FIG 1 The R&S®SMA100A offers excellent performance and compact design at a favorable price.

Signal Generator R&S®SMA100A

Analog signal generator that meets virtually every requirement

Signal quality, speed and flexibility – these are the criteria by which signal generators are measured today. The R&S®SMA100A perfectly meets these criteria, and thus is a premium-class analog generator that is impressive due to its outstanding characteristics.

Premium signal quality

The Signal Generator R&S®SMA100A (FIG 1) combines premium signal quality with very high setting speed, which makes it ideal for any task. Whether in development, production, service or maintenance, the R&S®SMA100A does an excellent job. Covering a wide frequency range of 9 kHz to 3 GHz, it is suitable even for EMC applications.

The R&S®SMA100A is the ideal solution for measurement applications requiring high spectral purity, e.g. adjacent-channel or phase-noise measurements, and is also optimal for use as a local oscillator or VCO.

Due to an innovative synthesizer concept, the standard version of the instrument already offers excellent values in terms of SSB phase noise (typ. –135 dBc (1 Hz) at a carrier frequency of 1 GHz and 20 kHz carrier offset) and nonharmonic suppression (<–80 dBc for frequencies <1.5 GHz).

With the Enhanced Phase Noise Performance and FM / φM Modulator option (R&S®SMA-B22), high-grade reference oscillators are added to the generator synthesizer, even further improving SSB phase noise (typ. –140 dBc (1 Hz) at a carrier frequency of 1 GHz and 20 kHz carrier offset) for frequency offsets of up to approx. 100 kHz (FIGs 2 and 3). The option contains a phase-locked loop, which is connected after the synthesizer and improves nonharmonic spurious suppression to typ. <–100 dBc (for frequencies <1.5 GHz).

Unlike conventional signal generators, the R&S®SMA100A generates frequencies down to 6.6 MHz by division of the fundamental frequency range. In the lower frequency range from 6.6 MHz, this yields spectral purity on par with that of high-grade crystal oscillators.

The oven-controlled crystal oscillator (OCXO) built in as standard provides very high frequency accuracy and stability. Even these characteristics are further improved with the R&S®SMA-B22 option.

Due to its sophisticated RF design, the signal generator also stands out for excellent broadband noise (typ. <–160 dBc (1 Hz) at a carrier frequency of 1 GHz), a value that conventional generators can usually achieve only by inserting steep-edged filters after the synthesizer.

Ideal for use in production

In production and ATE applications, the test equipment must provide short setting times in order to ensure high throughput and thus low measurement costs. The R&S®SMA100A features the very short level and frequency setting times that Rohde&Schwarz signal generators are known for and is thus an ideal choice in time-critical measurement systems. Even in normal operation (remote control via the IEC/IEEE bus, trigger to EOI), very short setting times of typ. 1.5 ms are achieved for the frequency (to an offset of $<1 \times 10^{-7}$ from the set frequency) and the level (to an error of <0.1 dB of the set level). A further significant reduction in setting time (to <450 µs) is obtained in the list mode, which uses frequency and level settings previously stored in a list.

In the fast hopping mode, the generator features setting times as short as in the list mode. Plus, up to 10000 frequency and level pairs can be addressed as desired via a serial bus.

The electronic attenuator enables rapid and wear-free level setting of the R&S®SMA100A. The normal mode uses purely electronic level setting, ranging from –145 dBm to +13 dBm (typ. +21 dBm in the overrange; see green trace in FIG 4). Higher output levels of up to typ. +26 dBm can be supplied in the high-power mode (with the electronic attenuator bypassed; see blue trace in FIG 4). In this mode, the lower limit for electronic level setting is –20 dBm.

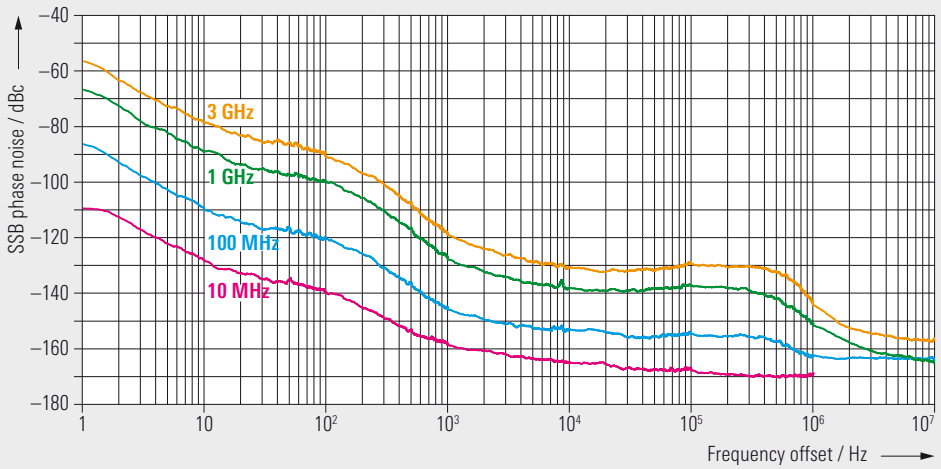

FIG 2 Typical SSB phase noise at different RF frequencies with the R&S®SMA-B22 option (measurement bandwidth 1 Hz).

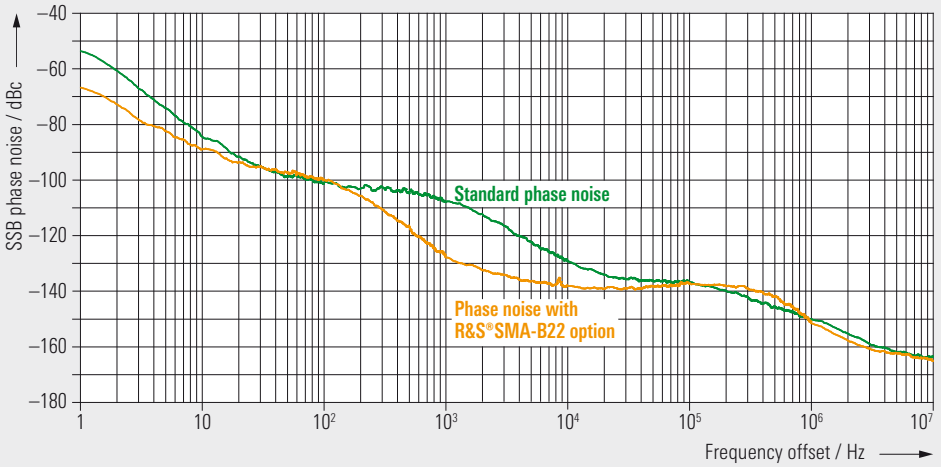

FIG 3 Typical SSB phase noise with and without the R&S®SMA-B22 option (f = 1 GHz, measurement bandwidth 1 Hz).

Condensed data of the R&S®SMA100A

Frequency	
Frequency range	9 kHz to 3 GHz
Setting time	<3 ms
Setting time in list mode	<450 µs
Level range	–145 dBm to +18 dBm (up to typ. +26 dBm overrange)
Spectral purity (at f = 1 GHz)	
Nonharmonics (carrier offset >10 kHz)	<–80 dBc; typ. –90 dBc <–90 dBc; typ. –100 dBc with R&S®SMA-B22 option
SSB phase noise (carrier offset 20 kHz, 1 Hz measurement bandwidth)	<–131 dBc; typ. –135 dBc <–136 dBc; typ. –140 dBc with R&S®SMA-B22 option
Broadband noise (carrier offset >10 MHz, 1 Hz measurement bandwidth)	<–153 dBc; typ. –160 dBc
Modulation modes	AM, FM/φM, pulse
Clock frequency range	100 kHz to 1.5 GHz
Interfaces	IEEE 488.2, LAN (100BaseT), 2 × USB, 1 × USB slave

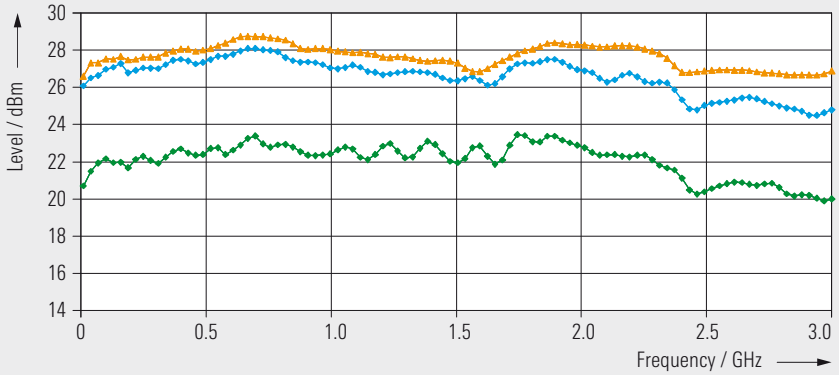

FIG 4 Maximum output power across the entire frequency range using different level modes (green: normal mode; blue: high-power mode; orange: with R&S®SMA-B103L option (RF path without attenuator)).

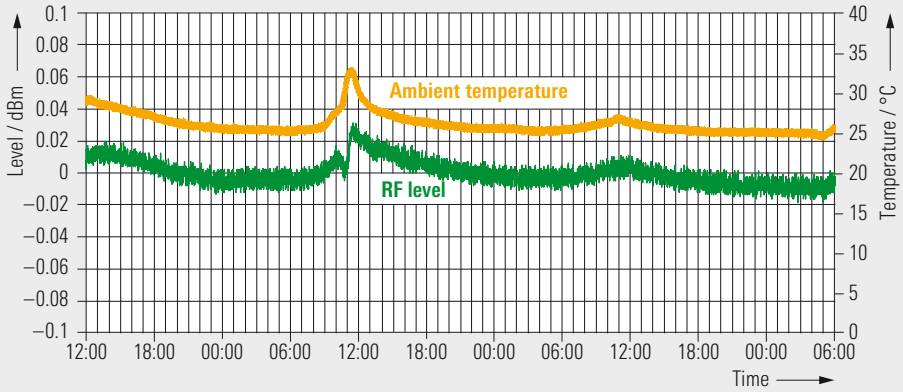

FIG 5 High level repeatability ensures extremely accurate results in series measurements.

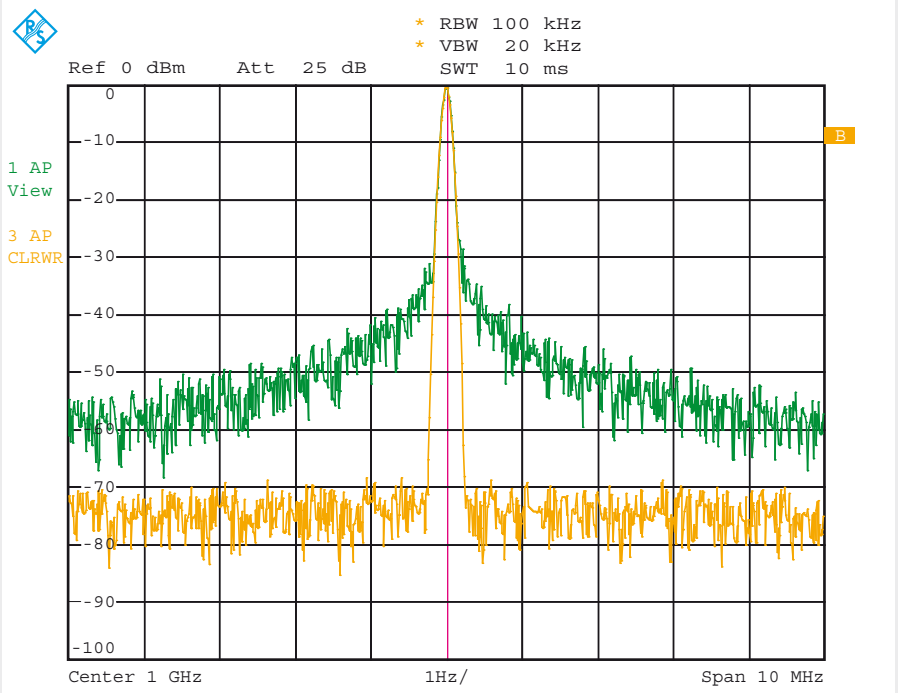

FIG 6 Frequency modulation with noise (green: with FM noise, orange: CW).

For applications requiring only high output levels of >–20 dBm, a favorably priced frequency option without an attenuator is available (R&S®SMA-B103L). Overvoltage protection across the entire frequency range is implemented in the R&S®SMA100A as standard to protect the unit against high external feedback power.

The high level accuracy and repeatability of the R&S®SMA100A ensure results of utmost precision in series measurements (FIG 5). Complex and time-consuming level calibration is a thing of the past. On top of this, the generator is of highly compact design – while offering a wide range of outstanding features and capabilities, it takes up no more than two height units.

Versatile analog modulation capabilities

The R&S®SMA100A performs amplitude and pulse modulation as standard. Frequency and phase modulation with a bandwidth of 10 MHz can optionally be implemented (R&S®SMA-B20/-B22), which makes the generator suitable for all common receiver measurements. The FM/φM modulator option is implemented by means of a direct digital synthesizer (DDS) and offers a modulation bandwidth of 10 MHz for FM and φM.

Due to digital deviation setting, the phase noise caused by modulation does not become visible until FM deviation is equal to or exceeds 100 kHz (at a carrier frequency of 1 GHz). The generator is thus ideal as a reference for phase noise measurements. It can be synchronized to the DUT by means of frequency modulation, which enables phase noise measurements even on free-running VCOs.

The RF signal can be internally modulated by means of the built-in LF generator (0.1 Hz to 1 MHz sinewave) or

the optional multifunction generator (R&S®SMA K24, bandwidth 10 MHz). The multifunction generator supplies various waveforms including sinewave, squarewave, user-programmable trapezoidal waveforms or noise with selectable bandwidth. Modulation signals can be added together with different weighting. The modulation signals for AM, FM and φM and for the LF output can be set independently of one another. Based on this concept, the R&S®SMA100A offers a level of modulation flexibility previously unknown in analog signal generators.

Using noise as a modulation signal, the generator supplies adjustable phase or FM noise to simulate, for example, a VCO or an interference signal of variable spectral purity for receiver tests (FIG 6).

Moreover, the R&S®SMA-B20 and -B22 FM and φM options can be used to implement extremely fast frequency changes across a limited frequency range. Direct access to the DDS yields frequency setting times of typ. <10 µs across a range of max. 40 MHz. This allows fast frequency hopping transmitters to be simulated, for example.

For pulse modulation, the R&S®SMA100A includes as standard a high-quality pulse modulator with an on / off ratio of >80 dB and a rise / fall time of typ. 10 ns as well as a basic pulse generator. Optionally, a high-performance pulse generator with a minimum pulse width of 20 ns and a variety of setting options is available (R&S®SMA-K23). This option makes the R&S®SMA100A also suitable for measurements on radar systems.

Optional clock generator

Tests on integrated RF circuits frequently require an ultra-pure clock signal in addition to the RF signal. In the past, the clock signal was usually delivered by an extra signal generator. This is different in the case of the R&S®SMA100A. Equipped with the clock synthesizer option (R&S®SMA-B29), it delivers a low-jitter clock signal that can be set independently of the RF output signal. The clock signal is available as a differential signal in the frequency range from 100 kHz to 1.5 GHz at two separate connectors on the rear of the unit. It is thus possible to test mixed-signal ICs such as A / D converters using only one signal generator.

Other special features

For many years, the HP 8662/63 was one of the most commonly used analog high-end signal generators. It was part of many test systems, e.g. the HP 3048A phase noise measurement system. The HP 8662/63 is no longer available and must be replaced by newer equipment in case of failure. The R&S®SMA100A is an ideal replacement for the HP generator since it offers an HP 8662A/63A-compatible mode in addition to the common SCPI remote-control command set. Based on this mode, the R&S®SMA100A can replace generators of the HP 8662/63 family without requiring the test system to be reprogrammed.

In areas where security is an issue, unauthorized access to internal instrument data and settings must be prevented. This may be the case, for example, during servicing or transport. To meet this requirement, the R&S®SMA100A can be fitted with an ejector option (R&S®SMA-B80), by means of which the storage medium (CompactFlash™ card) can be removed from the signal generator at the press of a button and kept or transported separately from the generator (FIG 7).

FIG 7 The R&S®SMA-B80 ejector option allows generator data and settings to be stored on a removable CompactFlash™ card.

Intuitive operation and a variety of connectors

The generator is based on the same operating philosophy as the known generators of the R&S®SMx family (see page 16). The 320 × 240 pixel (¼ VGA) color display shows the signal flow in a straightforward manner as a block diagram (FIG 8). Thus, you can immediately see the activated and deactivated functions and where you can make settings.

The generator is operated via the rotary knob, the cursor and function keys or a USB mouse and/or keyboard. In addition, the R&S®SMA100A can also be manually operated from an external PC using remote desktop control (e.g. VNC).

The generator can be remotely controlled via LAN or an IEC/IEEE bus. Hardware for a USB slave connector has been implemented, and the connector will later be available for remote control when appropriate software is added. Two USB connectors on the front and the rear panel allow the connection of a memory stick or a hard disk for data storage or firmware upgrades.

Moreover, power sensors of the R&S®NRP family can be connected to the generator, allowing the unit to perform high-speed, high-precision power measurements.

Summary

The R&S®SMA100A perfectly rounds out the Rohde&Schwarz portfolio of high-end signal generators. In addition to the established R&S®SMU200A, SMJ100A and SMATE signal generators for digital modulation, Rohde&Schwarz now offers a signal generator for analog applications that meets virtually every requirement.

The R&S®SMA100A offers excellent performance and compact design at a favorable price and is therefore a highly attractive instrument. Its high measurement speed also makes it an ideal choice in production. In short, it is unrivaled in its ability to handle almost any job.

Günther Klage

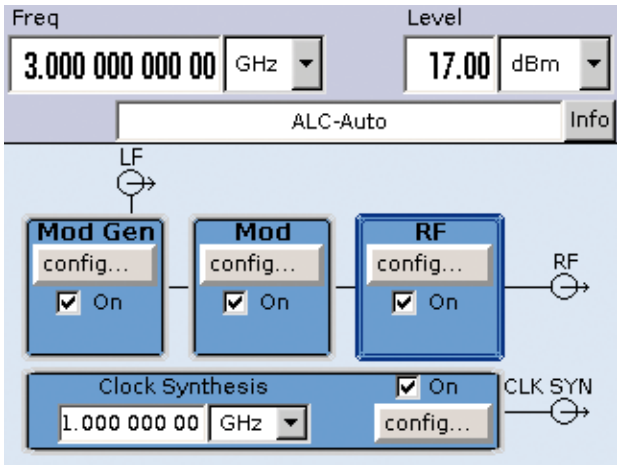

FIG 8
The R&S®SMA100A features the innovative user interface that is standard on generators of the R&S®SMx family.

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