

# Microwave in a compact package: R&S®SMB100A generators up to 40 GHz

From RF to microwave: With their new options, the R&S®SMB100A analog signal generators can now generate frequencies up to 20 GHz or 40 GHz. These “new” signal generators also incorporate the excellent characteristics of the proven Rohde&Schwarz RF instruments, including excellent single sideband phase noise and high output power. What makes them so special? They prove that microwave and compact size are not mutually exclusive terms.

## The R&S®SMB100A family covers the range from RF to microwave

The popular R&S®SMB100A analog signal generators (FIG 1) move into the microwave range. The new R&S®SMB-B120 and R&S®SMB-B140 options now expand the generators’ frequency range beyond the previous upper limit of 12.75 GHz\* to 20 GHz or 40 GHz – with a lower frequency limit of 100 kHz (FIG 2). The frequency options are also available without attenuator for applications in which the wide dynamic range offered by the generators is not needed. Dimensions were kept small by fitting the sophisticated modular architecture into tried-and-tested housing that is only two rack units

high, ¾ 19" wide and 418 mm deep. As a result, precious lab bench and equipment rack space is not wasted. Their low maximum weight of 6.9 kg also makes the generators ideal for mobile applications.

## Outstanding dynamic range

Even in its basic configuration, the R&S®SMB100A offers output power up to +14 dBm between 50 MHz and 20 GHz and up to +11 dBm between 50 MHz and 40 GHz (in both cases without attenuator). And even higher power levels up to +19 dBm are possible with the R&S®SMB-B31 high output power option. The R&S®SMB-B32 option delivers high output power between 50 MHz and 40 GHz, for a power increase of 5 dB to the specified +16 dBm. Typically, these values are significantly exceeded (FIG 3).

\* R&S®SMB100A generator: now with electronic step attenuator and expanded range up to 12.75 GHz. NEWS (2011) No. 203, pp. 42–43.



FIG 1 The R&S®SMB100A with the R&S®NRP-Z85 power sensor (connected using the R&S®NRP-Z4 USB adapter cable) for direct level measurement and output to the generator display.

The frequency options at a glance									
9 kHz	100 kHz	1.1	2.2	3.2	6.0	10	12.75	20	40 GHz
R&S®SMB-B101									
9 kHz	100 kHz	1.1	2.2	3.2	6.0	10	12.75	20	40 GHz
R&S®SMB-B102									
9 kHz	100 kHz	1.1	2.2	3.2	6.0	10	12.75	20	40 GHz
R&S®SMB-B103									
9 kHz	100 kHz	1.1	2.2	3.2	6.0	10	12.75	20	40 GHz
R&S®SMB-B106									
9 kHz	100 kHz	1.1	2.2	3.2	6.0	10	12.75	20	40 GHz
R&S®SMB-B112 or R&S®SMB-B112L*									
9 kHz	100 kHz	1.1	2.2	3.2	6.0	10	12.75	20	40 GHz
R&S®SMB-B120 or R&S®SMB-B120L*									
9 kHz	100 kHz	1.1	2.2	3.2	6.0	10	12.75	20	40 GHz
R&S®SMB-B140 or R&S®SMB-B140L*									

FIG 2 The frequency range expansion options for the R&S®SMB100A family of generators at a glance.

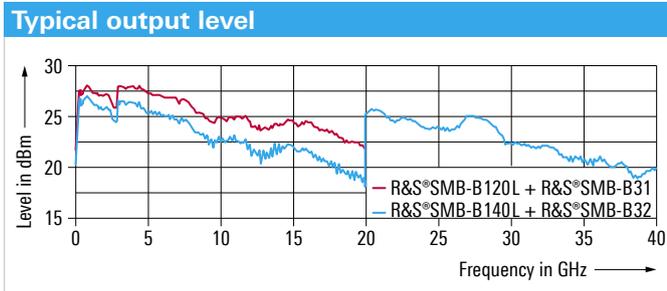


FIG 3 Typical output level of the R&S®SMB100A with the R&S®SMB-B120L and R&S®SMB-B140L frequency options (each with the high output power option).

In instruments without an attenuator, the level can be set anywhere from  $-20$  dBm to the maximum value. The fast, temperature-stable level control allows low-drift, extremely accurate level setting with excellent repeatability. Many applications require levels significantly below  $-20$  dBm, for example when measuring the sensitivity of communications or radar receivers. Various test specifications define power levels between  $-60$  dBm and  $-110$  dBm for such applications. The R&S®SMB-B120 and R&S®SMB-B140 frequency options use a mechanical attenuator to generate such low levels. They decrease the specified lowest level from  $-20$  dBm to  $-120$  dBm (the lowest value in this class) while maintaining a high level linearity (FIG 4). The resolution of the level setting is typically  $0.01$  dB, with or without an attenuator.

### High spectral purity is a must for many applications

Two of the key quality criteria for analog signal generators are high spectral purity and especially low single sideband (SSB) phase noise. The R&S®SMB100A excels with a typical SSB phase noise of  $< -108$  dBc (10 GHz, at 20 kHz, 1 Hz bandwidth; FIG 5). And the phase noise remains exceptional even at the lowest frequencies. This is because conventional synthesizers use downmixing to generate the lower frequency range, while the R&S®SMB100A uses an extended divider range and direct digital synthesis (DDS), in which not only the actual carrier frequency, but also the phase noise, is divided.

This characteristic makes the R&S®SMB100A the preferred reference source for many applications with strict single sideband phase noise requirements. For the most stringent requirements, the phase noise close to the carrier can be further improved by using the optional R&S®SMB-B1 or R&S®SMB-B1H reference oscillators (OCXO) (FIG 6). The output signal's excellent single sideband phase noise is the result of an innovative frequency synthesis concept that also yields a high setting resolution of  $0.001$  Hz, superb stability and short setting times.

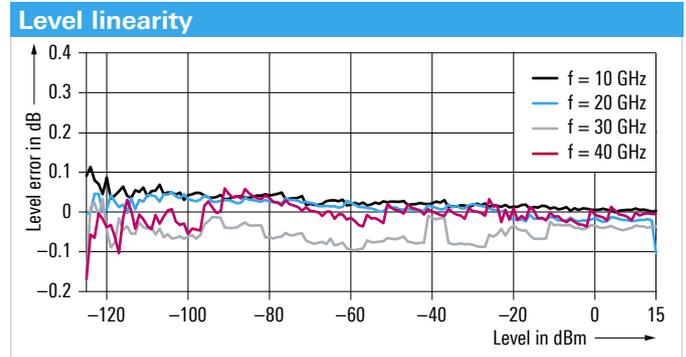


FIG 4 Level error of the R&S®SMB100A at different frequencies.

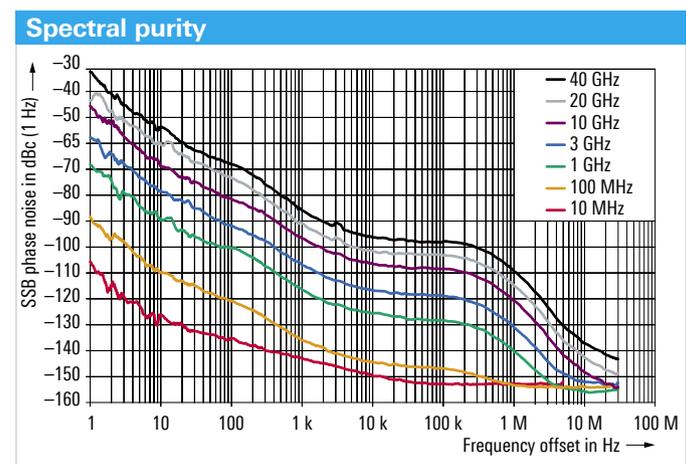


FIG 5 SSB phase noise at different frequencies with the R&S®SMB-B1H reference OCXO.

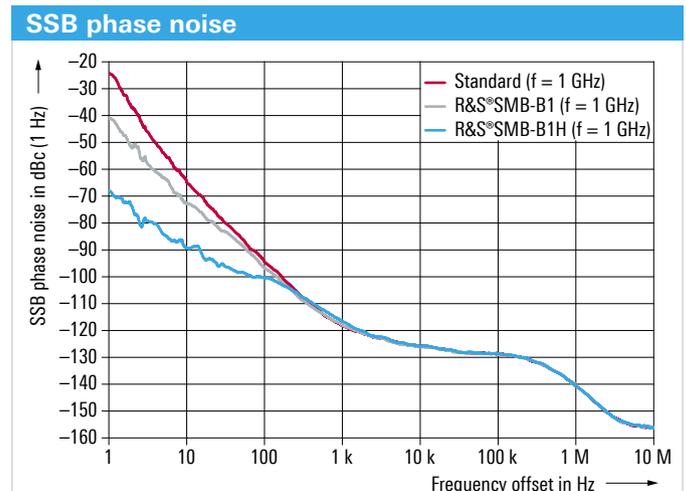


FIG 6 SSB phase noise with standard reference and with the R&S®SMB-B1 and R&S®SMB-B1H reference oscillators (OCXO).

### Rapid level and frequency changes

Fast VCOs are built into all R&S®SMB100A generators. With frequency setting times of several microseconds, they are clearly superior to the YIG oscillators (which require several hundred microseconds) often used in the microwave range. The difference is especially apparent during a frequency sweep or in List mode, a programmable sequence of up to 2000 frequency and level settings. The rapid frequency and level changes provide a significant cost advantage in automated test systems and on production lines.

In remote control operation, a level setting takes place in less than 3 ms after the IEC/IEEE bus delimiter (without mechanical attenuator switching). The frequency change is complete after only 2.5 ms. It is even faster in List mode where setting times of typically only a few 100 µs are achieved, making this mode ideal for fast frequency and level sweeps.

### Versatile right down to the pulse signal generator

The R&S®SMB100A standard configuration is more than adequate for many tasks. It not only has outstanding quality criteria, it also features excellent functionality. All of the new frequency options include amplitude, frequency and phase modulation. In addition, the signal generator can be combined with the R&S®SMB-K21 pulse modulator option, the R&S®SMB-K23 pulse generator option and particularly the R&S®SMB-K27 pulse train option to create a versatile, high-quality pulse signal generator. Pulse trains are configurable pulse scenarios used in radar applications. These pulse trains can be programmed with varying pulse widths, varying pulse pauses and with the necessary repetitions (FIG 7). This permits the simulation of jittered or staggered pulses, and the two effects can be used on both the pulse width and the pulse pause.

It is also possible to connect an R&S®NRP-Zxx power sensor to the generator via USB (FIG 1). For demanding applications, the desired power can then be measured directly on the DUT, taking into account cable loss and other components. Corrections can be made on the generator to set the desired level on the DUT. The R&S®SMB100A can even replace legacy OEM generators in applications. Since it understands their remote control commands, it can emulate many OEM generators (for more details, please refer to R&S®LegacyPro on [www.rohde-schwarz.com](http://www.rohde-schwarz.com)).

### Summary

The new frequency options expand the scope for R&S®SMB100A signal generators into the microwave range. Even in their basic configuration, they are both functionally and qualitatively ideal for many tasks. The versatile pulse generator options allow them to be adapted to special requirements. Production lines and ATE systems benefit from their short level and frequency setting times. Both the low power consumption of only 120 W for a fully equipped 40 GHz instrument and the recommended calibration interval of three years contribute to profitability. All the generators have clear block diagram displays, the same appearance and handling, and identical remote control commands, thereby making day-to-day work easier.

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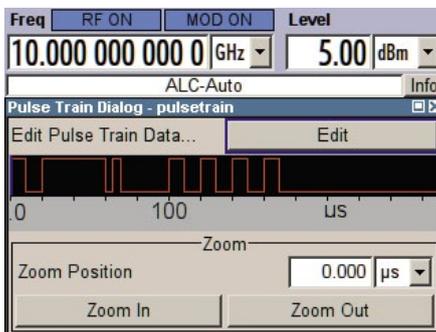


FIG 7 Pulse train display on the R&S®SMB100A.