

R&S®SMB 100A Signal Generator

Whether broadcast, aerospace and defense, or EMC: analog signals for every application

Good spectral purity, high output power, and short settling times are features that make the analog R&S®SMB 100A signal generator exceptional in its class. The signal generator offers not only excellent specifications but also a compact and modular design.

The R&S®SMB 100A at a glance

The new analog R&S®SMB 100A signal generator (FIG 1) offers performance that is unrivaled in its price class:

- ◆ **Wide frequency range from 9 kHz to 6 GHz** – covers all frequency bands important for RF applications
- ◆ **Best spectral purity in its class** – ensures high measurement accuracy in a wide variety of applications
- ◆ **Highest output power in its class** – eliminates the need for external amplifiers
- ◆ **Very fast frequency and power settling times** – supports high throughput in production
- ◆ **Easy on-site servicing** – ensures low operating costs as well as maximum instrument availability
- ◆ **Wide temperature range, operating altitude up to 4600 m, fast pulse modulation** – meets the special requirements in aerospace and defense applications
- ◆ **Compact design, low weight** – for tight space requirements and easy transport

Best spectral purity in its class

Phase noise, harmonic spurious and nonharmonic spurious, as well as wide-band noise are the most important parameters characterizing the spectral properties of analog signal generators. The R&S®SMB 100A features very good performance in all these respects. In particular, the instrument displays its full strength in receiver blocking tests, where noise and nonharmonic spurious produced by the interfering

signal generator in the receiver channel bandwidth degrade the measurement accuracy.

A major factor contributing to the signal generator's good spectral properties is its RF synthesizer, which is implemented as a DDS-based single-loop synthesizer. A new patented algorithm for DDS frequency generation enables the synthesizer to achieve spectral properties that were previously not attainable with conventional single-loop synthesizers. In the frequency range up to 1500 MHz, the generator achieves nonharmonics suppression of typ. –85 dBc while providing excellent phase noise characteristics (FIG 2). The R&S®SMB 100A exhibits such outstanding spectral properties over the entire frequency range. FIG 3 shows the simplified architecture of an instrument outfitted with the R&S®SMB-B106 6 GHz frequency option.

In conventional generators, a down-converter is used to generate frequencies below a specific limit (typ. 100 MHz to 250 MHz). This downconverter mixes the frequency-synthesized signal with a fixed-frequency signal (LO) of typ. 1 GHz. However, this method has the substantial drawback that the spectral purity of the resulting signal is degraded by the SSB phase noise of the LO.

The R&S®SMB 100A takes a different approach. Its divider range has been expanded down to 23 MHz; below this value, the DDS synthesizer generates the output signal directly. FIG 4 makes the advantages of this concept obvious. The phase noise at low signal frequencies is significantly reduced compared



FIG 1 Excellent specifications and the capability to perform instrument maintenance yourself make the R&S®SMB100A a valuable general-purpose instrument.

FIG 2 Typical SSB phase noise at various RF frequencies (with optional R&S®SMB-B1 reference oscillator).

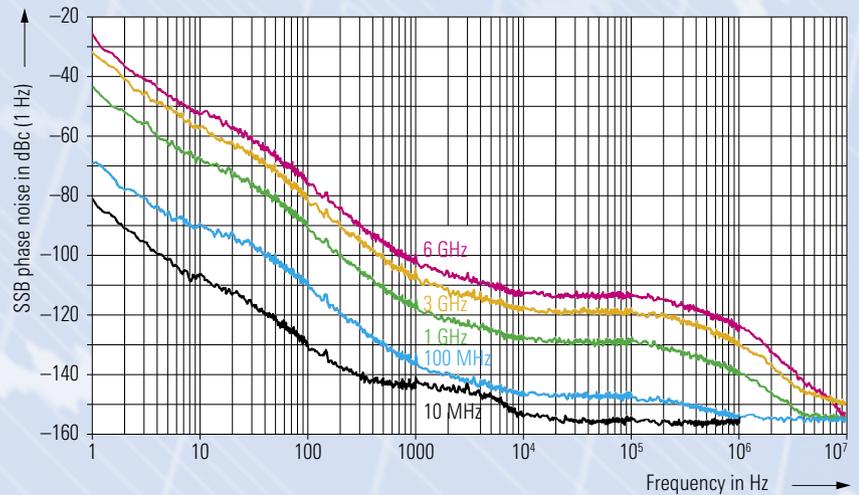
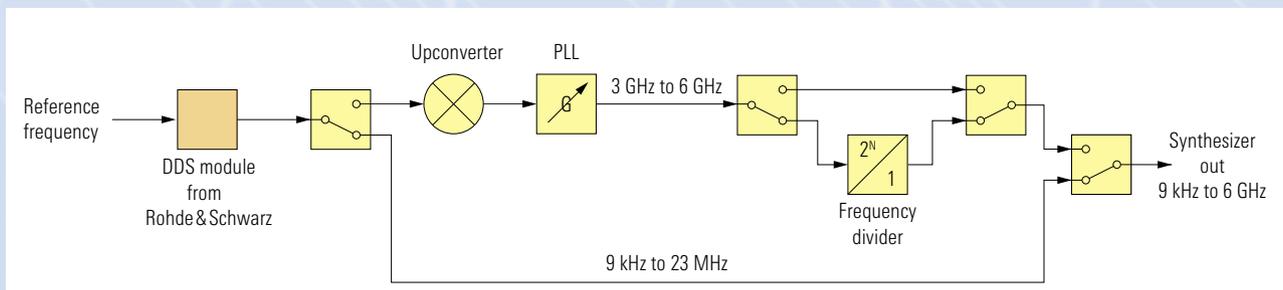


FIG 3 Simplified block diagram of the frequency generation architecture of the R&S®SMB100A with the R&S®SMB-B106 frequency option.



- ▶ to conventional designs based on a downconverter.

This makes the R&S®SMB100A an ideal substitute for reference oscillators or for all applications that require a low-jitter signal (e.g. A/D and D/A converter testing).

The DDS-based synthesizer generates both frequency and phase modulation directly in digital form, thus enabling the R&S®SMB100A to achieve excellent modulation characteristics. In the frequency range below 23 MHz, it also generates amplitude modulation directly in digital form. It thus provides amplitude modulation of higher accuracy than available from conventional generators in this frequency range, which enables highly accurate measurements on radio receivers in the shortwave range (FIG 5).

Highest output power in its class

The R&S®SMB100A provides maximum output power of typ. +25 dBm over the frequency range from 1 MHz to 6 GHz (FIG 6). The generator's wear-free electronic step attenuator extends its dynamic range down to -145 dBm, thus making it ideal for receiver measurements. However, since the insertion loss of the attenuator reduces the output power, a subsequent wideband output amplifier in the R&S®SMB100A compensates for this loss and provides additional gain. This results in the very high output power available at the RF output (FIG 7), which usually eliminates the need for an additional external output amplifier to compensate for high cable losses toward the DUT or for controlling a power amplifier.

The wideband output amplifier is only switched into the signal path at high output levels. At low output levels, this amplifier is not used, since it would degrade the wideband noise of the output signal due to its noise factor. A PIN attenuator connected in series to the wideband output amplifier is analog-controlled by the output frequency and the amplifier temperature. This PIN attenuator compensates for the first-order temperature drift of the gain of the wideband output amplifier. Thus, a highly stable output level is obtained even if the wideband output amplifier is active.

Another special feature of the R&S®SMB100A is its reverse power protection up to 6 GHz. This mechanism includes a pair of limiter diodes for limiting any RF power or voltage transient unintentionally applied at the generator's RF output. If the control circuit detects such an error condition, a relay disconnects the RF output from the output connector. While the instrument is being powered down, this relay also remains open, thus protecting the output from damage. This overvoltage protection comes in handy especially in the lab or during servicing, when measurements on the receiver section of a transceiver may accidentally cause the equipment to start transmitting.

Very short settling times for frequency and level

Automatic test systems for production require especially short settling times in the test equipment in order to keep test time short, thus ensuring high throughput. The R&S®SMB100A excels in this area with an average power level settling time of 1.2 ms and an average frequency settling time of 1.6 ms. FIG 8 shows the distribution of the settling times in remote control operation for 10 000 random changes in power level and an equal number of changes in frequency.

The level settling time is defined as the time the R&S®SMB100A requires for its output level to settle to a deviation of 0.1 dB from its final value. This is achieved through the use of a fast level control and fast CMOS RF switches. These highly reliable RF switches do not exhibit the long level settling times that are common with GaAs switches.

In addition, the generator signals completion of the settling transient at its Signal Valid output. By means of this signal, you can immediately trigger the measurement of the DUT, thus ensuring the fastest possible test sequences. To address the needs of highly time-critical applications such as measurements

Condensed data of the R&S®SMB 100A

Frequency

Frequency range

9 kHz to 6 GHz

Settling time

<3 ms, typ. 1.6 ms

Level

Level range

-145 dBm to +18 dBm
(overrange up to typ. 25 dBm)

Settling time

<2.5 ms, typ. 1.2 ms

Spectral purity (f = 1 GHz)

SSB phase noise (20 kHz carrier offset,

1 Hz measurement bandwidth)

<-122 dBc, typ. -128 dBc

Nonharmonics (carrier offset > 10 kHz)

<-70 dBc, typ. -85 dBc

Wideband noise (carrier offset > 10 MHz,

1 Hz measurement bandwidth)

<-142 dBc, typ. -152 dBc

Modulation modes

Interfaces

AM, FM / φM, pulse

IEC 60625 (IEEE 488)

Ethernet (TCP/IP)

USB

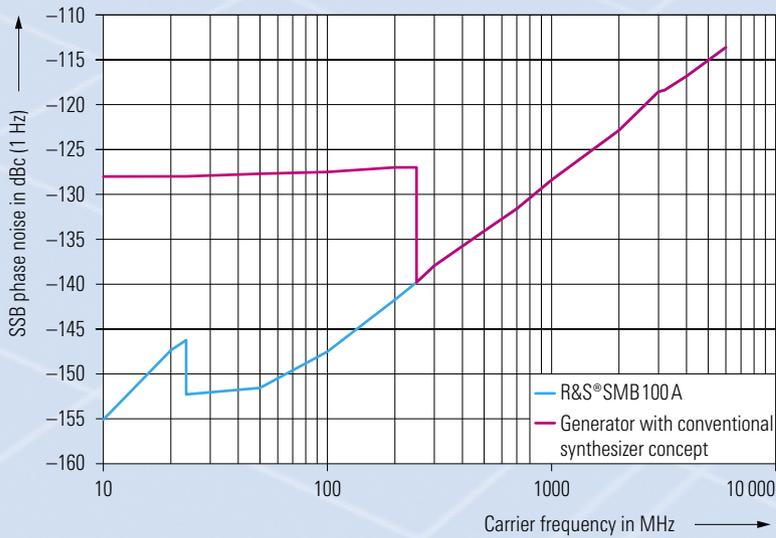


FIG 4
SSB phase noise at 20 kHz offset from carrier frequency: comparison between the R&S®SMB100A and a generator with conventional synthesizer concept.

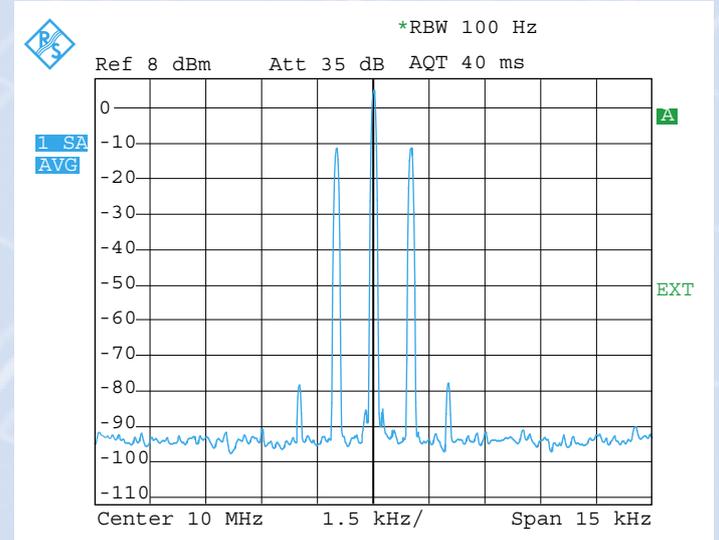


FIG 5 Amplitude-modulated spectrum at $f = 10$ MHz with low total harmonic distortion.

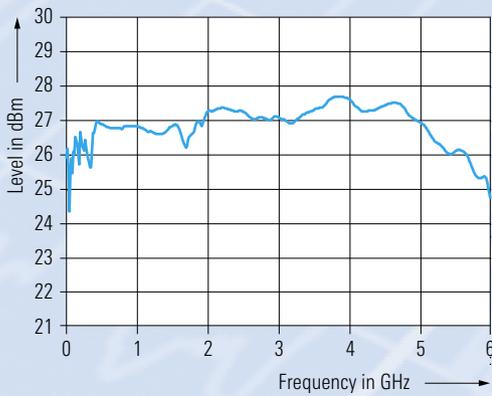


FIG 6 Measured maximum output level of the R&S®SMB100A.

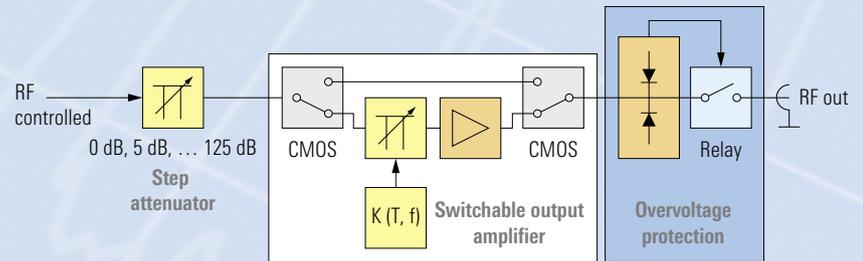
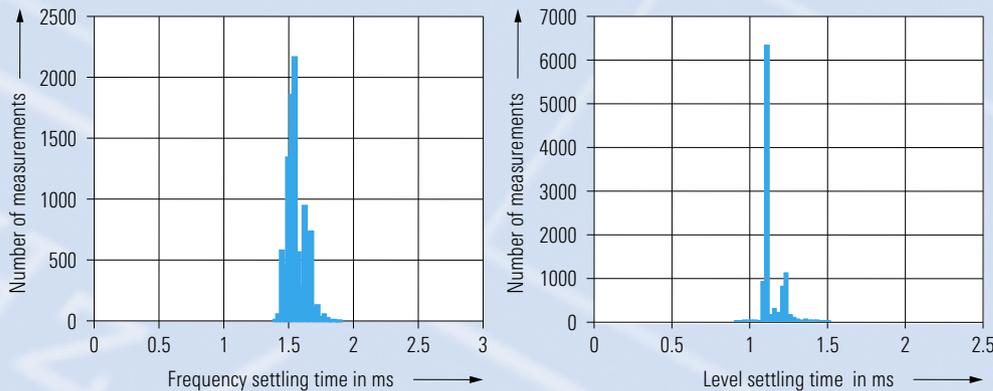


FIG 7 Output circuit of the R&S®SMB100A .

FIG 8 Statistics for the level and frequency settling times (10000 measurements each).



- ▶ on frequency-hopping systems, the R&S®SMB100A supports the List mode as a standard feature enabling an average settling time of 650 μ s.

Easy on-site servicing

During the development of the R&S®SMB100A, particular emphasis was placed on high reliability and simple design. The generator therefore consists of only four modules (FIG 9):

1. Power supply
2. Processor module including all digital internal and external interfaces
3. Front panel unit including display, keypad, and rotary knob
4. RF board including the entire RF test and measurement equipment

However, if the instrument should nevertheless malfunction, its straightforward design will facilitate the localization of the defective module. The built-in selftest, which automatically checks instrument functions, helps with troubleshooting. Since the instrument is easy to take apart and put back together, on-site module replacement is possible. This keeps downtime to a minimum and generator availability high.

After module replacement, the instrument is immediately ready for use again, since replacement modules come from the factory fully adjusted and tested. No additional external adjustment of parameters is necessary – a simple functional test is usually sufficient. You can calibrate the signal generator on your own; a calibration interval of three years is recommended.

To achieve optimal power level accuracy after servicing, a fully automatic power level correction can be performed by means of an R&S®NRP-Z92 power sensor connected to the generator output (FIG 10).*

Special requirements for aerospace and defense

The R&S®SMB100A is suitable for mobile use in aerospace and defense applications not only due to its low weight and compact design. Additional attributes such as its highly robust design, generously dimensioned power supply, and cooling controlled by the instrument temperature enable operation up to 4600 m above sea level and an operating temperature range from 0 °C to 55 °C.

The integrated high-quality pulse modulator with rise and fall times of typ. <10 ns is exceptional in this instrument class and is usually available only in significantly higher price classes. FIG 11 shows an example of the signal amplitude of a 20 ns pulse at 6 GHz. Besides the very clean characteristic, the pulse dynamic range with an on/off ratio of typ. 90 dB is also very good.

Owing to its fast internal pulse generator, which can generate not only single pulses but also double pulses, the R&S®SMB100A is also ideal for radar applications.

Compact design, low weight

With its compact dimensions of 344 mm \times 112 mm \times 368 mm, the generator requires only a small amount of space on crowded lab benches and service tables. Its convenient size and low weight of only 5.3 kg make it particularly well-suited for mobile use.

Variety of remote control capabilities

The PC module, which has been specially designed for the R&S®SMB100A, includes as standard the IEC/IEEE bus interface customarily used in test and measurement as well as a USB and a LAN interface. The generator can thus be easily integrated into the individual setup. If you want to operate the R&S®SMB100A from your computer via the LAN interface, you can do so by means of a conventional web browser or via the supplied virtual network computing (VNC) software.

Summary

The R&S®SMB100A complements the portfolio of analog signal generators from Rohde & Schwarz. It is a mid-range instrument that stands alongside its well-established high-end brother, the analog R&S®SMA100A signal generator. The R&S®SMB100A will also impress you with its highly attractive price/performance ratio. Moreover, it features excellent spectral purity, very high output power, short settling times, as well as a compact and robust design.

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* Available as of January 2008 via firmware update.

FIG 9
The R&S®SMB100A is designed for ease of service and consists of only four modules.



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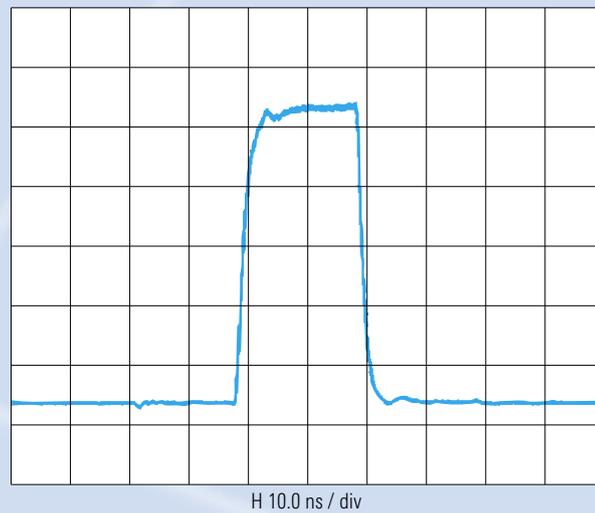
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FIG 10 The R&S®SMB100A performs automatic level correction when an R&S®NRP-Z92 power sensor is connected.*

More information, brochure,
and data sheet at
www.rohde-schwarz.com
(search term: SMB100A)



FIG 11
Signal amplitude of a
20 ns pulse at 6 GHz
with 0 dBm level.



Ch 1 rise
3.128 ns
Ch 2 fall
2.225 ns

H 10.0 ns / div