Signal Generator SME06/SMT06

Analog and digital signals for receiver measurements up to 6 GHz

The boom in the communications sector is continuing. More and more mobile-radio networks and new radiocommunication applications are being devised. As the frequency bands below 3 GHz are already densely occupied, increasing use will have to be made of the region above 3 GHz. Rohde & Schwarz has responded to this trend by extending its line of signal generators by two new models: SME06 and SMT06 for the frequency range up to 6 GHz.

FIG 1 Externally identical models SME06 and SMT06 extend signal-generator family to cover analog and digital receiver measurements up to 6 GHz. Photo 42 455

Since 1993, Rohde & Schwarz Signal Generators SME and SMT for up to 3 GHz have been highly successful on the market. Now this signal-generator family has grown by two new members: models SME06 (FIG 1) and SMT06 for applications up into the 6-GHz range. Good news for customers who have to meet requirements which stipulate immunity to interference tests on electrical equipment up to 4 GHz. SMT06 is an ideal and at the same time cost-effective signal source for this purpose. Further applications will open up in the 5-GHz range, where intensive R&D is under way on new systems such as WLAN (wireless local area network), WLL (wireless local loop) and electronic road toll systems.

With SME06 and SMT06, the measurement technology for these applications is in place well ahead of time.

The two new models are based on their lower-frequency "brothers" and were developed using frequency doubling. In other words, SME06 and SMT06 are identical to SME03 and SMT03 up to 3 GHz except for overvoltage protection, which is not provided on the new models since it would result in a considerable deterioration of the output reflection coefficient at 6 GHz. Despite this, reflected RF power up to 1 W is permissible with SME06 and SMT06. To eliminate any danger when working on transceivers, which often have RF output powers above 1 W, an external high-power attenuator (eg 10 or 20 dB) can be switched in. This external attenuation can be taken into account in SME and SMT as an offset, and the signal generator then indicates the level after the attenuator. In this way measurement errors are prevented.

Synthesizer concept

The market success of the Rohde & Schwarz signal generators proves that the right concepts were chosen. This holds both for SMT, which is a budget-priced solution with a single-loop synthesizer, and for SME, which features direct digital multiloop frequency synthesis, short settling times and digital modulation. From the different synthesizer concepts, different fields of application are obtained.

SMT covers the complete range of conventional analog receiver and EMC measurements, while SME is capable of both analog and digital modulation. Moreover, thanks to its fast frequency synthesis, SME is ideal for measurements on frequency-hopping systems and for tasks where every millisecond counts, eg tests on integrated circuits, since test time for the IC manufacturer is equivalent to test costs. A reduction of test time from 20 to a few milliseconds, for example, will substantially reduce manufacturing costs. With 500 µs settling time in the list mode, SME offers an excellent prerequisite for cutting down on these costs.

The difference between the two synthesizer concepts can clearly be seen, for example, from the SSB phase noise (FIG 2), where SME features excellent values close to the carrier up to 10 kHz. With –115 dBc at 1 kHz from a 1-GHz carrier, SME can compete with the very best of today's low-noise generators. Its favourable SSB phase-noise values make SME ideal for substituting a local oscillator, especially when it comes to critical applications in digital transmission and radar systems. SMT, on the other hand, shows its strength at more than 100 kHz from the carrier. With SSB phase noise of –150 dBc at 1 MHz from a 1-GHz carrier, SMT is suitable for blocking measurements even on high-end receivers.

Modulation

SME and SMT feature versatile modulation modes for tests on communications, navigation, telemetry and broadcast receivers. The generators are capable of simultaneous **AM, FM (φM) and pulse modulation.** For two-tone modulation, internal and external sources can be combined. The AM frequency range is DC to 100 kHz, the FM range DC to 8 MHz (SMT) or 2 MHz (SME) with maximum deviation of 40 MHz (SMT) and 4 MHz (SME). A special control circuit ensures high carrier-frequency accuracy in the FM DC mode. DC coupling is possible also with phase modulation. The φM bandwidth is 2 MHz for SMT and 100 kHz for SME. Another valuable feature is the high-quality pulse modulation, featuring a rise/fall time shorter than 10 ns and an on/off ratio better than 80 dB.

The versatile modulation capabilities are backed up by a variety of modulation sources. In addition to a fixed-frequency generator incorporated as standard, an LF generator can be fitted to SME/SMT to supply **sinewave, triangular, squarewave and noise signals.** The maximum frequency for sinewaves is 500 kHz. A multifunction generator provides the same signals as the LF generator over an extended frequency range up to 1 MHz and, in addition, **stereo multiplex and VOR/ILS modulation signals.** The multifunction generator makes SME/SMT suitable even for highly demanding measurements on FM stereo and VOR/ILS navigation receivers. A pulse generator supplies single and double pulses up to 10 MHz. It can be internally or externally triggered. The pulse delay can be selected between 40 ns and 1 s. The signals generated by SME/SMT are available at separate outputs for external applications so that in some cases there is no need for an external AF or pulse generator.

Besides the analog modulation modes named above, SME06 provides virtually all types of **digital modulation** used in today's mobile-radio networks: GMSK, GFSK, FSK, FFSK, 4FSK, QPSK, O-QPSK and π/4-DQPSK, the data of the QPSK-based modulation modes degrading in the range above 3 GHz. The bit rate, filters and frequency deviation can be selected over a wide range, and a variety of combinations is possible. With 4FSK and QPSK, the bit rate can be set in the ranges 1 to 24.3 kbit/s and 27 to 48.6 kbit/s [1].

PRBS sequences can be selected as fixed standard patterns of various lengths or user-programmed with the aid of a list editor. Moreover, externally generated data sequences up to a length of 8 Mbits can be stored in SME. Such sequences are needed, for example, for propagation measurements in GSM networks. In SME, spurious AM and FM can be added to the digital modulation. This allows receivers to be tested not only with virtually ideal signals but also with interference signals as encountered in practice [2].

Ease of operation

Despite the wealth of functions provided, operation of SME is extremely easy thanks to a well thought-out operating concept featuring a large LCD display and menu guidance. All parameters and conditions selectable for a specific function are logically arranged in a single display. The user can be sure of not overlooking any hidden criteria or options associated with a particular function.

Another feature that greatly facilitates operation is the patented, magnetically locking tuning knob. Although smooth-running, it provides fine stepping which the user can clearly distinguish. As a result, the display of SME/SMT need not be watched all the time, eg in stepwise tuning. Tiresome turning from one

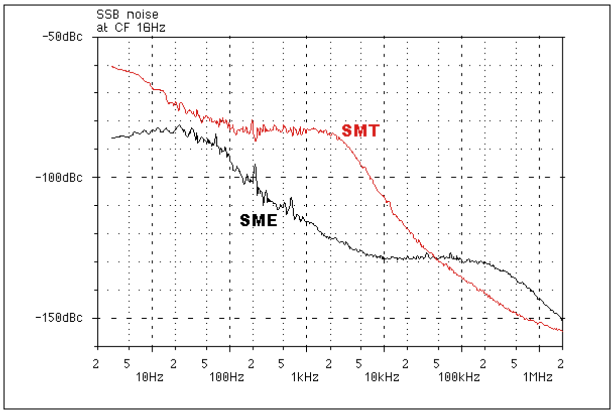

FIG 2
SSB phase noise
of SME and SMT
at 1 GHz

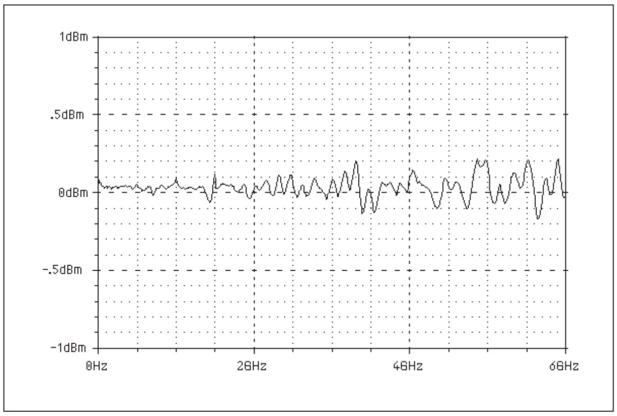

FIG 3
Level frequency response of SMT06 at 0 dBm output level

display to another, eg when operating SME/SMT and another instrument at the same time, is a thing of the past.

Operator convenience is further enhanced by a variety of useful features. Every RF specialist is aware of the problem: the higher the operating frequency in a test system, the more difficult it is to apply the RF signal to the EUT without any losses or appreciable frequency response occurring on the connecting lines. Here the **user correction** function is helpful: level correction values for up to 160 frequency points can be stored in SME/SMT, the values between these points being determined automatically by interpolation (FIG 3). This allows the frequency response of external cables to be corrected and the level at the EUT to be kept constant. The user correction function is equally valuable in EMC measurements, where the frequency response of amplifiers, antennas or TEM cells connected after the signal generator are to be compensated. This does away with complicated, external level controls or test routines.

For frequently repeated measurement series or sequences of different types of single measurements, the **memory sequence** function affords convenience otherwise obtained only through processor control. Up to 50 instrument settings can be stored in nonvolatile memory. After programming the sequence of measurements (up to 256 steps) and the step time in a list, the automatic test run can be started.

Remote control of SME/SMT is normally via the IEC/IEEE-bus interface. If no IEC/IEEE-bus interface is available on the external PC, the RS-232-C interface can be used instead. This is expedient, for example, if a long data sequence has to be reprogrammed in SME and SME should remain in the test system. In such cases SME can be reprogrammed on site via the RS-232-C interface with the aid of a laptop.

Future-proof investment

It is difficult to say at present what new applications lie ahead in radiocommunications. There are however two reasons pointing to a strong increase in the demand for test equipment for the 3-to-6-GHz range: first, the range up to 2.7 GHz is already densely occupied so that higher frequencies will have to be used to an increasing extent. Second, the trend towards higher frequencies is being speeded up through new technologies allowing the use of small, favourably priced components. With its Signal Generators SME06 and SMT06, Rohde & Schwarz takes account of this trend already now, making sure that the right instrumentation is ready and in place.

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REFERENCES

[1] Klier, J.: Extensions to Signal Generator SME for testing new digital networks. News from Rohde & Schwarz (1994) No. 146, pp 40–41

[2] Klier, J.: Simulating vector errors with Signal Generator SME. News from Rohde & Schwarz (1995) No. 148, pp 32–33

Condensed data of Signal Generator SME06/SMT06

Frequency range	5 kHz to 6 GHz
Setting time SME06/SMT06	<10 ms (<500 µs in list mode) / <15 ms
Spurious (f < 1.5/3/6 GHz)	<–80/–74/–68 dBc
SSB phase noise (f = 1 GHz, at 20 kHz from carrier) SME06/SMT06	<–126 dBc/<–116 dBc
Level range	–144 to +13 dBm (overrange 16 dBm)
AM/FM/φM SME06	DC to 100 kHz/2 MHz/100 kHz
AM/FM/φM SMT06	DC to 100 kHz/8 MHz/2 MHz
Digital modulation (SME only)	GMSK, GFSK, FSK, FFSK, 4FSK, QPSK, O-QPSK and π/4-DQPSK
Pulse modulation	
On/off ratio	>80 dB
Rise/fall time	<10 ns
Pulse generator	single pulse, double pulse, external trigger
Pulse repetition period	100 ns to 85 s
Pulse width	20 ns to 1 s
Pulse delay	40 ns to 1 s
Multifunction generator	sinewave, triangular, squarewave, noise, VOR/ILS modulation signals, stereo MPX signals

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