Signal Generator SML

Economy at its best

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

ROHDE&SCHWARZ

Unequalled 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

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.

Lab and R&D

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

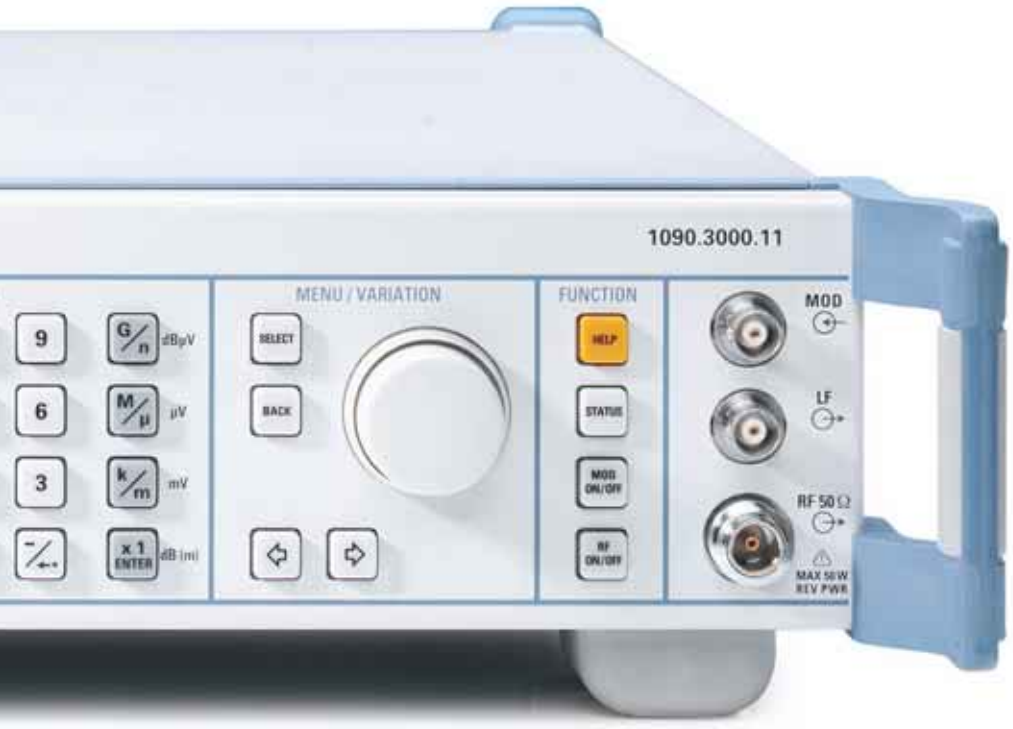
Versatile modulation modes
SML in conjunction with the optional Pulse Modulator SML-B3 handles all analog types of modulation. AM, FM/φM and pulse modulation can be used simultaneously. TDMA signals or amplitude variations at FM, for example, can thus be simulated.

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.



- 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, Δf = 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 redduction 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.

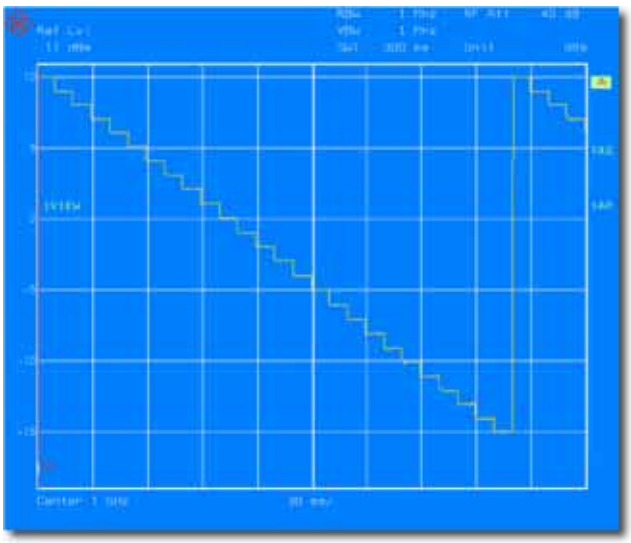
Output level
Production test systems, in which the signal is taken to the DUT via switches and cables, cause level losses which can be easily compensated by the high output power of SML.

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

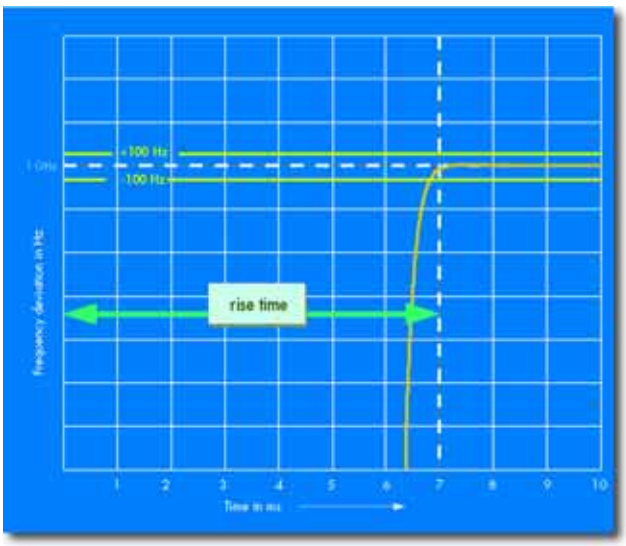
Example: component test

- 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 with out 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

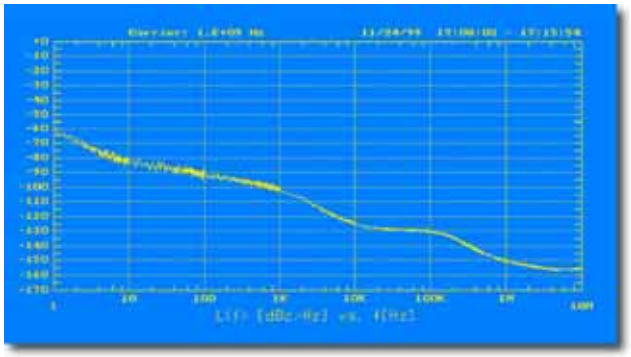
EMS measurements call for non-interrupting level setting which should moreover be performed without any overshoots. SML operates free of overshoots and offers a wide dynamic range of typ. 30 dB for non-interrupting level variation (with Attenuator Mode Fixed).

Wide frequency range

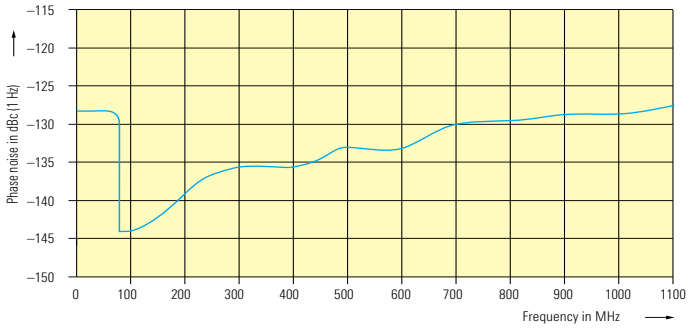
SML has a lower frequency limit of 9 kHz as standard and so fully covers the frequency range required for EMC measurements.

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).

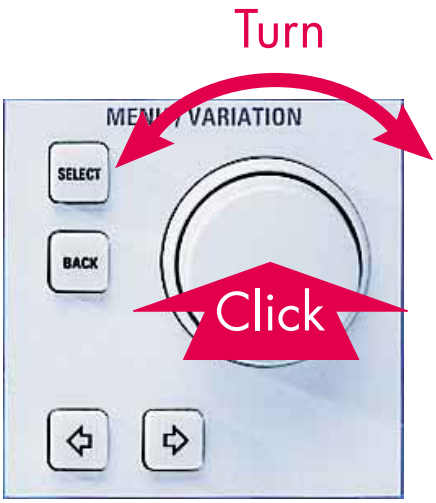


Typical SSB noise at 1 GHz
(with OCXO option SML-B1)



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 vaues 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 SML02 SML03	9 kHz to 1.1 GHz 9 kHz to 2.2 GHz 9 kHz to 3.3 GHz
Resolution	0.1 Hz
Setting time (for an offset of $<1x10^{-7}$ or <90 Hz for f ≤76 MHz) after IEC/IEEE-bus delimiter	<10 ms

Reference frequency

	Standard	**Option SML-B1**
Aging (after 30 days of operation)	$<1x10^{-6}$/year	$<1x10^{-7}$/year or $<5x10^{-10}$/day
Temperature drift (0 °C to 55 °C)	$<1x10^{-6}$	$<2x10^{-8}$
Output for internal reference Frequency Output voltage, V rms, sinewave Source impedance	 10 MHz >0.5 V into 50 Ω 50 Ω	
Input for external reference Frequency Permissible frequency drift Input voltage, V rms, sinewave Input impedance	 10 MHz $5x10^{-6}$ 0.5 V to 2 V into 50 Ω 50 Ω	

Spectral purity

Spurious signals Harmonics [1] SML01 SML02/SML03 f ≤20 kHz f >20 kHz Subharmonics f ≤1.1 GHz f >1.1 GHz Nonharmonics (carrier offset >10 kHz) f ≤1,1 GHz f >1.1 GHz to 2.2 GHz f >2.2 GHz to 3.3 GHz	 <–30 dBc at levels ≤+10 dBm <–25 dBc at levels ≤+8 dBm <–30 dBc at levels ≤+8 dBm none <–50 dBc <–70 dBc <–70 dBc <–64 dBc <–58 dBc
Broadband noise [2](f = 1GHz, 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 0.03 kHz to 20 kHz	 <4 Hz, typ. 1 Hz <10 Hz, typ. 3 Hz
Spurious AM, rms (0.03 kHz to 20 kHz)	<0.02%

Level

Range	–140 dBm to +13 dBm[3] (Overrange +19dBm)
Resolution	0.1 dB
Total level deviation[3] Output>–120 dBm SML01 SML02/SML03 100 kHz to ≤ 2 GHz f >2 GHz	 <0.5 dB <0.5 dB <0.9 dB
Frequency response at 0 dBm[3] SML01 SML02/SML03 100 kHz to ≤ 2 GHz f >2 GHz	 <0.5 dB, typ. 0.3 dB <0.7 dB <1,0 dB
Characteristic impedance	50 Ω
VSWR SML01 SML02/03 100kHz to 1.5 Ghz f >1.5 GHz	 <1,5 1.6 2.3
Setting time (IEC/IEEE bus), f >100 kHz	<10 ms, typ. 5 ms
Non-interrupting level setting[4]	20 dB, overrange 30 dB

Overvoltage protection

safeguards unit against externally applied RF power and DC voltage (50 Ω source)

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

Internal modulation generator

Frequency range Resolution	0.1 Hz to 1 MHz 0.1 Hz
Frequency accuracy	as for reference frequency + 2.4×10^{-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 Ω)	<0.1%
Open-circuit voltage V_p (LF connector) Resolution Setting accuracy (at 1 kHz)	1 mV to 4 V 1 mV 1% of V_p+ 1 mV
Output impedance	approx. 10 Ω
Frequency setting time (after reception of last IEC/IEEE-bus character)	<10 ms

Simultaneous modulation

AM, FM/φM and pulse modulation

Amplitude modulation[5]

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 %)[6]	<4% of reading +1%
AM distortion at 1 kHz m = 30% m = 80%	 <1% <2%
Modulation frequency range (3 dB), f >100 kHz	DC/10 Hz to 50 kHz
Incidental φM at AM (30%), AF = 1 kHz	<0.2 rad
Modulation input EXT Input impedance Input voltage V_p for set modulation depth	 >100 kΩ 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 kΩ
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[7]	
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 kΩ
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 kΩ or 50 Ω, 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	$<1 \times 10^{-4}$
Pulse width	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	$<(1 \times 10^{-4} + 3$ ns)
Pulse delay	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	$<(1 \times 10^{-4} + 3$ ns)
Double-pulse spacing	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	$<(1 \times 10^{-4} + 3$ ns)
Trigger delay	typ. 50 ns
Jitter	<10 ns
PULSE/VIDEO output	TTL signal ($R_L \geq 50$ Ω)

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

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, C0

[1] With option SML-B3 only for f > 20 MHz
[2] With Attenuator Mode Auto.
[3] SML02, SML03: +11 dBm at f ≤5MHz, f>3GHz.
[4] With Attenuator Mode Fixed.
[5] With Attenuator Mode Auto, f≥100 kHz.
[6] With option SML-B3 only for f > 10 MHz.
[7] Values in brackets apply to wide modulation bandwidth.

General data

Temperature resistance	
Within specifications between	0 °C and 55 °C; meets IEC68-2-1 and IEC68-2-2
Storage temperature range	–40°C to +70°C
Climatic resistance	
Humid heat	95% relative humidity at +25 °C/+40 °C cyclically; meets IEC68-2-3
Mechanical resistance	
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

Signal Generator	SML01 SML02 SML03	1090.3000.11 1090.3000.12 1090.3000.13
Accessories supplied		power cable, user manual
Options		
Reference Oscillator OCXO	SML-B1	1090.5790.02
Pulse Modulator	SML-B3	1090.5403.02[1)]
Rear Connectors for AF, RF	SML-B19	1090.5303.02[1)]
Recommended extras		
Service Kit	SML-Z2	1090.5203.02
19" rack adapter	ZZA-211	1096.3260.00
Transport Bag	ZZT-214	1109.5119.00
Service Manual Modules		1090.3123.24

[1)] factory fitted

Certified Quality System
ISO 9001
DQS REG. NO 1954-04

Certified Environmental System
ISO 14001
REG. NO 1954

ROHDE&SCHWARZ

ROHDE&SCHWARZ GmbH & Co. KG · Muehldorfstrasse 15 · 81671 Munich, Germany · P.O.B. 80 14 69 · 81614 Munich, Germany · Telephone +49 89 41 29-0
www.rohde-schwarz.com · CustomerSupport: Tel. +49 1805 12 42 42, Fax +49 89 41 29-37 77, E-mail: CustomerSupport@rsd.rsd.de

Printed in Germany 9/2000 (U we)