Signal Generators SML 02/03

Economy class extended to 3.3 GHz

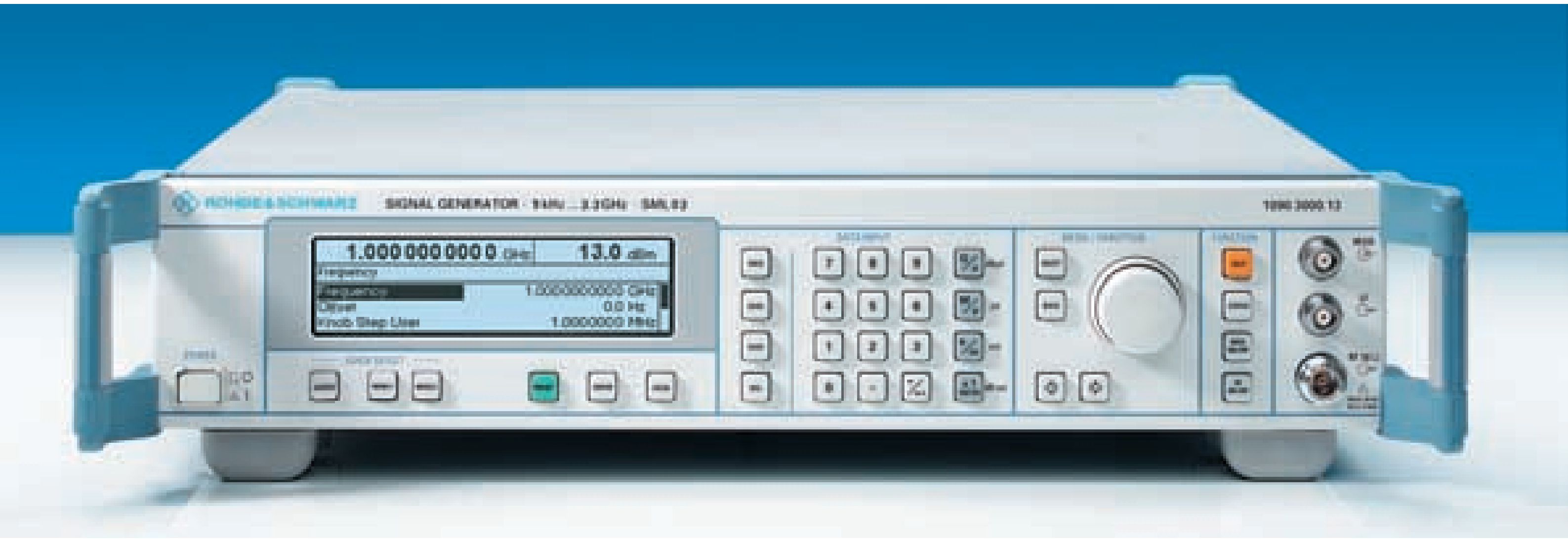

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FIG 1 With models SML 02 and SML 03, excellent economy-class generators up to 3.3 GHz are now available

The SML 01 economy generator was launched a year ago, a signal source for the frequency range 9 kHz to 1.1 GHz [*]. Based on this successful unit, Rohde & Schwarz has developed follow-on Signal Generators SML 02 and SML 03, creating an instrument family that continues the excellent technical characteristics of SML 01 up to 2.2 GHz (SML 02) and 3.3 GHz (SML 03).

Classic modulation of every kind

Like SML 01 before them, SML 02 and SML 03 (FIG 1) also generate amplitude-, frequency- and phase-modulated RF signals. That makes them excellent RF sources for all classic receiver measurements that do not require digitally modulated signals. Using an externally applied multiplex signal, stereo modulation can also be produced.

When it comes to generating sinusoidal modulation signals, all SML models comprise an AF generator covering frequencies from 0.1 Hz to 1 MHz. Its signal can also be brought out for external applications at a separate connector. For two-tone modulation, you can operate the AF generator together with an external signal source.

Option SML-B3 upgrades all generators for pulse modulation. In addition to a high-end pulse modulator, this option includes a pulse generator with enhanced features.

All modulation modes are possible simultaneously. Only frequency and phase modulation exclude each other because they share circuitry in SML.

Advanced DDS synthesis

Where frequency accuracy and spectral purity are concerned, all SML models are almost a match for the high-end generators in the Rohde & Schwarz range. You can set frequency with crystal resolution of 0.1 Hz. With option SML-B1 (OCXO reference oscillator) frequency accuracy fulfills even the most exacting requirements.

The excellent SSB phase noise deserves special mention. For the first time, with the introduction of SML 01, a typical specification of –128 dBc (at 1 GHz, 20 kHz carrier offset, 1 Hz measurement bandwidth) made its entry into this instrument class (FIG 2). The DDS-based frequency synthesis is not only notable for its excellent noise quality however. Short frequency setting times (typ.

7 ms) and high spurious suppression (typ. –64 dBc over 2.2 GHz) are further advantages.

Electronic attenuator

Tough production environments place heavy demands on the attenuator in the output of a signal generator. Precision and speed are called for, and above all maximum reliability.

That is why all SMLs are fitted with an electronic attenuator to standard. Any number of levels may be set without causing wear, and setting times of 5 ms are typical. Using special frequency response correction, level error of <±0.5 dB up to 2 GHz and <±0.9 dB up to 3.3 GHz is obtained. These figures can compete with those of conventional signal generators and their mechanical attenuators.

Wide range of use

Receiver measurements

Thanks to their low spurious FM of typically 0.5 Hz (at 1 GHz, 0.3 kHz to 3 kHz weighting bandwidth to CCITT), minimal SSB phase noise and high spurious suppression, these signal generators are ideal for all in-channel measurements on receivers.

The same applies if they are used as an interference source outside the receive channel (blocking measurements), because the SSB phase noise is still very low even with carrier offsets of several hundred kHz.

Sensitivity measurements require high level accuracy. Plus, the signal generator must have sufficient RF shielding – especially in the presence of unshielded receivers or units like pagers with integrated antennas. Every SML model fully satisfies these two requirements (FIGs 3 and 4).

EMC measurements

The European preliminary standard ENV 50204 has defined a test method for simulating interference caused by digital mobile phones. SML can be used here with its option SML-B3 for pulse modulation. Measurement is performed with a pulse-modulated carrier frequency of 900 MHz ±5 MHz, with the pulse generator set to a pulse period of 5 ms and 2.5 ms pulse width.

Reference source for measuring SSB phase noise

Conventional signal generators produce their lowest frequencies by downconverting the signal from a UHF oscillator. Even at low frequencies, this method ensures good AM and FM characteristics. So SML also operates in this way up to 76 MHz. The SSB phase noise is about the same level as at 1 GHz (FIG 2, continuous curve).

But this generator has an extra, interesting feature at the bottom of its frequency range, a mode called extended divider range. Here the RF signal is generated by frequency division, resulting in excellent figures for SSB phase noise. They easily compare with the high-grade crystal oscillators normally used as reference sources from about 10 MHz up to 30 MHz (FIG 2, dashed curve and FIG 5).

With such noise characteristics, SML is an excellent reference source for automatic test stations used to determine the SSB phase noise of synthesizers for mobile-radio base stations. Compared

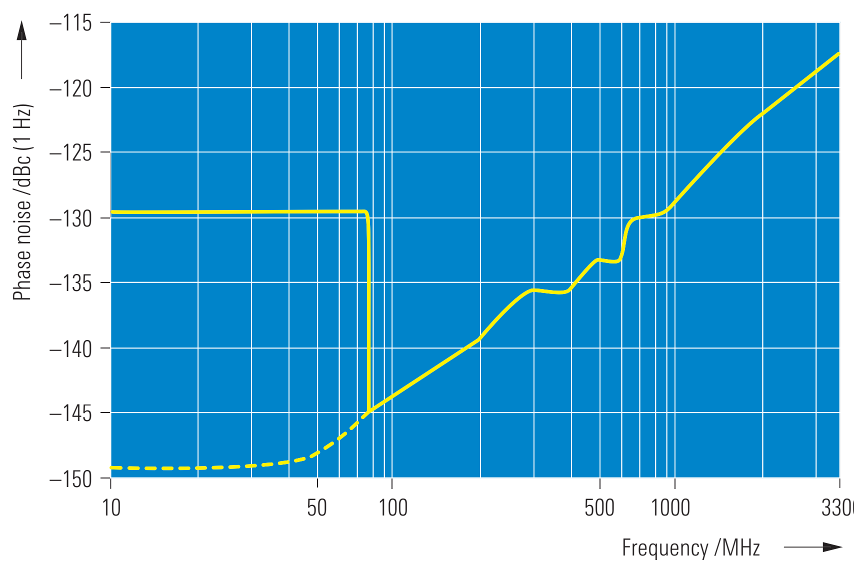

FIG 2 Typical SSB phase noise of SML03 versus carrier frequency (20 kHz carrier offset), continuous: normal mode, dashed: extended divider range

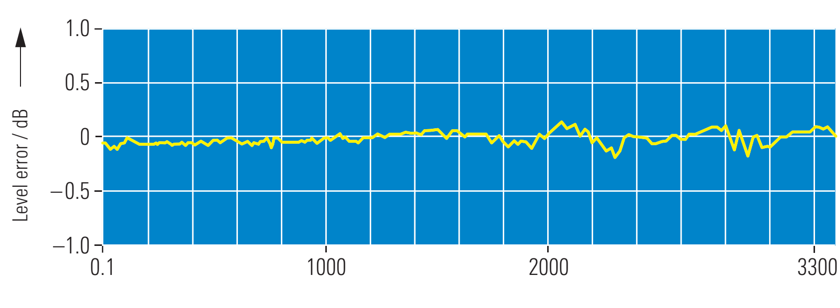

FIG 3 Typical level error at 0 dBm (SML03)

to the crystal oscillators normally found in these applications, SML additionally offers the following benefits:

- Frequency can be set in 0.1 Hz steps and synchronized to an external reference
- All functions can be remotely controlled via the IEC/IEEE-bus or serial interface

Reliable and economical

The reliability of a signal generator has a lot to do with the quality of the components used and of the processes involved in its production, not forgetting due attention to every aspect of the design phase of course. The name Rohde & Schwarz ensures that SML makes no compromises in any respect.

In the unlikely event of a fault, built-in diagnostics help cut time to repair to a minimum. Not only an extremely attractive price but also low follow-on costs make SML a solid investment, particularly because it only needs calibration every three years at the most.

Wilhelm Kraemer

Condensed data of SML 02 / 03

Frequency range	SML 02	9 kHz to 2.2 GHz
	SML 03	9 kHz to 3.3 GHz
Resolution		0.1 Hz
Setting time		<10 ms
Harmonics		<–30 dBc
Subharmonics		none (f ≤1.1 GHz)
		<–50 dBc (f >1.1 GHz)
Spurious		<–70 dBc (f ≤1.1 GHz)
		<–64 dBc (>1.1 GHz to 2.2 GHz)
		<–58 dBc (f >2.2 GHz)
SSB phase noise		<–122 dBc (f = 1 GHz, 20 kHz carrier offset, 1 Hz bandwidth)
Level		–140 dBm to +13 dBm (f >5 MHz to 3 GHz)
		–140 dBm to +11 dBm (f ≤5 MHz, f >3 GHz)
Resolution		0.1 dB
AM (3 dB bandwidth)		0 to 100% (DC to 50 kHz)
FM (3 dB bandwidth)		deviation up to 4 MHz (DC to 500 kHz)
φM (3 dB bandwidth)		deviation up to 40 rad (DC to 100 kHz)
		deviation up to 8 rad (DC to 500 kHz)
AF generator		0.1 Hz to 1 MHz
Pulse modulation (option SML-B3)		
On/off ratio		>80 dB
Rise/fall time		<20 ns
Pulse generator (option SML-B3)		
Pulse period		100 ns to 85 s

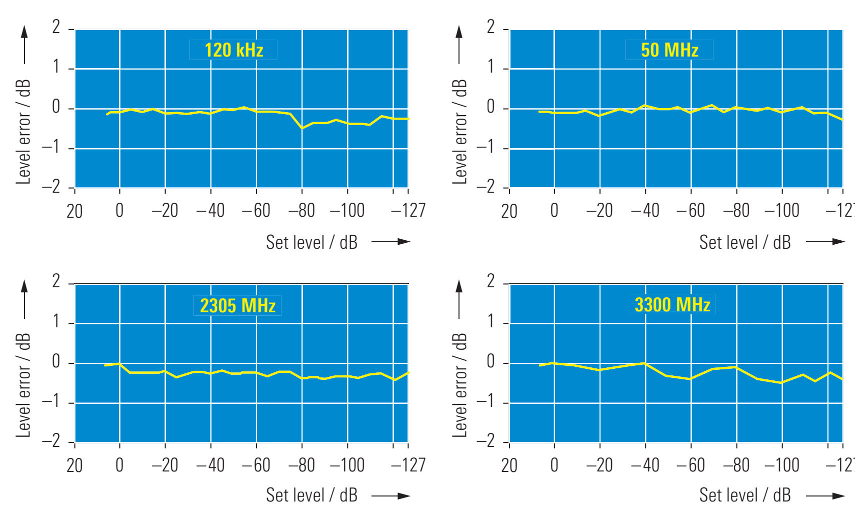

FIG 4 Level error as a function of set level

	Offset from carrier				
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz
SML 01 / 02 / 03 (measured figure)	–95 dBc	–120 dBc	–130 dBc	–138 dBc	–148 dBc
Crystal oscillator 220 (guaranteed figure)	–80 dBc	–120 dBc	–130 dBc	–140 dBc	–150 dBc

FIG 5 Signal Generator SML compared to high-grade crystal oscillator 220 (OCXO) from MTI-Milliren (USA). SML: 9.5 MHz output frequency, extended divider range activated; crystal oscillator 220: 9.5 MHz output frequency, 1 Hz measurement bandwidth

REFERENCES
[*] Signal Generator SML 01: Top-class economy generator. News from Rohde & Schwarz (1999) No. 165, pp 8–10

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