



## Signal Generator SML

### Economy at its best

- 9 kHz to 1.1 GHz/2.2 GHz/3.3 GHz
- SSB phase noise:  
<math><-122\text{ dBc}</math> (1 Hz)  
(at  $f = 1\text{ GHz}$ ,  $\Delta f = 20\text{ kHz}$ )
- Setting times <math><10\text{ ms}</math>
- High level accuracy  
(deviation <math><0.5\text{ dB}</math>  
at levels >math>>-120\text{ dBm}</math>)
- High reliability through electronic attenuator
- Digital frequency and level sweep
- AM/FM/ $\phi$ M
- Optional pulse modulator with integrated pulse generator
- 3-year calibration cycle



**ROHDE & SCHWARZ**

# Unequaled universality

## Frequency

- 9 kHz to 1.1 GHz/2.2 GHz/3.3 GHz
- 0.1 Hz frequency resolution

## Level

- -140 dBm to +13 dBm (+19 dBm overrange)
- High level accuracy (deviation <0.5 dB, at levels >-120 dBm)
- Level setting without overshoots
- Electronic attenuator
- Non-interrupting level setting

## Spectral purity

- SSB phase noise <-122 dBc (1 Hz), typ. -128 dBc (1 Hz) (f = 1 GHz, carrier offset 20 kHz)
- Broadband noise <-140 dBc (1 Hz), typ. <-150 dBc (1 Hz) (f = 1 GHz, carrier offset >2 MHz)

## Speed

- Setting times <10 ms for frequency and level

## Modulation

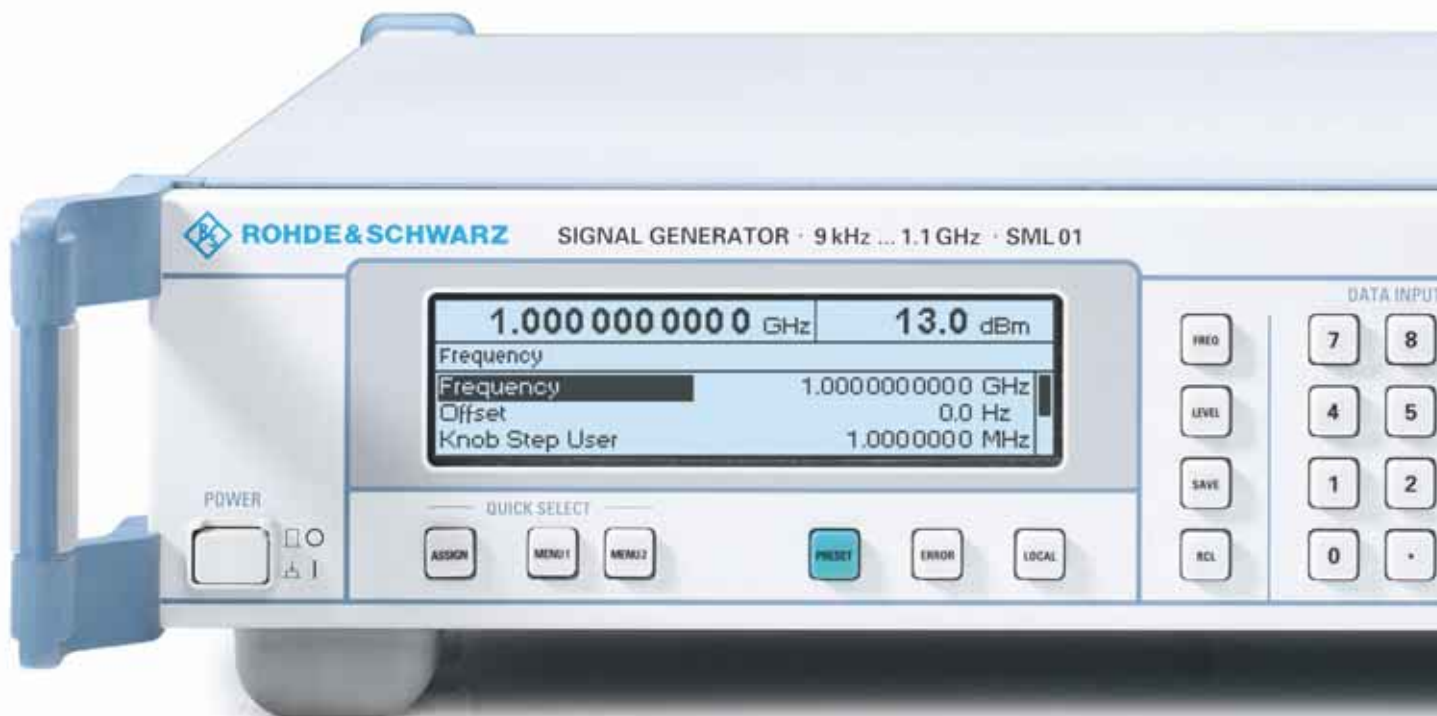
- AM/FM/φM as standard
- Simultaneous AM, FM/φM and pulse modulation
- Optional pulse modulator with integrated pulse generator (SML-B3)

## Low cost of ownership

- 3-year calibration cycle
- Low purchase price
- High reliability through electronic attenuator (wear-free)
- Service-friendly (continuous selftest, access to internal test points)
- Options OCXO (SML-B1) and pulse modulator (SML-B3) retrofittable

## Size

- Compact size: 427 mm x 88 mm x 450 mm
- Low weight: <8 kg



# Wide variety of applications

## Lab and R&D

### High spectral purity

Thanks to its low phase noise SML is ideally suited to replace LOs.

### Versatile modulation modes

SML in conjunction with the optional Pulse Modulator SML-B3 handles all analog types of modulation. AM, FM/ $\phi$ M and pulse modulation can be used simultaneously. TDMA signals or amplitude variations at FM, for example, can thus be simulated.

### High and precise output level

SML has plenty of power in reserve so level loss produced by the test setup can be easily compensated. Its high output level makes SML an ideal source for driving high-level mixers.

### Excellent modulation characteristics

The DC-coupled FM allows the SML to be used as an accurate VCO.

### Example: receiver measurements

- Sensitivity measurements require a signal generator with high level accuracy. This is particularly true at low output levels. With its sophisticated calibration technique, SML features high level accuracy ( $<0.5$  dB at levels  $>-120$  dBm).
- Squelch measurements call for continuous level setting. Non-interrupting level variation by typ. 30 dB makes SML the ideal choice for squelch measurements.

SML offers all features required of a state-of-the-art general-purpose signal generator: wide frequency range, large variety of modulation functions and high reliability – at an extremely attractive price. The fields of application of SML are virtually unlimited in development, servicing or production where it is used as a flexible signal source in automatic test systems. SML benefits both from our long-standing experience in the field of signal generators and the latest technology. Its uses are as versatile as its functionalities.



- Low spurious, low broadband noise and above all excellent SSB phase noise are prerequisites for using a signal generator as an interference source. With typ.  $-128$  dBc (1 Hz) SSB phase noise (at  $f = 1$  GHz,  $\Delta f = 20$  kHz), spurious suppression of typ.  $<-76$  dBc and broadband noise of typ.  $<-150$  dBc (1 Hz), SML easily meets even the most exacting requirements.
- The mechanical design of SML ensures excellent RF shielding of its casing. This is particularly important for measurements on highly sensitive receivers with built-in antenna such as pagers.

# Applications (continued)

## Servicing: robust, compact, lightweight

### Mobility

SML is lightweight and compact and therefore very easy to transport.

### Flexible control

In service environments, an IEC/IEEE interface is not always available for controlling the generator. This is no problem for SML since it can also be driven via a standard RS-232 interface.

### Protection against overvoltage

The integrated overvoltage protection of RF-input protects against very high external voltages as they may occur during transceiver measurements.

## Production: fast, accurate, reliable

### Accuracy

Measurement uncertainty can be split into the contribution from the instrument and that introduced by the test setup. With a smaller uncertainty of the generator, greater tolerances can be allowed for the setup. If the small level deviation of the analyzer is used to allow for higher DUT tolerances, the result will be a marked reduction of manufacturing rejects – an advantage that pays off immediately.

### Speed

Speed is of prime importance in production. And this is exactly one of the strong points of SML, with a setting time  $< 10$  ms for frequency and level.

### Reliability

A signal generator used in production must have high reliability. SML meets this requirement for example through the use of a completely wear-free electronic

attenuator. Should a fault nevertheless occur, the continuous self-diagnosis of SML prevents expensive erroneous measurements.

### Output level

Production test systems, in which the signal is taken to the DUT via switches and cables, cause level losses which can be easily compensated by the high output power of SML.

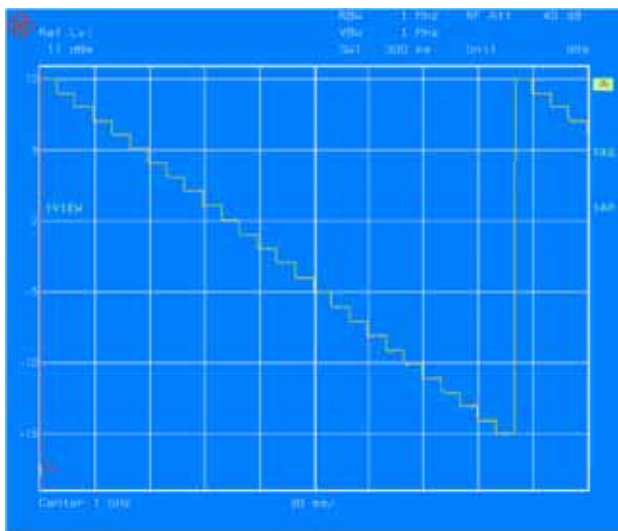
### Dimensions

Space is often at a premium in production. The compact size of SML makes it ideal for use in such environments.

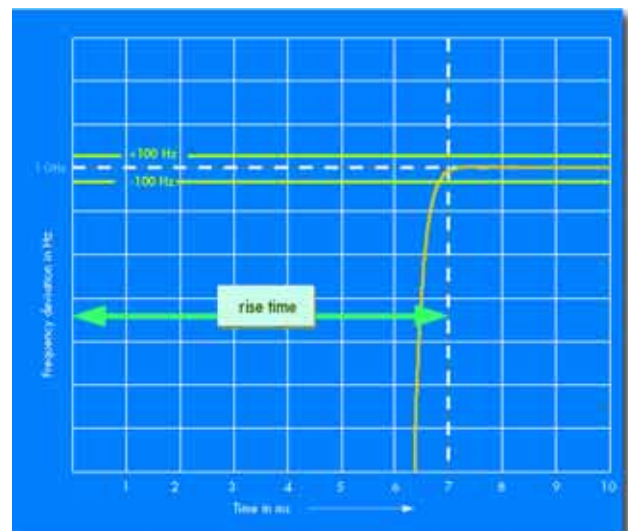
## Example: component test

- To obtain reliable information on component quality, high level accuracy and precise reproducibility of the output level are called for. SML fully meets these requirements thanks to the level deviation of  $< 0.5$  dB (at levels  $> -120$  dBm) and high reproducibility.

Level sweep within 25 dB range



Settling upon frequency change from 100 MHz to 1 GHz



- With short times (<10 ms) for frequency and level setting SML enables fast testing and is without competition for use in production.
- Overshoots in case of level change may damage or destroy the DUT. This cannot happen with SML since it operates without any overshoots.

## EMS measurements

### Non-interrupting level setting without overshoots

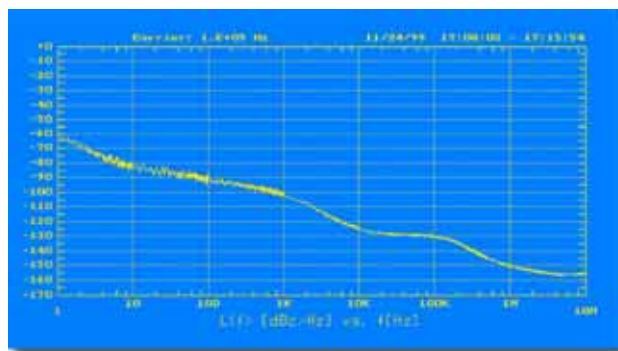
EMS measurements call for non-interrupting level setting which should moreover be performed without any overshoots. SML operates free of overshoots and offers a wide dynamic range of typ. 30 dB for non-interrupting level variation (with Attenuator Mode Fixed).

### Wide frequency range

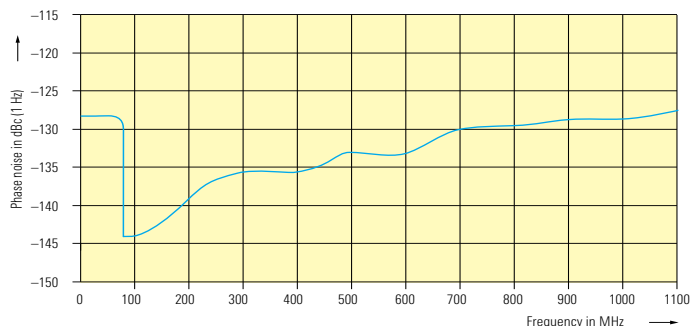
SML has a lower frequency limit of 9 kHz as standard and so fully covers the frequency range required for EMC measurements.

### Simultaneous modulation

TDMA signals can be simulated since SML offers simultaneous AM, FM/φM and pulse modulation. SML is suitable, for example, for measurements in line with standards ENV 50204 (test of immunity to high-frequency electromagnetic fields of digital radiotelephones) and MIL-462D (measurement of electromagnetic interference characteristics).

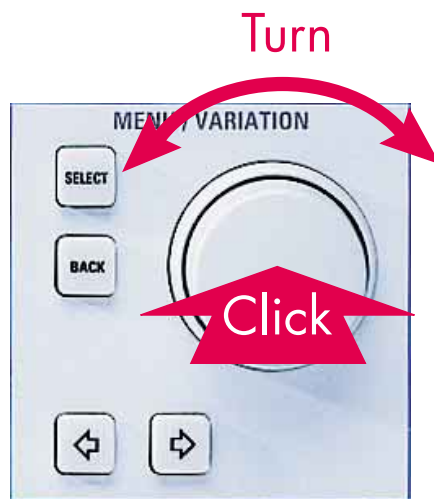


Typical SSB noise at 1 GHz  
(with OCXO option SML-B1)



Typical SSB phase noise versus carrier frequency  
(carrier offset 20 kHz)

## User-friendly operation



Simply select the desired menu with the spinwheel and click the button to open the submenu

### EasyWheel

- One-hand operation with EasyWheel
- All settings simple and self-explanatory
- High-contrast LC display
- User-assignable menu keys
- Online help including IEC/IEEE-bus commands

## Specifications

Specifications are guaranteed under the following conditions:  
 15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed.  
 Data without tolerances: typical values only.  
 Data designated with "nominal" apply to design parameters and are not tested.  
 Data designated "overrange" are not guaranteed.

### Frequency

Range	9 kHz to 1.1 GHz
SML01	9 kHz to 1.1 GHz
SML02	9 kHz to 2.2 GHz
SML03	9 kHz to 3.3 GHz
Resolution	0.1 Hz
Setting time (for an offset of $<1 \times 10^{-7}$ or $<90$ Hz for $f \leq 76$ MHz) after IEC/IEEE-bus delimiter	$<10$ ms

### Reference frequency

	Standard	Option SML-B1
Aging (after 30 days of operation)	$<1 \times 10^{-6}$ /year	$<1 \times 10^{-7}$ /year or $<5 \times 10^{-10}$ /day
Temperature drift (0 °C to 55 °C)	$<1 \times 10^{-6}$	$<2 \times 10^{-8}$
Output for internal reference		
Frequency	10 MHz	
Output voltage, V rms, sinewave	$>0.5$ V into $50 \Omega$	
Source impedance	$50 \Omega$	
Input for external reference		
Frequency	10 MHz	
Permissible frequency drift	$5 \times 10^{-6}$	
Input voltage, V rms, sinewave	$0.5$ V to $2$ V into $50 \Omega$	
Input impedance	$50 \Omega$	

### Spectral purity

Spurious signals	
Harmonics <sup>1)</sup>	
SML01	$<-30$ dBc at levels $\leq +10$ dBm
SML02/SML03	
$f \leq 20$ kHz	$<-25$ dBc at levels $\leq +8$ dBm
$f > 20$ kHz	$<-30$ dBc at levels $\leq +8$ dBm
Subharmonics	
$f \leq 1.1$ GHz	none
$f > 1.1$ GHz	$<-50$ dBc
Nonharmonics	$<-70$ dBc
(carrier offset $> 10$ kHz)	
$f \leq 1.1$ GHz	$<-70$ dBc
$f > 1.1$ GHz to $2.2$ GHz	$<-64$ dBc
$f > 2.2$ GHz to $3.3$ GHz	$<-58$ dBc
Broadband noise <sup>2)</sup> ( $f = 1$ GHz, carrier offset $> 2$ MHz, $1$ Hz bandwidth)	$<-140$ dBc, typ. $-150$ dBc
SSB noise ( $f = 1$ GHz, $20$ kHz carrier offset, $1$ Hz bandwidth)	$<-122$ dBc, typ. $-128$ dBc
Spurious FM, rms ( $f = 1$ GHz)	
$0.3$ kHz to $3$ kHz	$<4$ Hz, typ. $1$ Hz
$0.03$ kHz to $20$ kHz	$<10$ Hz, typ. $3$ Hz
Spurious AM, rms ( $0.03$ kHz to $20$ kHz)	$<0.02\%$

## Level

Range	$-140$ dBm to $+13$ dBm <sup>3)</sup> (Overrange $+19$ dBm)
Resolution	$0.1$ dB
Total level deviation <sup>3)</sup> Output $>-120$ dBm	
SML01	$<0.5$ dB
SML02/SML03	
$100$ kHz to $\leq 2$ GHz	$<0.5$ dB
$f > 2$ GHz	$<0.9$ dB
Frequency response at $0$ dBm <sup>3)</sup>	
SML01	$<0.5$ dB, typ. $0.3$ dB
SML02/SML03	
$100$ kHz to $\leq 2$ GHz	$<0.7$ dB
$f > 2$ GHz	$<1.0$ dB
Characteristic impedance	$50 \Omega$
VSWR	
SML01	$<1.5$
SML02/03	
$100$ kHz to $1.5$ GHz	$1.6$
$f > 1.5$ GHz	$2.3$
Setting time (IEC/IEEE bus), $f > 100$ kHz	$<10$ ms, typ. $5$ ms
Non-interrupting level setting <sup>4)</sup>	$20$ dB, overrange $30$ dB

### Overvoltage protection

safeguards unit against externally applied RF power and DC voltage ( $50 \Omega$  source)

Max. permissible RF power	
$f \leq 2.2$ GHz	$50$ W
$f > 2.2$ GHz	$25$ W
Max. permissible DC voltage	$35$ V

### Internal modulation generator

Frequency range	$0.1$ Hz to $1$ MHz
Resolution	$0.1$ Hz
Frequency accuracy	as for reference frequency + $2.4 \times 10^{-3}$ Hz
Frequency response (up to $500$ kHz, level $>100$ mV)	$<0.5$ dB
THD (up to $100$ kHz, level $4$ V, $R_L = 600 \Omega$ )	$<0.1\%$
Open-circuit voltage $V_p$ (LF connector)	$1$ mV to $4$ V
Resolution	$1$ mV
Setting accuracy (at $1$ kHz)	$1\%$ of $V_p + 1$ mV
Output impedance	approx. $10 \Omega$
Frequency setting time (after reception of last IEC/IEEE-bus character)	$<10$ ms

### Simultaneous modulation

AM, FM/ $\phi$ M and pulse modulation

### Amplitude modulation<sup>5)</sup>

Operating modes	internal, external AC/DC, internal/external two-tone
Modulation depth	$0\%$ to $100\%$ , settable modulation depth continuously decreasing between $+7$ dBm and $+13$ dBm while adhering to AM specifications; a status message is output when modulation depth is too high
Resolution	$0.1\%$
Setting accuracy at $1$ kHz ( $m < 80\%$ ) <sup>6)</sup>	$<4\%$ of reading $+1\%$
AM distortion at $1$ kHz	
$m = 30\%$	$<1\%$
$m = 80\%$	$<2\%$
Modulation frequency range ( $3$ dB), $f > 100$ kHz	DC/ $10$ Hz to $50$ kHz
Incidental $\phi$ M at AM ( $30\%$ ), AF = $1$ kHz	$<0.2$ rad
Modulation input EXT	
Input impedance	$>100$ k $\Omega$
Input voltage $V_p$ for set modulation depth	$1$ V

## Frequency modulation

Operating modes	internal, external AC/DC, internal/external two-tone
Frequency deviation	9 kHz to 76 MHz 0 MHz to 1 MHz >76 MHz to 151.3125 MHz 0 kHz to 125 kHz >151.3125 MHz to 302.625 MHz 0 kHz to 250 kHz >302.625 MHz to 605.25 MHz 0 kHz to 500 kHz >605.25 MHz to 1,2105 GHz 0 MHz to 1 MHz >1,2105 GHz to 1,818 GHz 0 MHz to 2 MHz >1,818 GHz to 2,655 GHz 0 MHz to 3 MHz >2,655 GHz to 3,300 GHz 0 MHz to 4 MHz
Resolution	<1% of set deviation, minimum 10 Hz
Setting accuracy (at AF = 1 kHz)	<4% of reading + 20 Hz
FM distortion (at AF = 1 kHz and 50% of max. deviation)	<0.2%, typ. 0.1%
Modulation frequency range (–3 dB), standard/wide	DC/10 Hz to 100 kHz/500 kHz
Incidental AM (at AF = 1 kHz, f > 10 MHz, 40 kHz deviation)	<0.1%
Stereo modulation at 40 kHz useful deviation, AF = 1 kHz, RF = 87 MHz to 108 MHz	
Crosstalk	>50 dB
S/N ratio unweighted, rms	>70 dB
S/N ratio weighted, rms	>70 dB
Distortion	<0.2%, typ. 0.1%
Carrier frequency offset at FM DC	typ. 0.1% of set deviation
Modulation input EXT	
Input impedance	>100 k $\Omega$
Input voltage $V_p$ for set deviation (nominal value)	1 V

## Phase modulation

Operating modes	internal, external AC/DC, internal/external two-tone
Phase deviation <sup>1)</sup>	9 kHz to 76 MHz 0 rad to 10 (2) rad >76 MHz to 151.3125 MHz 0 rad to 1.25 (0.25) rad >151.3125 MHz to 302.625 MHz 0 rad to 2.5 (0.5) rad >302.625 MHz to 605.25 MHz 0 rad to 5 (1) rad >605.25 MHz to 1.2105 GHz 0 rad to 10 (2) rad >1.2105 GHz to 1.818 GHz 0 rad to 20 (4) rad >1.818 GHz to 2.655 GHz 0 rad to 30 (6) rad >2.655 GHz to 3.300 GHz 0 rad to 40 (8) rad
Resolution	<1%, min. 0.001 rad
Setting accuracy at AF = 1 kHz	<4% of reading + 0.02 rad
Phase distortion (at AF = 1 kHz and 50% of maximum deviation)	<0.2%, typ. 0.1%
Modulation frequency range (–3 dB), standard/wide	DC/10 Hz to 100 kHz/500 kHz
Modulation inputs EXT	
Input impedance	>100 k $\Omega$
Input voltage $V_p$ for set deviation (nominal value)	1 V

## Pulse modulation (with option SML-B3)

Operating modes	internal, external
On/off ratio	>80 dB
Rise/fall time (10%/90%)	<20 ns, typ. 10 ns,
Pulse repetition frequency	0 MHz to 2.5 MHz
Pulse delay	typ. 50 ns
Video crosstalk ( $V_p$ )	<30 mV
Modulation input PULSE	
Input level	TTL level (HCT)
Input impedance	10 k $\Omega$ or 50 $\Omega$ , selectable with internal link

## Pulse generator (with option SML-B3)

Operating modes	automatic, externally triggered, external gate mode, single pulse, double pulse, delayed pulse (externally triggered)
Active trigger edge	positive or negative
Pulse period	100 ns to 85 s
Resolution	5 digits, min. 20 ns
Accuracy	<1 x 10 <sup>-4</sup>
Pulse width	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	<(1 x 10 <sup>-4</sup> + 3 ns)
Pulse delay	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	<(1 x 10 <sup>-4</sup> + 3 ns)
Double-pulse spacing	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	<(1 x 10 <sup>-4</sup> + 3 ns)
Trigger delay	typ. 50 ns
Jitter	<10 ns
PULSE/VIDEO output	TTL signal ( $R_L \geq 50 \Omega$ )

## Sweep

digital in discrete steps

RF sweep, AF sweep	
Operating modes	automatic, single shot, manually or externally triggered, linear or logarithmic
Sweep range	user-selectable
Step width (lin)	user-selectable
Step width (log)	0.01% to 100%
Level sweep	
Operating modes	automatic, single-shot, manually or externally triggered, logarithmic
Sweep range	user-selectable
Step width (log)	user-selectable
Step time	10 ms to 1 s
Resolution	0.1 ms

## Memory for device settings

Storable settings	100
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## Remote control

System	IEC 625 (IEEE 488) and RS-232
Command set	SCPI 1995.0
Connector	Amphenol, 24 and 9 contacts
IEC/IEEE-bus address	0 to 30
Interface functions	SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, CO

<sup>1)</sup> With option SML-B3 only for f > 20 MHz

<sup>2)</sup> With Attenuator Mode Auto.

<sup>3)</sup> SML02, SML03: +11 dBm at f  $\leq$  5MHz, f > 3GHz.

<sup>4)</sup> With Attenuator Mode Fixed.

<sup>5)</sup> With Attenuator Mode Auto, f  $\geq$  100 kHz.

<sup>6)</sup> With option SML-B3 only for f > 10 MHz.

<sup>7)</sup> Values in brackets apply to wide modulation bandwidth.

## General data

<b>Temperature resistance</b>	
Within specifications between	0 °C and 55 °C; meets IEC68-2-1 and IEC68-2-2
Storage temperature range	-40°C to +70°C
<b>Climatic resistance</b>	
Humid heat	95% relative humidity at +25 °C/+40 °C cyclically, meets IEC68-2-3
<b>Mechanical resistance</b>	
Vibration, sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, max. 0.5 g between 55 Hz and 150 Hz, meets IEC68-2-6, IEC1010-1 and MIL-T-28800D, class 5
Vibration, random	10 Hz to 300 Hz, acceleration 1.2 g (rms)
Shock	40 g shock spectrum, meets MIL-STD-810D and MIL-T-28800D, class 3/5
Electromagnetic compatibility	meets EN 50081-1 and EN 50082-1 (EMC directive of EU)
Radiated susceptibility	10 V/m
Power supply	100 V to 120 V (AC), 50 Hz to 60 Hz, 200 V to 240 V (AC), 50 Hz to 60 Hz, autoranging, max. 150 VA
Safety	meets DIN EN 61010-1, IEC 1010-1, UL 3111-1, CSA 22.2 No. 1010-1
Dimensions (W x H x D)	427 mm x 88 mm x 450 mm
Weight	<8 kg when fully equipped

## Ordering information

<b>Signal Generator</b>	SML01 SML02 SML03	1090.3000.11 1090.3000.12 1090.3000.13
<b>Accessories supplied</b>	power cable, user manual	
<b>Options</b>	SML-B1 SML-B3 SML-B19	1090.5790.02 1090.5403.02 <sup>1)</sup> 1090.5303.02 <sup>1)</sup>
<b>Recommended extras</b>	SML-Z2 ZZT-214	1090.5203.02 1109.5119.00 1090.3123.24

<sup>1)</sup>factory fitted

