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# R&S® SMA100A Signal Generator

Data sheet



**ROHDE & SCHWARZ**

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# Key features

## Excellent signal quality

- Very low SSB phase noise of typ.  $-135$  dBc (20 kHz carrier offset,  $f = 1$  GHz, 1 Hz measurement bandwidth), typ.  $-140$  dBc with the Enhanced Phase Noise Performance option (R&S<sup>®</sup>SMA-B22)
- Wideband noise of typ.  $-160$  dBc (>10 MHz carrier offset,  $f = 1$  GHz, 1 Hz measurement bandwidth)
- Nonharmonics of typ.  $-100$  dBc (>10 kHz carrier offset,  $f < 1500$  MHz, with the R&S<sup>®</sup>SMA-B22 option)
- High-stability reference oscillator as standard
- Very low phase noise at low frequencies due to internal division of the fundamental frequency range (750 MHz to 1500 MHz) down to 6.6 MHz

## Ideal for use in production

- Very short frequency and level setting times of <3 ms across the entire frequency and level range, <450  $\mu$ s in list mode
- Fast hopping mode with flexibly addressable frequency and level pairs, as fast as normal list mode
- Frequency setting time of typ. 10  $\mu$ s within a bandwidth of up to 80 MHz due to direct access to the DDS-based synthesizer (with the option R&S<sup>®</sup>SMA-B20 or -B22; FM EXTERNAL DIGITAL mode)
- Very high level accuracy and repeatability
- High output power of up to +18 dBm, overrange up to +28 dBm
- Electronic attenuator with built-in overvoltage protection over entire frequency range
- Minimum space requirements due to compact size (only two height units)

## Mil/Aero applications

- Pulse modulator with excellent characteristics (on/off ratio typ. 100 dB, rise/fall time typ. 10 ns)
- Pulse generator integrated as standard
- Optional high-performance pulse generator with minimum pulse width of 20 ns (R&S<sup>®</sup>SMA-K23)
- Optional removable mass storage (compact flash disk, R&S<sup>®</sup>SMA-B80)
- Optional VOR/ILS modulation (R&S<sup>®</sup>SMA-K25)
- Optional operating altitude up to 4600 m (R&S<sup>®</sup>SMA-B46)

## All-purpose instrument

- Frequency range of 9 kHz to 3 GHz (R&S<sup>®</sup>SMA-B103/-B103L) or 6 GHz (R&S<sup>®</sup>SMA-B106/-B106L)
- Frequency, level and LF sweeps
- AM, broadband FM/ $\phi$ M (SMA-B20 or -B22), pulse modulation
- Built-in LF generator up to 1 MHz, optional multifunction generator (R&S<sup>®</sup>SMA-K24) up to 10 MHz
- Optional low-jitter clock synthesizer up to 1.5 GHz (R&S<sup>®</sup>SMA-B29)

## Intuitive operating concept

- Color display with 320  $\times$  240 pixels ( $\frac{1}{4}$  VGA)
- Intuitive user interface with graphical display of signal flow (block diagram)
- Context-sensitive online help

## Versatile interfaces

- Remote control via GPIB or LAN
- USB connectors (e.g. for keyboard, mouse, memory stick)
- Connector for R&S<sup>®</sup>NRP power sensors for precise power measurements
- Selectable SCPI- or 8662A/63A-compatible IEC/IEEE bus command set
- Control via remote operation tool (e.g. VNC)

# Specifications

Specifications apply under the following conditions:

30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed. Data designated "overrange" or "underrange" and data without tolerance limits is not binding.

## RF characteristics

### Frequency

Range	R&S®SMA-B103/-B103L	9 kHz to 3 GHz
	R&S®SMA-B106/-B106L	9 kHz to 6 GHz
Resolution of setting		0.01 Hz
Resolution of synthesis	standard, fundamental frequency range	
	750 MHz to 1500 MHz	5 µHz
	with option R&S®SMA-B22	0.2 µHz
Setting time	to within $<1 \times 10^{-7}$ for $f > 6.6$ MHz or $<35$ Hz for $f < 6.6$ MHz	
	after IEC/IEEE bus delimiter	<3 ms
	in ALC OFF S&H mode	<5 ms
	after trigger pulse in LIST mode	<450 µs
Phase offset		adjustable in 0.1° steps

### Frequency sweep

Operating modes	digital sweep in discrete steps	AUTOMATIC, STEP, SINGLE SWEEP, EXTERNAL SINGLE, EXTERNAL STEP, EXTERNAL START/STOP, MANUAL/EXTERNAL TRIGGER, LINEAR/LOGARITHMIC SPACING
Sweep range		full frequency range
Step width	linear logarithmic	full frequency range 0.01 % to 100 % per step
Dwell time	range	10 ms to 10 s
	resolution	0.1 ms

### Reference frequency

Aging	after 30 days of uninterrupted operation	$1 \times 10^{-9}$ /day, $1 \times 10^{-7}$ /year
	with option R&S®SMA-B22	$5 \times 10^{-10}$ /day, $3 \times 10^{-8}$ /year
Maximum temperature effect	in temperature range 0 °C to +50 °C	$\pm 6 \times 10^{-8}$
	with option R&S®SMA-B22	$\pm 6 \times 10^{-9}$
Warm-up time	to nominal thermostat temperature	≤10 min
Output for internal reference signal	frequency (approx. sinewave)	10 MHz or external input frequency
	level	typ. 5 dBm
	source impedance	50 Ω
Input for external reference	frequency	5 MHz, 10 MHz or 13 MHz
	maximum deviation	$3 \times 10^{-6}$
	input level, limits	≥-6 dBm, ≤19 dBm
	recommended	0 dBm to 19 dBm
Electronic tuning from input (EXT. TUNE)	input impedance	50 Ω
	sensitivity	typ. $4 \times 10^{-9}$ V to $3 \times 10^{-8}$ V
	input voltage	-10 V to +10 V
	input impedance	typ. 10 kΩ
	with option R&S®SMA-B22	typ. 5 kΩ

## Level

The R&S®SMA100A has three different modes for level setting:

**NORMAL mode:** In this mode, the attenuator switches without wear and tear due to the exclusive use of electronic switches. The maximum specified level depends on the set frequency (see table below). A typical level overrange up to +20 dBm is available.

**HIGH POWER mode:** In this mode, the electronic attenuator is bypassed with mechanical relays for high output power (up to typ. 28 dBm overrange). The relays are not switched over in this mode. The typical minimum level is -11 dBm.

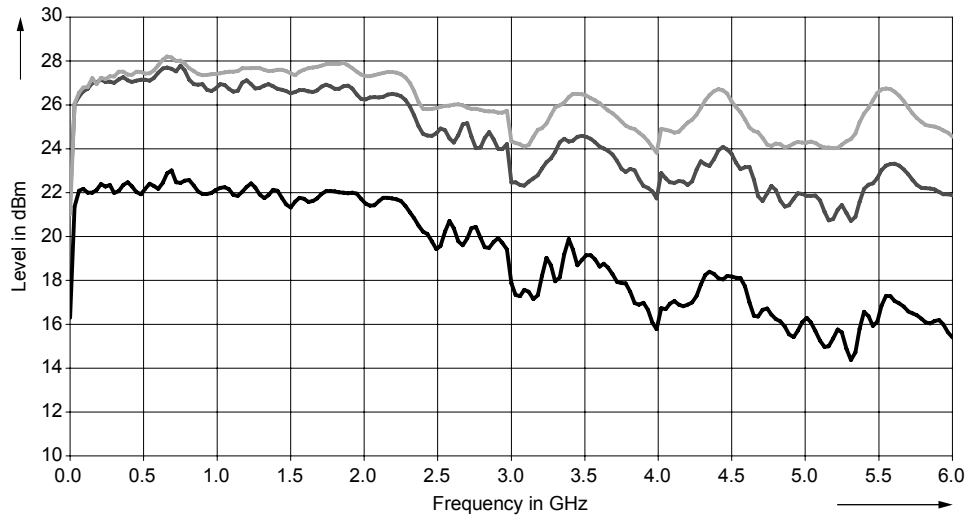
**AUTO mode:** In this mode, the mechanical relay bypass is switched automatically if the set level is higher than the specified max. level in the mode NORMAL. The output level is specified over the full range from -120 dBm up to +18 dBm (+15 dBm for R&S®SMA-B106).

The R&S®SMA100A is also available without attenuator (option R&S®SMA-B103L and R&S®SMA-B106L).

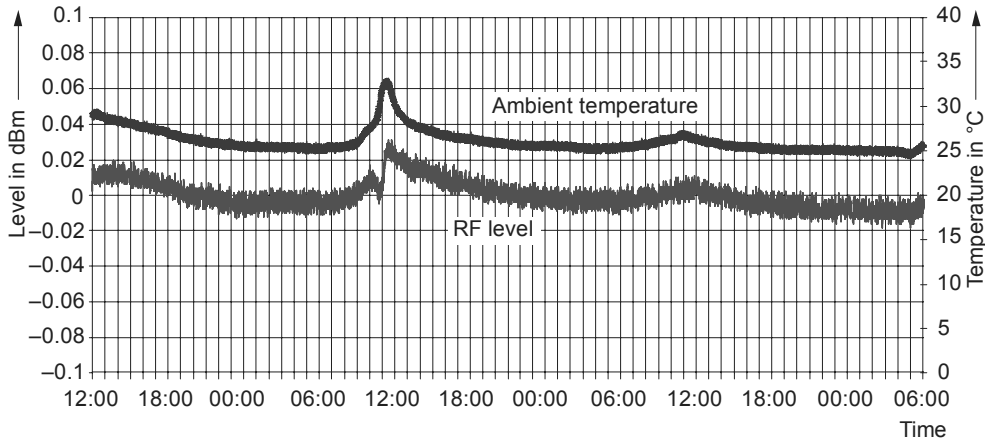
Setting range	with electronic attenuator (option R&S®SMA-B103/-B106)	-145 dBm to +30 dBm <sup>1</sup>
	without attenuator (option R&S®SMA-B103L/-B106L)	-20 dBm to +30 dBm <sup>1</sup>
Specified level range with R&S®SMA-B103/-B106 frequency option	NORMAL mode	
	100 kHz < f ≤ 250 kHz	-120 dBm to +11 dBm (PEP) <sup>2</sup>
	250 kHz < f ≤ 3 GHz	-120 dBm to +13 dBm (PEP)
	f > 3 GHz	-120 dBm to +9 dBm (PEP)
	AUTO mode	
	100 kHz < f ≤ 30 MHz	-120 dBm to +16 dBm (PEP)
Specified level range with R&S®SMA-B103L/-B106L frequency option	AUTO mode	
	100 kHz < f ≤ 30 MHz	+12 dBm to +17 dBm (PEP)
	30 MHz < f ≤ 3 GHz	+12 dBm to +19 dBm (PEP)
	f > 3 GHz	+10 dBm to +17 dBm (PEP)
Resolution		0.01 dB
Level uncertainty	ALC state on, attenuator mode AUTO temperature range +18 °C to +33 °C	
	100 kHz < f ≤ 3 GHz	<0.5 dB
	f > 3 GHz	<0.9 dB
Additional uncertainty with ALC OFF, S&H	this mode is only needed with pulse modulation, after "search once"	<0.3 dB
Output impedance VSWR in 50 Ω system with R&S®SMA-B103/-B106 frequency option	NORMAL mode, ALC state on	
	6.6 MHz < f ≤ 3 GHz	<1.65, typ. <1.35
	f > 3 GHz	<1.9, typ. <1.65
	HIGH POWER mode, ALC state on	
Output impedance VSWR in 50 Ω system with R&S®SMA-B103L/-B106L frequency option	without attenuator, ALC state on	
	6.6 MHz < f ≤ 3 GHz	<1.9, typ. <1.7
	f > 3 GHz	<2.3, typ. <2.0
	Setting time	
Uninterrupted level setting	after IEC/IEEE bus delimiter, with GUI update stopped, attenuator mode AUTO temperature range +18 °C to +33 °C, to <0.1 dB deviation from final value	
	ALC state ON	<3 ms
	ALC state OFF	<5 ms
	in LIST mode after trigger impulse	<450 μs
	to <0.3 dB deviation from final value	
	relay switchover in AUTO mode	<10 ms
Back-feed (from ≥50 Ω source) with R&S®SMA-B103/-B106	with attenuator mode FIXED; ALC state on setting range	
	>20 dB	
	maximum permissible RF power in output frequency range of RF path for f > 1 MHz	
	1 MHz < f ≤ 3 GHz	50 W
3 GHz < f < 6 GHz	10 W	
Back-feed (from ≥50 Ω source) with R&S®SMA-B103L/-B106L	maximum permissible DC voltage	
	50 V	
	maximum permissible RF power in output frequency range of RF path for f > 1 MHz	
	0.05 W	
	maximum permissible DC voltage	
	5 V	

<sup>1</sup> Level uncertainty only valid within the specified level range

<sup>2</sup> PEP = peak envelope power.



Maximum available power, attenuator mode NORMAL (lower trace) or "high power" (middle trace) and without attenuator (upper trace)



R&S®SMA100A level repeatability at 2.1 GHz, 0 dBm, ALC ON

### Level sweep

Digital sweep in discrete steps	operating modes	AUTO, STEP, SINGLE SWEEP, EXTERNAL SINGLE, EXTERNAL STEP, EXTERNAL START/STOP, MANUAL/EXTERNAL TRIGGER
Sweep range with R&S®SMA-B103/-B106 frequency option	The relais switching threshold (= maximum specified level of attenuator mode NORMAL) must not be crossed during sweep.	level range of attenuator modes NORMAL or HIGH POWER
	uninterrupted level sweep with attenuator mode FIXED	0.01 dB to 30 dB
Sweep range with R&S®SMA-B103L/-B106L frequency option		full level range
Step width	resolution	0.01 dB
Step time	range	10 ms to 10 s
	resolution	0.1 ms

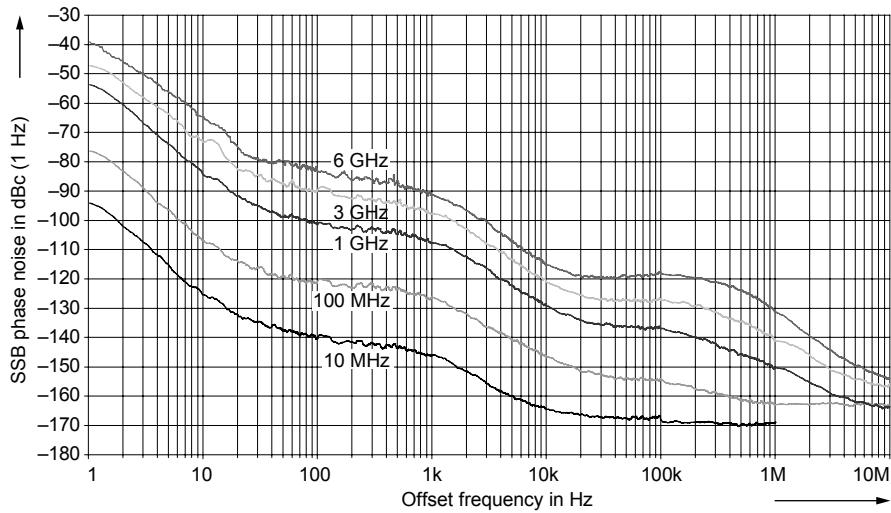
## Spectral purity

Harmonics	for $f > 1$ MHz; CW	
	with R&S®SMA-B103/-B106	
	AUTO/NORMAL mode, level $\leq 9$ dBm	$<-30$ dBc
	HIGH POWER mode, level $\leq 14$ dBm	$<-30$ dBc
	with R&S®SMA-B103L/-B106L	
	levels $\leq 15$ dBm	$<-30$ dBc
Nonharmonics	CW, level $>-10$ dBm,	
	offset $>10$ kHz from carrier	
	$f \leq 1500$ MHz	$<-80$ dBc
	$1500$ MHz $< f \leq 3$ GHz	$<-74$ dBc
	$f > 3$ GHz	$<-68$ dBc
	offset $>850$ kHz from carrier	
	$f \leq 1500$ MHz	$<-86$ dBc
	$1500$ MHz $< f \leq 3$ GHz	$<-80$ dBc
	$f > 3$ GHz	$<-74$ dBc
Nonharmonics with option R&S®SMA-B22	CW, level $>-10$ dBm	
	offset $>10$ kHz from carrier	
	$f \leq 750$ MHz	$<-96$ dBc
	$750$ MHz $< f \leq 1500$ MHz	$<-90$ dBc
	$1500$ MHz $< f \leq 3$ GHz	$<-84$ dBc
	$f > 3$ GHz	$<-78$ dBc
Subharmonics	$f \leq 1500$ MHz	none
	$f > 1500$ MHz	$<-74$ dBc
Wideband noise	attenuator mode AUTO	
	for level $> 10$ dBm with R&S®SMA-B10xL	
	for level $> 5$ dBm with R&S®SMA-B10x	
	carrier offset $>10$ MHz,	
	measurement bandwidth 1 Hz, CW	
	$9$ kHz $\leq f \leq 6.6$ MHz	$<-147$ dBc, typ. $-150$ dBc
	$6.6$ MHz $< f \leq 750$ MHz	$<-152$ dBc, typ. $-156$ dBc
	$750$ MHz $< f \leq 1500$ MHz	$<-153$ dBc, typ. $-160$ dBc
	$1.5$ GHz $< f \leq 3$ GHz	$<-150$ dBc, typ. $-155$ dBc
$f > 3$ GHz	$<-148$ dBc, typ. $-152$ dBc	
SSB phase noise	carrier offset 20 kHz, measurement bandwidth 1 Hz, CW	
	$f \leq 6.6$ MHz	$<-141$ dBc, typ. $-145$ dBc
	$f = 100$ MHz	$<-147$ dBc, typ. $-151$ dBc
	$f = 1$ GHz	$<-131$ dBc, typ. $-135$ dBc
	$f = 2$ GHz	$<-125$ dBc, typ. $-129$ dBc
	$f = 3$ GHz	$<-121$ dBc, typ. $-125$ dBc
	$f = 4$ GHz	$<-119$ dBc, typ. $-123$ dBc
	$f = 6$ GHz	$<-115$ dBc, typ. $-119$ dBc
SSB phase noise with option R&S®SMA-B22	CW, carrier offset 20 kHz, measurement bandwidth 1 Hz	
	$f \leq 6.6$ MHz	$<-145$ dBc, typ. $-148$ dBc
	$f = 100$ MHz	$<-151$ dBc, typ. $-154$ dBc
	$f = 1$ GHz	$<-136$ dBc, typ. $-140$ dBc
	$f = 2$ GHz	$<-130$ dBc, typ. $-134$ dBc
	$f = 3$ GHz	$<-126$ dBc, typ. $-130$ dBc
	$f = 4$ GHz	$<-123$ dBc, typ. $-126$ dBc
	$f = 6$ GHz	$<-120$ dBc, typ. $-124$ dBc

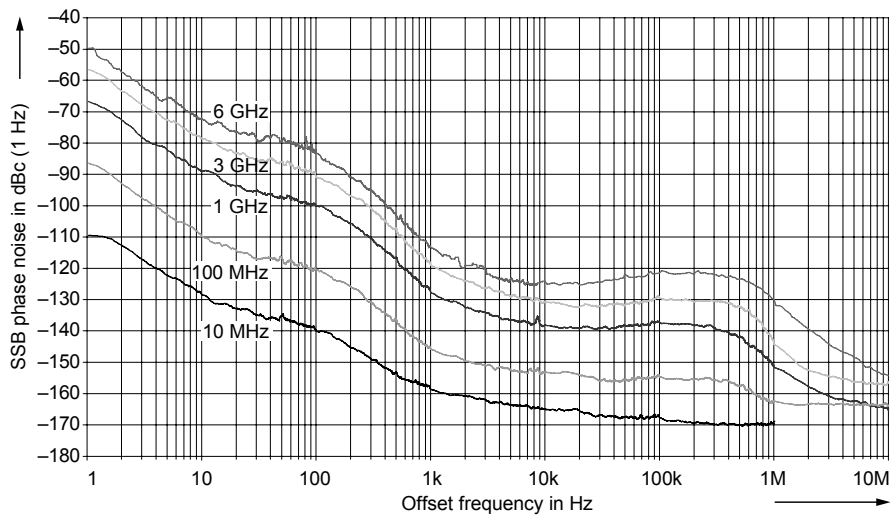
Carrier frequency in MHz	typical phase noise in dBc (1 Hz) with R&S®SMA-B22 option							
	frequency offset from carrier							
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
0.1 to 6.6	-83	-107	-121	-141	-151	-152	-155	-
6.6 to 15.625	-100	-124	-135	-158	-165	-165	-165	-165
15.625 to 23.4375	-96	-120	-131	-156	-165	-165	-165	-165
23.4375 to 31.25	-94	-118	-129	-154	-162	-162	-162	-162
31.25 to 46.875	-90	-114	-125	-150	-160	-160	-162	-162
46.875 to 62.5	-88	-112	-123	-149	-158	-158	-162	-162
62.5 to 93.75	-84	-108	-119	-145	-155	-157	-162	-162
93.75 to 125	-82	-106	-117	-144	-153	-155	-161	-162
125 to 187.5	-78	-102	-113	-141	-150	-150	-157	-157
187.5 to 250	-76	-100	-111	-139	-148	-148	-157	-157
250 to 375	-72	-96	-107	-136	-146	-147	-156	-157
375 to 500	-70	-94	-105	-134	-144	-143	-154	-157
500 to 750	-66	-90	-101	-130	-142	-140	-153	-156
750 to 1000	-64	-88	-99	-128	-138	-137	-150	-162
1000 to 1500	-60	-84	-95	-124	-137	-135	-149	-162
1500 to 2000	-58	-82	-93	-122	-132	-131	-144	-157
2000 to 3000	-54	-78	-88	-118	-131	-129	-143	-157
3000 to 4000	-52	-76	-86	-116	-126	-124	-134	-156
4000 to 6000	-48	-72	-82	-112	-125	-121	-131	-154

RMS jitter	carrier frequency	RMS jitter bandwidth	
	1 GHz	1 Hz to 10 MHz	typ. 430 fs (430 µUI)
	155 MHz	100 Hz to 1.5 MHz	typ. 60 fs (9 µUI)
	622 MHz	1 kHz to 5 MHz	typ. 36 fs (22 µUI)
RMS jitter with R&S®SMA-B22 option	2.488 GHz	5 kHz to 15 MHz	typ. 22 fs (55 µUI)
	carrier frequency	RMS jitter bandwidth	
	1 GHz	1 Hz to 10 MHz	typ. 135 fs (135 µUI)
	155 MHz	100 Hz to 1.5 MHz	typ. 42 fs (6.5 µUI)
Residual FM	622 MHz	1 kHz to 5 MHz	typ. 21 fs (13 µUI)
	2.488 GHz	5 kHz to 15 MHz	typ. 19 fs (47 µUI)
	RMS value at f = 1 GHz		
	0.3 kHz to 3 kHz, weighted (ITU-T)	<1 Hz	
Residual AM	0.03 kHz to 23 kHz	<4 Hz	
	RMS value (0.03 kHz to 20 kHz)	<0.02 %	

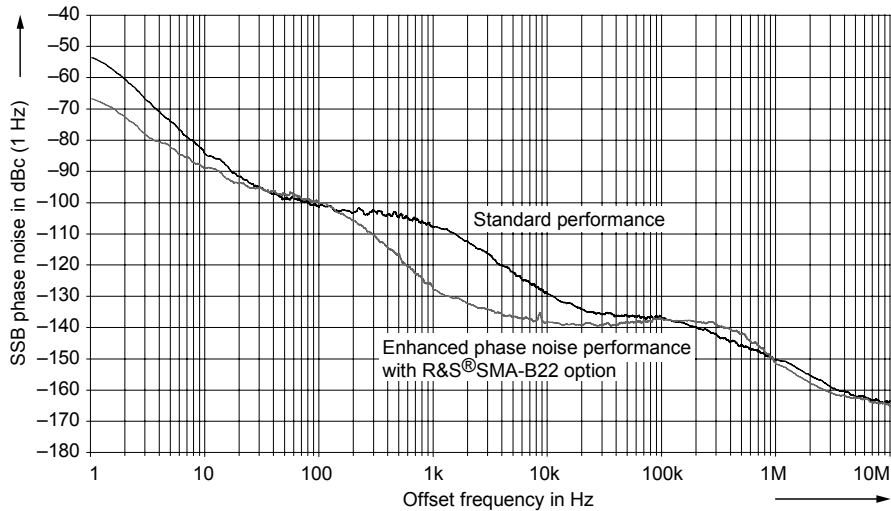




Typical SSB phase noise with internal reference oscillator (standard instrument)



Typical SSB phase noise with internal reference oscillator  
(with enhanced phase noise performance and R&S<sup>®</sup> SMA-B22 FM/φM modulator)



Measured SSB phase noise,  $f = 1$  GHz, comparison of standard performance  
to performance with R&S<sup>®</sup> SMA-B22 option, typical values

## 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/EXTERNAL TRIGGER fast hopping with immediate and external trigger
Max. number of stored settings		2000
Dwell time		1 ms to 1 s
	resolution	0.1 ms
Setting time	after external trigger	see frequency and level data

## Analog modulation

### Possible modulation types

Amplitude modulation, frequency modulation, phase modulation, pulse modulation

### Simultaneous modulation

	Amplitude modulation	Frequency modulation	Phase modulation	Pulse modulation
Amplitude modulation		+	+	–
Frequency modulation	+		–	+
Phase modulation	+	–		+
Pulse modulation	–	+	+	

+ = compatible, – = incompatible

### Amplitude modulation

For  $f \geq 100$  kHz, attenuator mode AUTO, level (PEP)<sup>3</sup> 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 %
Setting uncertainty	$f_{\text{mod}} = 1$ kHz and $m < 80$ %	<(3 % of reading + 1 %)
AM distortion	$f_{\text{mod}} = 1$ kHz	
	$m = 30$ %	<1 %
	$m = 80$ %	<2 %
Modulation frequency response	$m = 60$ %, up to 100 kHz	<3 dB
Incidental $\phi$ M at AM	$m = 30$ %, $f_{\text{mod}} = 1$ kHz, $\pm$ peak/2	<0.1 rad

### Frequency modulation (option R&S<sup>®</sup> SMA-B20 or R&S<sup>®</sup> SMA-B22)

FM multiplier for different frequency ranges	$f \leq 46.875$ MHz	$rm = 0.5$ (all modes except LOW NOISE)
	$f \leq 6.6$ MHz	$rm = 0.5$ (only in LOW NOISE mode)
	$6.6 \text{ MHz} < f \leq 11.71875$ MHz	$rm = 1/128$ (only in LOW NOISE mode)
	$11.71875 \text{ MHz} < f \leq 23.4375$ MHz	$rm = 1/64$ (only in LOW NOISE mode)
	$23.4375 \text{ MHz} < f \leq 46.875$ MHz	$rm = 1/32$ (only in LOW NOISE mode)
	$46.875 \text{ MHz} < f \leq 93.75$ MHz	$rm = 1/16$
	$93.75 \text{ MHz} < f \leq 187.5$ MHz	$rm = 1/8$
	$187.5 \text{ MHz} < f \leq 375$ MHz	$rm = 1/4$
	$375 \text{ MHz} < f \leq 750$ MHz	$rm = 1/2$
	$750 \text{ MHz} < f \leq 1500$ MHz	$rm = 1$
	$1500 \text{ MHz} < f \leq 3$ GHz	$rm = 2$
	$f > 3$ GHz	$rm = 4$
Operating modes		INTERNAL, EXTERNAL, INTERNAL + EXTERNAL, AC/DC, EXTERNAL DIGITAL, FM mode NORMAL, FM mode LOW NOISE (with R&S <sup>®</sup> SMA-B22 option only)

<sup>3</sup> PEP = peak envelope power.

Maximum deviation	FM mode NORMAL	$rm \times 10 \text{ MHz}$
	FM mode LOW NOISE	$rm \times 100 \text{ kHz}$
Resolution		<0.02 % of set deviation min. $rm \times 0.1 \text{ Hz}$
Setting uncertainty	$f_{\text{mod}} = 10 \text{ kHz}$ , deviation $\leq$ half of max. deviation	
	internal	<(1.5 % of reading + 20 Hz)
	external	<(2 % of reading + 20 Hz)
FM distortion	$f_{\text{mod}} = 10 \text{ kHz}$ , deviation = $rm \times 1 \text{ MHz}$	<0.1 %
Modulation frequency response	FM mode NORMAL	
	DC/10 Hz to 100 kHz	<0.5 dB
	DC/10 Hz to 10 MHz	<3 dB
	FM mode LOW NOISE	
	DC/10 Hz to 100 kHz	<3 dB
Synchronous AM	40 kHz deviation, $f_{\text{mod}} = 1 \text{ kHz}$	
	$f > 5 \text{ MHz}$	<0.1 %
	$f > 3 \text{ GHz}$	<0.2 %
Carrier frequency offset with FM DC	after FM offset calibration	
	input impedance 50 $\Omega$	<0.2 % of set deviation

### Phase modulation (option R&S<sup>®</sup>SMA-B20 or R&S<sup>®</sup>SMA-B22)

$\phi$ M Multiplier for different frequency ranges	$f \leq 46.875 \text{ MHz}$	$rm = 0.5$ (all modes except LOW NOISE)
	$f \leq 6.6 \text{ MHz}$	$rm = 0.5$ (only in LOW NOISE mode)
	$6.6 \text{ MHz} < f \leq 11.71875 \text{ MHz}$	$rm = 1/128$ (only in LOW NOISE mode)
	$11.71875 \text{ MHz} < f \leq 23.4375 \text{ MHz}$	$rm = 1/64$ (only in LOW NOISE mode)
	$23.4375 \text{ MHz} < f \leq 46.875 \text{ MHz}$	$rm = 1/32$ (only in LOW NOISE mode)
	$46.875 \text{ MHz} < f \leq 93.75 \text{ MHz}$	$rm = 1/16$
	$93.75 \text{ MHz} < f \leq 187.5 \text{ MHz}$	$rm = 1/8$
	$187.5 \text{ MHz} < f \leq 375 \text{ MHz}$	$rm = 1/4$
	$375 \text{ MHz} < f \leq 750 \text{ MHz}$	$rm = 1/2$
	$750 \text{ MHz} < f \leq 1500 \text{ MHz}$	$rm = 1$
	$1500 \text{ MHz} < f \leq 3 \text{ GHz}$	$rm = 2$
Operating modes	$f > 3 \text{ GHz}$	$rm = 4$
		INTERNAL, EXTERNAL, INTERNAL + EXTERNAL, AC/DC, EXTERNAL DIGITAL, $\phi$ M mode LOW NOISE (with R&S <sup>®</sup> SMA-B22 option only), $\phi$ M mode HIGH DEVIATION, $\phi$ M mode HIGH BANDWIDTH
Maximum deviation	$\phi$ M mode LOW NOISE	$rm \times 0.25 \text{ rad}$
	$\phi$ M mode HIGH DEVIATION	$rm \times 20 \text{ rad}$
	$\phi$ M mode HIGH BANDWIDTH	$rm \times 1 \text{ rad}$
Resolution	$\phi$ M mode LOW NOISE/HIGH DEVIATION	<0.02 % of set deviation, min. $rm \times 20 \mu\text{rad}$
	$\phi$ M mode HIGH BANDWIDTH	<0.1 % of set deviation, min. $rm \times 20 \mu\text{rad}$
Setting uncertainty	$f_{\text{mod}} = 10 \text{ kHz}$ , deviation $\leq$ half of max. deviation	
	internal	<(1.5 % of reading + 0.003 rad)
	external	<(2 % of reading + 0.003 rad)
Distortion	$f_{\text{mod}} = 10 \text{ kHz}$ , half of max. deviation	<0.2 %, typ. 0.1 %
Modulation frequency response	$\phi$ M mode HIGH DEVIATION	
	deviation $\leq rm \times 5 \text{ rad}$ DC/10 Hz to 500 kHz	<1 dB
	deviation $> rm \times 5 \text{ rad}$ DC/10 Hz to 10 kHz	<1 dB
	$\phi$ M mode HIGH BANDWIDTH	
	DC/10 Hz to 100 kHz	<0.5 dB
	DC/10 Hz to 10 MHz	<3 dB
	$\phi$ M mode LOW NOISE	
	DC/10 Hz to 100 kHz	<3 dB

## Pulse modulation

Warning: When pulse modulation is activated, the ALC state of the R&S®SMA100A is automatically changed to ALC OFF (sample & hold). In this state the ALC loop is opened and the output level is not regulated but the level modulator is set directly. In order to set the correct output level a sample & hold measurement is executed after each frequency or level setting.

In the following cases the nominal ON level is present for typ. 3 ms to 5 ms after level or frequency setting:

- No attenuator is fitted (R&S®SMA-B103L/-B106L frequency option)
- in HIGH POWER mode
- in AUTO mode if the level is in the high power range, i.e. the mechanical relay bypass is switched

Otherwise, the level is decreased by 30 dB during sample & hold measurement

Operating modes		external, internal
On/off ratio		>80 dB, typ. 100 dB
Rise/fall time	f > 180 MHz	
	10 %/90 % of RF amplitude	20 ns, typ. 10 ns
Pulse repetition frequency		0 Hz to 10 MHz
Video crosstalk	spectral line of fundamental of 100 kHz squarewave modulation	<-30 dBc

## Input for external modulation signals

Modulation input AM EXT	input impedance	>100 kΩ
	input sensitivity (peak value for set modulation depth or deviation)	1 V
Modulation input PULSE	input level	threshold 0.8 V
	input impedance	>10 kΩ or 50 Ω
	polarity	selectable

### With option R&S®SMA-B20/-B22 (FM/φM)

Modulation input FM/φM EXT	input impedance	>100 kΩ or 50 Ω
	input sensitivity (peak value for set modulation depth or deviation)	1 V

## Modulation sources

### Internal modulation generator

Frequency range		0.1 Hz to 1 MHz
Resolution of setting		0.1 Hz
Frequency accuracy		<0.005 Hz + relative deviation of reference frequency
Frequency response		<0.3 dB
Distortion	f < 100 kHz at $R_L > 50 \Omega$ , level ( $V_{EMF}$ ) < 1 V	<0.1 %
Output voltage	$V_p$ at LF connector, open circuit voltage EMF	1 mV to 4 V
	resolution	1 mV
	setting accuracy at 1 kHz	<(1 % of reading + 1 mV)
Output impedance		50 $\Omega$
Frequency setting time	to within $<1 \times 10^{-7}$ , after IEC/IEEE bus delimiter	<3 ms
Sweep	digital sweep in discrete steps	
	operating modes	AUTO, STEP, SINGLE SWEEP, EXTERNAL SINGLE, EXTERNAL STEP, EXTERNAL START/STOP, MANUAL/EXTERNAL TRIGGER, LINEAR/LOGARITHMIC SPACING
	sweep range	full frequency range
	step width (lin)	full frequency range
	step width (log)	0.01 % to 100 % per step

### Standard pulse generator

Pulse period		5 $\mu$ s to 85 s
	resolution	1 $\mu$ s
Pulse width		2 $\mu$ s to 1 s
	resolution	1 $\mu$ s
PULSE/VIDEO output		LVTTL signal ( $R_L \geq 50 \Omega$ )

### High-performance pulse generator (option R&S<sup>®</sup> SMA-K23)

Operating modes		AUTO, EXTERNAL TRIGGER, EXTERNAL GATE, SINGLE PULSE, DOUBLE PULSE, DELAYED PULSE (EXTERNAL TRIGGER)
Active trigger edge		positive or negative
Pulse period		100 ns to 85 s
	resolution	20 ns
Pulse width	pulse width of double pulses is settable independently	20 ns to 1 s
	resolution	20 ns
Pulse delay		20 ns to 1 s
	resolution	20 ns
Double-pulse spacing		20 ns to 1 s
	resolution	20 ns
Uncertainty for pulse timing	pulse timing generated digitally; ensured by design	relative deviation of reference frequency
External trigger	delay	typ. 50 ns
	jitter	<10 ns
PULSE/VIDEO output		LVTTL signal ( $R_L \geq 50 \Omega$ )

## Multifunction generator (option R&S® SMA-K24)

The multifunction generator option (R&S® SMA-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.

Waveforms	LF generator 1	sine
	LF generator 2	sine, square, triangle user-programmable ramp $\Delta T = 20$ ns
	noise generator	noise amplitude distribution Gaussian, equal
Frequency range	sine	0.1 Hz to 10 MHz
	triangle, square	0.1 Hz to 1 MHz
	noise bandwidth	100 kHz to 10 MHz
Resolution of setting	sine, triangle, square	0.1 Hz
	ramp: rise, fall, low and high time	20 ns
Frequency uncertainty		<0.005 Hz + relative deviation of reference frequency
Frequency response	sine	
	up to 1 MHz	<0.3 dB
	up to 10 MHz	<1 dB
Distortion	$f < 100$ kHz	
	at $R_L > 50 \Omega$ , level ( $V_{EMF}$ ) 1 V	<0.1 %
Output voltage	$V_p$ at LF connector, open circuit voltage EMF	1 mV to 4 V
	resolution	1 mV
	setting accuracy at 1 kHz	<(1 % of reading + 1 mV)
Output impedance		50 $\Omega$
Frequency setting time	to within $<1 \times 10^{-7}$ , after IEC/IEEE bus delimiter	<3 ms
Sweep		digital sweep in discrete steps
	operating modes	AUTO, STEP, SINGLE, EXTERNAL SINGLE, EXTERNAL STEP, MANUAL/EXTERNAL TRIGGER, LINEAR/LOGARITHMIC SPACING
	sweep range	full frequency range
	step width (lin)	full frequency range
	step width (log)	0.01 % to 100 % per step

## VOR modulation (option R&S® SMA-K25)

Attenuator mode AUTO, level (PEP)<sup>4</sup> within specified level range.

VOR specification valid for carrier frequency range from 108 MHz to 118 MHz

VOR operating modes	NORM	VOR signal + COM/ID tone (can be switched off)
	VAR	30 Hz VAR tone
	subcarrier	9.96 kHz carrier, unmodulated
	subcarrier + FM	9.96 kHz carrier, modulated
Modulation tones		
30 Hz (VAR, REF)	frequency uncertainty	<(0.005 Hz + relative deviation of reference frequency)
9.96 kHz FM carrier	frequency setting range	10 Hz to 60 Hz
	resolution	0.1 Hz
30 Hz REF	frequency setting range	5 kHz to 15 kHz
	resolution	0.1 Hz
	frequency deviation	0 Hz to 960 Hz
	resolution	1 Hz
	FM error (at deviation 480 Hz)	<1 Hz
COM/ID tone	default	1020 Hz
External AM tone	input	AM EXT
	frequency setting range	0.1 Hz to 20 kHz
	resolution	0.1 Hz

<sup>4</sup> PEP = peak envelope power

Phase (VAR, REF)	default	0.00°
	setting range	0° to 360°
	resolution	0.01°
	bearing error	<0.05°
Modulation depth	sum of modulation depths of 30 Hz (VAR) signal, 9.96 kHz FM carrier, COM/ID and external AM signal must not exceed 100 %	
30 Hz (VAR, REF)	setting range AM depth	0 % to 100 %
	resolution	0.1 %
	setting uncertainty	<0.5 % AM depth at 30 % AM depth
9.96 kHz FM carrier	setting range AM depth	0 % to 100 %
	resolution	0.1 %
	setting uncertainty	<0.5 % AM depth at 30 % AM depth
COM/ID tone	setting range AM depth	0 % to 100 %
	resolution	0.1 %
	setting uncertainty (COM/ID = 1020 Hz)	<0.5 % AM depth at 10 % AM depth
External AM tone	sensitivity	0.01 V/%

### ILS modulation (option R&S® SMA-K25)

Attenuator mode AUTO, level (PEP)<sup>5</sup> within specified level range.

ILS-LOC specification valid for carrier frequency range from 108 MHz to 118 MHz

ILS-GS specification valid for carrier frequency range from 329 MHz to 335 MHz

ILS operating modes	ILS-LOC/ILS-GS	
	NORM	standard localizer/glideslope signal + COM/ID tone (can be switched off)
	90 Hz	suppression of 150 Hz modulation tone
	150 Hz	suppression of 90 Hz modulation tone
ILS modulation tones	if the frequency of 90 Hz or 150 Hz tone is varied, the other tone is automatically changed in proportion	
	frequency uncertainty	<0.02 Hz + relative deviation of reference frequency
90 Hz tone	frequency setting range	60 Hz to 120 Hz
	resolution	0.3 Hz
150 Hz tone	frequency setting range	100 Hz to 200 Hz
	resolution	0.5 Hz
COM/ID tone	default	1020 Hz
	frequency setting range	0.1 Hz to 20 kHz
	resolution	0.1 Hz
External AM tone	input	AM EXT
Modulation depth	sum of modulation depths of 90 Hz, 150 Hz, COM/ID and external AM signal must not exceed 100 %	
Sum of depth of modulation (SDM) of 90 Hz tone and 150 Hz tone	setting range AM depth/resolution	0 % to 100 %/0.1 %
	default, localizer	40 %
	default, glideslope	80 %
	setting uncertainty	<0.8 % AM depth at 40 % SDM <1.6 % AM depth at 80 % SDM
COM/ID tone	setting range AM depth	0 % to 100 %
	resolution	0.1 %
	setting uncertainty (COM/ID = 1020 Hz)	<0.5 % AM depth at 10 % AM depth
External AM tone	sensitivity	0.01V/%
Difference in depth of modulation (DDM)	setting range	0 to ± SDM
	setting resolution	0.0001
	setting uncertainty	<0.0003 + 2 % of DDM reading
	setting range	0° to 120°
Phase setting	resolution	0.01°
	setting uncertainty	<0.05°

<sup>5</sup> PEP = peak envelope power.

### Marker Beacon (MKR BCN) (option R&S®SMA-K25)

Attenuator mode AUTO, level (PEP) within specified level range.

MKR-BCN specification valid for carrier frequency range from 74 MHz to 76 MHz

MKR BCN tones	frequency uncertainty	<0.005 Hz + relative deviation of reference frequency
Marker frequencies		400 Hz, 1300 Hz and 3000 Hz
COM/ID tone	default	1020 Hz
	frequency setting range	0.1 Hz to 20 kHz
	resolution	0.1 Hz
Modulation depth	sum of modulation depths of marker tone and COM/ID signal must not exceed 100 %	
Marker frequency	setting range AM depth	0 % to 100 %
	resolution	0.1 %
	default	95 %
	setting uncertainty marker depth = 95 %	<4 %
COM/ID tone	setting range AM depth	0 % to 100 %
	resolution	0.1 %
	setting uncertainty COM/ID = 1020 Hz	<0.5 % AM depth at 5 % AM depth

### ADF mode (option R&S®SMA-K25)

The ADF mode provides a carrier frequency of 190 kHz with 30 % AM depth at 1 kHz modulation rate.

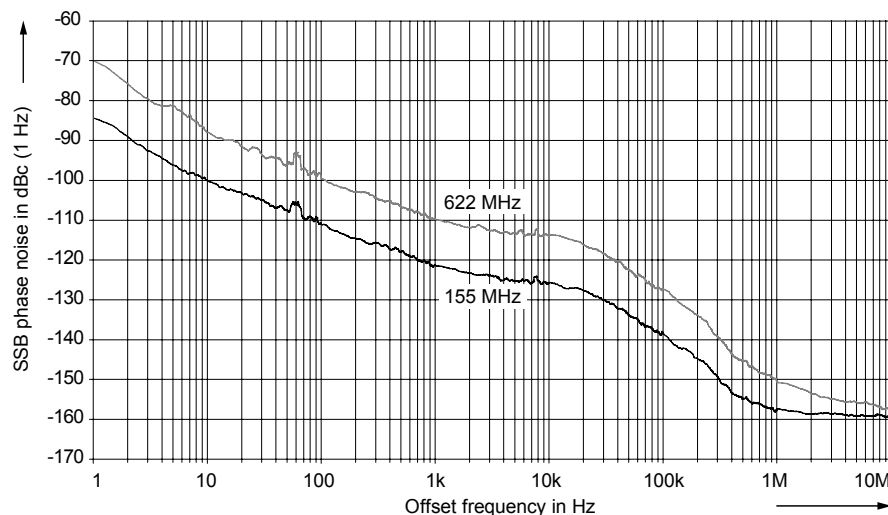
ADF tone	frequency uncertainty	<0.005 Hz + relative deviation of reference frequency
ADF frequencies	frequency setting range	0.1 Hz to 20 kHz
	resolution	0.1 Hz
Modulation depth	setting range AM depth	0 % to 100 %
	resolution	0.1 %
	default	30 %



## Clock synthesizer (option R&S<sup>®</sup>SMA-B29)

The frequency of the clock synthesizer (option R&S<sup>®</sup>SMA-B29) can be set independently of the RF frequency of the R&S<sup>®</sup>SMA100A. It provides a differential clock signal (AC-coupled, symmetric square) on the rear panel of the R&S<sup>®</sup>SMA100A.

Frequency range		100 kHz to 1.5 GHz	
Resolution of setting		0.01 Hz	
Resolution of synthesis		<100 $\mu$ Hz	
Frequency setting time	to within $<1 \times 10^{-7}$ , after IEC/IEEE bus delimiter	<30 ms	
Output voltage (CLK SYN, CLK SYN_N)	into 50 $\Omega$ , peak to peak, f = 10 MHz	typ. 0.5 V	
Frequency response	100 kHz to 1.5 GHz both outputs terminated with 50 $\Omega$	typ. 4 dB	
Back-feed (from $\geq 50 \Omega$ source)	maximum permissible RF power in output frequency range of CLKSYN path		
	for f > 1 MHz	0.05 W	
	maximum permissible DC voltage	3 V	
Spectral purity			
Nonharmonics	>10 kHz offset from carrier		
	f $\leq$ 325 MHz	<-82 dBc	
	325 MHz < f $\leq$ 650 MHz	<-76 dBc	
	650 MHz < f $\leq$ 1300 MHz	<-70 dBc	
	1300 MHz < f $\leq$ 1500 MHz	<-64 dBc	
Wideband noise	carrier offset >10 MHz; measurement bandwidth 1 Hz	typ. <-154 dBc	
SSB phase noise	carrier offset 20 kHz, measurement bandwidth 1 Hz		
	f = 100 MHz	<-123 dBc, typ. -129 dBc	
	f = 250 MHz	<-113 dBc, typ. -119 dBc	
	f = 500 MHz	<-109 dBc, typ. -115 dBc	
	f = 1000 MHz	<-103 dBc, typ. -109 dBc	
SSB phase noise with option R&S <sup>®</sup> SMA-B22	carrier offset 20 kHz, measurement bandwidth 1 Hz		
	f = 100 MHz	<-125 dBc, typ. -131 dBc	
	f = 250 MHz	<-115 dBc, typ. -121 dBc	
	f = 500 MHz	<-111 dBc, typ. -117 dBc	
	f = 1000 MHz	<-105 dBc, typ. -111 dBc	
RMS jitter	carrier frequency	RMS jitter bandwidth	
	100 MHz	1 Hz to 10 MHz	typ. 300 fs (30 $\mu$ UI)
	155 MHz	100 Hz to 1.5 MHz	typ. 220 fs (34 $\mu$ UI)
	622 MHz	1 kHz to 5 MHz	typ. 190 fs (118 $\mu$ UI)
RMS jitter with option R&S <sup>®</sup> SMA-B22	carrier frequency	RMS jitter bandwidth	
	100 MHz	1 Hz to 10 MHz	typ. 220 fs (22 $\mu$ UI)
	155 MHz	100 Hz to 1.5 MHz	typ. 160 fs (25 $\mu$ UI)
	622 MHz	1 kHz to 5 MHz	typ. 140 fs (87 $\mu$ UI)



Clock synthesizer (option R&S<sup>®</sup>SMA-B29): SSB phase noise measured with option R&S<sup>®</sup>SMA-B22, typical values

# General data

## Remote control

Systems	IEC/IEEE bus, in line with IEC 60625 (IEEE 488) Ethernet (TCP/IP) USB	
Command set	SCPI 1999.5 or 8662/63A compatible	
Interfaces	IEC	24-contact Amphenol
	Ethernet	Western
	USB	USB
IEC/IEEE bus address		0 to 30
Interface functions IEC	SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0	
LAN interface	10/100baseT	

## Operating data

Power supply	input voltage range, AC, nominal	100 V to 240 V (AC) $\pm 10\%$
	AC supply frequency	50 Hz to 400 Hz, $-5\%/+10\%$
	power consumption	250 VA
Power factor correction		EN 61000-3-2
EMC		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 EN 60068-2-1, EN 60068-2-2
	storage temperature range	-40 °C to +71 °C
	operating altitude	
	standard	$\leq 3000$ m
	with R&S <sup>®</sup> SMA-B46	$\leq 4600$ m
	climatic resistance, +40 °C/95 % rel. humidity	EN 60068-2-3
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, EN 60068-2-6
	random	10 Hz to 300 Hz, acceleration 1.2 g (rms) meets EN 60068-2-64
Shock		40 g shock spectrum. EN 60068-2-27, MIL-STD-810E
Electrical safety		IEC 61010-1, EN 61010-1, CAN/CSA-C22.2 No. 61010-1-04, UL 61010-1
Certification marks		VDE-GS, cCSA <sub>US</sub>
Dimensions (W × H × D)		427 mm × 88 mm × 450 mm (16.81 in × 3.46 in × 17.72 in)
Weight	when fully equipped	10 kg (22 lb)
Recommended calibration interval		3 years

## Ordering information

Designation	Type	Order No.
Signal Generator <sup>6</sup>	R&S <sup>®</sup> SMA100A	1400.0000.02
Including power cable, Quick Start Guide and CD-ROM (with operating and service manual)		
<b>Options</b>		
RF Path		
9 kHz to 3 GHz with electronic attenuator	R&S <sup>®</sup> SMA-B103	1405.0209.02
9 kHz to 6 GHz with electronic attenuator	R&S <sup>®</sup> SMA-B106	1405.0809.02
9 kHz to 3 GHz without attenuator	R&S <sup>®</sup> SMA-B103L	1405.0609.02
9 kHz to 6 GHz without attenuator	R&S <sup>®</sup> SMA-B106L	1405.1005.02
FM/φM Modulator	R&S <sup>®</sup> SMA-B20	1405.1605.02
Enhanced Phase Noise Performance and FM/φM Modulator	R&S <sup>®</sup> SMA-B22	1405.1805.02
Clock Synthesizer	R&S <sup>®</sup> SMA-B29	1400.2503.02
Operating Altitude up to 4600 m	R&S <sup>®</sup> SMA-B46	1405.1305.02
Removable Mass Storage (compact flash disk)	R&S <sup>®</sup> SMA-B80	1405.2001.02
Rear Connectors	R&S <sup>®</sup> SMA-B81	1405.2401.02
High-Performance Pulse Generator	R&S <sup>®</sup> SMA-K23	1405.2801.02
Multifunction Generator	R&S <sup>®</sup> SMA-K24	1405.2901.02
VOR/ILS Modulation	R&S <sup>®</sup> SMA-K25	1405.3008.02
<b>Recommended extras</b>		
Hardcopy manuals (in English, UK)		1400.0075.32
Hardcopy manuals (in English, US)		1400.0075.39
Spare Compact Flash Card (R&S <sup>®</sup> SMA-B80 required)	R&S <sup>®</sup> SMA-Z10	1405.4004.02
19" Rack Adapter	R&S <sup>®</sup> ZZA-211	1096.3260.00
Keyboard with USB Interface (US characteristic set)	R&S <sup>®</sup> PSL-Z2	1157.6870.04
Mouse with USB Interface, optical	R&S <sup>®</sup> PSL-Z10	1157.7060.03
External USB DVD Drive	R&S <sup>®</sup> PSP-B6	1134.8201.22

## License information

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

<sup>6</sup> The base unit must be ordered together with an R&S SMA-B103/R&S SMA-B106/R&S SMA-B103L/R&S SMA-B106L frequency option.



For product brochure, see PD 5213.6412.12  
and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)  
(search term: SMA100A)



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[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

Europe: +49 1805 12 4242, [customersupport@rohde-schwarz.com](mailto:customersupport@rohde-schwarz.com)  
USA and Canada: 1-888-837-8772, [customer.support@rsa.rohde-schwarz.com](mailto:customer.support@rsa.rohde-schwarz.com)  
Asia: +65 65130488, [customersupport.asia@rohde-schwarz.com](mailto:customersupport.asia@rohde-schwarz.com)