Signal Generator SME

New: 6 GHz

For digital communication
5 kHz to 1.5/2.2/3/6 GHz

- All types of modulation for mobile radio networks of today and tomorrow
- Generation of frames for TDMA systems
- Enhanced measurement capabilities through optional FM and pulse modulation
- Internal modulation sources: data generator, LF generator, pulse generator

ROHDE&SCHWARZ

Signal Generator SME

Equipped for the digital age

The SME supplies the complex signals required for the development and testing of digital mobile radio receivers. The SME is capable of generating all signals used in the important digital mobile radio networks in line with relevant standards regarding the type of modulation, data format, TDMA structure and frequency hop patterns.

The SME is completely at home also in the analog signal world. Featuring AM, FM, φM and pulse modulation, it covers the entire spectrum of functions provided by conventional signal generators.

The three models SME02, SME03 and SME06 differ essentially in their frequency ranges. Economy Signal Generator SME03E has been designed as an especially economical solution for applications involving digitally modulated signals. Signal Generator SME03A already contains option Fast CPU SM-B50.

Configurable to user's requirements

The SME can be tailored to user's requirements by means of a wide range of options. The variety of options available allows the SME to be configured with the emphasis either on digital modulation or on analog applications or to be expanded into a universal unit.

Overview of digital modulation modes

GMSK

Bit rate	Filter	Remarks
2.4/3.6/4/4.8/7.2/8/9.6/14.4/16/19.2/ 28.8/32/38.4/64/76.8/270.833 Kbit/s	B x T = 0.3/0.5	GSM, CDPD, DCS1800 (PCN), DSRR, MOBITEX
2.5/3/5/6/10/12/20/24/40/48/80/160/ 512 Kbit/s	B x T = 0.5	
8 Kbit/s	B x T = 0.25	
270.833 Kbit/s	B x T = 0.2	
1000 Kbit/s *)	B x T = 0.4	

GFSK

Bit rate	Deviation	Filter	Remarks
10.0 to 585 Kbit/s	14.4 kHz	B x T = 0.7	
640 to 1170 Kbit/s	18/20 kHz	B x T = 0.5	CT2
	25.2 kHz	B x T = 0.4	
	160/180/202/259/288/317/403 kHz*)	B x T = 0.5	CT3, DECT

FSK

Bit rate	Deviation	Filter	Remarks
0.05 to 90 Kbit/s	4/4.5 kHz	Gauss B x T = 2.73	Cityruf, POCSAG
	4.8 kHz	Bessel B x T = 1.22/2.44	FLEX™
0.05 to 1900 Kbit/s	0.01 to 25 (800) kHz**)	OFF	

4FSK

Bit rate	Deviation	Filter	Remarks
1.00 to 24.3 Kbit/s	0.01 to 25 (800) kHz**)	cos 0.2	APCO25
27.0 to 48.6 Kbit/s		√cos 0.2	MODACOM
		Bessel B x T = 1.25	ERMES
		Bessel B x T = 1.22/2.44	FLEX™

FFSK

Bit rate	Deviation	AF	Remarks
0.05 to 90 Kbit/s	1.5/2/3/3.5/4/4.5 kHz	AF1 = bit rate AF2 = 1.5 x bit rate	POCSAG

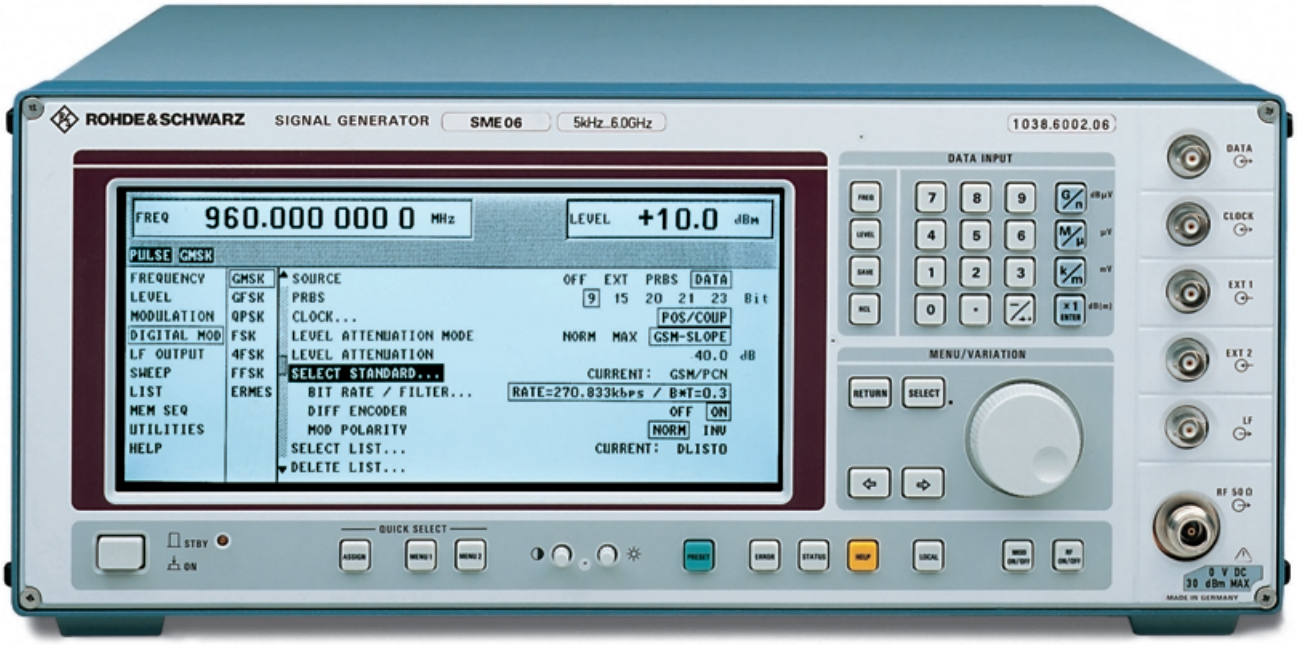
QPSK, π/4-QPSK, π/4-DQPSK *)**

Bit rate	Filter	Remarks
1.00 to 24.3 Kbit/s 27.0 to 48.6 Kbit/s	cos 0.2/0.35/0.4/0.5/0.6 √cos 0.35/0.4/0.5/0.6	APCO25, NADC, MSAT, PDC, TETRA, TFTS

O-QPSK *)**

Bit rate	Filter	Remarks
1.00 to 24.3 Kbit/s 27.0 to 48.6 Kbit/s	√cos 0.6	INMARSAT

*) Not possible in frequency range 130 MHz to 187.5 MHz.
**) Maximum deviation dependent on carrier frequency.
***) QPSK not specified for f > 3 GHz.



Features

- All common digital modulation modes provided in one unit
- No external modulation or data sources required
- Generation of paging signals in line with ERMES, FLEX™, FLEX-TD, REFLEX™ and POCSAG standards
- Internal control of frequency hopping and power ramping synchronous with the data signal
- Freely programmable data sequences and TDMA structure
- High spectral purity for out-of-channel measurements
- RF, LF and level sweep
- Memory sequence: programmable measurement sequence for up to 50 complete instrument settings
- List mode: programmable measurement sequence for up to 2000 frequency and level combinations, setting time <500 µs (not SME03E)
- Ultra-low RF leakage for measurements on highly sensitive paging receivers
- Easy to operate

Overview of options

Designation, function	Option
Reference Oscillator OCXO: Aging <1 x 10^{-9}/day	SM-B1
LF Generator: sinewave, noise 0.1 Hz to 500 kHz, triangular, squarewave 0.1 Hz to 50 kHz	SM-B2
Pulse Modulator: 50 MHz to 1.5/3/6 GHz, on/off ratio >80 dB, rise/fall time <10 ns	SM-B3/SM-B8/ SM-B9
Pulse Generator (only with SM-B3, SM-B8 or SM-B9): generates single pulse, delayed pulse and double pulse	SM-B4
FM/φM Modulator: FM DC to 2 MHz, φM DC to 100 kHz	SM-B5
Multifunction Generator: generates stereo multiplex and VOR/ILS signals; sinewave, noise 0.1 Hz to 1 MHz, triangular, sawtooth, squarewave 0.1 Hz to 50 kHz	SM-B6
DM Coder: generates FSK, FFSK, 4FSK, GFSK, GMSK, QPSK, π/4-QPSK, π/4-DQPSK, O-QPSK modulation; freely programmable data sequences and PRBS	SME-B11*)
8-Mbit DM Memory Extension: extends the 8-Kbit memory of the DM coder to 8 Mbit (data only)	SME-B12
FLEX Protocol (only with SM-B11 and SM-B12): generates paging signals in line with FLEX™ and FLEX-TD standards for tests on pagers	SME-B41
POCSAG Protocol (only with SM-B11 and SM-B12): generates paging signals in line with POCSAG standard for tests on pagers	SME-B42
REFLEX™ Protocol (only with SM-B11 and SM-B12): generates paging signals in line with REFLEX™ standard for tests on pagers	SME-B43
Fast CPU: reduces the settlng times of frequency and level (frequency: <3 ms, level: <2 ms)	SM-B50**)
Rear connectors for RF and AF (replacing front-panel connectors)	SME-B19

*) Already included in basic model of SME03E. **) Already included in basic model of SME03A.

Possible combinations of options

The SME options can be freely combined with two exceptions:

- The LF generator (SM-B2) and the multifunction generator (SM-B6) cannot be combined if a pulse modulator (SM-B3, SM-B8 or SM-B9) is fitted.
- The LF generator (SM-B2) can be fitted twice if no pulse modulator (SM-B3, SM-B8 or SM-B9) and no multifunction generator (SM-B6) is fitted.

All modulation modes of mobile radio

Digital modulation

With the DM coder option (included in basic model of SME03E), the SME provides a variety of network-specific digital modulation modes:

Modulation	**Network**
GMSK	GSM, DCS 1800, PCS 1900, CDPD, MC9, DSRR, Mobitex 8000
GFSK	DECT, CT2, CT3
π/4-DQPSK	NADC, PDC, TFTS, TETRA, APCO 25
FSK, FFSK	POCSAG, Cityruf
4FSK	ERMES, APCO 25, FLEX™, FLEX-TD

For a complete overview of digital modulation modes please refer to page 2.

Frequency and phase changes are produced by DDS (direct digital synthesis). The frequency and phase response are therefore synthesizer-accurate.

For varying the modulation spectrum, filters other than the standard ones may be used, eg filters with B x T = 0.2, 0.3, 0.5 for GSM networks. With GFSK modulation for DECT, non-standard deviations may be set to allow receiver tests.

For tests on pagers, SME generates paging signals in line with the ERMES, FLEX™, FLEX-TD and POCSAG standards. All important parameters and messages to be transmitted are freely selectable.

Internal data generator

The data generator supplies freely programmable data signals and PRBS signals in line with CCITT. For PRBS signals, five sequence lengths between 2^9-1 and $2^{23}-1$ are selectable. A list editor greatly facilitates programming. Up to ten data sequences with a total length of 8 kbit can be stored.

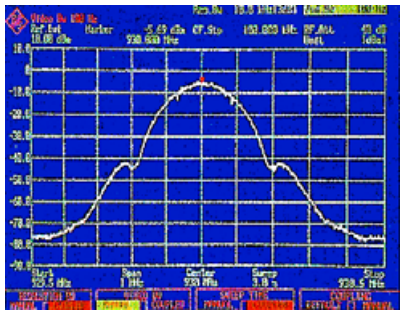
8-Mbit DM memory extension

An extension to the data generator memory is available for all applications requiring much longer data sequences. The 8-Mbit memory permits even BCCH and TCH data sequences to be stored which are needed for propagation measurements in GSM networks. This makes SME ideal as the core of a favourably priced mobile test base station.

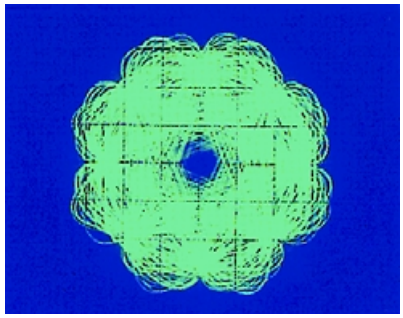
Power ramping and frequency hopping synchronous with the data signal

In addition to the data signal, the data generator supplies a data-synchronous burst and a level switch signal for the generation of TDMA frames.

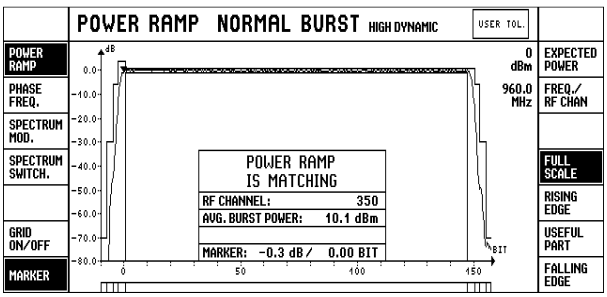
The burst and level switch signals are programmed bit-parallel with the data signal via list entries. The level switch signal controls the AM modulator to produce highly accurate level variations of up to 20 dB (overrange up to 40 dB). Together with a switchable GSM filter and the pulse modulator option, this allows the generation of bursts in line with the GSM standard.



GMSK modulation spectrum



π/4-DQPSK vector diagram



GSM power ramping

The burst signal available at a socket serves for controlling frequency changes (<0.5 ms) via the trigger input or fast level changes (>80 dB) via the pulse input.

The internal level switch signal can be replaced by an external logic signal. The signal switches the level in selectable steps with a rise/fall time <10 µs.

Analog modulation

The SME sets new standards in the field of digital modulation – without any restrictions on the analog side. The SME also stands out for its excellent analog characteristics.

Amplitude modulation
The modulation frequency range is DC to 100 kHz. Particularly noteworthy is the extremely low incidental phase modulation with AM, which plays an important role in AM sensitivity tests on FM receivers (RF frequency ≤3 GHz).

Frequency modulation
The modulation frequency range is DC to 2 MHz. The maximum selectable deviation for modulation frequencies above 500 kHz linearly decreases to 25 % at 2 MHz. In the FM DC mode, extremely high carrier frequency accuracy is ensured through the use of a novel control circuit. There is virtually no drift. This characteristic allows the digital signalling of receivers also by means of analog frequency modulation.

Phase modulation
Phase modulation ranges from DC to 100 kHz. This wide span opens up fields of application for which most signal generators do not qualify, for instance tests on phase-sensitive circuits or the generation of PSK modulation with freely selectable phase deviation.

Pulse modulation
Its high-quality pulse modulation, featuring an on/off ratio better than 80 dB and a rise/fall time shorter than 10 ns, make the SME an ideal choice for radar applications. The pulse generator option allows pulsed signals to be produced independent of an external source.

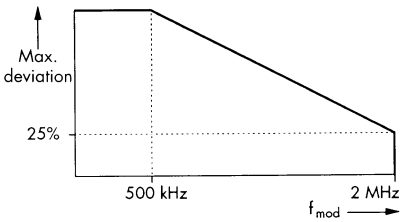
Analog modulation sources

Three optional modulation sources are available in addition to the fixed-frequency LF generator provided as standard:

- LF generator
- Multifunction generator
- Pulse generator

The **LF generator** is a synthesizer up to 500 kHz. In addition to sinewave, squarewave and triangular signals, it also supplies a noise signal. If two LF generators are provided in the unit, multitone signals can be generated internally.

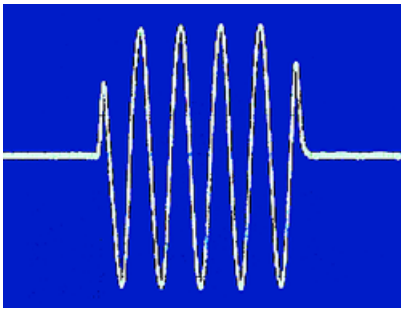
The **multifunction generator** produces sinewave and noise signals up to 1 MHz, triangular, sawtooth and squarewave signals up to 50 kHz



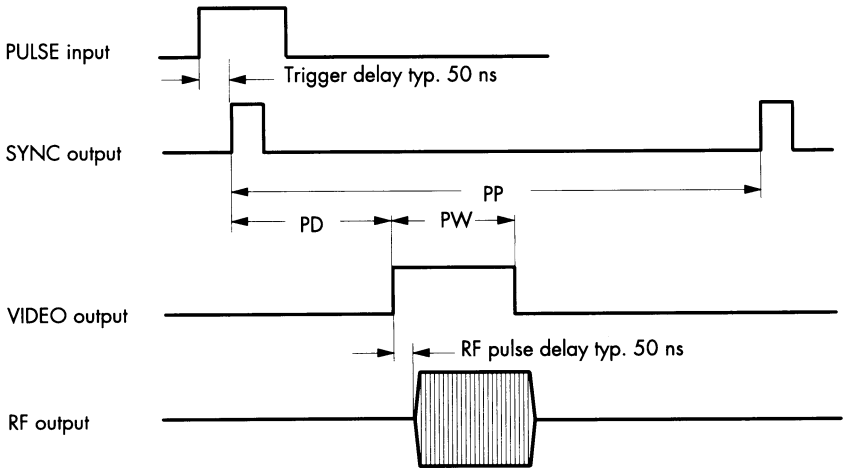
Adjustable progress of max. deviation at FM

and, in addition, stereo multiplex and VOR/ILS modulation signals. The multifunction generator option makes the SME suitable even for highly demanding measurements on FM stereo and navigation receivers.

The **pulse generator** permits the pulse repetition period, pulse width and pulse delay to be set with high accuracy and resolution. Single and double pulses required for radar receiver testing are generated.



Pulse modulation of 50-MHz carrier



The pulse generator option enables the pulse delay PD, pulse width PW and pulse repetition period PP to be set with high accuracy and resolution

State-of-the-art technology ...

Simultaneous modulation

... is required for simulating the complex signals used in modern communications and radar systems. The SME is capable of simultaneous DM, AM, FM (φM) and pulse modulation.

On a digitally modulated signal, for example, pulse modulation may be used to generate power bursts synchronous to the data signal in line with the TDMA structure used in today's networks. At the same time, Doppler shifts can be simulated by means of FM DC, and fading superimposed by AM DC.

Of the digital modulation (DM) modes, GMSK, GFSK, FSK, 4FSK, FFSK, QPSK, O-QPSK, π/4-QPSK or π/4-DQPSK may be selected.

With AM and FM, multitone modulation can be effected either by means of an internal and an external modulation signal or by means of two internal modulation signals (FM only).

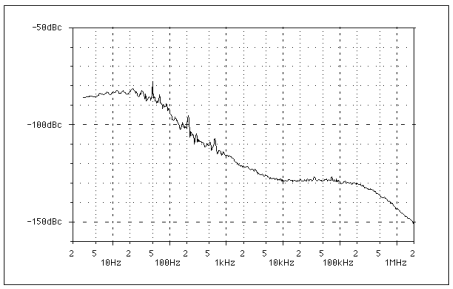
Excellent RF characteristics for unambiguous results

To measure critical receiver characteristics such as sensitivity or adjacent-channel selectivity, exacting demands are made on the spectral purity and level accuracy of the test signal. With respect to these characteristics, the SME ranks among the top units available on the market.

SSB phase noise at 20 kHz from a 1-GHz carrier is –130 dBc; non-harmonic spuria are below –80 dBc. Level setting in the range up to 2 GHz is accurate to 0.5 dB even for extremely small levels down to –127 dBm. Attenuator resettability is 0.01 dB.

Minimum RF leakage

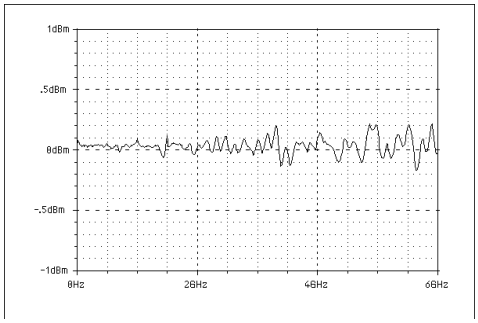
Measurements on high-sensitivity receivers such as radiopagers require signal sources with extremely high RF shielding. Elaborate shielding measures keep radiated interference on the SME to a minimum, ie <0.1 µV, induced in a two-turn loop 25 mm in diameter in the immediate vicinity of the instrument.



Typical SSB phase noise at 1 GHz (CW)

Modulation	AM	FM (φM)	Pulse	DM
AM	TT	●	●	●
FM (φM)	●	TT	●	●
Pulse	●	●	–	●
DM	●	●	●	–

Combination of modulation modes (TT = two-tone modulation)



Typical level frequency response at 0 dBm

... designed for great ease of operation

Low settling times for frequency and level

Today's applications in high volume production or ATE systems with complete test runnings in seconds require lowest frequency and level settling times to be competitive and ensure maximum throughput.

Option SM-B50 (not available for SME03G) reduces these settling times by factor 5 compared to a standard SME. Equipped with this option SME becomes one of the fastest signal generators on the market.

Convenient sweeps by means of list mode

In addition to the standard RF, AF and level sweeps, the SME offers a fast and highly flexible sweep function referred to as list mode (not SME03E). In this mode, frequency and level settings are made by means of values stored in lists which may contain up to 2000 pairs of frequency and level. This mode allows the frequency response of cable connections, amplifiers, TEM cells, etc in EMC measurements to be compensated already in the signal generator. Complicated external level controls or test routines are superfluous.

The setting time in the list mode is below 500 µs. The list mode may be executed either automatically with presettable dwell time, in single-step operation, or by means of external triggering. The latter allows the control of frequency hopping signals. The modulation settings will not be changed by the list mode, ie this mode can be used with modulated signals of any type.

Useful extra facilities

Memory sequence for automatic sequence control
For standard measurement series and for recurring sequences of different types of single measurements, the memory sequence function affords a convenience otherwise obtained only by means of processor control. Up to 50 instrument settings can be stored in a non-volatile memory. After programming the sequence of measurements and the step time in a list, the sequence can be started.

External triggering
In addition to automatic control, the list mode, memory sequence, RF, LF and level sweep functions may also be triggered by an external signal. This facility enables synchronous operation with other units.

Compensation of external frequency response
The frequency response of external cables can be compensated by entering level correction values for up to 160 frequency points. The correction values for the frequencies between these points are determined by means of interpolation. The frequency response correction will be active in any operating mode, also during sweeps.

A wealth of functions – yet easy to operate

As a rule, the more functions provided in a unit, the more complex the operation. This certainly applies to conventional signal generators with multifunction keys and a variety of special functions.

But not with the SME: operation 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. Looking up functions in a manual is a thing of the past.

The IEC/IEEE bus commands are in line with SCPI guidelines.

Minimum maintenance requirements

Calibration

Calibration of the unit is required every three years at the earliest. Calibration values are loaded via the RS-232-C or the IEC/IEEE-bus interface to ensure frequency and level accuracy to specifications. The unit neither needs to be opened, nor are any mechanical adjustments to be made.

Self-diagnostics

For maintenance and calibration, precise data on the instrument status are needed. Using built-in test equipment, the SME provides these data without any extra equipment required.

Self-test for enhanced reliability
The signal generator status is continuously monitored. The SME signals malfunctions and deviations from nominal values by means of a message on the display.

Built-in test equipment
The signal generator can be fully checked without any extra test equipment required and without opening the unit. There are 80 test points covering all crucial areas in signal generation such as RF signal levels and control circuit monitoring voltages. When a test point is called up via the keyboard or the IEC/IEEE bus, its number and value appear on the display. The source of error can thus easily be identified in the event of a malfunction.

A diagnostic and adjustment program for process controllers compatible with the industry standard (included in Service Kit SM-Z2) enables the automatic evaluation and logging of the instrument status. Adjustments can easily and rapidly be made without any extra test equipment required. During the several days of burn-in following production, the SME is continuously checked through with the aid of this program. This ensures that an extremely reliable instrument tested over the entire temperature range will be supplied to the customer.

Rear panel of SME

Specifications

Frequency

Range SME02	5 kHz to 1.5 GHz
SME03E	5 kHz to 2.2 GHz
SME03	5 kHz to 3 GHz
SME03A	5 kHz to 3 GHz
SME06	5 kHz to 6 GHz
Underrange (specs not binding)	down to 1 kHz
Resolution	0.1 Hz
Setting time (to within $<1 \times 10^{-7}$ for f >130 MHz and <73 Hz for f <130 MHz)	
after IEC/IEEE-bus delimiter SME03A, SME including option SM-B50	<10 ms
	<3 ms
after trigger pulse in list mode	<500 µs
Phase offset	adjustable in steps of 1°

Reference frequency	**Standard**	**Option SM-B1**
Aging (after 30 days of operation)	1×10^{-6}/year	$<1 \times 10^{-9}$/day
Temperature effect (0 °C to 55 °C)	2×10^{-6}	$<5 \times 10^{-8}$
Warm-up time	—	10 min
Output for internal reference		
Frequency	10 MHz	
Level (EMF, sinewave)	1 V_{rms}	
Source impedance	50 Ω	
Input for external reference		
Frequency	1 MHz to 16 MHz in steps of 1 MHz	
Permissible frequency error	3×10^{-6}	
Input level	0.1 V_{rms} to 2 V_{rms}	
Input impedance	200 Ω	
Electronic tuning (TUNE)	1×10^{-7}/V	
Input voltage range	0 V to ±10 V	
Input impedance	10 kΩ	

Spectral purity

Spurious signals	
Harmonics	
level ≤10 dBm [1])	<–30 dBc
level without overrange	<–26 dBc
Subharmonics	
f <1.5 GHz	none
f >1.5 GHz	<–40 dBc
f >3 GHz	<–34 dBc
Nonharmonics at >5 kHz from carrier	
f <1.5 GHz	<–80 dBc, <–66 dBc for digital modulation
f >1.5 GHz	<–74 dBc, <–60 dBc for digital modulation
f >3 GHz	<–68 dBc, <–54 dBc for digital modulation
Broadband noise for CW [1]) at >10 MHz from carrier, 1-Hz bandwidth	
f ≤3 GHz	<–140 dBc (typ. <–145 dBc)
f >3 GHz	<–134 dBc (typ. <–139 dBc)
SSB phase noise 20 kHz from carrier at 1-Hz bandwidth, FM/φM deviation <5% of maximum deviation	
f = 6 GHz	<–110 dBc
f = 3 GHz	<–116 dBc
f = 2 GHz	<–120 dBc
f = 1 GHz	<–126 dBc
f = 500 MHz	<–132 dBc
f = 250 MHz	<–137 dBc
f = 125 MHz	<–140 dBc
f <93.75 MHz	<–129 dBc
Residual FM, rms (f = 1 GHz)	
0.3 kHz to 3 kHz (CCITT)	<1 Hz
0.03 kHz to 20 kHz	<4 Hz
Residual AM, rms (0.03 kHz to 20 kHz) [1])	<0.02%

Level

Range	–144 dBm to +13 dBm
Overrange (specs not binding)	up to 16 dBm
Resolution	0.1 dB
Total error for levels >–127 dBm [1])	
f <2 GHz	<0.5 dB
f >2 GHz to 4 GHz	<0.9 dB
f >4 GHz	<1.2 dB
Level flatness at 0 dBm [1])	<1 dB
f ≤3 GHz	<1 dB
f >3 GHz	<1.5 dB
Output impedance	50 Ω

VSWR [1])	f ≤3 GHz	3 GHz < f ≤5 GHz	f >5 GHz
Level >0 dBm	<2	<2	<2
Level >0 dBm and option SM-B9 fitted (SME06)	<2	<2	<2.5
Level ≤0 dBm	<1.5	<2	<2

Setting time (IEC/IEEE bus)	<25 ms
with electronic level setting	<10 ms
SME03A, SME including option SM-B50	<2 ms
Non-interrupting level setting (ATTENUATOR MODE FIXED)	
Setting range	0 dB to 20 dB
Rise/fall time	<10 µs

Overvoltage protection protects the unit from externally applied RF power (50-Ω source) and DC voltages

Max. RF power	50 W (SME02, SME03/A/E) 1 W (SME06)
Max. DC voltage	35 V (SME02, SME03/A/E) 0 V (SME06)

Simultaneous modulation any combination of AM, FM (φM), pulse modulation and DM (DM = FSK, 4FSK, FFSK, GFSK, GMSK or QPSK)

Amplitude modulation

Operating modes	internal, external AC/DC
Modulation depth	0 % to 100 % modulation depths meeting AM specifications linearly decrease on increasing the level from 7 dBm to 13 dBm; a status message will be output if the modulation depth is too great
Resolution	0.1 %
Setting error at 1 kHz (m <80 %) [1])	<4 % of reading ±1 %
AM distortion at 1 kHz [1]) [2])	
m = 30 %	<1 %
m = 80 %	<2 %
Modulation frequency range	DC to 100 kHz
Modulation frequency response (m = 60 %) [1])	
20 Hz (DC) to 50 kHz	<1 dB, typ. 0.3 dB
SME06:	
20 Hz (DC) to 50 kHz	<1 dB (f ≤3 GHz)
20 Hz (DC) to 10 kHz	<1 dB (f >3 GHz)
Incidental φM with 30 % AM, AF = 1 kHz	<0.1 rad (f ≤3 GHz) <1 rad (f >3 GHz)
EXT1 modulation input	
Input impedance	>100 kΩ
Input voltage for selected modulation depth	1 V_P (high/low indication for inaccuracy >3 %)

Frequency modulation with option SM-B5

Operating modes	internal, external AC/DC, two tone with two separate channels FM1 and FM2
Max. deviation at carrier frequency	
<130 MHz	500 kHz
130 MHz to 187.5 MHz	125 kHz
187.5 MHz to 375 MHz	250 kHz
375 MHz to 750 MHz	500 kHz
750 MHz to 1500 MHz	1 MHz
1500 MHz to 3000 MHz	2 MHz
3000 MHz to 6000 MHz	4 MHz

Resolution	<1 %, min. 10 Hz
Setting error at AF = 1 kHz	<3 % of reading + 20 Hz
FM distortion at AF = 1 kHz and half max. deviation	<0.5 %, typ. 0.05 %
Modulation frequency range	
with maximum deviation	DC to 500 kHz
at <25 % of maximum deviation	DC to 2 MHz
Modulation frequency response	
10 Hz (DC) to 100 kHz	<0.5 dB
10 Hz (DC) to 2 MHz	<3 dB
Preemphasis	50 µs, 75 µs (deviation limited to 25 % of max. value)
Incidental AM at AF = 1 kHz, f >1 MHz, deviation = 40 kHz	<0.1 %
Stereo modulation at 40 kHz deviation, AF = 1 kHz, f <125 MHz	
Stereo separation	>50 dB
Unweighted S/N ratio (rms)	>76 dB
Weighted S/N ratio (rms)	>76 dB
Distortion	<0.1 %
Carrier frequency offset with FM	
<93.75 MHz	<50 Hz + 1 % of deviation
93.75 MHz to 187.5 MHz	<12.5 Hz + 1 % of deviation
187.5 MHz to 375 MHz	<25 Hz + 1 % of deviation
375 MHz to 750 MHz	<50 Hz + 1 % of deviation
750 MHz to 1500 MHz	<100 Hz + 1 % of deviation
1500 MHz to 3000 MHz	<200 Hz + 1 % of deviation
3000 MHz to 6000 MHz	<400 Hz + 1 % of deviation
EXT1, EXT2 modulation inputs	
Input impedance	>100 kΩ
Input voltage for selected deviation	1 V_P (high/low indication for inaccuracy >3 %), for AF = 10 Hz to 100 kHz

Phase modulation — with option SM-B5

Operating modes	internal, external AC/DC, two tone with two separate modulation channels φM1 and φM2
Max. deviation at carrier frequency	
<130 MHz	5 rad
130 MHz to 187.5 MHz	1.25 rad
187.5 MHz to 375 MHz	2.5 rad
375 MHz to 750 MHz	5 rad
750 MHz to 1500 MHz	10 rad
1500 MHz to 3000 MHz	20 rad
3000 MHz to 6000 MHz	40 rad
Resolution	<1 %, min. 0.001 rad
Setting error at AF = 1 kHz	<3 % of reading + 0.01 rad
Distortion at AF = 1 kHz and half max. deviation	<1 %
Modulation frequency range	DC to 100 kHz
Modulation frequency response, 10 Hz (DC) to 100 kHz	<0.5 dB
EXT1, EXT2 modulation inputs	
Input impedance	>100 kΩ
Input voltage for selected deviation	1 V_P (high/low indication for inaccuracy >3 %)

Digital modulation — with option SME-B11; standard in SME03E

Modulation modes	FSK, 4FSK, FFSK, GFSK, GMSK, QPSK (for overview see page 2)
Operating modes	internal, external
Internal data generator	programming of data, level switching and burst output
Storage capacity	8192 bit, extendable to 8 Mbit with option SME-B12
Frequency accuracy	same as for reference frequency
PRBS (pseudo random bit sequence)	selectable lengths: 2^9–1, 2^{15}–1, 2^{20}–1, 2^{21}–1 and 2^{23}–1
DATA, CLOCK modulation inputs	
Permissible dev. from data rate	1 %
Input level	TTL (HCT)
Input impedance (polarity of active clock edge and of modulation deviation can be selected)	1 kΩ
DATA, CLOCK, BURST modulation outputs	
Output level	TTL (HC)
Data setup and hold time referred to CLOCK signal	>50 ns
FSK, FFSK	
Shift error (peak)	<1 %
GFSK	
Shift error (peak)	<7 %
GMSK	
Modulation phase error	
rms	<1°
peak	<3°
QPSK	
Modulation vector error rms[1])[2])	<2.5 % (f ≤3 GHz)

DM memory extension — option SME-B12

Storage capacity	
8M x 1 mode (DATA)	8388480 bit
1M x 3 mode (DATA, LEV ATT, BURST)	3 x 1048560 bit
TRIGGER input	
Input impedance	47 kΩ
Pulse width	>100 ns
Level	TTL (HCT)
Setup time referred to active CLOCK edge	>700 ns

FSK modulation — without option SME-B11

Operating mode	external
Maximum shift	20 % of FM deviation
Resolution	<0.1 %, min. 0.1 Hz
Frequency error	<(0.1 Hz + 0.1 % of shift)
Bit rate	0 kHz to 100 kHz

Pulse modulation — with option SM-B3, SM-B8 or SM-B9

Operating modes	external, internal with Pulse Generator SM-B4
Frequency range	50 MHz to 1.5 GHz (SM-B3) 50 MHz to 3.0 GHz (SM-B8) 50 MHz to 6.0 GHz (SM-B9)
Max. output level	10 dBm (SM-B3) 9 dBm (SM-B8) 8 dBm (SM-B9)
Harmonics	<–30 dBc for levels ≤5 dBm
On/off ratio	>80 dB
Rise/fall time (10/90 %)	<10 ns
Pulse repetition rate	0 MHz to 10 MHz
Pulse delay	typ. 50 ns
Video feedthrough	<–30 dBc
PULSE modulation input	
Input level	TTL (HCT)
Input impedance	50 Ω or 10 kΩ

Internal modulation generator

Frequency	0.4/1/3/15 kHz ±3 %
Open-circuit voltage	1 V_P ± 2 % (R_{out} = 10 Ω, R_L >200 Ω)

LF generator — Option SM-B2

Waveforms	sinewave, triangular, squarewave, noise
Frequency range	
sinewave, noise	0.1 Hz to 500 kHz
triangular, squarewave	0.1 Hz to 50 kHz
Resolution	0.1 Hz
Frequency error	<1 x 10^{-4}
Frequency response (sinewave)	
up to 100 kHz	<0.3 dB
up to 500 kHz	<0.5 dB
Distortion (20 Hz to 100 kHz)	<0.1 % (level >0.5 V)
Open-circuit voltage	1 mV_P to 4 V_P (R_{out} = 10 Ω, R_L >200 Ω)
Resolution	1 mV
Setting error at 1 kHz	1 % + 1 mV (sinewave)
Frequency setting time	<10 ms (after receipt of last character from IEC/IEEE bus)

Multifunction generator — option SM-B6

Waveforms	sinewave, triangular, sawtooth, squarewave, noise, stereo MPX signals, VOR/ILS modulation signals
Frequency range	
sinewave, noise	0.1 Hz to 1 MHz
triangular, sawtooth, squarewave	0.1 Hz to 50 kHz
Resolution	0.1 Hz
Frequency error	same as for reference frequency

Frequency response (sinewave)	
up to 100 kHz	<0.3 dB
up to 1 MHz	<0.5 dB
Distortion (20 Hz to 100 kHz)	<0.1 % (level >0.5 V)
Open-circuit voltage	1 mV_P to 4 V_P (R_{out} = 10 Ω, R_L >200 Ω)
Resolution	1 mV
Setting error at 1 kHz	1 % + 1 mV
Frequency setting time	<10 ms (after receipt of last character from IEC/IEEE bus)

Stereo multiplex signal	option SM-B6
Stereo operating modes	R, L, R = L, R = –L, ARI (pilot tone or MPX signal can be connected to LF socket)
Frequency range of L, R signal	0.1 Hz to 15 kHz
Preemphasis	50 µs, 75 µs
Pilot-tone frequency	19 kHz ±1 Hz
Pilot-tone phase	0° to 360°
Resolution	0.1°
Stereo separation	>60 dB
Distortion	<0.1 % (L, R = 1 kHz)
Carrier suppression (38 kHz)	>65 dB
Settings selectable for ARI [3]) (ARI = broadcast information for motorists)	
Area identification	A, B, C, D, E, F
Traffic announcement identification	on/off
Additional signals (RDS, RDS+ARI)	application via EXT1 input

VOR modulation signal [1])	option SM-B6
Settings	30 Hz (VAR, REF)/9.96-kHz FM carrier, FM deviation, COM/ID tone
Phase	0° to 360°
Phase resolution	0.01°
Bearing error (RF output, 108 MHz to 118 MHz)	<0.05°
FM error (deviation 480 Hz)	<1 Hz

ILS modulation signal [1])	option SM-B6
Settings	90-Hz, 150-Hz tone, COM/ID tone, marker beacon
DDM setting range	0 to ±0.8
DDM resolution	0.0001
DDM error (RF output)	
Localizer (108 MHz to 112 MHz)	<0.0004 + 2% of DDM reading
Glideslope (329 MHz to 335 MHz)	<0.0008 + 2% of DDM reading

Pulse generator	option SM-B4
Operating modes	single pulse, delayed pulse, double pulse
Active trigger edge	positive or negative
Pulse repetition period	100 ns to 85 s
Resolution	5-digit, min. 20 ns
Accuracy	same as for reference frequency
Pulse width	20 ns to 1 s
Resolution	4-digit, min. 20 ns
Accuracy	5 % of reading ±5 ns
Pulse delay	40 ns to 1 s
Resolution	4-digit, min. 20 ns
Accuracy	5 % of reading –10 ns to +20 ns
Double pulse	60 ns to 1 s
Resolution	4-digit, min. 20 ns
Accuracy	5 % of reading –10 ns to +20 ns
Trigger delay	typ. 50 ns
PULSE modulation input	
Input level	TTL (HCT)
Input impedance	50 Ω or 10 kΩ
Sync output	TTL level (HC), 40 ns pulse width
Video output	TTL level (HC)

Sweep	digital, in discrete steps
RF sweep, AF sweep	AF sweep with option SM-B2 or -B6
Operating modes	automatic, single-shot, manual or externally triggered, linear or logarithmic
Sweep range and step width (lin)	freely selectable
step width (log)	0.01 % to 100 %
Level sweep	
Operating modes	automatic, single-shot, manual or externally triggered, logarithmic
Sweep range	0.1 dB to 20 dB
Step width	0.1 dB to 20 dB
Step time	10 ms to 5 s
SME03A, SME including option SM-B50	2 ms to 5 s
Resolution	0.1 ms
Markers	3, freely selectable
MARKER output signal	TTL/HC logic signal, selectable polarity
X output	0 V to 10 V
BLANK output signal	TTL/HC logic signal, selectable polarity

List mode (not SME03E)	frequency and level values can be stored in a list and will be set in an extremely short time; permissible level variation: 20 dB
Operating modes	automatic, single-shot, manual, externally triggered
Max. number of channels	2000
SME03A, SME including option SM-B50	4000
Step time	1 ms to 1 s
Resolution	0.1 ms

Memory for instrument settings	
Storable settings	50
Memory sequence modes	automatic, single-shot, manual or externally triggered
Step time	50 ms to 60 s
Resolution	1 ms

Remote control	
System	IEC 625 (IEEE 488)
Instruction set	SCPI 1993.0
Connector	24-contact Amphenol
IEC/IEEE-bus address	0 to 30
Interface functions	SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0

General data

Power supply	90 V to 132 V/180 V to 265 V (AC), 47 Hz to 440 Hz, autosetting to AC voltage, max. 300 VA, safety class I to VDE 0411(IEC 348)

Electromagnetic compatibility	
Standards met	German Postal Decree 243/1991, EN 55011 (VDE 0875 T11), class B VDE 0875, interference suppression level K, MIL-STD 461 B – RE 02 radiated emissions – CE 03 conducted emissions – CS 01/02 conducted susceptibility
RF leakage (f < 1 GHz)	<0.1 µV (induced in a two-turn loop 25 mm in dia at a distance of 25 mm from any surface of the enclosure)
Radiated susceptibility	10 V/m

Ambient conditions	
Operating temperature range	0 °C to 55 °C [4])
Storage temperature range	–40 °C to +70 °C
Humidity	DIN IEC 68-2-30, +40 °C

Mechanical stress	
Shock	to MIL-STD 810 D, 40 g shock spectrum
Vibration, sinewave	to DIN IEC 68-2-6, 5 Hz to 55 Hz
Vibration, noise	10 m/s^2 rms, 10 Hz to 300 Hz

Dimensions (W x H x D)	435 mm x 192 mm x 460 mm
Weight	25 kg for fully equipped unit

Certified Quality System
ISO 9001
DQS REG. NO 1954

Ordering information

Order designations

Signal Generator	SME02	1038.6002.02
	SME03	1038.6002.03
	SME03A	1038.6002.53
	SME03E	1038.6002.13
	SME06	1038.6002.06

Accessories supplied power cable, operating manual

Options
(for possible combinations see page 3)

Reference Oscillator OCXO	SM-B1	1036.7599.02
LF Generator	SM-B2	1036.7947.02
Pulse Modulator for SME02[5])	SM-B3	1036.6340.02
SME03/A/E[5])	SM-B8	1036.6805.02
SME06[5])	SM-B9	1039.5100.02
Pulse Generator (only with option SM-B3, SM-B8 or SM-B9)	SM-B4	1036.9310.02
FM/φM Modulator	SM-B5	1036.8489.02
Multifunction Generator	SM-B6	1036.7760.02
DM Coder	SME-B11	1036.8720.02
DM Memory Extension (8 Mbit)	SME-B12	1039.4090.02
FLEX Protocol	SME-B41	1039.5645.02
POCSAG Protocol	SME-B42	1039.5745.02
REFLEX™ Protocol	SME-B43	1039.5797.02
Fast CPU	SM-B50	1104.8410.02
Rear Connectors for RF and AF	SME-B19	1039.3907.02

Recommended extras

19" Rack Adapter	ZZA-94	0396.4905.00
Service Kit	SM-Z2	1039.3520.02
Trolley	ZZK-1	1014.0510.00
Transit Case	ZZK-944	1013.9366.00
SME Service Manual		1039.1856.24

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1) Does not apply to non-interrupting level setting (ATTENUATOR MODE FIXED and USER CORR).
2) Applies to levels ≤7 dBm.
3) In the ARI mode, L = R = OFF.
4) Contrast of LCD display degraded at high temperatures.
5) Retrofit by authorized service centers only.

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