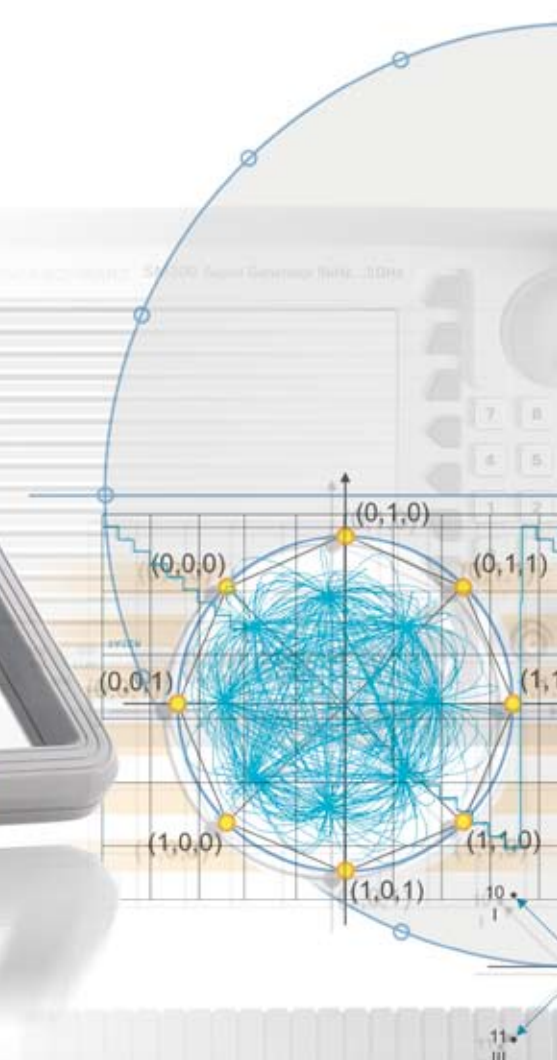# RF Signal Generator
R&S®SM300

9 kHz to 3 GHz

R&S Smart Instruments™
The new product family from Rohde & Schwarz

Third Edition April 2006

ROHDE&SCHWARZ

Professional signal generator
for production, laboratory and service

The R&S®SM300 is a favourably priced signal generator for applications in the 9 kHz to 3 GHz frequency range. The instrument features a broad scope of functions, outstanding technical characteristics and compact design.
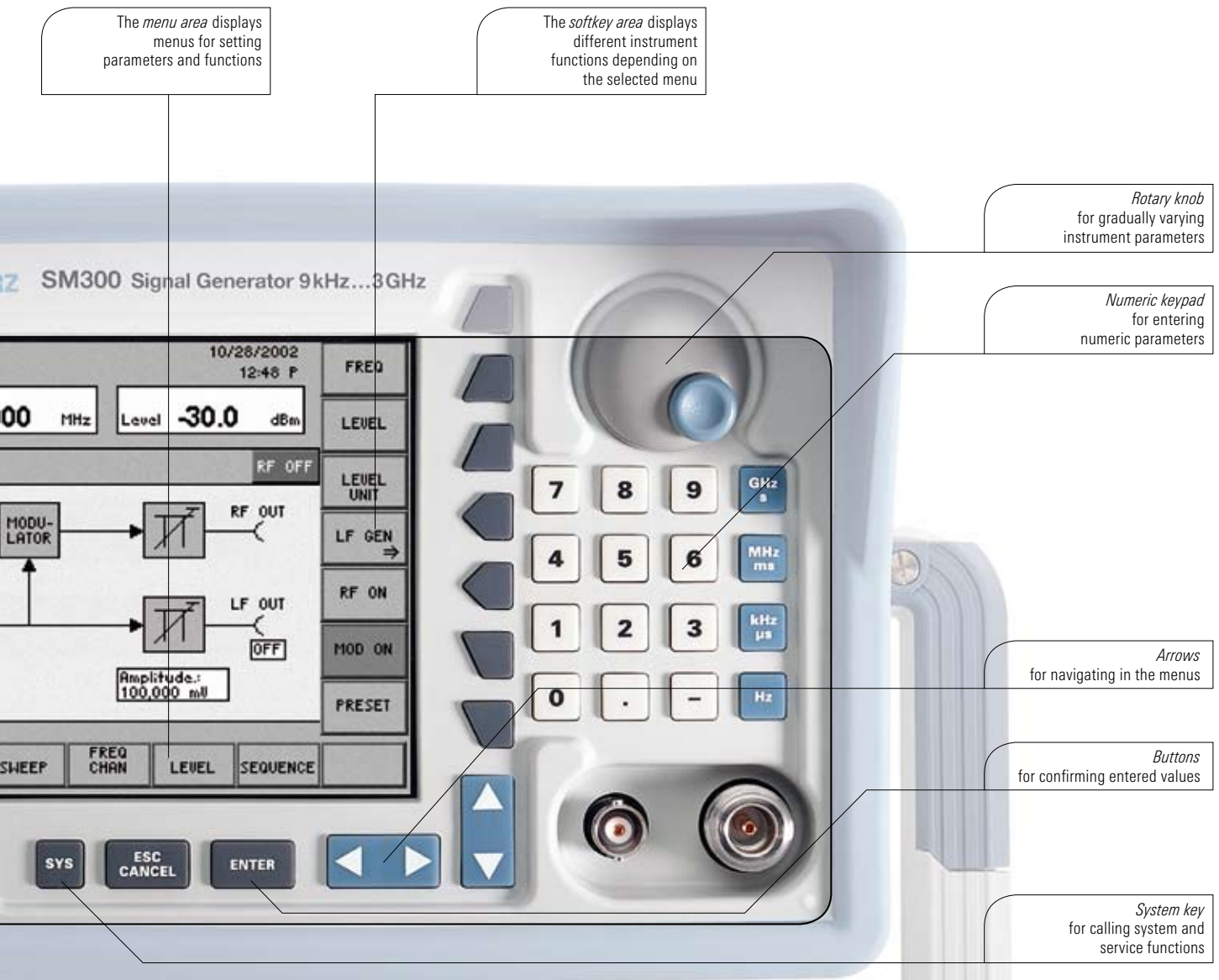
The analog modulation modes AM, FM, φM and pulse modulation can be set on the R&S®SM300. The built-in I/Q modulator adds vector modulation capabilities to the R&S®SM300. Digitally modulated signals can thus be generated, as required in mobile radio, for example.

The R&S®SM300 offers an immense range of applications – whether on the lab bench, in service or as a flexible measuring instrument in automatic production systems.

High signal quality

Built-in I/Q modulator

All analog modulation modes

Frequency sweep, level sweep

High level accuracy

Internal pulse generator

**USB remote control**

Condensed data

Frequency range	RF: 9 kHz to 3 GHz, LF: 20 Hz to 80 kHz
Frequency resolution	0.1 Hz
Frequency setting time	<10 ms
Modulation modes	AM/FM/φM/pulse/IQ
Level resolution	0.1 dB
Level uncertainty	<1 dB (for levels >−120 dBm)
Level range	−127 dBm to +13 dBm
Level setting time	<200 ms
Single-sideband (SSB) phase noise	<−95 dBc (1 Hz) (at f = 1 GHz, Δf = 20 kHz)
Internal modulation generator	20 Hz to 80 kHz

The *menu area* displays menus for setting parameters and functions

The *softkey area* displays different instrument functions depending on the selected menu

Rotary knob for gradually varying instrument parameters

Numeric keypad for entering numeric parameters

Arrows for navigating in the menus

Buttons for confirming entered values

System key for calling system and service functions

Ergonomic user interface

Operation is menu-guided so that even untrained users will quickly obtain correct results. A clear structure simplifies navigation within the menus.

The high-contrast TFT colour display with 320 × 240 pixel resolution allows traces to be read even at odd angles or when the incidence of light is unfavourable.
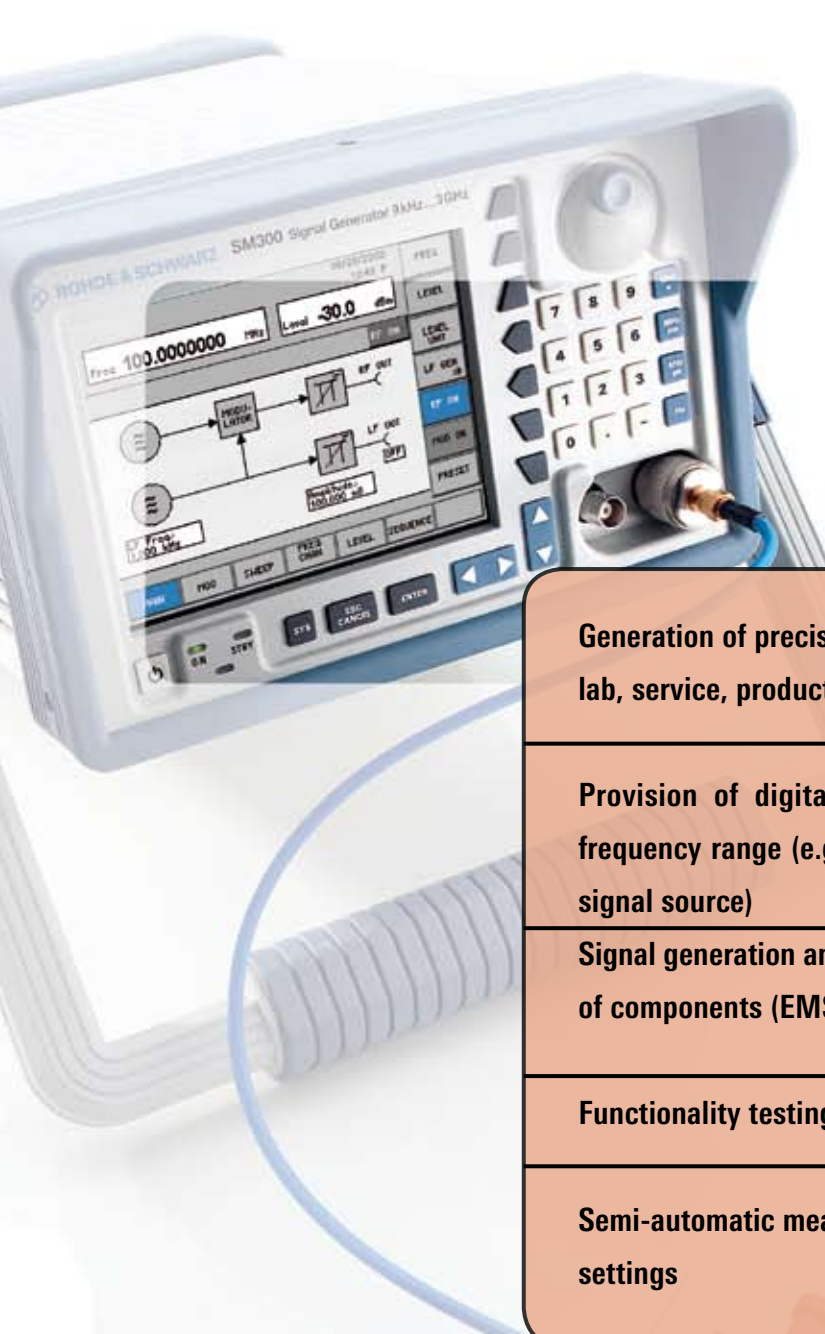
Applications

Its broad scope of functions makes the R&S®SM300 the ideal instrument for diverse use, e.g. in digital and analog mobile radio or for EMC applications.

Generation of precise test signals for the following applications: lab, service, production and quality assurance

Provision of digitally modulated signals in the 9 kHz to 3 GHz frequency range (e.g. with the R&S®AM300 as an external baseband signal source)

Signal generation and modulation (AM, pulse) for EMC measurements of components (EMS)

Functionality testing of components in production

Semi-automatic measurements by pressing a button to retrieve stored settings

Vector modulation[1]

- High I/Q bandwidth (DC to 40 MHz) for WLAN measurements in accordance with IEEE 802.11b and IEEE 802.11g

- Generation of WCDMA test signals for measuring ACLR, EVM and code domain power
  ACLR WCDMA 3GPP FDD (test model 1, 64 DPCHs)
  Offset 5 MHz: typ. 54 dB
  Offset 10 MHz: typ. 55 dB
  Composite EVM (test model 1, 64 DPCHs): typ. 3.3 %

- Generation of GSM signals for measuring phase error
 Phase error: typ. 1.2° rms

EMC

- Provision of signal generator control level in 20 Hz to 3.0 GHz frequency range

- AM, pulse modulation modes

- Internal pulse generator

- EN61000-4-3/6 standards; MIL-STD-461E, ISO 11451 and ISO 11452, each up to 3 GHz

[1] Requires an external baseband signal source, e.g. the R&S®AM300 or R&S®AFQ100A.

High signal quality

The RF characteristics of the R&S®SM300 set new standards in the lower price segment. With a frequency range from 9 kHz to 3 GHz, it is suitable for diverse applications. Its low wideband and single-sideband phase noise make the R&S®SM300 the ideal tool for use in labs, test sets at colleges and universities, in service and at production sites.
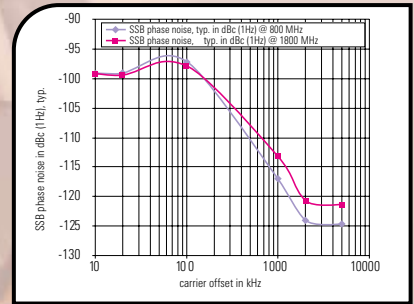

Built-in I/Q modulator

The R&S®SM300 is equipped with an I/Q modulator. Together with a baseband source such as the R&S®AM300, it can thus generate complexly modulated signals. Applications in mobile radio are also possible, for example for GSM, 3GPP or IEEE 802.11b and IEEE 802.11g.
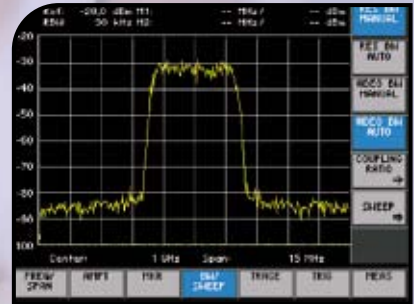
## Wide variety of analog modulation modes

The R&S®SM300 can handle all common modulation modes, i.e. AM, FM, φM, pulse. It is used for generating interference signals in EMC applications, e.g. automobile industry, military or avionics.
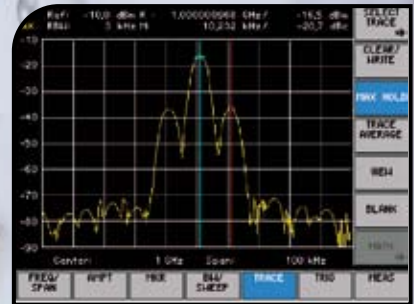
Frequency sweep, level sweep

The R&S®SM300 makes it possible to sweep the internal LF generator as well as the RF frequency and the RF level in user-selectable steps.
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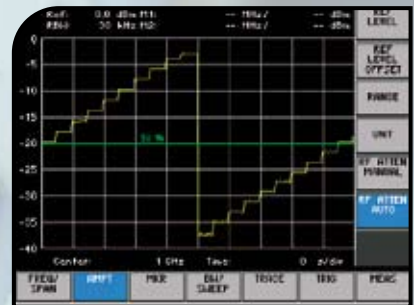
The new instrument family – equipped for the future

Versatile applications

■ Desktop use

■ Portable for mobile use

■ Integration into 19-inch racks

USB interfaces

The USB host interface links the instruments to the PC world. The bus ensures high data transmission rates at low cost. Other peripherals (e.g. printers) can be addressed via another USB interface.

Identical housing

All instruments based on the Family 300 concept have an almost identical "face", a 5.4-inch VGA TFT display, front-panel control elements, protective guards and a handle that can be adjusted to different positions. Only the connectors on the front and rear panel vary depending on the instrument type.

If the protective guards and the handle are removed, the R&S®SM300 can be installed in a 19-inch rack. Owing to their slim design, two instruments of the Family 300 can be placed next to each other.
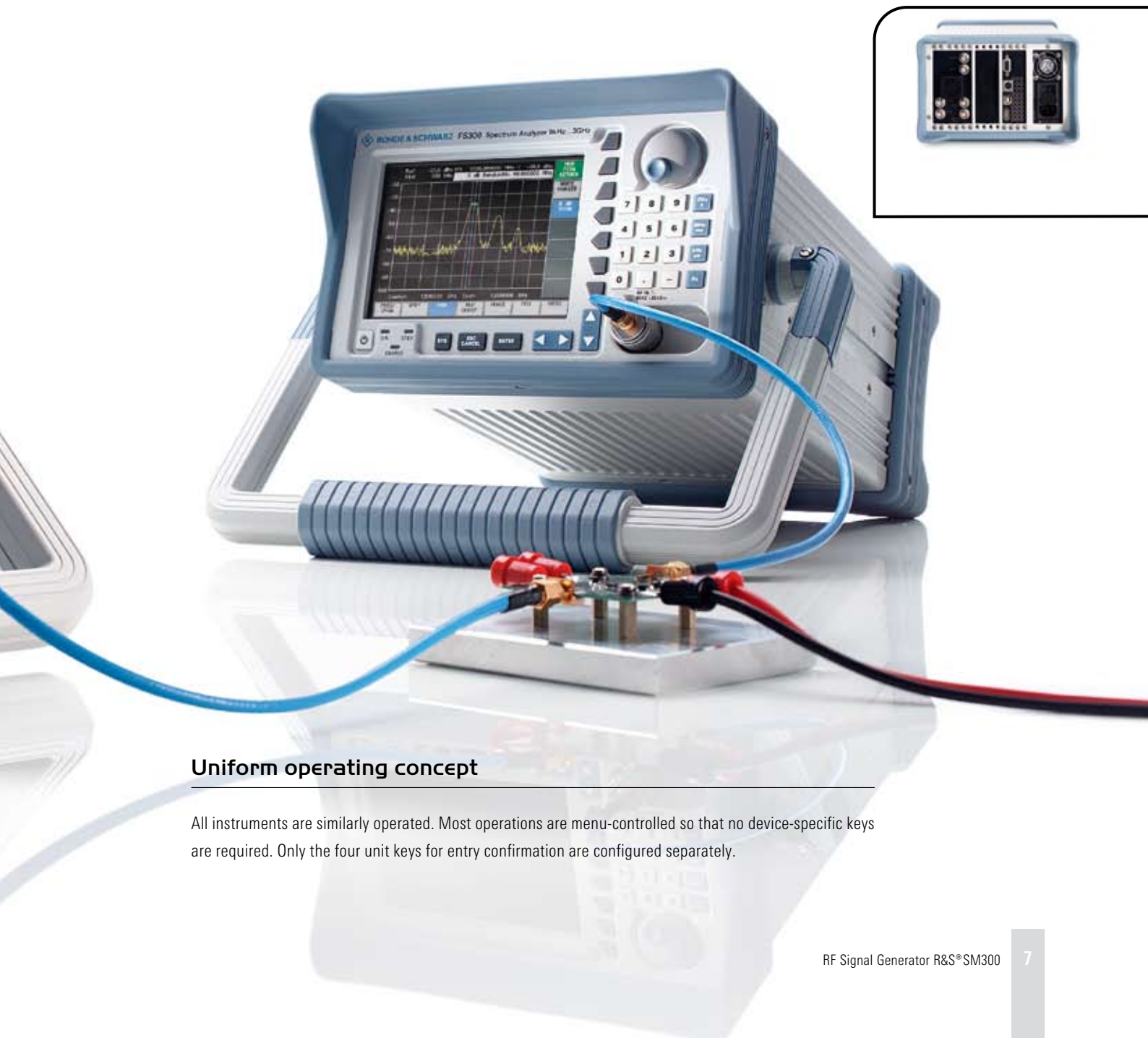
Uniform operating concept

All instruments are similarly operated. Most operations are menu-controlled so that no device-specific keys are required. Only the four unit keys for entry confirmation are configured separately.

Specifications

Important: We continuously refine our products. Please check our homepage **www.sm300.rohde-schwarz.com** for new applications and features.

Specifications are valid under the following conditions: specified environmental conditions met, calibration cycle adhered to and total calibration performed.

RF frequency

Frequency range		9 kHz to 3 GHz
Setting resolution		0.1 Hz
Setting time	for an offset of $<1 \times 10^{-7}$	<10 ms
Reference frequency		10 MHz
Aging		$<2 \times 10^{-6}$/year
Temperature drift	5 °C to 45 °C	$<1 \times 10^{-6}$
Spectral purity		
Spurious		
Harmonics	level ≤0 dBm, $f_c > 1$ MHz	<−30 dBc
Subharmonics	$f_c > 1$ MHz	<−50 dBc
Nonharmonics	>10 kHz from carrier	<−50 dBc
Wideband noise	$f_c = 1$ GHz, carrier offset >2 MHz	<−123 dBc (1 Hz)
Single-sideband phase noise	$f_c = 1$ GHz, carrier offset 20 kHz	<−95 dBc (1 Hz)
Residual FM	$f_c = 1$ GHz	
	0.3 Hz to 3 kHz	<10 Hz rms <30 Hz peak
	0.03 kHz to 20 kHz	<60 Hz rms <300 Hz peak
Residual AM	$f_c = 1$ GHz	
	0.3 kHz to 3 kHz	<0.03 % rms <0.2 % peak

RF level

Level range		−127 dBm to +13 dBm
Setting time	to <0.3 dB deviation	<200 ms
Setting resolution		0.1 dB
Level uncertainty	f_c >100 kHz, level >−120 dBm, 20 °C to 30 °C	<1 dB

LF generator

Frequency range		20 Hz to 80 kHz
Frequency resolution		0.1 Hz
Frequency response	20 Hz to 20 kHz	<0.2 dB
Total harmonic distortion	20 Hz to 20 kHz	<0.1 %

Modulation

Amplitude modulation		
Operating modes		internal, external AC/DC
Modulation depth	the modulation depth that can be set observing the AM specifications continuously decreases from +7 dBm to +13 dBm	0% to 100%
Resolution		0.1%
Setting uncertainty	f_{LF} = 1 kHz, m <80%, level = 0 dBm	<5% of setting + 0.2%
AM total harmonic distortion	f_{LF} = 1 kHz, m <80%, level = 0 dBm	<2%
Modulation frequency range		DC/20 Hz to 20 kHz
Frequency modulation		
Operating modes		internal, external AC/DC
Frequency deviation		20 Hz to 100 kHz
Resolution		<1%, min. 1 Hz
Setting uncertainty	f_{LF} = 1 kHz	<5% of setting + 300 Hz
FM total harmonic distortion	f_{LF} = 1 kHz, deviation = 50 kHz	<1%
Carrier frequency deviation	external	<200 Hz
Modulation frequency range		DC/20 Hz to 80 kHz
Phase modulation		
Operating modes		internal
Phase deviation	$f_{LF} \leq$ 10 kHz	0 to 10 rad
	10 kHz < $f_{LF} \leq$ 20 kHz	0 to 5 rad
Resolution		<1%, min. 0.001 rad
Setting uncertainty	f_{LF} = 1 kHz	<5% of setting + 0.2 rad
φM total harmonic distortion	f_{LF} = 1 kHz, deviation = 5 rad	<1.5%
Modulation frequency range		300 Hz to 20 kHz
I/Q modulation		
Operating modes		external
Modulation frequency range (3 dB)		DC to 40 MHz
Carrier suppression		typ. 40 dBc
ACLR	WCDMA 3GPP FDD (test model 1, 64 DPCHs) offset 5 MHz offset 10 MHz	typ. 54 dB typ. 55 dB
Composite EVM	WCDMA 3GPP FDD (test model 1, 64 DPCHs)	typ. 3.3%
Phase uncertainty	GSM	typ 1.2°
Pulse modulation/pulse generator		
Operating modes		external, internal
Rise/fall time (10%/90%)		<3 µs
Delay time (external)		100 µs to 1 s
Pulse width (internal, external)		100 µs to 1 s
Pulse period (internal)		200 µs to 2 s
Time resolution		1 µs

Simultaneous modulation[1]

	AM int	AM ext	I/Q	FM int	FM ext	φM	Pulse int	Pulse ext
AM int	–	✓	–	✓	✓	✓	–	–
AM ext	✓	–	–	✓	✓	✓	–	–
I/Q	–	–	–	✓	✓	✓	✓	✓
FM int	✓	✓	✓	–	✓	–	✓	✓
FM ext	✓	✓	✓	–	–	–	✓	✓
φM	✓	✓	✓	–	–	–	✓	✓
Pulse int	–	–	✓	✓	✓	✓	–	–
Pulse ext	–	–	✓	✓	✓	✓	–	–

[1] Combinations marked in red are not visible on the MMI screen.

Sweep

RF sweep, LF sweep	
Operating modes	continuous sweep, single sweep, single step
Sweep range	LF: 20 Hz to 80 kHz RF: 9 kHz to 3 GHz
Step width (log)	0.01 % to 100 %
Step width (lin)	LF: 0.1 Hz to 80 kHz RF: 0.1 Hz to 1 GHz
Level sweep	
Operating modes	continuous sweep, single sweep, single step
Sweep range	–127 dBm to +13 dBm
Step width	0.1 dB to 20 dB
Step time	10 ms to 1 s

Inputs

Reference frequency input	
Connector	BNC female
Reference frequency	10 MHz, 5 MHz, 2 MHz
Input voltage	0.5 V to 2 V
Input impedance	50 Ω
AM/FM modulator input	
Connector	BNC female
Input voltage for max. modulation depth or modulation deviation	1 V
Input impedance	>100 kΩ
I/Q modulator inputs	
I/Q inputs	BNC female
Input impedance	50 Ω
Input voltage	$\sqrt{V_I^2 + V_Q^2} = 0.5\ \text{V}$
VSWR	<1.5
Pulse modulator input	
Connector	BNC female
Input voltage	TTL voltages

Outputs

RF output		
Connector		N female on front panel
Characteristic impedance		50 Ω
VSWR	1 MHz < f_c ≤ 3 GHz	<1.8
Max. permissible RF power	1 minute	+36 dBm
Max. permissible DC voltage		30 V
LF output		
Connector		BNC female on front panel
Output voltage		1 mV to 2 V rms, into 50 Ω
Output voltage resolution		<1%, 1 mV minimum resolution
Spurious suppression		<–60 dBc
Reference frequency output		
Connector		BNC female
Reference frequency		10 MHz
Output voltage		>0.5 V into 50 Ω

Interfaces

USB host		
Connector		A plug
Protocol		version 1.1
USB interface		
Connector		B plug
Protocol		version 1.1
Command set		device-specific, remote control via supplied Windows driver (Windows XP, 2000)

Power supply

Input voltage range		100 V to 240 V (AC), 50 Hz to 60 Hz, autoranging
Power consumption		<35 VA

General data

Display		
Type		5.4″ active colour TFT display
Resolution		320 × 240 pixels
Memory locations		
Device setups		10
Ambient conditions		
Operating temperature range	meets DIN EN 60068-2-1/2	+5 °C to +45 °C
Storage temperature range		−20 °C to +70 °C
Relative humidity	meets DIN EN 60068-2-3 (no moisture condensation)	95 % at +40 °C
Mechanical resistance		
Vibration, sinusoidal	meets DIN EN 60068-2-6, DIN EN 61010-1 and MIL-T-28800D class 5	5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz: 0.5 g constant
Vibration, random	meets DIN EN 60068-2-64	10 Hz to 500 Hz: 1.9 g
Shock	meets DIN EN 60068-2-27 and MIL-STD-810	shock spectrum
Electromagnetic compatibility	meets EN 55011 class B and EN 61326 (EMC Directive 89/336/EEC)	
EMI field strength		<10 V/m
Protection class	DIN EN 61010-1 / IEC61010-1 UL3111-1; CSA22.2 No: 1010.1	
Dimensions (W × H × D)		219 mm × 147 mm × 350 mm
Weight		approx. 7 kg

Ordering information

RF Signal Generator R&S®SM300

Designation	Type	Order No.
RF Signal Generator	R&S®SM300	1147.1498.03
Rack Adapter	R&S®ZZA-300	1147.1281.00
Carrying Case	R&S®ZZK-300	1147.2542.02
Calibration Documentation	R&S®DCV-1	0240.2187.55

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