

R&S® SMB100A MICROWAVE SIGNAL GENERATOR

Specifications



Specifications
Version 03.00

ROHDE & SCHWARZ

Make ideas real



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Definitions

Phased-out articles and replacements

- The R&S®SMB100A-B101/-B103/-B104/-B106/-B5 are phased out from July 1, 2019.
- The successor unit is the R&S®SMB100B (-B101/-B103/-B104/-B106/-B5).
- The R&S®SMB100A (> 6 GHz) will be not phased out.

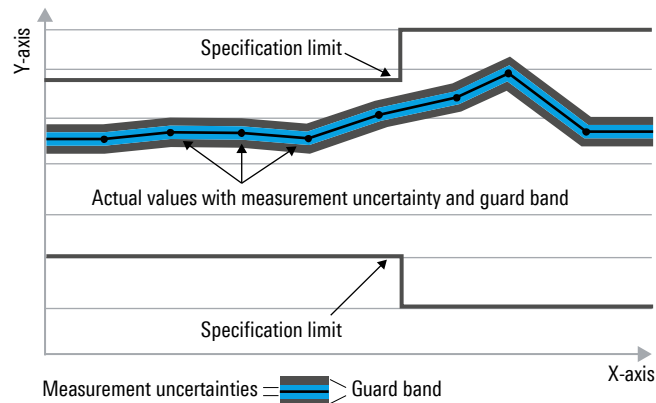
General

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 $<$, \leq , $>$, \geq , \pm , 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 designated with the format "parameter: value".

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

Specifications

Hardware and software option concept

Available frequency ranges and the corresponding hardware and software options:

	100 kHz to 12.75 GHz	100 kHz to 20 GHz	100 kHz to 31.8 GHz	100 kHz to 40 GHz
With electronic step attenuator	R&S®SMB-B112	–	–	–
With mechanical step attenuator	–	R&S®SMB-B120	R&S®SMB-B131	R&S®SMB-B140, R&S®SMB-B140N
Without step attenuator	R&S®SMB-B112L	R&S®SMB-B120L	–	R&S®SMB-B140L
High power	standard	R&S®SMB-B31		
Low harmonic filter	–	R&S®SMB-B25		
OCXO reference oscillator	R&S®SMB-B1			
OCXO reference oscillator, high performance	R&S®SMB-B1H			
Reverse power protection	R&S®SMB-B30	–		
Pulse modulator	R&S®SMB-K21			
Pulse generator	R&S®SMB-K23			
Pulse train	R&S®SMB-K27			

RF performance

Frequency

Frequency ranges	R&S®SMB-B112, R&S®SMB-B112L	100 kHz to 12.75 GHz
	R&S®SMB-B120, R&S®SMB-B120L	100 kHz to 20 GHz
	R&S®SMB-B131	100 kHz to 31.8 GHz
	R&S®SMB-B140, R&S®SMB-B140L, R&S®SMB-B140N	100 kHz to 40 GHz
Resolution of setting		0.001 Hz
Resolution of synthesis	$f = 1 \text{ GHz}$	0.44 μHz (nom.)
Setting time	to within $< 1 \times 10^{-7}$ for $f > 200 \text{ MHz}$ or $< 20 \text{ Hz}$ for $f \leq 200 \text{ MHz}$; specification does not apply when frequency crosses 20 GHz; specification does not apply to instruments equipped with R&S®SMB-B120/-B131/-B140 when frequency crosses 200 kHz after IEC/IEEE bus delimiter	
	ALC state on	< 3.5 ms
	ALC state S&H, $f \leq 20 \text{ GHz}$	< 7 ms
	ALC state S&H, $f > 20 \text{ GHz}$	< 10 ms
	after trigger pulse in list mode	< 1 ms
Resolution of phase offset setting		0.1°

Frequency sweep

Operating mode		digital sweep in discrete steps
Trigger mode	free run	automatic
	full sweep	single
	execute one step	step
	external trigger only	start/stop
Trigger source		keyboard, external trigger, remote control
Trigger slope		positive, negative
Sweep range		full frequency range
Sweep shape		triangle, sawtooth
Step spacing		linear, logarithmic
Step size	linear	full frequency range, min. 0.001 Hz
	logarithmic	0.01 % to 100 %
Dwell time range		10 ms to 100 s
Dwell time resolution		0.1 ms

Reference frequency

Frequency error	at time of calibration in production	$< 1 \times 10^{-7}$
	with R&S®SMB-B1/R&S®SMB-B1H option	$< 1 \times 10^{-8}$
Aging (after 10 days of uninterrupted operation)	standard	$< 1 \times 10^{-6}/\text{year}$
	with R&S®SMB-B1 option	$< 1 \times 10^{-9}/\text{day}, < 1 \times 10^{-7}/\text{year}$
	with R&S®SMB-B1H option	$< 5 \times 10^{-10}/\text{day}, < 3 \times 10^{-8}/\text{year}$
Temperature effect (0 °C to +50 °C)	standard	$< 2 \times 10^{-6}$
	with R&S®SMB-B1 option	$< 1 \times 10^{-7}$
	with R&S®SMB-B1H option	$< 1 \times 10^{-8}$
Warm-up time	to nominal thermostat temperature with R&S®SMB-B1/R&S®SMB-B1H option	$\leq 10 \text{ min}$
Reference frequency output		
Connector type	REF OUT on rear panel	BNC female
Output frequency	sine wave	
	instrument set to internal reference	10 MHz
	instrument set to external reference	applied external reference frequency
Output level		+7 dBm to +13 dBm, +10 dBm (typ.)
Source impedance		50 Ω (nom.)
Reference frequency input		
Connector type	REF IN on rear panel	BNC female
Input frequency		5 MHz, 10 MHz
Frequency locking range		$\pm 3 \times 10^{-6}$
Input level range		0 dBm to +16 dBm
Input impedance		50 Ω (nom.)

Level

General explanations

Instruments equipped with R&S®SMB-B112 frequency options include an electronic step attenuator with step ranges of 5 dB (6 dB with R&S®SMB-B112). Instruments equipped with R&S®SMB-B120/-B131/-B140 frequency options include a mechanical step attenuator. Instruments equipped with R&S®SMB-B112L/-B120L/-B140L frequency options do not include a step attenuator. These instruments have a limited level setting range and a limited specified level range.

Level setting modes

The R&S®SMB100A offers two different operating modes for level setting:

- Auto mode: The step attenuator is switched automatically
- Fixed mode: The level is set without switching the step attenuator. The step attenuator is fixed to the current setting. If ALC is on, level changes are performed without interruption. The maximum interruption-free setting range is limited

ALC modes

The R&S®SMB100A offers different 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, FM and ϕ M
- ALC state sample & hold (S&H): 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 pulse modulation

During an S&H measurement the level is decreased by 30 dB for instruments with electronic step attenuator. For instruments with mechanical attenuator or without step attenuator, the set on level is present for approximately 2 ms during an S&H procedure after level or frequency setting or after switching RF on.

Level settings

Setting ranges			
R&S®SMB-B112	100 kHz \leq f \leq 200 kHz	-145 dBm to +1 dBm	
	200 kHz < f \leq 300 kHz	-145 dBm to +6 dBm	
	300 kHz < f \leq 1 MHz	-145 dBm to +9 dBm	
	1 MHz < f \leq 12.75 GHz	-145 dBm to +30 dBm	
R&S®SMB-B112L	100 kHz \leq f \leq 200 kHz	-20 dBm to +5 dBm	
	200 kHz < f \leq 300 kHz	-20 dBm to +10 dBm	
	300 kHz < f \leq 1 MHz	-20 dBm to +13 dBm	
	1 MHz < f \leq 12.75 GHz	-20 dBm to +30 dBm	
R&S®SMB-B120/R&S®SMB-B131, R&S®SMB-B140/R&S®SMB-B140N	standard		
	100 kHz \leq f \leq 200 kHz	-145 dBm to +4 dBm	
	200 kHz < f \leq 300 kHz	-145 dBm to +9 dBm	
	300 kHz < f \leq 1 MHz	-145 dBm to +12 dBm	
	1 MHz < f \leq 40 GHz	-145 dBm to 3 dB above max. specified output power	
	with R&S®SMB-B31		
	100 kHz \leq f \leq 300 kHz	-145 dBm to +10 dBm	
	300 kHz < f \leq 50 MHz	-145 dBm to +12 dBm	
	50 MHz < f \leq 100 MHz	-145 dBm to +17 dBm	
	100 MHz < f \leq 200 MHz	-145 dBm to +20 dBm	
	200 MHz < f \leq 400 MHz	-145 dBm to +22 dBm	
	400 MHz < f \leq 20 GHz	-145 dBm to +30 dBm	
	R&S®SMB-B120L/R&S®SMB-B140L	standard	
		100 kHz \leq f \leq 200 kHz	-20 dBm to +4 dBm
200 kHz < f \leq 300 kHz		-20 dBm to +9 dBm	
300 kHz < f \leq 1 MHz		-20 dBm to +12 dBm	
1 MHz < f \leq 40 GHz		-20 dBm to 3 dB above max. specified output power	
with R&S®SMB-B31			
100 kHz \leq f \leq 300 kHz		-20 dBm to +10 dBm	
300 kHz < f \leq 50 MHz		-20 dBm to +12 dBm	
50 MHz < f \leq 100 MHz		-20 dBm to +17 dBm	
100 MHz < f \leq 200 MHz		-20 dBm to +20 dBm	
200 MHz < f \leq 400 MHz		-20 dBm to +22 dBm	
400 MHz < f \leq 20 GHz		-20 dBm to +30 dBm	
Resolution of setting			0.01 dB
Interruption-free level setting range		fixed mode, ALC state on	0 dB to +20 dB

Level performance

Specified level range, peak envelope power (PEP)		
R&S®SMB-B112	standard	
	200 kHz < f ≤ 1 MHz	-120 dBm to +6 dBm
	1 MHz < f ≤ 12.75 GHz	-120 dBm to +18 dBm
	with R&S®SMB-B30 option	
	200 kHz < f ≤ 1 MHz	-120 dBm to +5 dBm
R&S®SMB-B112L	standard	
	200 kHz < f ≤ 1 MHz	-5 dBm to +10 dBm
	1 MHz < f ≤ 12.75 GHz	-5 dBm to +18 dBm
	with R&S®SMB-B30 option	
	200 kHz < f ≤ 1 MHz	-5 dBm to +9 dBm
R&S®SMB-B120	standard	
	200 kHz < f ≤ 10 MHz	-120 dBm to +5 dBm
	10 MHz < f ≤ 50 MHz	-120 dBm to +10 dBm
	50 MHz < f ≤ 20 GHz	-120 dBm to +11 dBm
	with R&S®SMB-B31 option ¹	
	200 kHz < f ≤ 10 MHz	-120 dBm to +5 dBm
	10 MHz < f ≤ 50 MHz	-120 dBm to +10 dBm
R&S®SMB-B120L	standard	
	200 kHz < f ≤ 10 MHz	0 dBm to +5 dBm
	10 MHz < f ≤ 50 MHz	0 dBm to +10 dBm
	50 MHz < f ≤ 20 GHz	0 dBm to +14 dBm
	with R&S®SMB-B31 option ¹	
	200 kHz < f ≤ 10 MHz	0 dBm to +5 dBm
	10 MHz < f ≤ 50 MHz	0 dBm to +10 dBm
R&S®SMB-B131, R&S®SMB-B140, R&S®SMB-B140N	standard	
	200 kHz < f ≤ 10 MHz	-120 dBm to +5 dBm
	10 MHz < f ≤ 40 GHz	-120 dBm to +8 dBm
R&S®SMB-B140L	standard	
	200 kHz < f ≤ 10 MHz	0 dBm to +5 dBm
	10 MHz < f ≤ 50 MHz	0 dBm to +9 dBm
	50 MHz < f ≤ 40 GHz	0 dBm to +11 dBm
Level error		
ALC state on, temperature range: +18 °C to +33 °C		
R&S®SMB-B112	9 kHz ≤ f ≤ 200 kHz	< 1.0 dB
	200 kHz < f ≤ 3 GHz	< 0.5 dB
	f > 3 GHz	< 0.9 dB
R&S®SMB-B112L	200 kHz < f ≤ 3 GHz	< 0.7 dB
	f > 3 GHz	< 1.1 dB
R&S®SMB-B120L/-B140L	200 kHz < f ≤ 3 GHz	< 0.7 dB
	3 GHz < f ≤ 20 GHz	< 1.1 dB
	20 GHz < f ≤ 40 GHz	< 1.2 dB
R&S®SMB-B120/-B131, R&S®SMB-B140/-B140N	level > -90 dBm	
	200 kHz < f ≤ 3 GHz	< 0.5 dB
	3 GHz < f ≤ 20 GHz	< 0.9 dB
	20 GHz < f ≤ 40 GHz	< 1.0 dB
	level ≤ -90 dBm	
	200 kHz < f ≤ 3 GHz	< 0.5 dB
	3 GHz < f ≤ 20 GHz	< 1.2 dB
20 GHz < f ≤ 40 GHz	< 1.5 dB	
Additional level error	ALC state S&H	< 0.25 dB

¹ For instruments equipped with R&S®SMB-B25 option, the specification is valid with low harmonic filter off.
With low harmonic filter on, the standard level range is valid.

Level setting times

Setting time	level deviation < 0.1 dB ² from final value, with GUI update stopped, temperature range: +18 °C to +33 °C, without switching of the mechanical step attenuator	
	after IEC/IEEE bus delimiter	
	ALC state on	< 3 ms
	ALC state S&H, f ≤ 20 GHz	< 7 ms
	ALC state S&H, f > 20 GHz	< 10 ms
	in list mode after trigger pulse	< 1 ms
	with switching of the mechanical step attenuator	
	ALC state on	< 25 ms
ALC state S&H	< 30 ms	

Reverse power

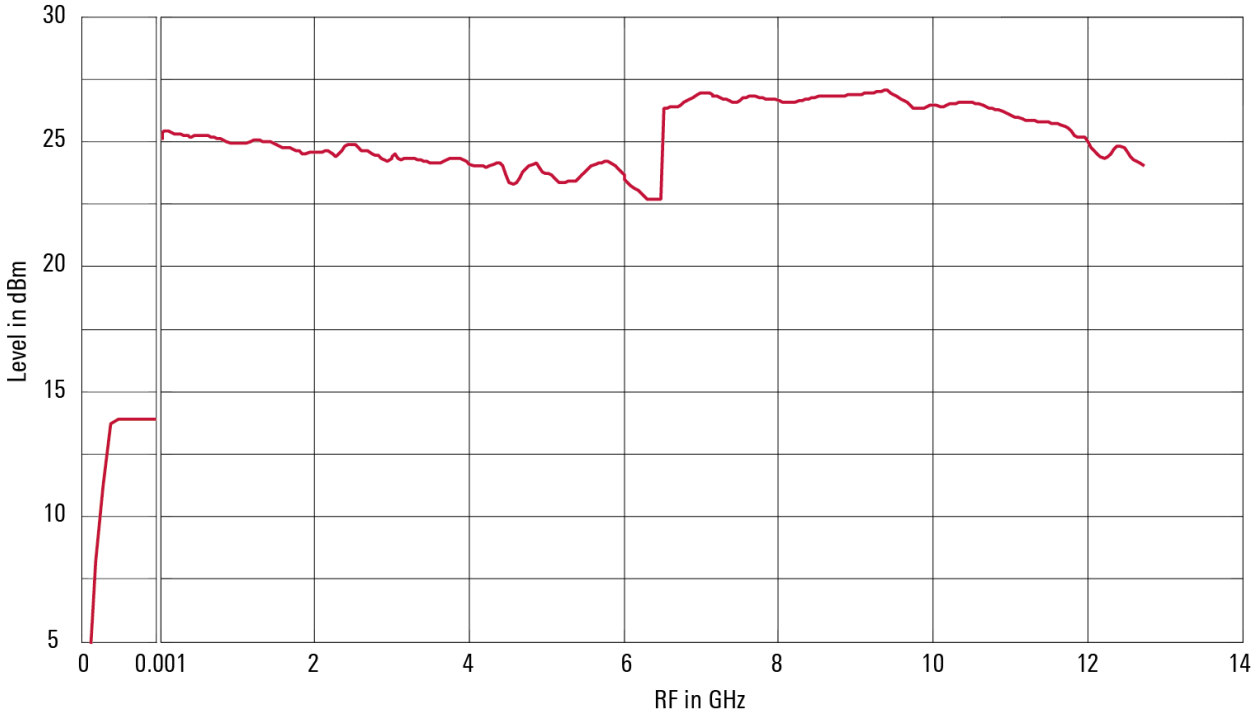
If the R&S®SMB100A is equipped with the R&S®SMB-B112 or R&S®SMB-B112L frequency option, a reverse power protection option (R&S®SMB-B30) is available.

Maximum permissible RF power in output frequency range of RF path for f > 1 MHz, from source ≥ 50 Ω		
Instruments with reverse power protection		
Reverse power	1 MHz < f ≤ 1 GHz	50 W
	1 GHz < f ≤ 2 GHz	25 W
	2 GHz < f ≤ 12.75 GHz	10 W
Maximum permissible DC voltage		35 V
Instruments without reverse power protection		
Reverse power		0.5 W
Maximum permissible DC voltage	R&S®SMB-B112/-B112L	35 V
	R&S®SMB-B120/-B120L, R&S®SMB-B131, R&S®SMB-B140/-B140L/-B140N	0 V

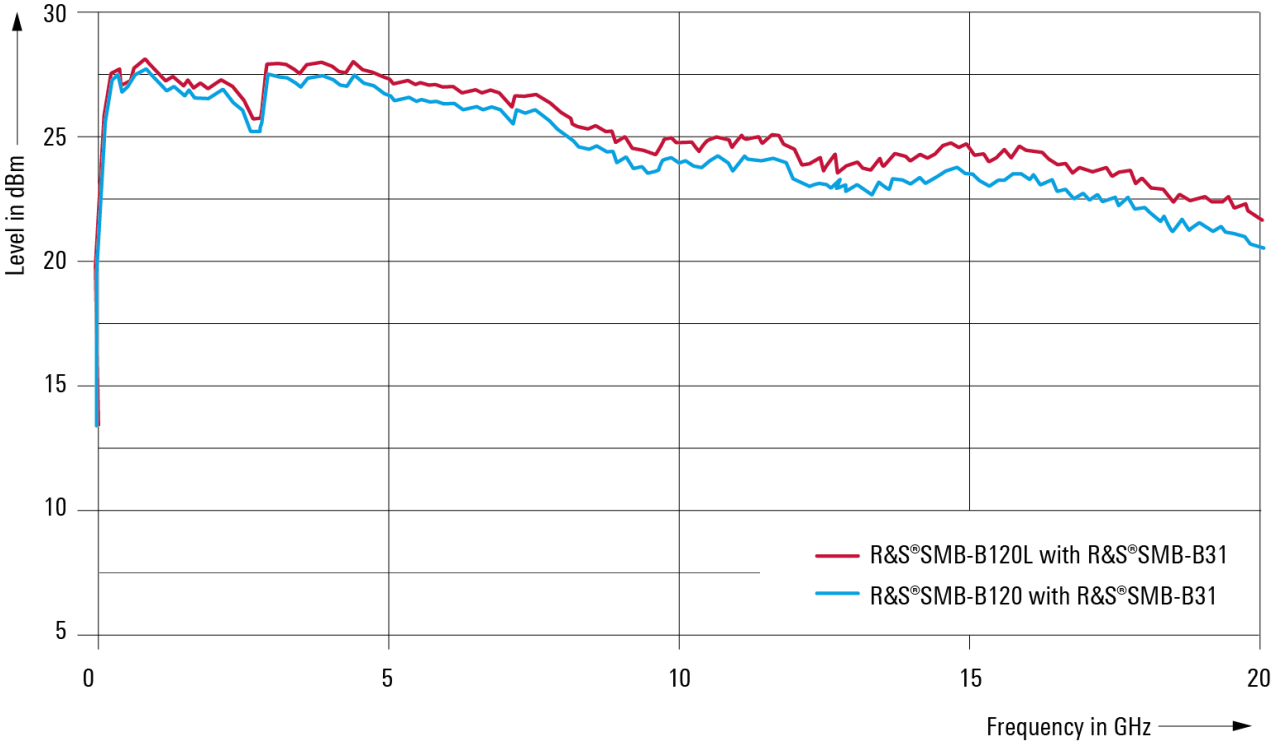
VSWR

Output impedance VSWR in 50 Ω system, ALC state on		
R&S®SMB-B112	f > 200 kHz	< 1.8
R&S®SMB-B112L/-B30	f > 200 kHz	< 2.0
R&S®SMB-B120/-B131, R&S®SMB-B140/-B140N	1 MHz < f ≤ 20 GHz	< 1.6 (meas.)
	20 GHz < f ≤ 40 GHz	< 1.8 (meas.)

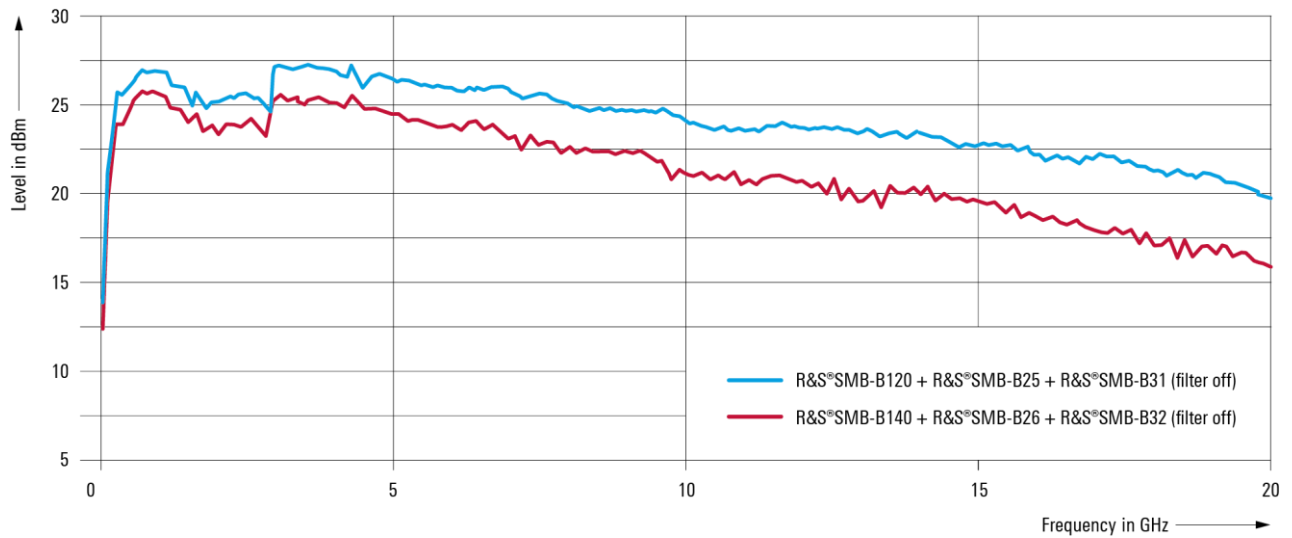
² Level deviation < 0.25 dB for f ≤ 23.4375 MHz for instruments equipped with an R&S®SMB-B112/-B112L/-B120/-B120L/-B131/-B140/-B140L/-B140N option.



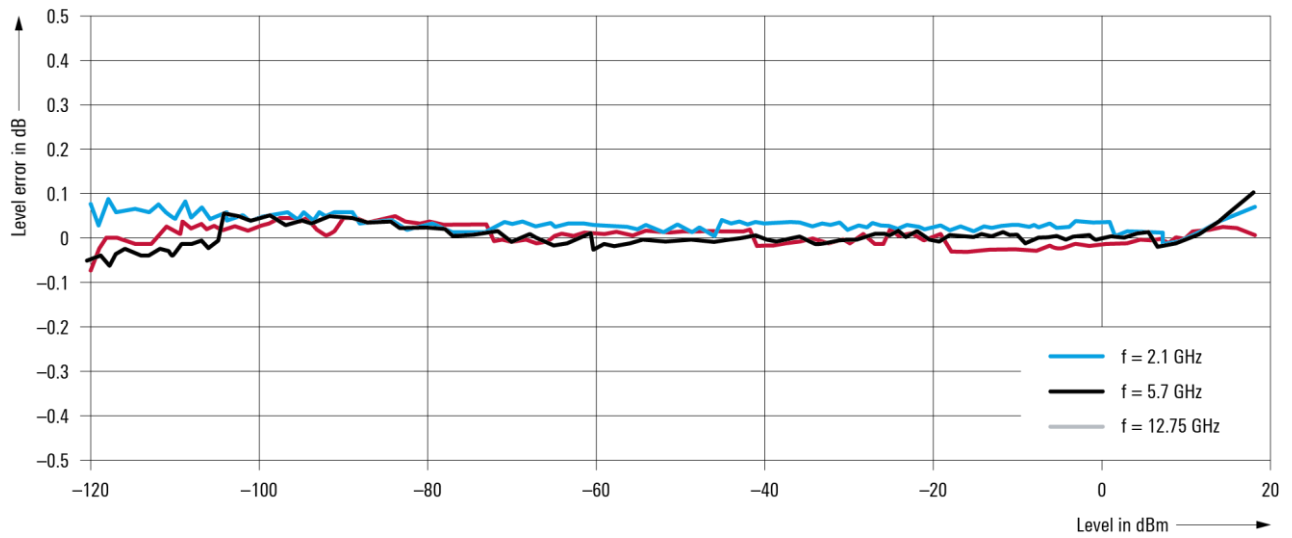
Maximum available output level versus frequency (meas.) for instruments equipped with R&S[®]SMB-B112 option



Maximum available output level versus frequency (meas.)



Maximum available output level versus frequency, low harmonic filter off (meas.)



Level linearity with R&S®SMB-B112 option, ALC on (meas.)

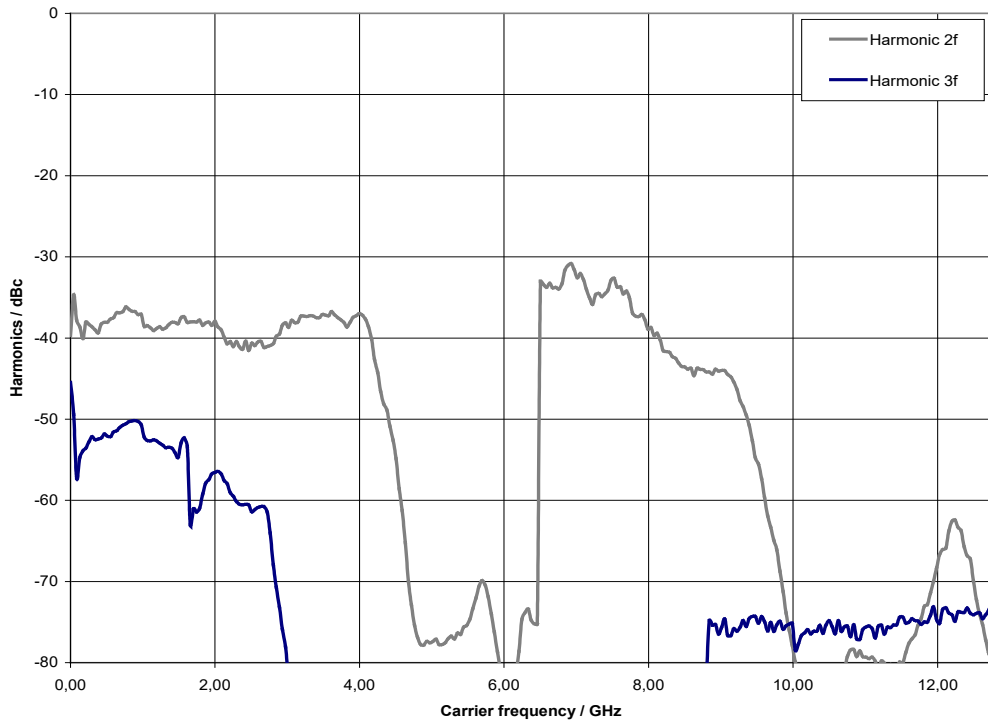
Level sweep

Operating mode		digital sweep in discrete steps
Trigger mode	free run	automatic
	full sweep	single
	execute one step	step
	external trigger only	start/stop
Trigger source		keyboard, external connector, remote control
Trigger slope	with external trigger	positive, negative
Sweep range		full specified level range
	interruption-free	-20 dB to +20 dB
Sweep shape		triangle, sawtooth
Step spacing		logarithmic
Step size setting resolution		0.01 dB
Dwell time setting range		10 ms to 100 s
Dwell time setting resolution		0.1 ms

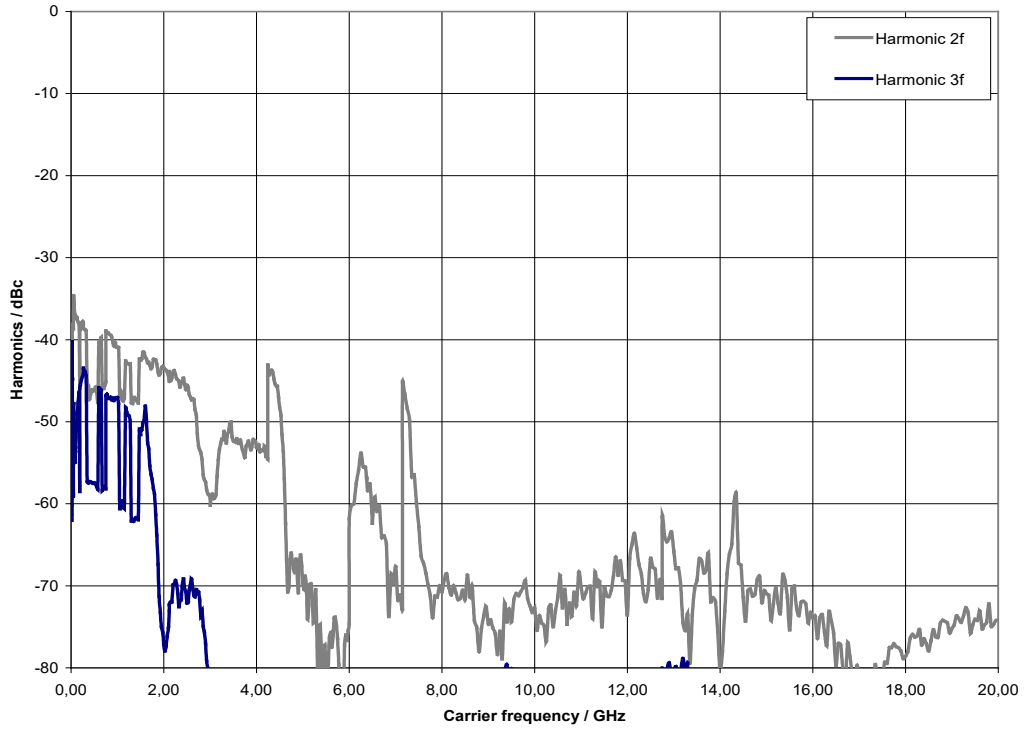
Spectral purity

Harmonics		
R&S®SMB-B112/-B112L	1 MHz < f ≤ 6 GHz, level ≤ 13 dBm ³	< -30 dBc
	f > 6 GHz, level ≤ 10 dBm ³	< -30 dBc
R&S®SMB-B120/-B120L/-B131, R&S®SMB-B140/-B140L/-B140N	standard, level ≤ 8 dBm ³	
	f > 1 MHz	< -30 dBc
	with R&S®SMB-B25 low harmonic option, low harmonic filter on, level ≤ 10 dBm ³	
	1 MHz < f ≤ 150 MHz	< -30 dBc
	150 MHz < f ≤ 3 GHz	< -58 dBc
	f > 3 GHz	< -50 dBc
Nonharmonics		
	CW, level > -10 dBm (level > 0 dBm for instruments without step attenuator), offset > 10 kHz from carrier	
	f ≤ 23.4375 MHz	< -70 dBc
	23.4375 MHz < f ≤ 1500 MHz	< -70 dBc, < -84 dBc (typ.)
	1500 MHz < f ≤ 3 GHz	< -64 dBc, < -78 dBc (typ.)
	3 GHz < f ≤ 6.375 GHz	< -58 dBc, < -72 dBc (typ.)
	6.375 GHz < f ≤ 12.75 GHz	< -52 dBc, < -66 dBc (typ.)
	12.75 GHz < f ≤ 25.5 GHz	< -46 dBc, < -60 dBc (typ.)
	25.5 GHz < f ≤ 40 GHz	< -40 dBc, < -54 dBc (typ.)
Subharmonics		
	level > -10 dBm (level > 0 dBm for instruments without step attenuator)	
	f < 6.375 GHz	none
	6.375 GHz < f ≤ 20 GHz	< -55 dBc
	20 GHz < f ≤ 40 GHz	< -50 dBc
Wideband noise		
	level operating mode: auto, level > 10 dBm ³ , measurement bandwidth 1 Hz, CW carrier offset: 10 MHz	
	15 MHz < f ≤ 6.375 GHz	< -142 dBc
	carrier offset: 30 MHz	
	6.375 GHz < f ≤ 12.75 GHz	< -138 dBc
	12.75 GHz < f ≤ 20 GHz	< -135 dBc
	20 GHz < f ≤ 40 GHz	< -132 dBc
SSB phase noise		
	carrier offset: 20 kHz, measurement bandwidth: 1 Hz, CW	
	f = 100 MHz, level = 10 dBm	< -141 dBc, -145 dBc (typ.)
	f = 1 GHz	< -122 dBc, -128 dBc (typ.)
	f = 2 GHz	< -116 dBc, -122 dBc (typ.)
	f = 3 GHz	< -112 dBc, -118 dBc (typ.)
	f = 4 GHz	< -110 dBc, -116 dBc (typ.)
	f = 6 GHz	< -106 dBc, -112 dBc (typ.)
	f = 10 GHz	< -102 dBc, -108 dBc (typ.)
	f = 20 GHz	< -96 dBc, -102 dBc (typ.)
	f = 30 GHz	< -92 dBc, -98 dBc (typ.)
	f = 40 GHz	< -90 dBc, -96 dBc (typ.)
RMS jitter		
	f = 1 GHz, bandwidth: 1 Hz to 10 MHz, CW	
	standard	7.2 ps (meas.), (7.2 mUI)
	with R&S®SMB-B1 option	1.3 ps (meas.), (1.3 mUI)
	with R&S®SMB-B1H option	105 fs (meas.), (105 μUI)
	f = 155 MHz, bandwidth: 100 Hz to 1.5 MHz, CW	83 fs (meas.), (12.9 μUI)
	f = 622 MHz, bandwidth: 1 kHz to 5 MHz, CW	63 fs (meas.), (39.2 μUI)
	f = 2.488 GHz, bandwidth: 5 kHz to 15 MHz, CW	55 fs (meas.), (137 μUI)
Residual FM		
	RMS value at f = 1 GHz, CW	
	0.3 kHz to 3 kHz, weighted (ITU-T)	< 4 Hz, 0.22 Hz (typ.)
	0.03 kHz to 23 kHz	< 10 Hz, 1.35 Hz (typ.)
Residual AM		
	RMS value (0.03 kHz to 20 kHz), CW, level: 8 dBm	
		< 0.02 %

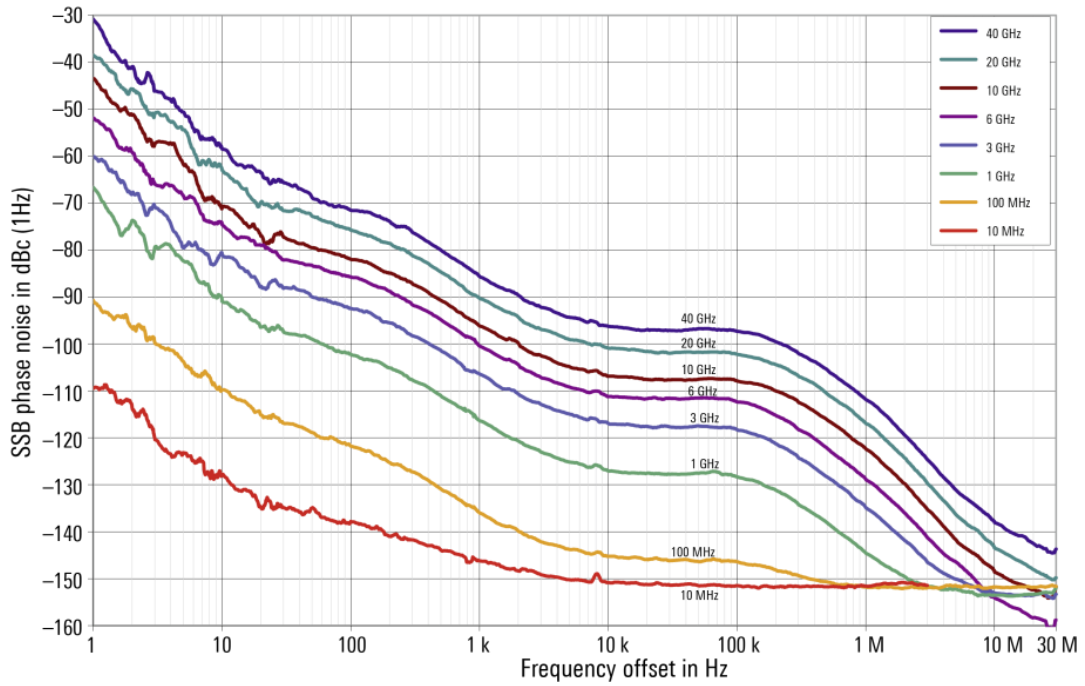
³ Or maximum specified output power, whichever is lower.



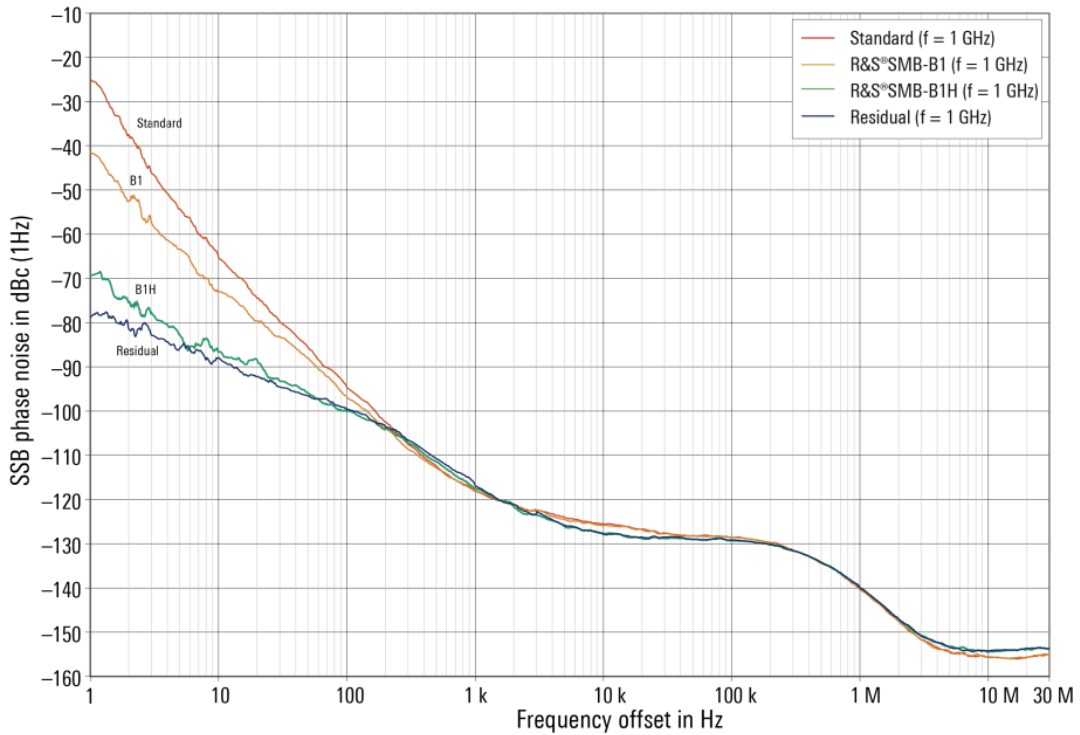
Harmonics versus carrier frequency at +15 dBm output level, with R&S[®]SMB-B112 option (meas.)



Harmonics versus carrier frequency at +8 dBm output level, with R&S[®]SMB-B140 option (meas.)



Measured SSB phase noise with R&S[®]SMB-B1H OCXO option, for the 12.75/20/40 GHz model



Measured SSB phase noise, $f = 1$ GHz, comparison with standard internal reference, R&S[®]SMB-B1 OCXO option, R&S[®]SMB-B1H OCXO option and residual phase noise

List mode settings

Frequency and level pairs can be stored in a list and set in an extremely short amount of time.

Trigger mode	free run	automatic
	full sweep	single
	execute one step	step
Trigger source		keyboard, external trigger, remote control
Maximum number of stored settings		2000
Dwell time setting range		1 ms to 100 s
Dwell time setting resolution		0.1 ms
Setting time	after external trigger	see frequency and level data

Analog modulation

Simultaneous modulation

	Amplitude modulation	Frequency modulation	Phase modulation	Pulse modulation
Amplitude modulation		●	●	(●)
Frequency modulation	●		○	●
Phase modulation	●	○		●
Pulse modulation	(●)	●	●	

● = compatible

○ = incompatible

(●) = compatible with limitations: No specification applies to AM distortion, AM depth error and on/off ratio with pulse modulation.

Amplitude modulation

For $f \geq 200$ kHz, level setting mode: auto, AM envelope within specified level range.

Modulation source		internal, external, internal and external	
External coupling		AC, DC	
AM depth setting range	at high levels; modulation is clipped when the maximum PEP is reached	0 % to 100 %	
Resolution of setting		0.1 %	
AM depth (m) error	$f_{\text{mod}} = 1$ kHz and $m < 80$ %	R&S [®] SMB-B112/-B112L/-B120/-B120L/-B131/-B140/-B140L/-B140N	
	$f > 1$ MHz, PEP ≤ 15 dBm ^{4,5}	< (4 % of setting + 1 %)	
AM distortion	$f_{\text{mod}} = 1$ kHz	$m = 30$ %	$m = 80$ %
	R&S [®] SMB-B112/-B112L/-B120/-B120L		
	$f > 5$ MHz, PEP ≤ 15 dBm ⁴	< 1.5 %	< 3 %
	R&S [®] SMB-B131/-B140/-B140L/-B140N		
	5 MHz < $f \leq 20$ GHz, PEP ≤ 13 dBm ⁴	< 1.5 %	< 3 %
	20 GHz < $f \leq 40$ GHz, PEP ≤ 10 dBm ^{4,5}	< 2 %	< 4 %
Modulation frequency response	$m = 60$ %, DC coupling: 0 Hz to 50 kHz, AC coupling: 10 Hz to 50 kHz	< 3 dB	
Synchronous ϕ M at AM	$m = 30$ %, $f_{\text{mod}} = 1$ kHz, \pm peak/2		
	$f \leq 20$ GHz	< 0.2 rad	
	20 GHz < $f \leq 40$ GHz	< 0.4 rad	

Frequency bands for frequency and phase modulation

Multiplier N is used to define FM and ϕ M specifications within this document.

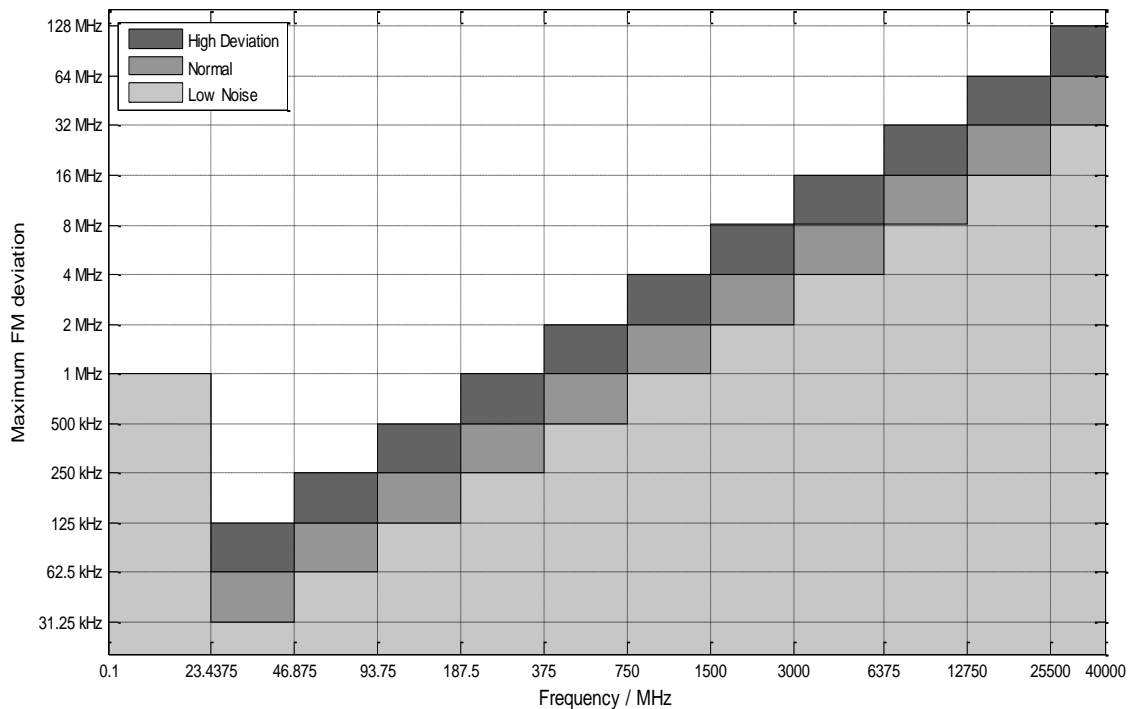
Multiplier N for different frequency ranges	$f \leq 23.4375$ MHz	1/4
	23.4375 MHz < $f \leq 46.875$ MHz	1/32
	46.875 MHz < $f \leq 93.75$ MHz	1/16
	93.75 MHz < $f \leq 187.5$ MHz	1/8
	187.5 MHz < $f \leq 375$ MHz	1/4
	375 MHz < $f \leq 750$ MHz	1/2
	750 MHz < $f \leq 1500$ MHz	1
	1500 MHz < $f \leq 3$ GHz	2
	3 GHz < $f \leq 6.375$ GHz	4
	6.375 GHz < $f \leq 12.75$ GHz	8
	12.75 GHz < $f \leq 25.5$ GHz	16
	25.5 GHz < $f \leq 40$ GHz	32

⁴ Or maximum specified output power, whichever is lower.

⁵ Temperature range: 0 °C to +33 °C for $f > 20$ GHz.

Frequency modulation

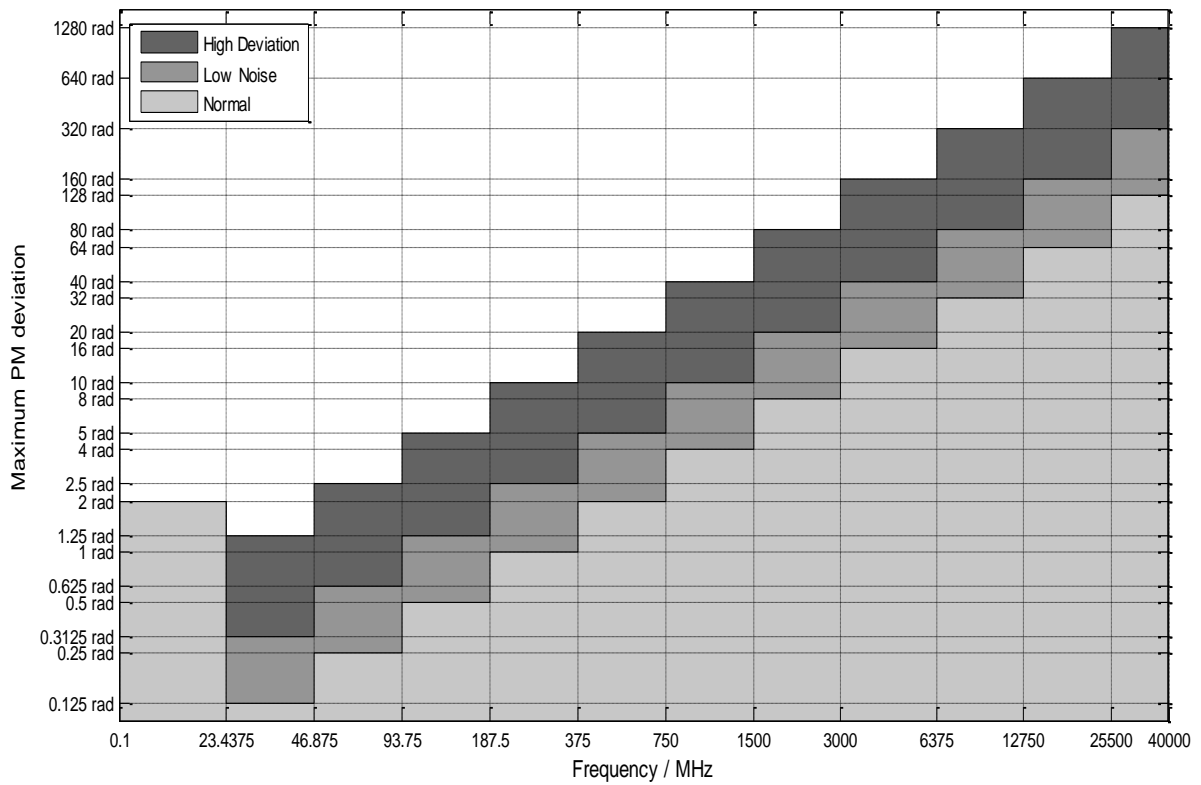
Modulation source		internal, external, internal and external
External coupling		AC, DC
Operating modes		<ul style="list-style-type: none"> • FM mode: low noise • FM mode: normal • FM mode: high deviation
Maximum deviation	$f \leq 23.4375$ MHz	1 MHz
	$f > 23.4375$ MHz	
	FM mode: normal	$N \times 2$ MHz
	FM mode: low noise	$N \times 1$ MHz
	FM mode: high deviation	$N \times 4$ MHz
Resolution		$< 0.02\%$ of set deviation, min. $N \times 0.1$ Hz
FM deviation error	$f_{\text{mod}} = 1$ kHz, deviation $\leq N \times 1$ MHz	
	internal	$< (2\% \text{ of setting} + 20 \text{ Hz})$
	external	$< (3\% \text{ of setting} + 20 \text{ Hz})$
FM distortion	$f_{\text{mod}} = 2$ kHz, deviation = $N \times 1$ MHz	$< 0.2\%$
Modulation frequency response	FM modes: low noise and high deviation	
	DC coupling: 0 Hz to 100 kHz, AC coupling: 10 Hz to 100 kHz	< 3 dB
	FM mode: normal	
	DC coupling: 0 Hz to 500 kHz, AC coupling: 10 Hz to 500 kHz	< 3 dB
Synchronous AM with FM	40 kHz deviation, $f_{\text{mod}} = 1$ kHz, $f > 10$ MHz	$< 0.2\%$
Carrier frequency offset with FM DC	after FM offset adjustment	$< 0.2\%$ of set deviation



FM deviation versus frequency and operating mode

Phase modulation

Modulation source		internal, external, internal and external
External coupling		AC, DC
Operating modes	φM modes: low noise/normal/high deviation	
Maximum deviation	f ≤ 23.4375 MHz	2 rad
	f > 23.4375 MHz	
	φM mode: normal	N × 4 rad
	φM mode: low noise	N × 10 rad
	φM mode: high deviation	N × 40 rad
Resolution		< 0.02 % of set deviation, min. N × 20 μrad
φM deviation error	f _{mod} = 1 kHz, deviation ≤ half of maximum deviation	
	internal	< (2 % of setting + 0.003 rad)
	external	< (3 % of setting + 0.003 rad)
φM distortion	f _{mod} = 10 kHz, half of maximum deviation	< 0.2 %
Modulation frequency response	φM modes: low noise and high deviation	
	DC coupling: 0 Hz to 100 kHz, AC coupling: 10 Hz to 100 kHz	< 3 dB
	φM mode: normal	
	DC coupling: 0 Hz to 500 kHz, AC coupling: 10 Hz to 500 kHz	< 3 dB



φM deviation versus frequency and operating mode

Pulse modulation (R&S®SMB-K21 or R&S®SMB-K22 option)

When pulse modulation is activated, the R&S®SMB100A automatically switches to ALC state S&H. In this case, the ALC loop is opened and the output level is set directly. In order to set the correct level, a S&H measurement is performed prior to each frequency or level setting or after switching RF on.

In the following cases, the nominal on level is present for approximately 2 ms during a S&H measurement after level or frequency setting or after switching RF on:

- No attenuator installed (R&S®SMB-B112L/-B120L/-B140L frequency option)
- A mechanical step attenuator installed (R&S®SMB-B120/-B131/-B140/-B140N frequency option)

For instruments with electronic step attenuator (R&S®SMB-B112 frequency option), the level during a sample and hold measurement is decreased by 30 dB.

The R&S®SMB-K21 option is available for R&S®SMB-B112/-B112L/-B120/-B120L/-B131/-B140/-B140L/-B140N.

Modulation source		external, internal
On/off ratio	level > 0 dBm for instruments without step attenuator	> 80 dB
Rise/fall time	10 % to 90 % of RF amplitude	
	23.4375 MHz < f ≤ 20 GHz	< 15 ns, < 5 ns (typ.)
	f > 20 GHz	< 15 ns, < 9 ns (typ.)
Minimum pulse width	50 %/50 % of RF amplitude	
	with R&S®SMB-B112, R&S®SMB-B112L, R&S®SMB-B120, R&S®SMB-B120L, R&S®SMB-B131, R&S®SMB-B140, R&S®SMB-B140L frequency options	20 ns
	with R&S®SMB-B140N frequency option	
	f ≤ 20.0 GHz	20 ns
	f > 20.0 GHz	30 ns
Pulse repetition frequency		0 Hz to 25 MHz
Video crosstalk for R&S®SMB-B112/-B112L/-B120/-B120L/ -B140/-B140L/-B140N	spectral line of fundamental of 100 kHz pulse repetition frequency	< -30 dBc

Input for external modulation signals

Modulation input EXT for AM/FM/φM		
Connector type	MOD EXT	BNC female
Input impedance	selectable	220 kΩ or 600 Ω (nom.)
Input sensitivity	peak value for set modulation factor or deviation	1 V (nom.)
Maximum input voltage		1 V (nom.)
Input damage voltage		±10 V
Modulation input PULSE EXT		
Connector type	PULSE EXT on rear panel	BNC female
Input impedance	selectable	10 kΩ or 50 Ω (nom.)
Input voltage	TTL, CMOS compatible, threshold low	0.5 V (nom.)
	TTL, CMOS compatible, threshold high	1.5 V (nom.)
Input damage voltage		± 5 V
Input polarity	selectable	normal, inverse

Modulation sources

Internal modulation generator (LF)

Waveforms		sine wave, square wave, sawtooth
Frequency range	sine wave	0.1 Hz to 1 MHz
	square wave, sawtooth	0.1 Hz to 20 kHz
Resolution of frequency setting		0.1 Hz
Frequency error	< (0.005 Hz + relative error of reference frequency × modulation frequency)	
Frequency response	sine wave, 0.1 Hz to 1 MHz	< 1 dB
Frequency setting time	to within $< 1 \times 10^{-7}$, after IEC/IEEE bus delimiter	< 5 ms (meas.)
Distortion	sine wave, $f \leq 100$ kHz at $R_L > 200 \Omega$, $V_p = 1$ V	< 0.1 %
Output voltage range	V_p at LF connector, open circuit voltage	1 mV to 3 V
Resolution of output voltage setting		1 mV
Output voltage setting error	at 1 kHz, $R_L \geq 10$ k Ω	< (1 % of setting + 1 mV)
Output impedance	selectable	10 Ω or 600 Ω (nom.)

LF frequency sweep

Operating mode		digital sweep in discrete steps
Trigger mode	free run	automatic
	full sweep	single
	execute one step	step
	external trigger only	start/stop
Trigger source		keyboard, external trigger, remote control
Trigger slope		positive, negative
Sweep range		full frequency range, min. 0.1 Hz
Sweep shape		triangle, sawtooth
Step spacing		linear, logarithmic
Step size setting resolution	linear	0.1 Hz
	logarithmic	0.01 %
Dwell time setting range		10 ms to 100 s
Dwell time setting resolution		0.1 ms

Pulse generator (R&S®SMB-K23 option)

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

Pulse mode		single pulse, double pulse
Trigger modes	free run, internally triggered	automatic
		externally triggered, externally gated
Active trigger edge		positive or negative
Pulse period setting range		40 ns to 100 s
Pulse period setting resolution		10 ns
Pulse width setting range	pulse widths of double pulses can be set independently	10 ns to 100 s
Pulse width setting resolution		10 ns
Pulse delay setting range	with external trigger	10 ns to 100 s
Pulse delay setting resolution	with external trigger	10 ns
Double-pulse spacing setting range		20 ns to 100 s
Double-pulse spacing setting resolution		10 ns
External trigger delay		50 ns (meas.)
External trigger jitter of delay		< 10 ns
Pulse video output signal	without load	digital signal 0 V/3.3 V (nom.)

Pulse train (R&S®SMB-K27 option)

The R&S®SMB-K27 option enhances the functionality of the pulse generator (R&S®SMB-K23 option). With this option, pulses and pulse sequences can be user-defined, e.g. to generate jittered or staggered pulse scenarios widely used in radar applications.

Pulse modes	setting of pulse width, pulse spacing and pulse sequences	user-programmable
Trigger modes		automatic (free run) externally triggered
Active trigger edge		positive or negative
Number of pulses		1 to 2047
Number of repetitions per pulse		1 to 65535
Pulse width and pulse spacing setting range		10 ns to 5 ms
Pulse width and pulse spacing setting resolution		10 ns

Remote control

Interfaces	remote control	IEC 60625 (GPIB IEEE-488.2)	
	Ethernet/LAN	10/100BASE-T	
	USB	2.0 (high speed)	
	serial	RS-232 ⁶	
Command set		SCPI 1999.5 or compatible command sets	
Compatible command sets	These command sets can be selected in order to emulate another instrument.	Agilent/Keysight/HP E442x	
		Agilent/Keysight/HP E443x	
Agilent/Keysight/HP E8663			
Agilent/Keysight/HP E8257/67			
Agilent/Keysight/HP N51xx Analog Parts			
Agilent/Keysight/HP 8642			
Agilent/Keysight/HP 8643A			
Agilent/Keysight/HP 8644A/B			
Agilent/Keysight/HP 8645			
Agilent/Keysight/HP 8647A			
Agilent/Keysight/HP 8648A/B/C/D			
Agilent/Keysight/HP 8656A/B			
Agilent/Keysight/HP 8657A/B			
Agilent/Keysight/HP 8664/65			
Agilent/Keysight N5161A, 5181A (MXG analog)			
Aeroflex/IFR 2023/2024			
Aeroflex/IFR 203x, 204x, 205x			
Panasonic PA8303			
R&S [®] SML			
R&S [®] SMT			
R&S [®] SMY			
Compatible command sets	additional command sets for instruments equipped with R&S [®] SMB-B112/B112L, R&S [®] SMB-B120/-B120L/-B131, R&S [®] SMB-B140/-B140L/-B140N	Anritsu 68017/37	
		Agilent/Keysight/HP 834x	
Agilent/Keysight/HP 8360			
Agilent/Keysight/HP 8362x			
Agilent/Keysight/HP 83630			
Agilent/Keysight/HP 8371x			
Agilent/Keysight/HP 8373x			
Agilent/Keysight/HP 8662/63			
Agilent/Keysight/HP 8673			
Agilent/Keysight N5183A (MXG microwave)			
Agilent/Keysight E8257D; 8663 B/D (PSG analog)			
R&S [®] SMR			
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 ease the direct connection to a system controller	
USB protocol		VISA USB-TMC	

⁶ Requires the R&S[®]TS-USB1 serial adapter (recommended extra).

Connectors

Front panel connectors

RF 50 Ω	RF output	
	R&S®SMB-B112/-B112L/-B120/-B120L	test port adapter, PC 3.5 mm female (interchangeable port connector system)
	R&S®SMB-B131/-B140/-B140L/-B140N	test port adapter, PC 2.92 mm female (interchangeable port connector system)
LF	modulation generator output	BNC female
MOD EXT	input for external analog modulation	BNC female

Rear panel connectors

REF IN	reference frequency input	BNC female
REF OUT	reference frequency output	BNC female
PULSE EXT	input for external pulse modulation	BNC female
PULSE VIDEO	pulse generator output	BNC female
INST TRIG	trigger input, TTL 5 V compatible	BNC female
SIGNAL VALID	output for triggering external devices; function 1: low state indicates that the instrument has settled to its final value; function 2 ⁷ : If the pulse generator is active and pulse sync is enabled, a pulse sync signal is provided at the beginning of a pulse sequence (e.g. pulse train). Pulse sync is not available for a pulse sequence < 100 ns.	BNC female
USB IN	USB 2.0 (high speed), remote control of instrument (USB-TMC)	USB type B
USB	USB 2.0 (high speed), connector for external USB devices, <ul style="list-style-type: none"> • 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 remote operation via VNC and file transfer via FTP	RJ-45
IEEE 488	remote control of instrument via GPIB	24-pin Amphenol series 57 female

⁷ Requires the R&S®SMB-K23 option; only available for instruments with serial number > 102400.

General data

Power supply		
AC input voltage range		90 V to 264 V
AC supply frequency	100 V to 240 V	45 Hz to 66 Hz
	100 V to 120 V	380 Hz to 440 Hz
Maximum input current		1.4 A (100 V) to 0.6 A (240 V)
	instruments with options	
	R&S®SMB-B112	80 W (meas.)
	R&S®SMB-B120 and R&S®SMB-B31	90 W (meas.)
	R&S®SMB-B120, R&S®SMB-B25 and R&S®SMB-B31	105 W (meas.)
R&S®SMB-B131/-B140/-B140N	125 W (meas.)	
Product conformity		
Electromagnetic compatibility	EU: in line with EMC directive 2014/30/EU	applied harmonized standards: <ul style="list-style-type: none"> 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	EU: in line with low voltage directive 2014/35/EU	applied harmonized standard: EN 61010-1
	USA	UL 61010-1
	Canada	CAN/CSA-C22.2 No. 61010-1
RoHS	EU: in line with directive 2011/65/EU	EN IEC 63000
International certification	VDE – Association for Electrical, Electronic and Information Technologies	VDE mark 40021972
	CSA – Canadian Standard Association	cCSAus
Mechanical resistance		
Vibration	sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, const. 0.5 g at 55 Hz to 150 Hz, in line with EN 60068-2-6
	random	10 Hz to 300 Hz, acceleration: 1.2 g (RMS), in line with EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810E, method no. 516.4, procedure I
Environmental conditions		
Temperature range	operating	0 °C to +55 °C, in line with DIN EN 60068-2-1, DIN EN 60068-2-2
	storage	–40 °C to +71 °C
Climatic resistance	+40 °C, 95 % relative humidity	in line with DIN EN 60068-2-78
Altitude	operating, maximum ambient temperature: +45 °C	up to 4600 m (15000 ft)
	storage	up to 4600 m (15000 ft)
Calibration interval		
Recommended calibration interval	when operated 40 h/week in the full range of the specified environmental conditions	3 years
Dimensions and weight		
Dimensions	instruments with R&S®SMB-B112/-B112L/-B120/-B120L/-B131/-B140/-B140L/-B140N option	344 mm x 112 mm x 418 mm (13.5 in x 4.4 in x 16.5 in)
Weight	when fully equipped	
	instruments with R&S®SMB-B112 option	5.6 kg (12.3 lb)
	instruments with R&S®SMB-B120/-B120L/-B131/-B140/-B140L/-B140N option	6.9 kg (15.2 lb)

Ordering information

Designation	Type	Order No.
Base unit		
RF and microwave signal generator ⁸	R&S®SMB100A	1406.6000.02
Including power cable, quick start guide and CD-ROM (with operating and service manual)		
Options		
RF path/frequency option		
100 kHz to 12.75 GHz, with electronic step attenuator	R&S®SMB-B112	1407.2109.02
100 kHz to 12.75 GHz, without step attenuator	R&S®SMB-B112L	1407.2150.02
100 kHz to 20 GHz, with mechanical step attenuator	R&S®SMB-B120	1407.2209.02
100 kHz to 20 GHz, without step attenuator	R&S®SMB-B120L	1407.2250.02
100 kHz to 31.8 GHz, with mechanical step attenuator	R&S®SMB-B131	1407.2280.02
100 kHz to 40 GHz, with mechanical step attenuator	R&S®SMB-B140	1407.2309.02
100 kHz to 40 GHz, without step attenuator	R&S®SMB-B140L	1407.2350.02
100 kHz to 40 GHz, with mechanical step attenuator, minimum pulse width limited	R&S®SMB-B140N	1407.2380.02
OCXO reference oscillator ⁹	R&S®SMB-B1	1407.3005.02
OCXO reference oscillator, high performance ⁹	R&S®SMB-B1H	1407.3070.02
Harmonic filter option, 150 MHz to 20 GHz (only available with R&S®SMB-B120/-B120L)	R&S®SMB-B25	1407.1660.02
Reverse power protection (only available with R&S®SMB-B112, R&S®SMB-B112L)	R&S®SMB-B30	1407.1160.02
High-power option, 50 MHz to 20 GHz (only available with R&S®SMB-B120/-B120L)	R&S®SMB-B31	1407.1260.02
Pulse modulator, for R&S®SMB-B112/-B112L/-B120/-B120L/-B131/-B140/-B140L/-B140N	R&S®SMB-K21	1407.3811.02
Pulse generator	R&S®SMB-K23	1407.3786.02
Pulse train ¹⁰	R&S®SMB-K27	1407.3828.02
Recommended extras		
19" rack adapter	R&S®ZZA-S234	1109.4493.00
Power sensor, 9 kHz to 6 GHz, for levels up to 33 dBm, incl. USB adapter cable	R&S®NRP-Z92	1171.7005.42
Power sensor, DC to 40 GHz, for levels up to 20 dBm	R&S®NRP-Z55	1138.2008.03
Power sensor, 10 MHz to 18 GHz, for levels up to 33 dBm	R&S®NRP-Z22	1137.7506.02
USB adapter for R&S®NRP-Zxx power sensors	R&S®NRP-Z4	1146.8001.02
USB serial adapter for RS-232 remote control	R&S®TS-USB1	6124.2531.00
Adapters for instruments with an R&S®SMB-B112/-B112L/-B120/-B120L frequency option		
Test port adapter, PC 3.5 mm female		1021.0512.00
Test port adapter, PC 3.5 mm male		1021.0529.00
Test port adapter, N female		1021.0535.00
Test port adapter, N male		1021.0541.00
Adapters for instruments with an R&S®SMB-B131/-B140/-B140L/-B140N frequency option		
Test port adapter, 2.4 mm female		1088.1627.02
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
DKD (ISO 17025) calibration including ISO 9000 calibration	R&S®SMB-DKD	1161.3607.02

⁸ The base unit must be ordered together with an R&S®SMB-B112/-B112L/-B120/-B120L/-B131/-B140/-B140L/-B140N frequency option.

⁹ Only one of the R&S®SMB-B1 or R&S®SMB-B1H option can be installed.

¹⁰ Requires the R&S®SMB-K23 option; only available for instruments with serial number > 102400.

Warranty		
Base unit		3 years
All other items ¹¹		1 year
Service options		
Extended warranty, one year	R&S®WE1	Contact your local Rohde & Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

Extended warranty with a term of one and two years (WE1 and WE2)

Repairs carried out during the contract term are free of charge ¹². 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 ¹² and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

Extended warranty with accredited calibration (AW1 and AW2)

Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated under accreditation, inspected and maintained during the term of the contract. It includes all repairs ¹² and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

Phased-out articles

R&S®SMB-B26 and R&S®SMB-B32 are phased out from November 15, 2023.

¹¹ For options installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

¹² Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.

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