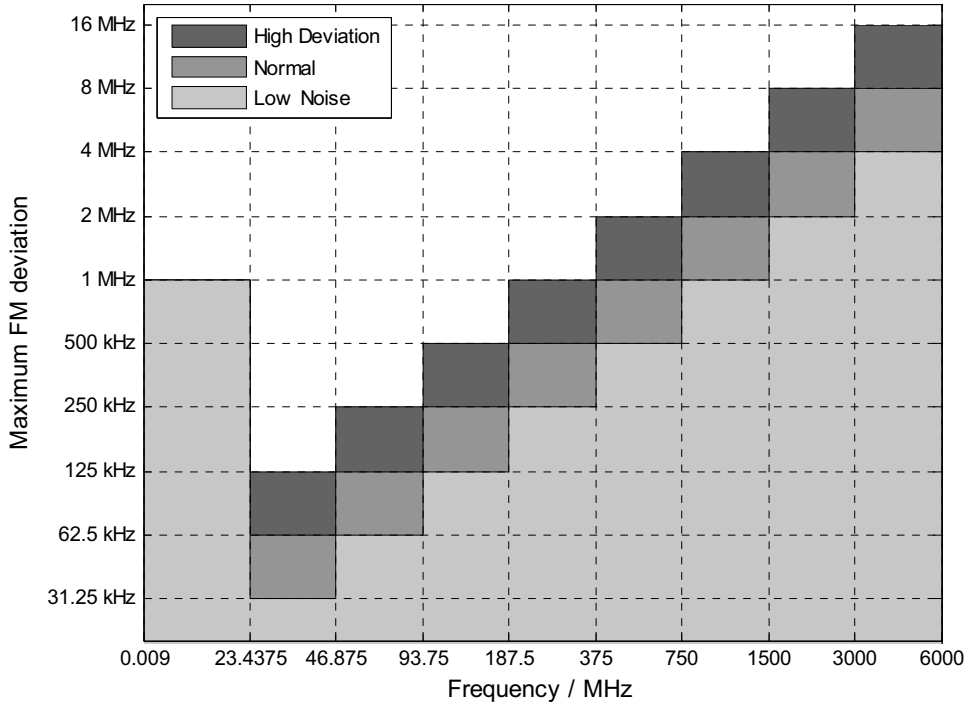
Amplitude modulation

For f ≥ 100 kHz, attenuator mode AUTO, level (PEP) within specified level range.

Operating modes		internal, external, internal + external, AC/DC
Modulation depth	At high levels, modulation is clipped when the maximum PEP is reached.	0 % to 100 %
Resolution		0.1 %
AM depth error	f_{mod} = 1 kHz and m <80 %	
	f ≤ 23.4375 MHz	<(1 % of setting + 1 %)
	f > 23.4375 MHz	<(4 % of setting + 1 %)
AM distortion	f_{mod} = 1 kHz, f ≤ 23.4375 MHz	
	m = 30 %	<0.25 %
	m = 80 %	<0.5 %
	f_{mod} = 1 kHz, f > 23.4375 MHz	
	m = 30 %	<1.5 %
	m = 80 %	<3 %
Modulation frequency response	m = 60 %, up to 50 kHz	<3 dB
Synchronous φM at AM	m = 30 %, f_{mod} = 1 kHz, ±peak/2	<0.2 rad

Frequency modulation

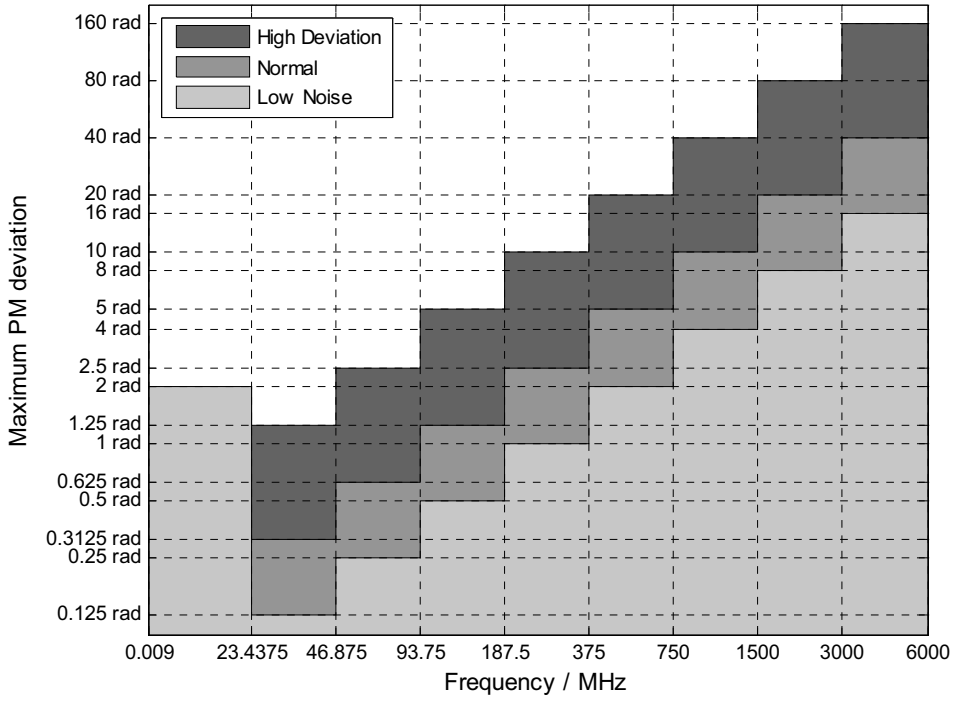
FM multiplier for different frequency ranges	f ≤ 23.4375 MHz	rm = 1/4
	23.4375 MHz < f ≤ 46.875 MHz	rm = 1/32
	46.875 MHz < f ≤ 93.75 MHz	rm = 1/16
	93.75 MHz < f ≤ 187.5 MHz	rm = 1/8
	187.5 MHz < f ≤ 375 MHz	rm = 1/4
	375 MHz < f ≤ 750 MHz	rm = 1/2
	750 MHz < f ≤ 1500 MHz	rm = 1
	1500 MHz < f ≤ 3 GHz	rm = 2
	f > 3 GHz	rm = 4
Operating modes		internal, external, internal + external, AC/DC, FM mode Low Noise, FM mode Normal, FM mode High Deviation
Maximum deviation	f ≤ 23.4375 MHz	1 MHz
	f > 23.4375 MHz	
	FM mode Normal	rm × 2 MHz
	FM mode Low Noise	rm × 1 MHz
	FM mode High Deviation	rm × 4 MHz
Resolution		<0.02 % of set deviation min. rm × 0.1 Hz
FM deviation error	f_{mod} = 1 kHz, deviation ≤ rm × 1 MHz	
	internal	<(2 % of setting + 20 Hz)
	external	<(3 % of setting + 20 Hz)
FM distortion	f_{mod} = 2 kHz, deviation = rm × 1 MHz	<0.2 %
Modulation frequency response	FM modes Low Noise and High Deviation	
	DC/10 Hz to 100 kHz	<3 dB
	FM mode Normal	
	DC/10 Hz to 500 kHz	<3 dB
Synchronous AM with FM	40 kHz deviation, f_{mod} = 1 kHz, f > 10 MHz	<0.2 %
Carrier frequency offset with FM DC	after FM offset calibration	<0.2 % of set deviation



FM deviation versus frequency and operating mode

Phase modulation

φM multiplier for different frequency ranges	f ≤ 23.4375 MHz	rm = 1/4
	23.4375 MHz < f ≤ 46.875 MHz	rm = 1/32
	46.875 MHz < f ≤ 93.75 MHz	rm = 1/16
	93.75 MHz < f ≤ 187.5 MHz	rm = 1/8
	187.5 MHz < f ≤ 375 MHz	rm = 1/4
	375 MHz < f ≤ 750 MHz	rm = 1/2
	750 MHz < f ≤ 1500 MHz	rm = 1
	1500 MHz < f ≤ 3 GHz	rm = 2
	f > 3 GHz	rm = 4
Operating modes		internal, external, internal + external, AC/DC, φM mode Low Noise, φM mode Normal, φM mode High Deviation
Maximum deviation	f ≤ 23.4375 MHz	2 rad
	f > 23.4375 MHz	
	φM mode Normal	rm × 4 rad
	φM mode Low Noise	rm × 10 rad
	φM mode High Deviation	rm × 40 rad
Resolution		<0.02 % of set deviation, min. rm × 20 µrad
φM deviation error	f_{mod} = 1 kHz, deviation ≤ half of max. deviation	
	internal	<(2 % of setting + 0.003 rad)
	external	<(3 % of setting + 0.003 rad)
Distortion	f_{mod} = 10 kHz, half of max. deviation	<0.2 %
Modulation frequency response	φM modes Low Noise and High Deviation	
	DC/10 Hz to 100 kHz	<3 dB
	φM mode Normal	
	DC/10 Hz to 500 kHz	<3 dB



φM deviation versus frequency and operating mode

Pulse modulation (R&S®SMBV-K22 option)

When pulse modulation is activated, the ALC state of the R&S®SMBV100A is automatically changed to ALC OFF (Sample & Hold). In this state, the ALC loop is opened and the output level is set directly. In order to set the correct output level, a Sample & Hold measurement is performed after each frequency or level setting.

Operating modes		external, internal
ON/OFF ratio		>80 dB
Rise/fall time	10 % to 90 % of RF amplitude	<20 ns, typ. 4 ns
Pulse repetition frequency		0 Hz to 2.5 MHz
Video crosstalk	spectral line of fundamental of 100 kHz squarewave modulation	<–30 dBc

Input for external modulation signals

Modulation input EXT for AM/FM/φM	nominal input impedance	>100 kΩ
	input sensitivity (peak value for set modulation depth or deviation)	nominal 1 V
	maximum permissible input voltage	±10 V
Modulation input PULSE	nominal input level	
	low threshold	0.5 V
	high threshold	1.5 V
	maximum permissible input voltage	±5 V
	nominal input impedance	>5 kΩ or 50 Ω
	polarity	selectable

Modulation sources

Internal modulation generator

Waveforms		sine, square
Frequency range	sine	0.1 Hz to 1 MHz
	square	0.1 Hz to 20 kHz
Resolution of setting		0.1 Hz
Frequency error		<(0.005 Hz + relative error of reference frequency × modulation frequency)
Frequency response	sine	
	0.1 Hz to 1 MHz	<1 dB
Distortion	sine	
	f < 100 kHz at R_L > 200 Ω, level (V_{EMF}) < 1 V	<0.1 %
Output voltage	V_p at LF connector, open circuit voltage EMF	1 mV to 3 V
	resolution	1 mV
	setting error at 1 kHz	<(1 % of setting + 1 mV)
Output impedance		nominal 10 Ω
Frequency setting time	to within <1 × 10^{-7}, after IEC/IEEE bus delimiter	<5 ms
Sweep	digital sweep in discrete steps	
	operating modes	automatic, step, single sweep, external single, external step, manual or external trigger, linear or logarithmic spacing
	sweep range	entire frequency range
	step width (lin)	entire frequency range
	step width (log)	0.01 % to 100 % per step

Pulse generator (R&S®SMBV-K23 option)

The pulse generator is fully digitally implemented; the clock is directly derived from the instrument's reference frequency

Operating modes		automatic, external trigger, external gate, single pulse, double pulse, delayed pulse (external trigger)
Active trigger edge		positive or negative
Pulse period settings	range	40 ns to 85 s
	resolution	10 ns
Pulse width settings	The pulse width of double pulses can be set independently.	
	range	10 ns to 1 s
	resolution	10 ns
Pulse delay settings	range	10 ns to 1 s
	resolution	10 ns
Double-pulse spacing settings	range	20 ns to 1 s
	resolution	10 ns
External trigger	delay	nominal 50 ns
	jitter of delay	<10 ns
PULSE/VIDEO output		LVTTL signal (RL ≥ 50 Ω)

I/Q modulation

I/Q modulator

Operating modes		external I/Q, internal I/Q
I/Q impairments	I offset, Q offset	
	setting range	–10 % to +10 %
	resolution	0.05 %
	gain imbalance	
	setting range	–1.0 dB to +1.0 dB
	resolution	0.01 dB
	quadrature offset	
	setting range	–8° to +8°
	resolution	0.05°
RF frequency response for entire instrument in modulation bandwidth	up to ±264 MHz at 3432 MHz, 3960 MHz and 4488 MHz	nominal <6 dB
	up to ±60 MHz	<6 dB
	up to ±10 MHz	<2 dB
	up to ±5 MHz	<1 dB
Carrier leakage	without input signal, referenced to full-scale input [7]	<–50 dBc, typ. < –65 dBc
Suppression of image sideband for entire instrument in modulation bandwidth	up to ±10 MHz	nominal 40 dB
	up to ±60 MHz	nominal 30 dB
External I/Q inputs	input impedance	nominal 50 Ω
	VSWR up to 60 MHz	<1.2
	nominal input voltage for full-scale input	$\sqrt{V_i^2 + V_q^2} = 0.5$ V
Error vector	measured with 16QAM, filter root cosine	
	α = 0.5, symbol rate 10 kHz	
	rms value	
	f ≤ 200 MHz	<0.6 %
	f > 200 MHz	<(0.4 % + 0.2 % × f/GHz)
	peak value	
	f ≤ 200 MHz	<1.2 %
	f > 200 MHz	<(0.8 % + 0.4 % × f/GHz)
3GPP FDD digital standard, adjacent-channel leakage ratio (ACLR)	test model 1, 64 DPCHs level ≤ 13 dBm PEP frequency 1800 MHz to 2200 MHz	
	offset 5 MHz	>65 dB, typ. 67 dB
	offset 10 MHz	>67 dB, typ. 69 dB

[7] Value applies after internal readjustment.

Internal baseband I/Q (with R&S®SMBV-B10/B50/B51 option)

Sample rate	R&S®SMBV-B10/B50	400 Hz to 150 MHz
	R&S®SMBV-B51	400 Hz to 90 MHz
Bandwidth (RF)	R&S®SMBV-B10/B50	nominal 120 MHz
	R&S®SMBV-B51	nominal 60 MHz
D/A converter	resolution	16 bit
Aliasing filter	with amplitude, group-delay and Si correction	
	bandwidth (drop to –0.1 dB)	nominal 60 MHz
	D/A converter interpolation spectra	
	up to 10 MHz	<–80 dBc
	up to 60 MHz	<–60 dBc
I/Q impairments	I offset , Q offset	
	setting range	–10 % to +10 %
	resolution	0.01 %
	gain imbalance	
	setting range	–1 dB to +1 dB
	resolution	0.001 dB
	quadrature offset	
	setting range	–10° to +10°
	resolution	0.01°

I/Q outputs (with R&S®SMBV-B10/B50/B51 option)

Output impedance	single-ended	nominal 50 Ω
	differential	nominal 100 Ω
Output voltage	EMF (output voltage depends on set modulation signal)	
	single-ended	
	setting range	20 mV to 1.50 V (V_p)
	resolution	1 mV
	differential	
	setting range	40 mV to 3.00 V (V_p)
	resolution	1 mV
Offset	EMF	<1.0 mV
Frequency response	at RL = 50 Ω, (referenced to 1 MHz)	
	magnitude	
	up to 10 MHz	<0.15 dB
	up to 30 MHz (R&S®SMBV-B51)	<0.3 dB
	up to 60 MHz (R&S®SMBV-B10/B50)	<0.3 dB
	nonlinear phase	
	up to 10 MHz	nominal 200 ps
	up to 30 MHz (R&S®SMBV-B51)	nominal 500 ps
	up to 60 MHz (R&S®SMBV-B10/B50)	nominal 500 ps
I/Q imbalance [8]	at RL = 50 Ω	
	magnitude	
	up to 10 MHz	<0.05 dB
	up to 30 MHz (R&S®SMBV-B51)	<0.15 dB
	up to 60 MHz (R&S®SMBV-B10/B50)	<0.15 dB
	nonlinear phase	
	up to 10 MHz	nominal 100 ps
	up to 30 MHz (R&S®SMBV-B51)	nominal 300 ps
	up to 60 MHz (R&S®SMBV-B10/B50)	nominal 300 ps
Spectral purity	SFDR (sine)	
	up to 2 MHz	>70 dB
	up to 20 MHz	typ. 60 dB
	phase noise	
	10 MHz sinewave at 20 kHz offset	nominal –135 dBc
	wideband noise	
	10 MHz sinewave at 1 MHz offset	nominal –145 dBc

[8] Mode “Optimize internal I/Q impairments for RF output” is switched OFF.

I/Q baseband generator (R&S®SMBV-B10/50/51 option) – arbitrary waveform mode

Waveform memory	output memory	
	waveform length	1 sample to 32 Msample in one-sample steps
	waveform length with R&S®SMBV-B55 option	1 sample to 256 Msample in one-sample steps
	resolution	16 bit
	loading time 1 Msample	nominal 10 s
	nonvolatile memory	hard disk, 80 Gbyte (with R&S®SMBV-B92 option)
Sample rate	setting range	
	R&S®SMBV-B10/B50	400 Hz to 150 MHz
	R&S®SMBV-B51	400 Hz to 90 MHz
	resolution	0.001 Hz
	clock source	internal, external
	frequency error (internal)	< (5 × 10^{-14} + reference frequency error) × sample rate
Interpolation	The waveform is automatically interpolated to the internal 150 MHz sample rate.	
	bandwidth (drop to –0.1 dB)	
	sample rate = 150 MHz (no interpolation)	nominal 60 MHz
	sample rate < 150 MHz	
	R&S®SMBV-B10	nominal 0.31 × sample rate
	R&S®SMBV-B50/51	nominal 0.33 × 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 apply.	
	setting range	
	R&S®SMBV-B10/B50	–60 MHz to 60 MHz
	R&S®SMBV-B51	–30 MHz to 30 MHz
	resolution	0.01 Hz
	frequency error	<(5 × 10^{-10} + reference frequency error) × frequency offset
Triggering	A trigger event restarts the I/Q generation. The I/Q signal is then synchronous with the trigger (with a specific timing jitter).	
	source	internal, external
	operating modes	Auto, Retrig, Armed Auto, Armed Retrig, Single, Next
	external trigger delay (in sample)	
	setting range	0 to (2^{16} – 1)
	resolution	0.01
	jitter	nominal ±3.3 ns
	external trigger inhibit (in sample)	
	setting range	0 to (2^{26} – 1)
	resolution	1
	external trigger pulse width	nominal >20 ns
Marker outputs	number	2
	level	LVTTL
	operating modes	unchanged, restart, pulse, pattern, ratio, trigger
	marker delay (in sample)	
	setting range	0 to (waveform length – 1)
	setting range without recalculation	0 to 2000
	resolution of setting	1

Multisegment waveform	number of segments	max. 100 segments
	changeover modes	GUI, remote control, external trigger
	extended trigger modes	same segment, next segment, next segment seamless
	changeover time at 50 MHz clock rate (external trigger, without clock change)	nominal 5 µs
	seamless changeover	output up to end of current segment, followed by changeover to next segment
Multicarrier waveform	number of carriers	max. 32
	carrier spacing	
	setting range	depends on number of carriers and bandwidth (RF)
	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
	resolution	0.01 dB
	single carrier start phase	
	setting range	0° to 360°
	resolution	0.01°
	single carrier delay	
	setting range	0 s to 1 s
	resolution	1 ns

Operation with R&S®WinIQSIM2™:
The software supports download of I/Q data and control of the R&S®SMBV-B10/50/51.

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

Types of modulation	ASK	
	modulation index	0 to 100 %
	resolution	0.1 %
	FSK	2FSK, 4FSK, MSK
	deviation	0.1 to 1.5 × f_{Sym}
	maximum	10 MHz
	resolution	0.1 Hz
	variable FSK	4FSK, 8FSK, 16FSK
	deviations	–1.5 × f_{sym} to +1.5 × f_{sym}
	maximum	10 MHz
	resolution	0.1 Hz
	PSK	BPSK, QPSK, QPSK 45° Offset, OQPSK, π/4-QPSK, π/2-DBPSK, π/4-DQPSK, π/8-D8PSK, 8PSK, 8PSK EDGE
	QAM	16QAM, 32QAM, 64QAM, 256QAM, 1024QAM
Coding	Not all coding methods can be used with every type of modulation.	OFF, Differential, Diff. Phase, Diff. + Gray, Gray, GSM, NADC, PDC, PHS, TETRA, APCO25 (PSK), PWT, TFTS, INMARSAT, VDL, EDGE, APCO25(FSK), ICO, CDMA2000® [9], WCDMA
Baseband filter	Any filter can be used with any type of modulation. The bandwidth of the modulation signal is max. 45 MHz.	
	cosine, root cosine	
	filter parameter α	0.05 to 1.00
	Gaussian	
	filter parameter B × T	0.15 to 2.50
	cdmaOne, cdmaOne+ equalizer	
	cdmaOne705 kHz	
	cdmaOne705 kHz+ equalizer	
	CDMA2000® 3x	
	APCO25 C4FM	
	rectangular	
	split phase	
	filter parameter B × T	0.15 to 2.5
	resolution of filter parameter	0.01
Symbol rate	If an external clock is used, the applied data rate may deviate from the set clock rate by ±2 %.	
	clock source	internal, external
	setting range	
	ASK, PSK and QAM	400 Hz to 50 MHz
	FSK	400 Hz to 40 MHz
	resolution	0.001 Hz
	frequency error (internal)	<(5 × 10^{-14} + reference frequency error) × symbol rate
	external clock modes	symbol, K × symbol
	clock divider K	1 to 64
	external clock rate	max. 150 MHz

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

Frequency offset	With the aid of the frequency offset, the center frequency of the modulation signal in the baseband can be shifted. The restrictions caused by the modulation bandwidth apply.	
	setting range	–60 MHz to 60 MHz
	resolution	0.01 Hz
	frequency error	$<(5 \times 10^{-10}$ + reference frequency error) × frequency offset
Data sources	ALL 0, ALL 1	
	PRBS	
	sequence length	9, 11, 15, 16, 20, 21, 23
	pattern	
	length	1 bit to 64 bit
	data lists	
	output memory	8 bit to 2 Gbit
	nonvolatile memory	hard disk (with R&S®SMBV-B92 option)
Triggering	A trigger event restarts the I/Q generation. The I/Q signal is then synchronous with the trigger (with a specific timing jitter).	
	source	internal, external
	operating modes	Auto, Retrig, Armed Auto, Armed Retrig, Single, Next
	external trigger delay (in symbol)	
	setting range	0 to $(2^{16} - 1)$
	resolution	0.01
	jitter	nominal ±3.3 ns
	external trigger inhibit (in symbol)	
	setting range	0 to $(2^{26} - 1)$
	resolution	1
	external trigger pulse width	nominal >20 ns
Marker outputs	number	2
	level	LVTTL
	operating modes	control list, pulse, pattern, ratio, trigger
	marker delay (in symbol)	
	setting range	0 to $2^{24} - 1$
	setting range without recalculation	0 to 2000
	resolution of setting	1
Level reduction	internal: The signal switches between nominal and reduced level (without edge shaping).	
	setting range	0 dB to 60 dB
	additional level error in case of reduction	
	up to 30 dB	<1 dB
	up to 50 dB	<3 dB
Burst	internal: The signal triggers the beginning of a power ramp. The positive edge starts power ramping from blank to full level, the negative edge ramping in the opposite direction from full level to blanking.	
	operating range	
	rise/fall time	
	setting range	0.5 symbol to 8 symbol
	resolution	¼ symbol
	ramp shape	cosine, linear

Trigger/clock inputs	Input impedance can be set separately for the trigger and the clock inputs.	
	input impedance	1 kΩ, nominal 50 Ω
	trigger/clock threshold	
	setting range	0.00 V to 2.00 V
	resolution	0.01 V
Clock output	level	LVTTL
Predefined settings	modulation, filter, symbol rate and coding in line with standard	
	standards	Bluetooth, DECT, ETC, GSM, GSM/EDGE, NADC, PDC, PHS, TETRA, WCDMA 3GPP, TD-SCDMA, CDMA2000® Forward, CDMA 2000® Reverse, Worldspace, TFTS

Modulation errors		
Deviation error with 2FSK, 4FSK	deviation 0.2 to 0.7 × symbol rate	
	Gaussian filter with B × T = 0.2 to 0.7	
	symbol rate up to 2 MHz	nominal 0.4 %
	symbol rate up to 10 MHz	nominal 1.2 %
Phase error with MSK	Gaussian filter with B × T = 0.2 to 0.7	
	bit rate up to 10 MHz	nominal 0.3°
EVM with QPSK, OQPSK, π/4-DQPSK, 8PSK, 16QAM, 32QAM, 64QAM	cosine, root cosine filter with α = 0.2 to 0.7	
	symbol rate up to 5 MHz	nominal 0.5 %
	symbol rate up to 20 MHz	nominal 2.0 %

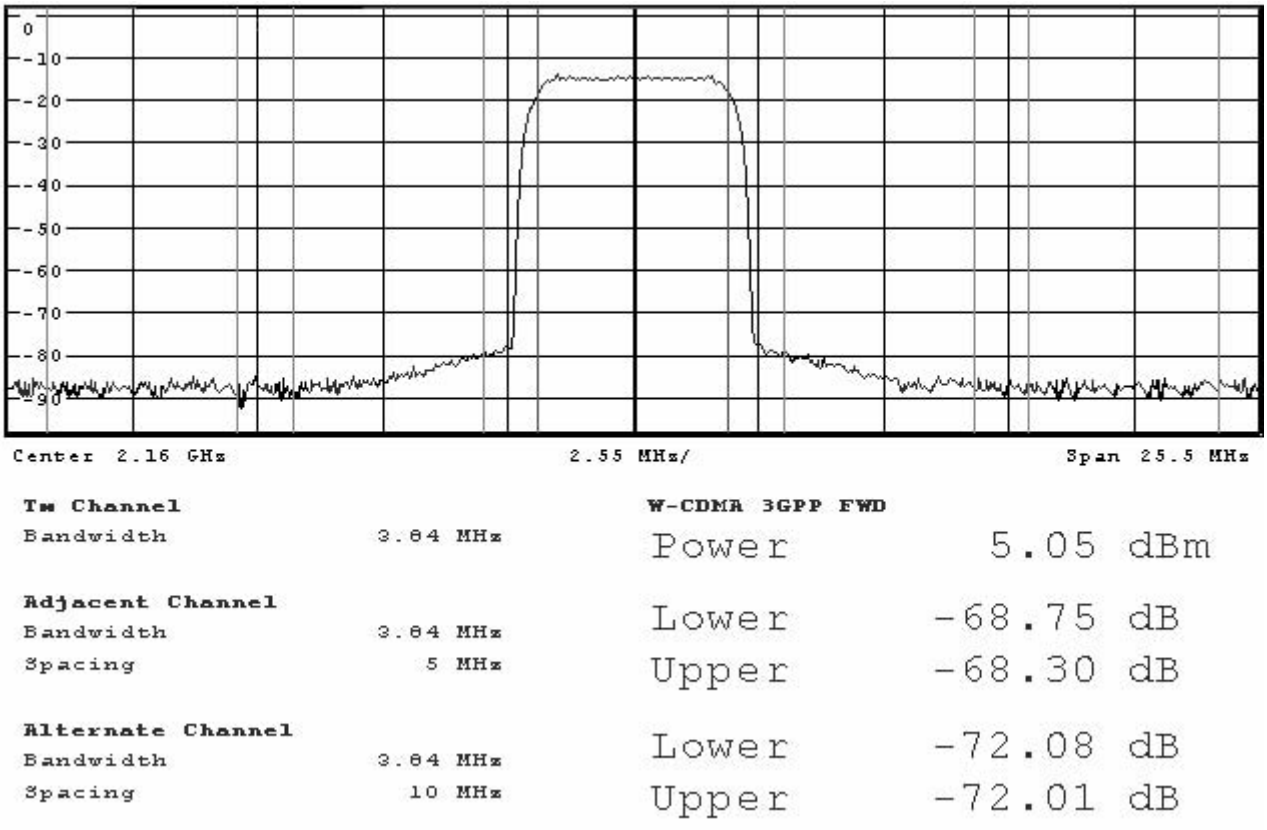
Modulation performance for main standards

Nominal values

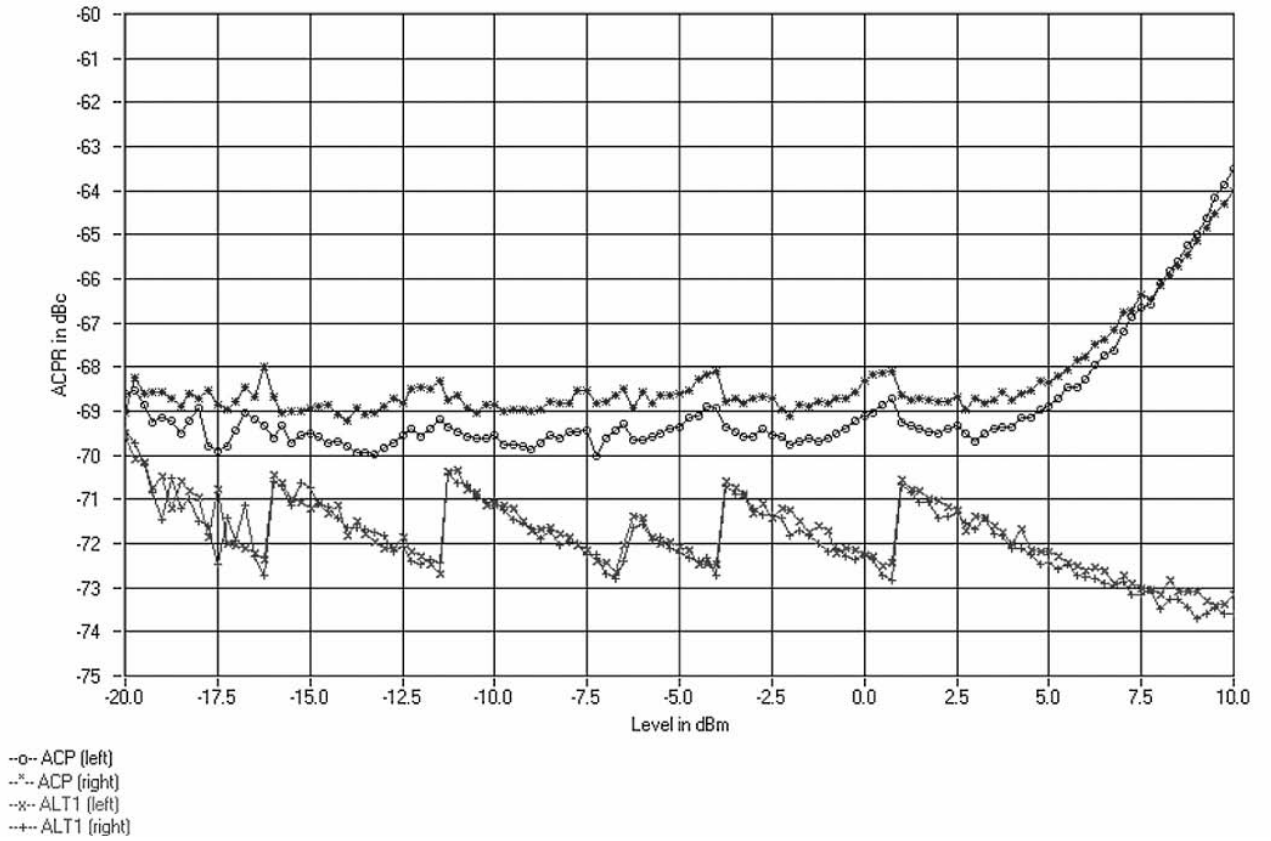
Standard	**GSM**	**EDGE**	**WCDMA 3GPP**		**CDMA2000®**	**IEEE 802.11a/g**	**WiMAX**		**LTE**
			1DPCH	**TM1-64**			**BW = 8.75 MHz**	**BW = 10 MHz**	
Frequency	400 MHz to 2000 MHz	400 MHz to 2000 MHz	1800 MHz to 2200 MHz	1800 MH to 2200 MHz	800 MHz	2400 MHz to 2485 MHz 5150 MHz to 5825 MHz	2304 MHz	5000 MHz	1800 MHz to 2200 MHz
EVM	–	0.2 %	0.3 %	0.6 %	0.4 %	0.6 %	0.3 %	0.4 %	0.4 %
Phase error	0.15°	–	–	–	–	–	–	–	–
Adjacent channel power ratio (ACPR) in dB									
Channel spacing	200 kHz	200 kHz	5 MHz	5 MHz	30 kHz	20 MHz	–	–	–
In adjacent channel	–37	–38	–69	–67	–79 at 0.75 MHz	–42	–	–	–
In alternate channel	–71	–71	–74	–69	–91 at 1.98 MHz	–55	–	–	–
In 2nd alternate channel	–85	–85	–	–	–	–56	–	–	–

Modulation performance for digital standards

GSM/EDGE	with R&S®SMBV-K40 option	
Burst ON/OFF ratio		typ. 100 dB
Phase error	MSK, Gaussian filter B × T = 0.3	
	rms	<0.4°, typ. 0.15°
	peak	<1.2°, typ. 0.4°
Error vector magnitude	8PSK EDGE, Gaussian linearized filter, rms	<0.5 %, typ. 0.2 %
Power density spectrum	Values measured with 30 kHz resolution bandwidth, referenced to level in band center without power ramping.	
	level ≤ 18 dBm PEP frequency 400 MHz to 2000 MHz	
	200 kHz offset	<–34 dB, typ. –37 dB
	400 kHz offset	<–66 dB, typ. –71 dB
	600 kHz offset	<–74 dB, typ. –85 dB
3GPP FDD	with R&S®SMBV-K42 option	
Error vector magnitude	1 DPCH, rms	<0.8 %, typ. 0.3 %
Adjacent channel leakage ratio (ACLR)	test model 1, 64 DPCH level ≤ 13 dBm PEP frequency 1800 MHz to 2200 MHz	
	offset 5 MHz	>65 dB, typ. 67 dB
	offset 10 MHz	>67 dB, typ. 69 dB

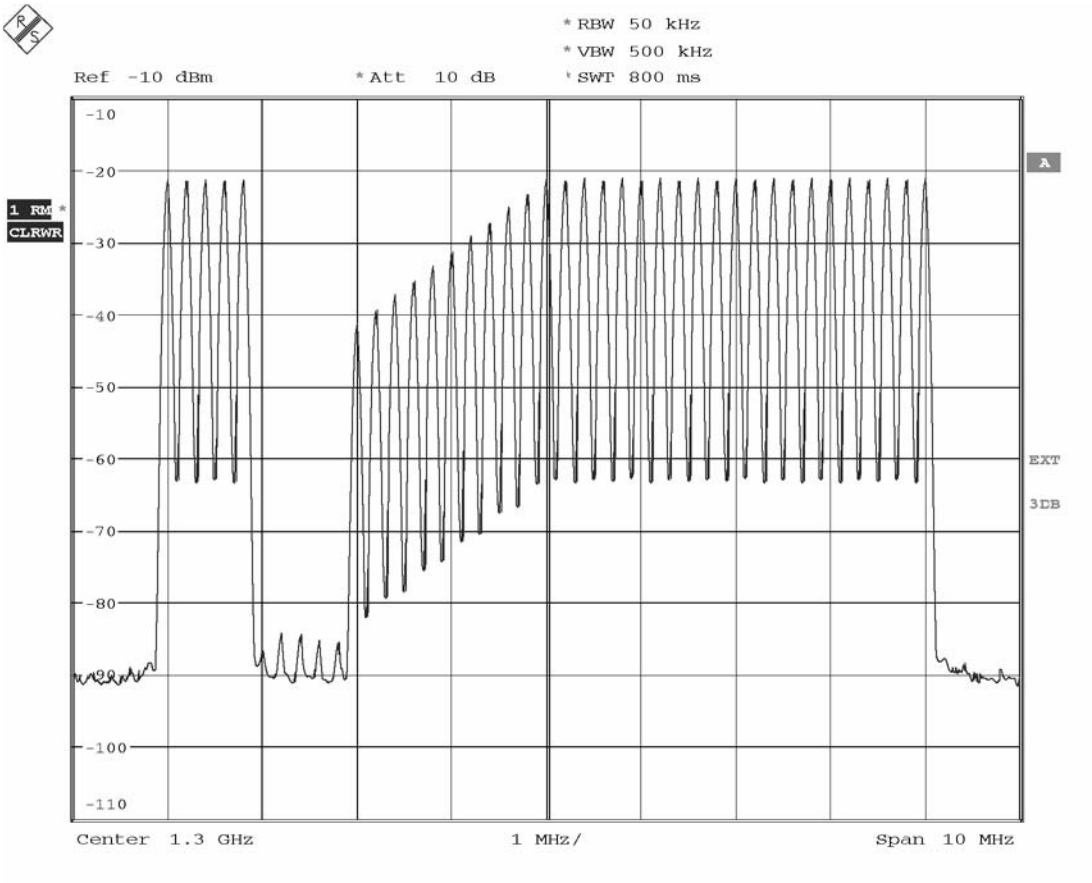


Digital standard 3GPP FDD test model 1, 64 DPCHs ACLR



Digital standard 3GPP FDD test model 1, 64 DPCHs, measured ACLR as function of carrier level at 2 GHz

Multicarrier CW	with R&S®SMBV-K61 option	
RF frequency response	up to 10 MHz	nominal 0.7 dB
	up to 60 MHz	nominal 2.0 dB
Suppression of unwanted carriers	up to 10 MHz	nominal 40 dB
	up to 60 MHz	nominal 30 dB



Example of multicarrier CW, with different carrier powers and some carriers switched off in the left half of the spectrum, measured with I/Q level 0.5 V

Digital standards (for R&S®SMBV-B10)

GSM/EDGE digital standard	R&S®SMBV-K40 option
3GPP FDD digital standard	R&S®SMBV-K42 option
3GPP FDD enhanced BS/MS tests including HSDPA	R&S®SMBV-K43 option
3GPP FDD enhanced BS/MS tests including HSUPA	R&S®SMBV-K45 option
CDMA2000® digital standard	R&S®SMBV-K46 option
1xEV-DO digital standard	R&S®SMBV-K47 option
IEEE 802.11a/b/g digital standard	R&S®SMBV-K48 option
IEEE 802.16 WiMAX digital standard including IEEE 802.16e	R&S®SMBV-K49 option
TD-SCDMA (3GPP TDD LCR) digital standard	R&S®SMBV-K50 option
TD-SCDMA (3GPP TDD LCR) enhanced BS/MS tests including HSDPA	R&S®SMBV-K51 option
DVB-H digital standard	R&S®SMBV-K52 option
IEEE 802.11n digital standard	R&S®SMBV-K54 option
EUTRA/LTE digital standard	R&S®SMBV-K55 option
HSPA+	R&S®SMBV-K59 option
Multicarrier CW signal generation	R&S®SMBV-K61 option

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

Digital system with external PC software (for R&S®SMBV-B10/-B50/-B51)

Pulse sequencer (external PC software)	R&S®SMBV-K6 option

The option is described in the Digital Standards data sheet (PD 5213.9434.22).

Playback of XM Radio Waveforms [10]	R&S®SMBV-K256 option
Playback of HD Radio™ Waveforms [11]	R&S®SMBV-K352 option

[10] Signal generation requires waveforms from XM radio.

[11] HD Radio™ is a proprietary trademark of iBiquity Digital Corp..

Digital standards with R&S®WinIQSIM2™ (for R&S®SMBV-B10/-B50/-B51 ARB)

R&S®WinIQSIM2™ requires an external PC.

GSM/EDGE digital standard	R&S®SMBV-K240 option
3GPP FDD digital standard	R&S®SMBV-K242 option
3GPP FDD enhanced BS/MS tests including HSDPA	R&S®SMBV-K243 option
GPS digital standard	R&S®SMBV-K244 option
3GPP FDD enhanced BS/MS tests including HSUPA	R&S®SMBV-K245 option
CDMA2000® digital standard	R&S®SMBV-K246 option
1 × EV-DO digital standard	R&S®SMBV-K247 option
IEEE 802.11a/b/g digital standard	R&S®SMBV-K248 option
IEEE 802.16 WiMAX digital standard including IEEE 802.16e	R&S®SMBV-K249 option
TD-SCDMA (3GPP TDD LCR) digital standard	R&S®SMBV-K250 option
TD-SCDMA (3GPP TDD LCR) enhanced BS/MS tests including HSDPA	R&S®SMBV-K251 option
DVB-H digital standard	R&S®SMBV-K252 option
IEEE 802.11n digital standard	R&S®SMBV-K254 option
EUTRA/LTE digital standard	R&S®SMBV-K255 option
HSPA+	R&S®SMBV-K259 option
Multicarrier CW signal generation	R&S®SMBV-K261 option
Additive white Gaussian noise (AWGN)	R&S®SMBV-K262 option

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

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

As prerequisite, R&S®SMBV-B10/-B50/-B51 must be installed.

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

Noise	distribution density	Gaussian, statistical, separate for I and Q
	crest factor	>18 dB
	periodicity	>48 h
C/N, E_b/N_0	setting range	–30 dB to +30 dB
	resolution	0.1 dB
	uncertainty for system bandwidth = symbol rate, 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 R&S®SMBV-B10/B50 R&S®SMBV-B51	 1 kHz to 120 MHz 1 kHz to 60 MHz
	setting resolution	100 Hz

General data

Remote control

Systems		IEC/IEEE bus, IEC 60625 (IEEE 488) Ethernet (TC/IP) USB
Command set		SCPI 1999.5
Connector	IEC Ethernet USB	24-contact Amphenol Western slave
IEC/IEEE bus address		0 to 30
Interface functions		SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0
LAN interface		10/100BaseT

Operating data

Power supply, nominal values	input voltage range	100 V to 240 V (AC) ±10 %
	AC supply frequency	50 Hz to 60 Hz, –5 %/+10 %
	max. input current	1.4 A (100 V) to 0.6 A (240 V)
Power factor correction		in line with EN 61000-3-2
EMC		in line with EN 55011 class B, EN 61326
Immunity to interfering field strength		up to 10 V/m
Environmental conditions	operating temperature range	0 °C to 55 °C in line with EN 60068-2-1, EN 60068-2-2
	storage temperature range	–40 °C to +71 °C
	climatic resistance, +40 °C/95 % rel. humidity	in line with EN 60068-2-78
	operating altitude if equipped with SMBV-B92	up to 4600 m up to 3000 m
Mechanical resistance	vibration, sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, max. 0.5 g at 55 Hz to 150 Hz, in line with EN 60068-2-6
	vibration, random	10 Hz to 300 Hz, acceleration 1.2 g (rms) in line with EN 60068-2-64
	shock	40 g shock spectrum in line with EN 60068-2-27, MIL-STD-810E
Electrical safety		in line with IEC 61010-1, EN 61010-1, CAN/CSA-C22.2 No. 61010-1-04, UL 61010-1
Approvals		VDE-GS, $_{C}$CSA$_{US}$
Dimensions (W × H × D)		344 mm × 112 mm × 368 mm (13.54 in × 4.41 in × 14.49 in)
Weight	when fully equipped	nominal 7.9 kg (17.4 lb)
Recommended calibration interval		3 years

Ordering information

Designation	Type	Order No.
Base unit		
Vector Signal Generator including power cable, Quick Start Guide and CD-ROM (with operating and service manual)	R&S®SMBV100A	1407.6004.02
Options		
RF		
9 kHz to 3.2 GHz	R&S®SMBV-B103	1407.9603.02
9 kHz to 6 GHz	R&S®SMBV-B106	1407.9703.02
Reference Oscillator OCXO	R&S®SMBV-B1	1407.8407.02
Phase Coherence	R&S®SMBV-B90	1407.9303.02
Pulse Modulator	R&S®SMBV-K22	1415.8019.02
Pulse Generator	R&S®SMBV-K23	1415.8025.02
Baseband		
Baseband Generator with Digital Modulation (realtime) and ARB (32 Msample), 120 MHz RF bandwidth	R&S®SMBV-B10	1407.8607.02
Baseband Generator with ARB (32 Msample), 120 MHz RF bandwidth	R&S®SMBV-B50	1407.8907.02
Baseband Generator with ARB (32 Msample), 60 MHz RF bandwidth	R&S®SMBV-B51	1407.9003.02
Memory Extension for ARB to 256 Msample	R&S®SMBV-B55	1407.9203.02
Hard Disc (removable)	R&S®SMBV-B92	1407.9403.02
Digital Baseband Connectivity [12]	R&S®SMBV-K18	1415.8002.02
Digital modulation systems		
Digital Standard GSM/EDGE	R&S®SMBV-K40	1415.8031.02
Digital Standard 3GPP FDD	R&S®SMBV-K42	1415.8048.02
3GPP FDD Enhanced MS/BS Tests incl. HSDPA	R&S®SMBV-K43	1415.8054.02
3GPP FDD HSUPA	R&S®SMBV-K45	1415.8077.02
Digital Standard CDMA2000® incl. 1x EV-DV	R&S®SMBV-K46	1415.8083.02
Digital Standard 1xEV-DO Rev. A	R&S®SMBV-K47	1415.8090.02
Digital Standard IEEE 802.11 (a/b/g)	R&S®SMBV-K48	1415.8102.02
Digital Standard IEEE 802.16	R&S®SMBV-K49	1415.8119.02
Digital Standard TD-SCDMA	R&S®SMBV-K50	1415.8125.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMBV-K51	1415.8131.02
Digital Standard DVB-H/DVB-T	R&S®SMBV-K52	1415.8148.02
Digital Standard IEEE 802.11 n	R&S®SMBV-K54	1415.8160.02
Digital Standard EUTRA/LTE	R&S®SMBV-K55	1415.8177.02
Digital Standard HSPA+	R&S®SMBV-K59	1415.8219.02
Multicarrier CW Signal Generation	R&S®SMBV-K61	1415.8225.02
Digital modulation systems using R&S®WinIQSIM2™ [13]		
Digital Standard GSM/EDGE	R&S®SMBV-K240	1415.8231.02
Digital Standard 3GPP FDD	R&S®SMBV-K242	1415.8248.02
3GPP FDD Enhanced MS/BS Tests incl. HSDPA	R&S®SMBV-K243	1415.8254.02
Digital Standard GPS	R&S®SMBV-K244	1415.8260.02
3GPP FDD HSUPA	R&S®SMBV-K245	1415.8277.02
Digital Standard CDMA2000 incl. 1x EV-DV	R&S®SMBV-K246	1415.8283.02
Digital Standard 1xEV-DO Rev. A	R&S®SMBV-K247	1415.8290.02
Digital Standard IEEE 802.11 (a/b/g)	R&S®SMBV-K248	1415.8302.02
Digital Standard IEEE 802.16	R&S®SMBV-K249	1415.8319.02
Digital Standard TD-SCDMA	R&S®SMBV-K250	1415.8325.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMBV-K251	1415.8331.02
Digital Standard DVB-H	R&S®SMBV-K252	1415.8348.02
Digital Standard IEEE 802.11 n	R&S®SMBV-K254	1415.8354.02
Digital Standard EUTRA/LTE	R&S®SMBV-K255	1415.8360.02
Digital Standard HSPA+	R&S®SMBV-K259	1415.8377.02
Multicarrier CW Signal Generation	R&S®SMBV-K261	1415.8383.02
Additive White Gaussian Noise (AWGN)	R&S®SMBV-K262	1415.8425.02

[12] Available as of January 2009 via software activation.

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

Digital modulation systems using an external PC software or waveforms		
Pulse Sequencer [14]	R&S®SMBV-K6	1415.8390.02
Playback of XM Radio Waveforms [15]	R&S®SMBV-K256	1415.8402.02
Playback of HD Radio™ Waveforms	R&S®SMBV-K352	1415.8431.02
Noise generation		
Additive White Gaussian Noise (AWGN)	R&S®SMBV-K62	1415.8419.02
Recommended extras		
Hardcopy manuals (in English, UK)		1407.6062.32
Hardcopy manuals (in English, US)		1407.6062.39
19” Rack Adapter	R&S®ZZA-S334	1109.4487.00
Power Sensor 9 kHz to 6 GHz	R&S®NRP-Z92	1171.7005.02
Keyboard with USB Interface (US character set)	R&S®PSL-Z2	1157.6870.04
Mouse with USB Interface, optical	R&S®PSL-Z10	1157.7060.03

[14] Pulse sequencer requires an external PC.

[15] Signal generation requires waveforms from XM radio.

License information

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

Service you can rely on

- In 70 countries
- Person-to-person
- Customized and flexible
- Quality with a warranty
- No hidden terms

About Rohde&Schwarz

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

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Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

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ISO 14001
DQS REG. NO 1954 UM

For product brochure,
see PD 5214.1114.12
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Subject to change

*0.14 €/min within German wireline network; rates may vary in other networks (wireline and mobile) and countries.