

# RF Signal Generator R&S® SM300

9 kHz to 3 GHz



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

  
**ROHDE & SCHWARZ**

*Third Edition September 2007*

# 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.

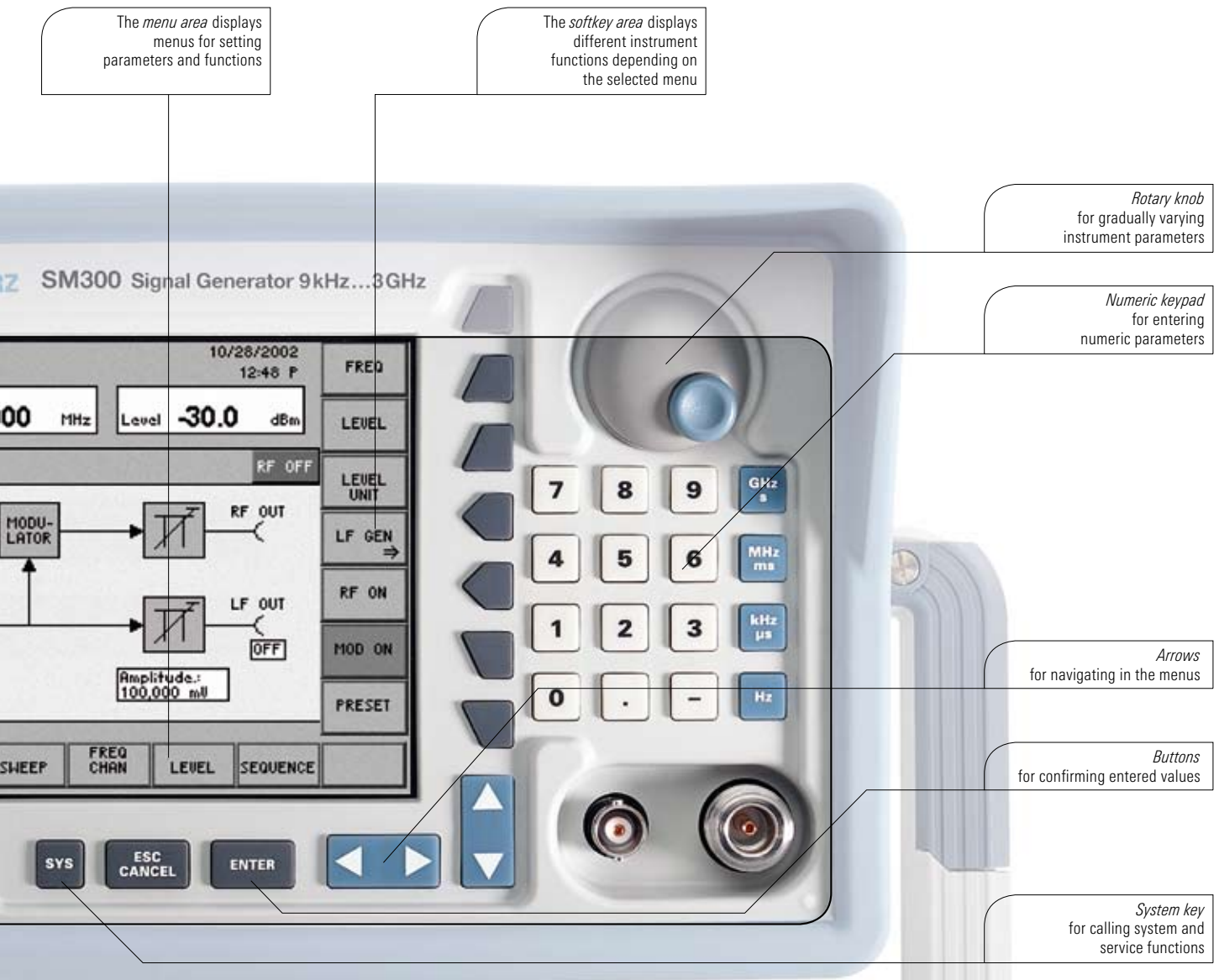
The analog modulation modes AM, FM,  $\phi$ M and pulse modulation can be set on the R&S®SM300. The built-in I/Q modulator adds vector modulation capabilities to the R&S®SM300. Digitally modulated signals can thus be generated, as required in mobile radio, for example.

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

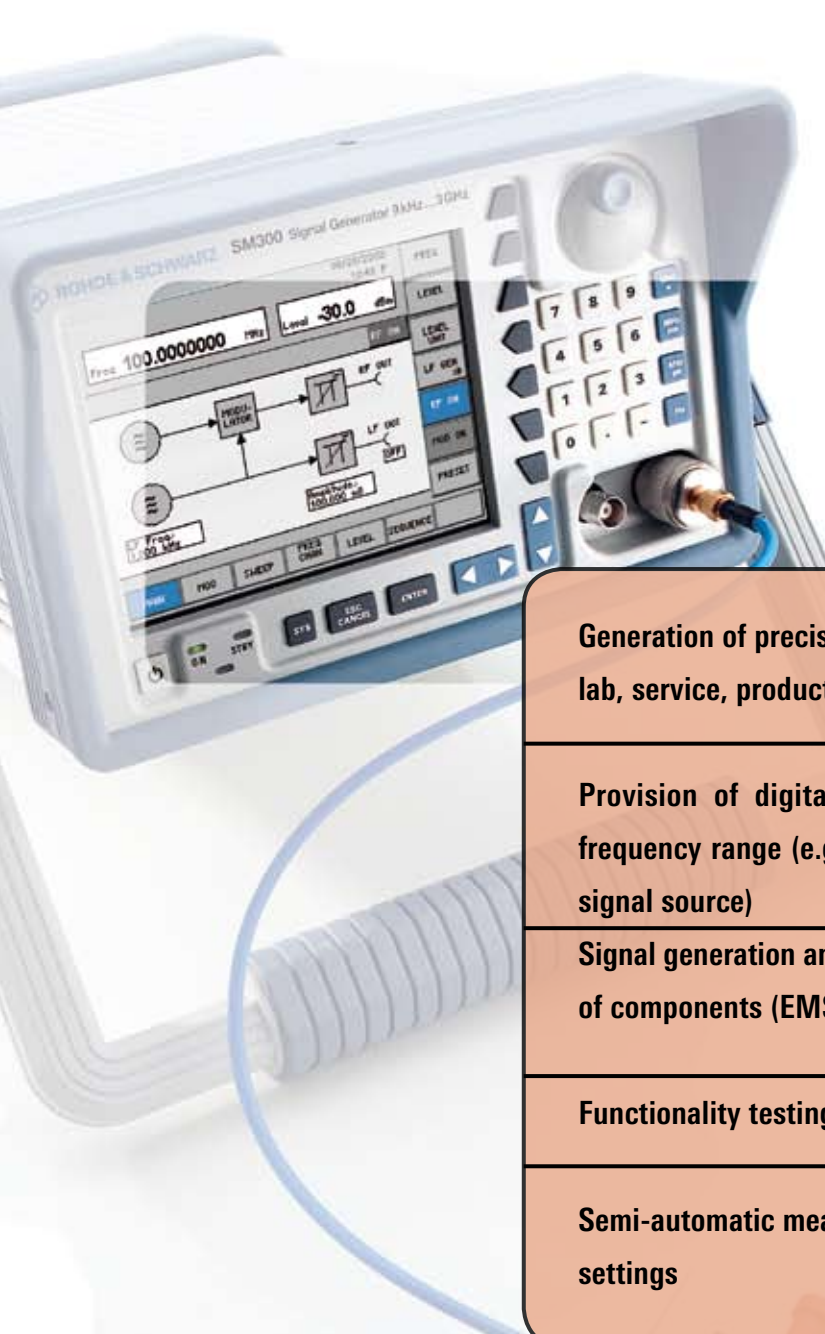
Frequency range	RF: 9 kHz to 3 GHz, LF: 20 Hz to 80 kHz
Frequency resolution	0.1 Hz
Frequency setting time	<10 ms
Modulation modes	AM/FM/ $\phi$ M/pulse/IQ
Level resolution	0.1 dB
Level uncertainty	<1 dB (for levels $\geq$ -120 dBm)
Level range	-127 dBm to +13 dBm
Level setting time	<200 ms
Single-sideband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



## 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<sup>1)</sup>

- 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

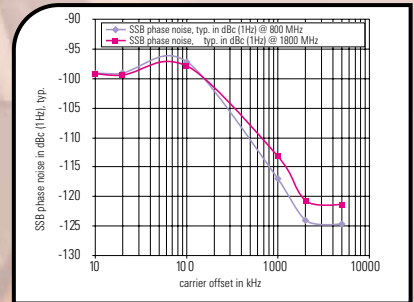
## EMC

- 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

<sup>1</sup> Requires an external baseband signal source, e.g. the R&S® AM300 or R&S® AFQ100A.

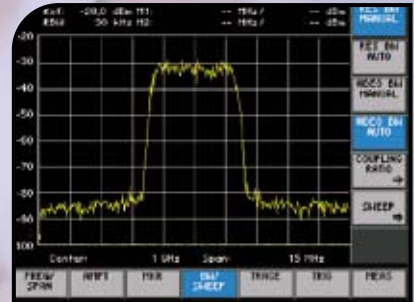
## High signal quality

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.



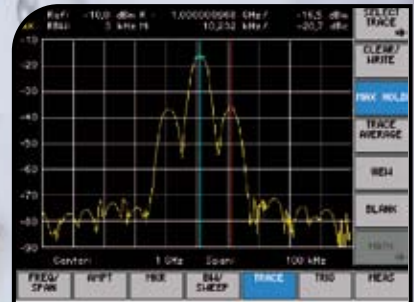
## Built-in I/Q modulator

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.



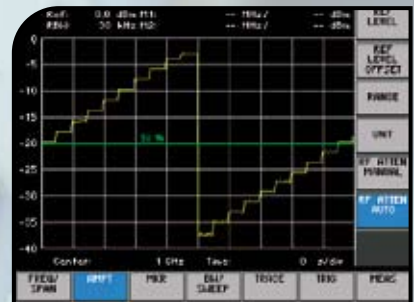
## Wide variety of analog modulation modes

The R&S®SM300 can handle all common modulation modes, i.e. AM, FM,  $\phi$ M, 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.



## The new instrument family – equipped for the future



### Versatile applications

- Desktop use
- Portable for mobile use
- Integration into 19-inch racks

## USB interfaces

---

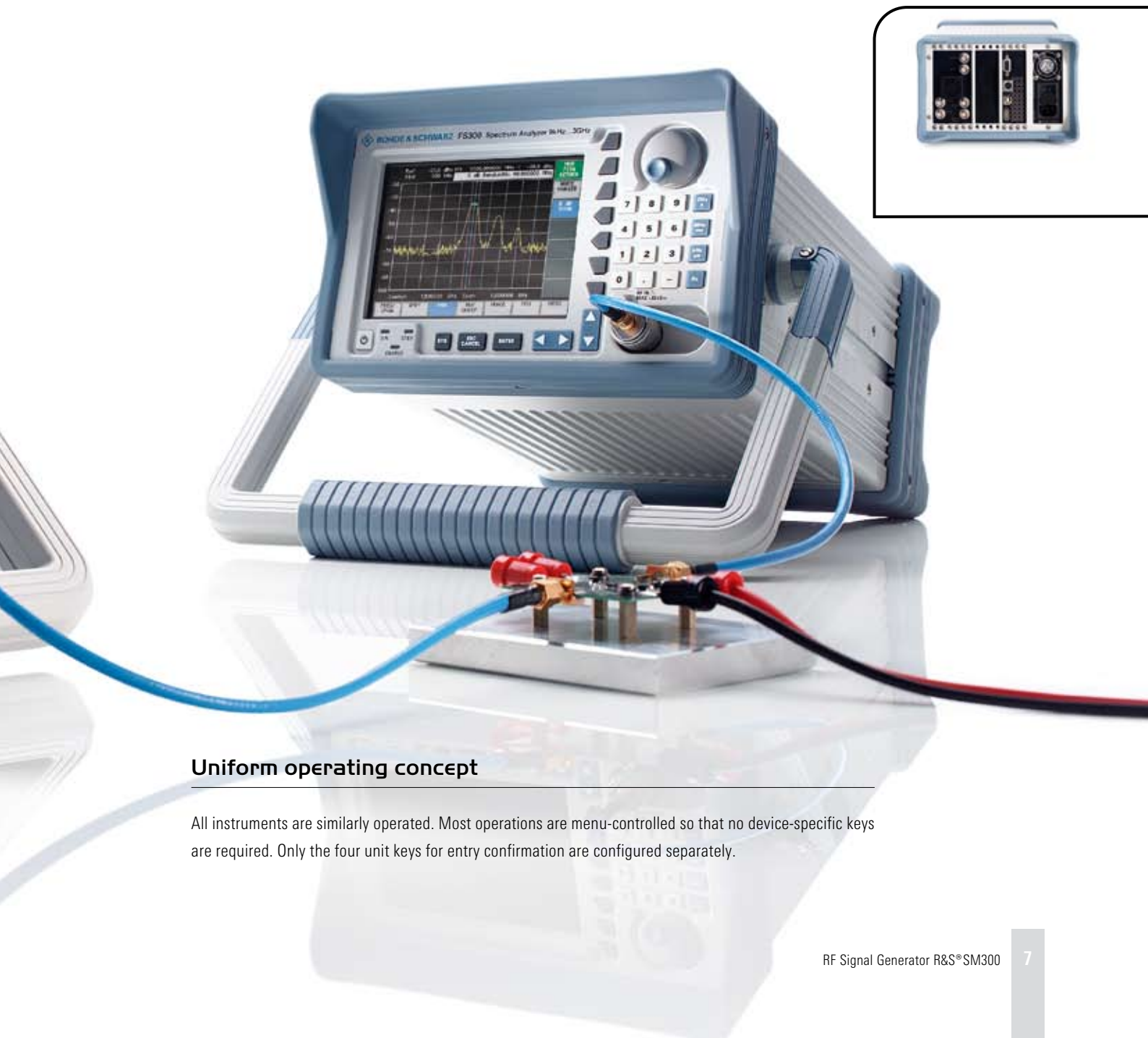
The USB host interface links the instruments to the PC world. The bus ensures high data transmission rates at low cost. Other peripherals (e.g. printers) can be addressed via another USB interface.

## 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](http://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.

<b>RF frequency</b>		
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	$<1 \times 10^{-6}$
<b>Spectral purity</b>		
Spurious		
Harmonics	level $\leq 0$ 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  0.03 kHz to 20 kHz	$<10$ Hz rms $<30$ Hz peak $<60$ Hz rms $<300$ Hz peak
Residual AM	$f_c = 1$ GHz 0.3 kHz to 3 kHz	$<0.03\%$ rms $<0.2\%$ peak

<b>RF level</b>		
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
<b>LF generator</b>		
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

<b>Amplitude modulation</b>		
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	$f_{LF} = 1 \text{ kHz}$ , $m < 80 \%$ , level = 0 dBm	<5 % of setting + 0.2 %
AM total harmonic distortion	$f_{LF} = 1 \text{ kHz}$ , $m < 80 \%$ , level = 0 dBm	<2 %
Modulation frequency range		DC/20 Hz to 20 kHz
<b>Frequency modulation</b>		
Operating modes		internal, external AC/DC
Frequency deviation		20 Hz to 100 kHz
Resolution		<1 %, min. 1 Hz
Setting uncertainty	$f_{LF} = 1 \text{ kHz}$	<5 % of setting + 300 Hz
FM total harmonic distortion	$f_{LF} = 1 \text{ kHz}$ , deviation = 50 kHz	<1 %
Carrier frequency deviation	external	<200 Hz
Modulation frequency range		DC/20 Hz to 80 kHz
<b>Phase modulation</b>		
Operating modes		internal
Phase deviation	$f_{LF} \leq 10 \text{ kHz}$	0 to 10 rad
	$10 \text{ kHz} < f_{LF} \leq 20 \text{ kHz}$	0 to 5 rad
Resolution		<1 %, min. 0.001 rad
Setting uncertainty	$f_{LF} = 1 \text{ kHz}$	<5 % of setting + 0.2 rad
$\phi$ M total harmonic distortion	$f_{LF} = 1 \text{ kHz}$ , deviation = 5 rad	<1.5 %
Modulation frequency range		300 Hz to 20 kHz
<b>I/Q modulation</b>		
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°
<b>Pulse modulation/pulse generator</b>		
Operating modes		external, internal
ON/OFF ratio		>60 dB
Rise/fall time (10%/90 %)		<3 $\mu$ s
Delay time (external)		100 $\mu$ s to 1 s
Pulse width (internal, external)		100 $\mu$ s to 1 s
Pulse period (internal)		200 $\mu$ s to 2 s
Time resolution		1 $\mu$ s

Simultaneous modulation <sup>1)</sup>								
	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	–	–	✓	✓	✓	✓	–	–

<sup>1)</sup> Combinations marked in red are not visible on the MMI screen.

Sweep	
<b>RF sweep, LF sweep</b>	
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
<b>Level sweep</b>	
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	
<b>Reference frequency input</b>	
Connector	BNC female
Reference frequency	10 MHz, 5 MHz, 2 MHz
Input voltage	0.5 V to 2 V
Input impedance	50 Ω
<b>AM/FM modulator input</b>	
Connector	BNC female
Input voltage for max. modulation depth or modulation deviation	1 V
Input impedance	>100 kΩ
<b>I/Q modulator inputs</b>	
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
<b>Pulse modulator input</b>	
Connector	BNC female
Input voltage	TTL voltages

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

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

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



<b>General data</b>		
<b>Display</b>		
Type		5.4" active colour TFT display
Resolution		320 × 240 pixels
<b>Memory locations</b>		
Device setups		10
<b>Ambient conditions</b>		
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
<b>Mechanical resistance</b>		
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
<b>Electromagnetic compatibility</b>		
meets EN 55011 class B and EN 61326 (EMC Directive 89/336/EEC)		
<b>EMI field strength</b>		
<10 V/m		
<b>Protection class</b>		
DIN EN 61010-1 / IEC61010-1 UL3111-1; CSA22.2 No: 1010.1		
<b>Dimensions (W × H × D)</b>		
219 mm × 147 mm × 350 mm		
<b>Weight</b>		
approx. 7 kg		

## Ordering information

<b>RF Signal Generator R&amp;S® SM300</b>		
<b>Designation</b>	<b>Type</b>	<b>Order No.</b>
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



[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG · Trade names are trademarks of the owners · Printed in Germany (Pe we/ch)  
PD 0758.0180.32 · R&S®SM300 · Version 03.01 · September 2007 · Data without tolerance limits is not binding · Subject to change