Signal Generator SML01

Top-class economy generator

Despite its amazingly attractive purchase price, the new Signal Generator SML01 (FIG 1) comes up with a variety of technical benefits. For example, it features a wear-free electronic attenuator guaranteeing short level setting times. Users in production and servicing, EMC testing and design alike will highly appreciate this feature. In frequency synthesis too, our engineers have taken new approaches and created a spectrally pure synthesizer with extremely short setting times previously only found in high-end equipment.

Photo 43 412/3

FIG 1 Great inner qualities and surprisingly compact outward appearance: the 19" case of SML01 is only 88 mm high and 450 mm deep. This makes the generator an attractive signal source for rack or desktop applications. Operation is by "EasyWheel" (FIG 2)

Modulation: classic modes

SML01 generates amplitude-, frequency- and phase-modulated RF signals in the frequency range 9 kHz to 1.1 GHz – just what is needed in all classic receiver measurements. Of course the FM modulator provides stereo modulation too with the aid of an external signal.

To generate sinusoidal modulation signals, an AF generator is built into SML01 covering the frequency range 0.1 Hz to 1 MHz. Its output signal is brought out at a separate connector and thus available for external applications. For two-tone modulation the AF generator can be operated in conjunction with an external signal source.

Pulse modulation for EMC applications or measurements in the radar IF range? Again no problem for SML01: adding the option SML-B3, these functions are easily implemented. SML-B3 not only comprises a high-grade pulse modulator but also a fully equipped pulse generator whose signal is brought out at an extra output.

All modulation modes can be operated simultaneously. Only frequency and phase modulation cannot be combined since they are generated by the same modulator.

Frequency synthesis: like the "big boys"

In terms of frequency accuracy and spectral purity, SML01 is equal to high-end Rohde&Schwarz signal generators in every way. Frequency setting is crystal-controlled with 0.1 Hz resolution. Fitted with option SML-B1 (OCXO reference oscillator), SML01 satisfies even the most stringent frequency accuracy requirements.

Particularly noteworthy is SSB phase noise (FIGs 3 and 4). A typical value of –128 dBc (at 1 GHz, 20 kHz from carrier, 1 Hz bandwidth) was simply unknown to date in this instrument class. FIG 3 shows a typical characteristic at 1 GHz for carrier offsets 1 Hz to

10 MHz. This excellent noise performance – just like the outstanding spurious suppression of typically –76 dBc – was achieved by sophisticated direct digital frequency synthesis (DDS). This concept at the same time means short frequency setting times (typ. 7 ms) for SML01. FIG 3 further shows broadband noise of typically –150 dBc (at >2 MHz from carrier), which meets the most exacting demands.

Level: electronic setting

The tough conditions of day-to-day use in production are a measure of the worth of any signal generator. Here, precision and speed and above all maximum reliability are called for. This applies in particular to the attenuator in the output path of the signal generator. While mechanical attenuators, which are frequently used, fully meet requirements in terms of level accuracy, they leave a great deal to be desired when it comes to setting speed and service life.

Not so SML01: its electronic attenuator handles any number of setting operations without any wear – and this with typical setting times of 5 ms. And because of the excellently devised frequency response compensation of the RF level by means of the SML 01 microprocessor, level accuracy (typ. 0.5 dB) well matches that of any signal generator using a mechanical attenuator (FIG 5).

FIG 2 The operating concept of SML01 is the same as that of Microwave Signal Generator SMR*: just turn the wheel to go to a desired menu item, then press it to open the corresponding submenu

The remaining RF level specifications are quite impressive too. For example, levels from –140 dBm to +13 dBm can be set in 0.1 dB steps – with overrange even up to +19 dBm. Of course, neither a mechanical nor an electronic attenuator performs level setting without interruption. SML01, therefore, like signal generators with a mechanical attenuator, offers the "non-interrupting" level setting mode, allowing level variation by typically 30 dB. This makes SML01 an ideal choice for squelch tests.

Applications: fit in every respect

Receiver measurements

These measurements belong to the classic applications of SML01. Featuring low residual FM of typically 0.5 Hz (at 1 GHz, weighting bandwidth 0.3 kHz to 3 kHz to CCITT) and low SSB phase noise as well as high spurious suppression, the signal generator is ideal for all in-channel measurements on receivers.

This also applies to its use as a noise source outside the receive channel. Here the low broadband noise is an additional advantage. Since SSB phase noise is very low even at several hundred kHz from the carrier, blocking measurements pose no problem.

Sensitivity measurements call for high level accuracy, especially at low RF levels. The signal generator should also feature adequate RF shielding – in particular with unshielded receivers or equipment with an integrated antenna (eg pagers). SML01 fully meets both requirements.

EMC measurements

EMC measurements, such as of electromagnetic susceptibility, are usually carried out with a power amplifier connected after SML01. The amplifier is extremely sensitive to fast level changes such as overshoots or dropouts, which may even cause damage. The following two characteristics of SML01 are, therefore, particularly valuable: level changes are practically without overshoots, and the non-interrupting level setting prevents RF level dropouts during level changes (FIG 6).

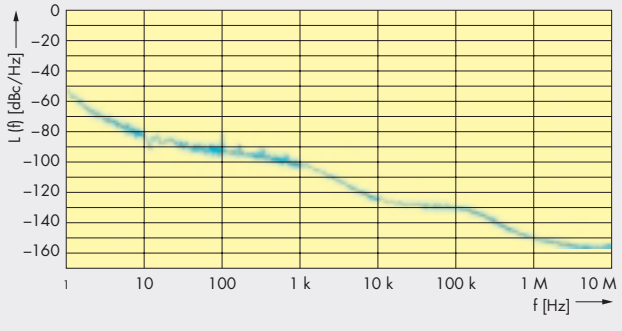


FIG 3 Typical SSB phase noise at 1 GHz

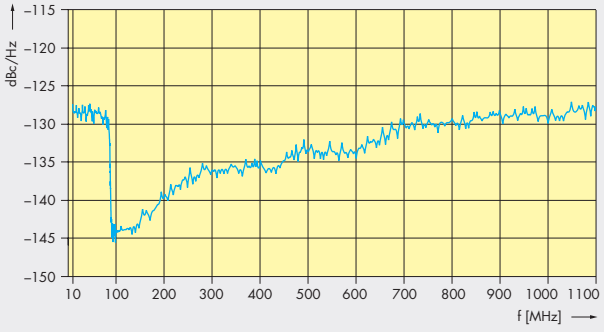
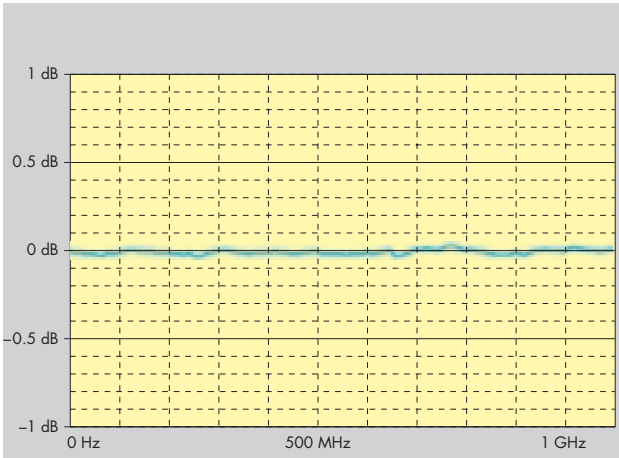


FIG 4 Typical SSB phase noise versus carrier frequency (20 kHz from carrier)



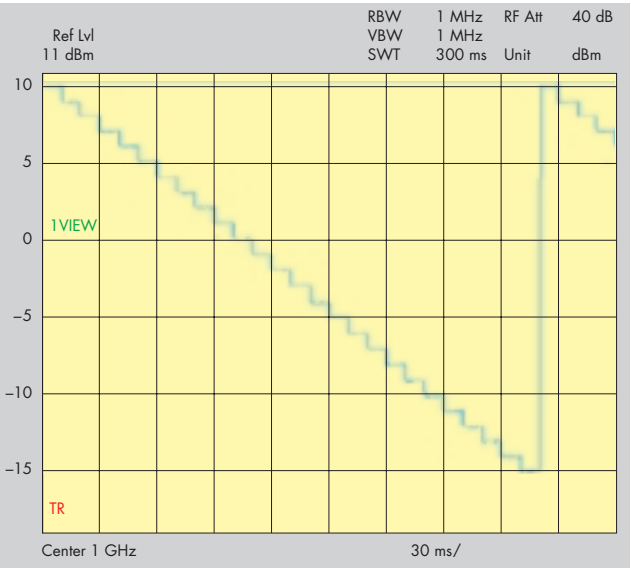


FIG 5 (top): Typical level accuracy at 0 dBm
FIG 6 (right): Level sweep over range of 25 dB

Due to the widespread use of digital radiotelephones, growing importance attaches to testing the immunity of these units to high-frequency electromagnetic fields. The European draft standard ENV 50204 specifies a relevant test method. The method can basically be implemented with an SML01 fitted with an optional SML-B3 pulse modulator. The measurement is carried out using a pulse-modulated carrier frequency of 900 MHz ±5 MHz, with the pulse generator set to a period of 5 ms and a pulse width of 2.5 ms. In this way the generator simulates interference caused by TDMA signals.

Servicing

SML01 is compact and lightweight. And another plus for field use: it can be controlled both via an IEEE bus interface and a serial RS-232-C interface. This allows straightforward operation from a notebook PC without an IEEE bus card.

In the servicing of transceivers or transmitters, there is a risk of RF power being inadvertently applied to the generator RF output. SML01 has a protective circuit integrated in its output that prevents the unit from being damaged (this applies to reverse power up to 50 W).

All in all: an investment you will not regret

When it comes to reliability, SML01 makes no compromises either. Should a fault ever occur, the built-in diagnostic system helps to drastically reduce repair times. So SML01 is a safe investment, not only due to the favourable purchase price but also to the low follow-up costs and the long calibration interval of at least three years.

Wilhelm Kraemer

* Kraemer, Wilhelm: Microwave Signal Generators SMR – Microwave in handy size. News from Rohde&Schwarz (1999) No. 162, pp 4–6

Condensed data of SML01

Frequency range	9 kHz to 1.1 GHz
Resolution	0.1 Hz
Setting time	<10 ms
Harmonics	<–30 dBc
Spurious	<–70 dBc
SSB phase noise	<–122 dBc/Hz
(f = 1 GHz, carrier offset 20 Hz)	
Residual FM to CCITT (f = 1 GHz)	<4 Hz
Level	–140 dBm to +13 dBm (+19 dBm)
Resolution	0.1 dB
AM (3 dB bandwidth)	0 to 100 % (DC to 50 kHz)
FM (3 dB bandwidth)	max. 1 MHz (DC to 500 kHz)
φM (3 dB bandwidth)	max. 10 rad (DC to 100 kHz)
	max. 2 rad (DC to 500 kHz)
Pulse modulation (option SML-B3)	
On/off ratio	>80 dB
Rise/fall time	<20 ns
AF generator	0.1 Hz to 1 MHz
Pulse generator (option SML-B3)	
Pulse period	100 ns to 85 s

Reader service card 165/02