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# Vector Signal Generator R&S® SMU200A

## Specifications



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## Introduction

The Vector Signal Generator R&S SMU200A has been designed to meet all requirements encountered in the research and development of modern communications systems as well as in their production. The R&S SMU200A not only combines up to two independent signal generators in one cabinet of only four height units, but also offers unrivaled RF and baseband characteristics.

Due to its modular design, the R&S SMU200A can be optimally adapted to the requirements of different applications. The first RF path can be equipped with one of the four available frequency options. The upper frequency limit of 2.2 GHz / 3 GHz / 4 GHz or 6 GHz is user-selectable. In addition, a second RF path can be installed with an upper frequency limit of 2.2 GHz or 3 GHz. The lower frequency limit of all frequency options is 100 kHz.

Two generators can also be installed in the baseband section. They generate complex signals in realtime and are equipped with an arbitrary waveform generator with 16 or 64 Msample memory for I and Q. The signals generated in the different basebands can be added, even with frequency offset.

The modern, intuitive concept of the R&S SMU200A ensures fast and easy operation.

# Key features

## Two signal generators in one

- Frequency options from 100 kHz to 2.2/3/4/6 GHz for the first RF path
- Optional second RF path up to 2.2 GHz or 3 GHz
- Up to two complete baseband paths
- Lossless combination of baseband signals in the digital domain (e.g. for testing multistandard base stations)

## Intuitive operation

- Color display with 800 x 600 pixels (SVGA format)
- Intuitive user interface with graphical display of signal flow (block diagram)
- Graphical display of baseband signals through built-in transient recorder
- Context-sensitive help system

## Outstanding signal quality

- I/Q modulator with 200 MHz RF bandwidth
- Very low SSB phase noise of typ.  $-135$  dBc ( $f = 1$  GHz, 20 kHz carrier offset, 1 Hz measurement bandwidth)
- Wideband noise of typ.  $-153$  dBc (CW,  $f = 1$  GHz,  $>5$  MHz carrier offset, 1 Hz measurement bandwidth)
- Excellent ACLR performance of typically  $+70$  dB with 3GPP FDD (test model 1, 64 DPCH)
- Very high level repeatability of 0.05 dB
- High output power of up to  $+19$  dBm (PEP), overrange  $+26$  dBm
- High-stability reference oscillator as standard

## Unrivalled flexibility

- Four code channels in realtime for 3GPP FDD
- Change of modulation from slot to slot for GSM/EDGE
- Baseband generator with universal coder for realtime signal generation
- Arbitrary waveform generator with 16/64 Msample
- Arbitrary waveform generator with multisegment support
- Arbitrary waveform generator supported by Simulation Software R&S WinIQSIM™
- Internal 20 Gbyte hard disk as standard for storing waveforms and modulation data

## Ideal for production

- Very short frequency setting times ( $<3$  ms); only 450  $\mu$ s in List mode
- Electronic attenuator up to 6 GHz over the full level range
- Minimum space required as two complete generators are accommodated in one instrument of only four height units

## Convenient connections

- Remote control via GPIB and LAN
- USB connectors for keyboard, mouse and memory stick
- User-selectable trigger and marker signals

# Specifications

Specifications apply under the following conditions:

30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and all internal adjustments performed. Data designated "overrange" or "underrange" and data without tolerance limits is not binding.

EMC specifications are tested with sufficiently shielded cables and accessories (e.g. mouse and keypad). To prevent degradation of these specifications, the user is responsible for using appropriate equipment.

In compliance with the 3GPP standard, chip rates are specified in Mcps (million chips per second), whereas bit rates and symbol rates are specified in kbps (thousand bits per second) or ksps (thousand symbols per second). Mcps, kbps and ksps are not SI units.

## Frequency and RF options

### Frequency options

One of the following frequency options must be installed in RF path A.

R&S SMU-B102	100 kHz to 2.2 GHz
R&S SMU-B103	100 kHz to 3 GHz
R&S SMU-B104	100 kHz to 4 GHz
R&S SMU-B106	100 kHz to 6 GHz

One of the following frequency options can be installed in RF path B.

(If the R&S SMU-B104 or R&S SMU-B106 and one of the options R&S SMU-B20 or R&S SMU-B22 are installed in RF path A, no options can be installed in RF path B.)

R&S SMU-B202	100 kHz to 2.2 GHz
R&S SMU-B203	100 kHz to 3 GHz

### RF options

#### Low phase noise and FM/φM

One of the following options can be installed in RF path A:

R&S SMU-B20	FM/φM Modulator
R&S SMU-B22	FM/φM Modulator and Low Phase Noise

These options cannot be installed in RF path B.

#### High-power output and overvoltage protection

One of the following options can be installed in RF path A.

R&S SMU-B30	Overvoltage Protection
R&S SMU-B31	High-Power Output
R&S SMU-B32	Overvoltage Protection and High-Power Output

The R&S SMU-B30 and R&S SMU-B32 are not compatible with the frequency options R&S SMU-B104 and R&S SMU-B106.

One of the following options can be installed in RF path B.

R&S SMU-B35	Overvoltage Protection
R&S SMU-B36	High-Power Output
R&S SMU-B37	Overvoltage Protection and High-Power Output

# Modulation

## Possible modulation types

### RF path A

Amplitude modulation, frequency/phase modulation (optional), vector modulation, digital modulation via internal baseband section (optional), vector modulation via baseband inputs (optional), pulse modulation, wideband amplitude modulation

### RF path B

Amplitude modulation, digital modulation via internal baseband section (optional), vector modulation via baseband inputs (optional), pulse modulation

## Simultaneous modulation

On the same RF path

+ = compatible, - = not compatible, switch off each other

	AM	FM	$\phi$ M	Pulse	BB-AM	I/Q	DM	ARB
Amplitude modulation (AM)	/	+	+	+	-	-	-	-
Frequency modulation (FM)	+	/	-	+	+	+	+	+
Phase modulation ( $\phi$ M)	+	-	/	+	+	+	+	+
Pulse modulation	+	+	+	/	+	+	+	+
Broadband AM (BB-AM)	-	+	+	+	/	-	-	-
Vector modulation (I/Q)	-	+	+	+	-	/	-	-
Digital modulation (DM)	-	+	+	+	-	-	/	-
ARB	-	+	+	+	-	-	-	/

## RF characteristics

### Frequency

Range	underrange R&S SMU-B102, R&S SMU-B202 R&S SMU-B103, R&S SMU-B203 R&S SMU-B104 R&S SMU-B106	100 kHz to <300 kHz up to 2.2 GHz up to 3 GHz up to 4 GHz up to 6 GHz
Resolution of setting		0.01 Hz
Resolution of synthesis	standard, fundamental frequency range 750 MHz to 1500 MHz with option R&S SMU-B22	5 $\mu$ Hz 0.2 $\mu$ Hz
Setting time <sup>1</sup>	to within $<1 \times 10^{-7}$ for $f > 200$ MHz or < 124 Hz for $f < 200$ MHz, with GUI update stopped after IEC/IEEE bus delimiter in ALC OFF MODE S&H after trigger pulse in List mode additional trigger delay in two-path units, both operated in List mode	<3 ms <5 ms <450 $\mu$ s <250 $\mu$ s
Phase offset		adjustable in 0.1° steps

### Frequency sweep

Digital sweep in discrete steps		
	operating modes  sweep range step width (lin) step width (log)	automatic, single shot, manual or external trigger, linear or logarithmic full range full range 0.01 % to 100 %

### Reference frequency

Aging	after 30 days of uninterrupted operation with option R&S SMU-B22	$<1 \times 10^{-9}$ /day, $<1 \times 10^{-7}$ /year $<5 \times 10^{-10}$ /day, $<3 \times 10^{-6}$ /year
Temperature effect	in operating temperature range with option R&S SMU-B22	$<6 \times 10^{-8}$ $<6 \times 10^{-9}$
Warm-up time	to nominal thermostat temperature	$\leq 10$ min
Output for internal reference signal	frequency (approx. sinewave) level source impedance	10 MHz or external input frequency typ. 5 dBm 50 $\Omega$
Input for external reference	frequency maximum deviation input level, limits recommended input impedance	5, 10 or 13 MHz $3 \times 10^{-6}$ $\geq -6$ dBm, $\leq 19$ dBm 0 dBm to 19 dBm 50 $\Omega$
Electronic tuning from input AUX I/O	sensitivity with option R&S SMU-B22 input voltage input impedance	typ. $1 \times 10^{-8}$ /V to $3 \times 10^{-8}$ /V typ. $4 \times 10^{-9}$ /V to $1.2 \times 10^{-8}$ /V -10 V to +10 V 10 k $\Omega$

<sup>1</sup> Installation of software that is not authorized by Rohde & Schwarz for use on the R&S SMU200A can deteriorate the setting time performance.

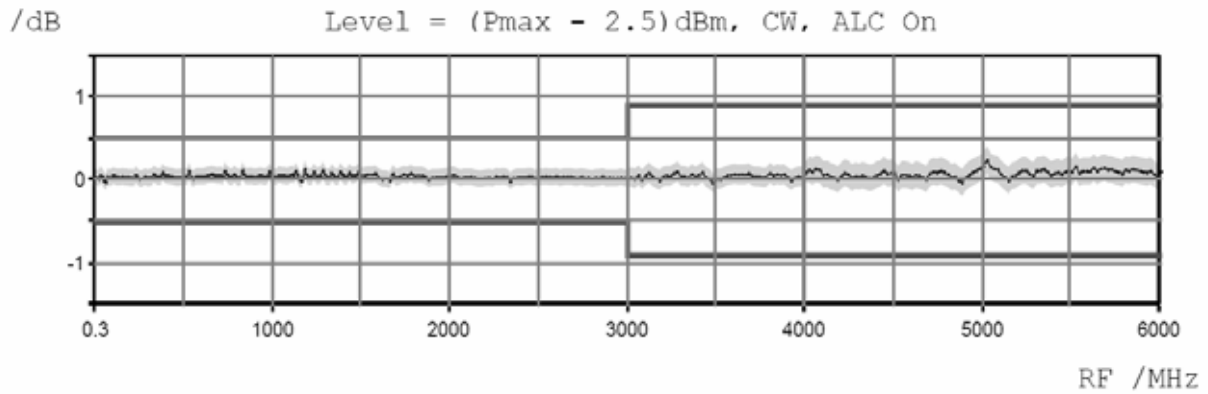
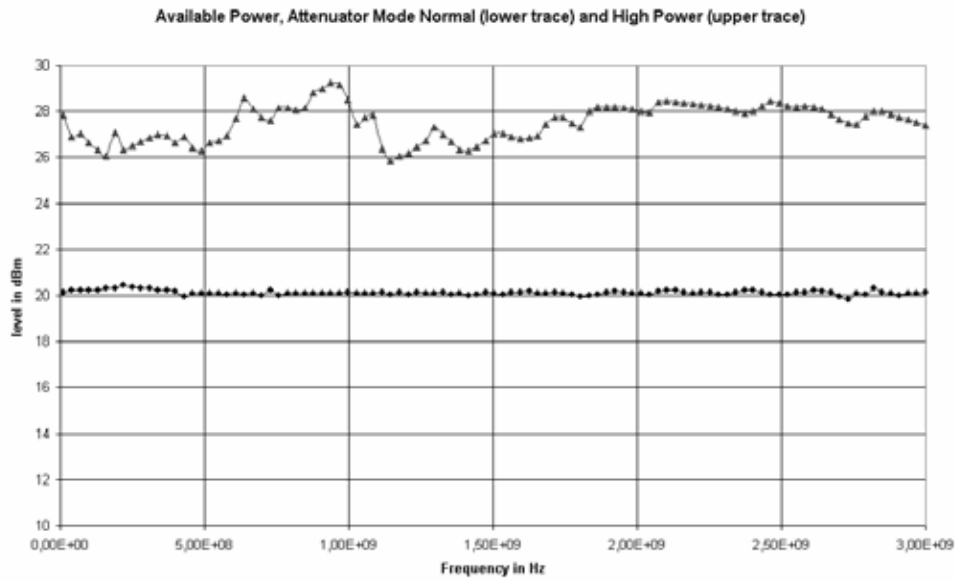
## Level

Setting range	with option R&S SMU-B31, -B32, -B36 or -B37	-145 dBm to +20 dBm to +30 dBm
Maximum level with frequency options up to 3 GHz	standard with option R&S SMU-B31, -B32, -B36 or -B37	+13 dBm (PEP) <sup>2</sup> +19 dBm (PEP)
Maximum level with frequency options above 3 GHz	standard with option R&S SMU-B31 or -B36	+8 dBm (PEP) +17 dBm (PEP)
Resolution		0.01 dB
Level uncertainty	for levels >-120 dBm, attenuator mode "auto", temperature range 18 to 28 °C 0.3 MHz ≤ f ≤ 3 GHz f > 3 GHz	<0.5 dB <0.9 dB
Additional uncertainty with ALC OFF, S&H	(This function is needed only for some special applications.)	<0.2 dB
Output impedance VSWR in 50 Ω system	ALC state ON, standard, f ≤ 3 GHz f > 3 GHz	<1.6, typ. <1.4 <1.85, typ. <1.6
	ALC state ON, with options R&S SMU-B31 or -B36 frequency options up to 3 GHz attenuator mode "normal" attenuator mode "high power"  frequency options above 3 GHz attenuator mode "high power" attenuator mode "normal", f ≤ 3 GHz attenuator mode "normal", f > 3 GHz	<1.65, typ. <1.45 <1.7, typ. <1.5  <1.9, typ. <1.65 <1.65, typ. <1.45 <1.9, typ. <1.65
Setting time <sup>3</sup>	after IEC/IEEE bus delimiter, to <0.3 dB deviation from final value, with GUI update stopped, temperature range 18 to 28 °C f ≤ 5 GHz f > 5 GHz ALC state OFF f ≤ 5 GHz f > 5 GHz  range switch-over with option R&S SMU-B31, -B32, -B36 or -B37	<3 ms typ. 3 ms  <5 ms typ. 5 ms  <15 ms
Uninterrupted level setting	with attenuator mode fixed, ALC state on setting range	>20 dB
Back-feed (from ≥50 Ω source) with R&S SMU-B103, -B203	maximum permissible RF power in output frequency range of RF path maximum permissible DC voltage with option R&S SMU-B31 switched on	0.5 W continuous 20 V 7 V
Back-feed (from ≥50 Ω source) with R&S SMU-B106, -B206	maximum permissible RF power in output frequency range of RF path maximum permissible DC voltage with option R&S SMU-B36 switched on	0.5 W 10 V 7 V

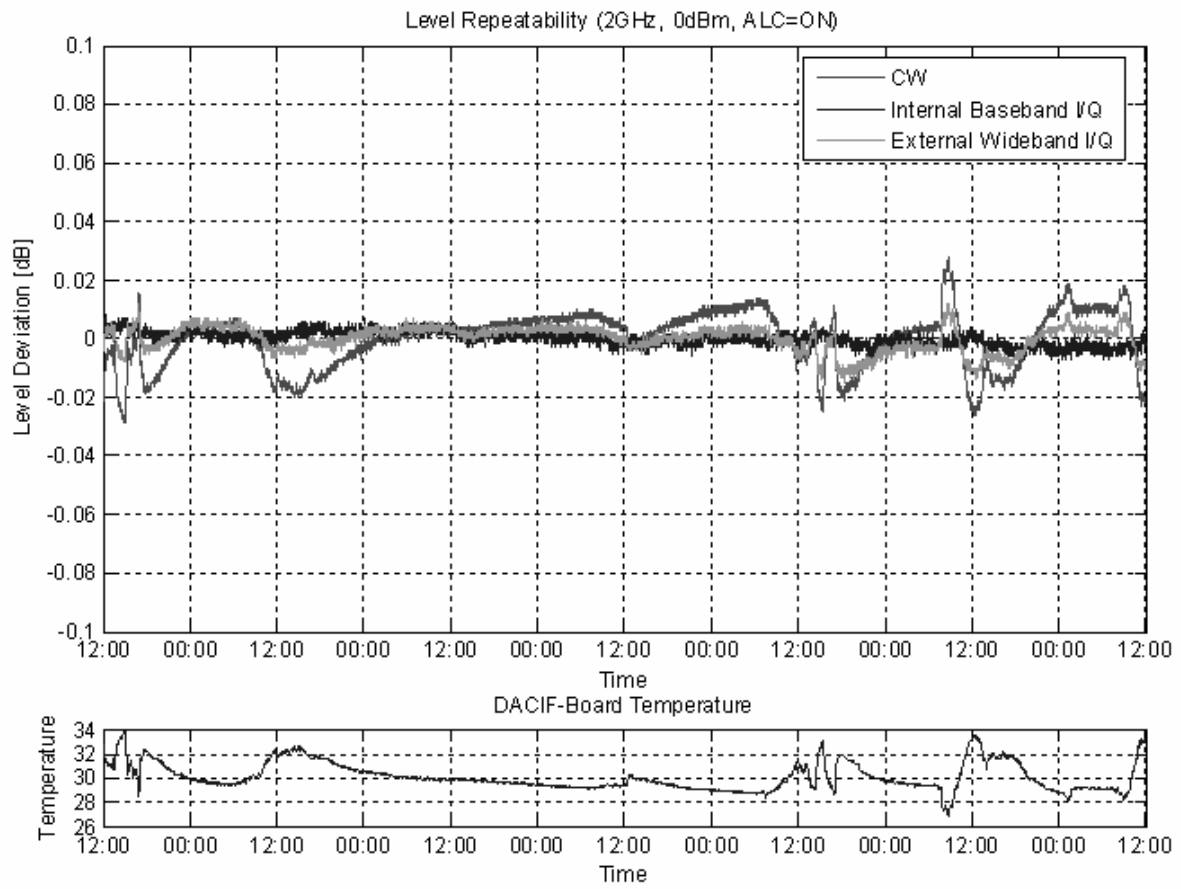
<sup>2</sup> PEP = peak envelope power.

<sup>3</sup> Installation of software that is not authorized by Rohde & Schwarz for use on the R&S SMU200A can deteriorate the setting time performance.

## Measured level data



Measured level uncertainty vs. frequency



*Level repeatability over 6 days with random settings between measurements*

## Level sweep

Digital sweep in discrete steps	<p>operating modes</p> <p>sweep range</p> <p>step width</p> <p>With option R&amp;S SMU-B31, -B32, -B36 or -B37: Since these options are switched on by mechanical relays, the switching threshold must not be crossed during sweep. Sweeping is therefore inhibited with attenuator mode "auto".</p>	<p>automatic, single sweep, manual or external trigger, logarithmic</p> <p>level range of attenuator modes "normal", "high power" or "fixed" 0.1 dB to 20 dB per step</p>
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## Overvoltage protection (option R&S SMU-B30 / -B32 / -B35 or -B37)

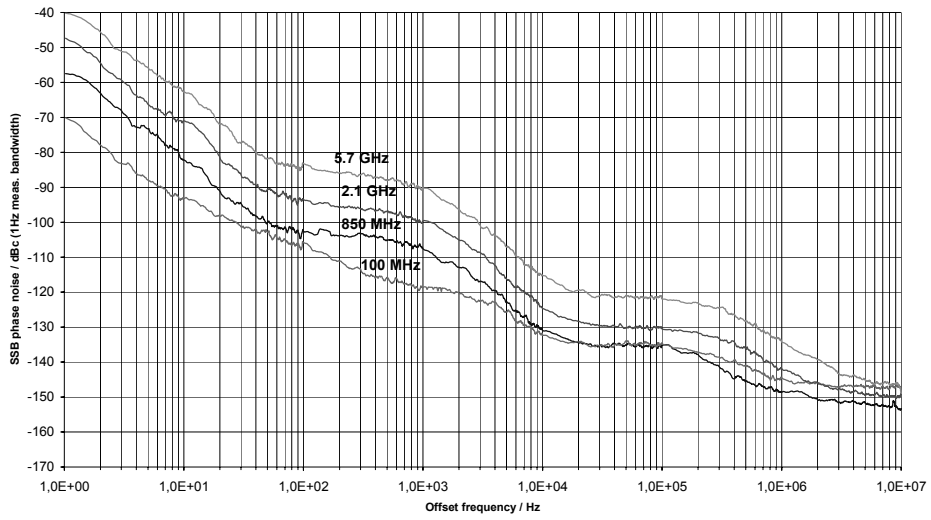
Protects the instrument against externally applied RF power from a 50 $\Omega$ source. Not available with options R&S SMU-B104 and R&S SMU-B106.		
Maximum permissible RF power	in output frequency range of RF path	50 W
Maximum permissible DC voltage	with R&S SMU-B30, -B35	20 V
	with R&S SMU-B32, -B37	35 V
If an overvoltage protection option is installed, the output impedance (VSWR) in the respective RF path deteriorates.		
VSWR	<p>up to 3 GHz</p> <p>attenuator mode "normal"</p> <p>attenuator mode "high power"</p>	<p>&lt;1.8, typ. &lt;1.6</p> <p>&lt;1.9, typ. &lt;1.7</p>

## Spectral purity

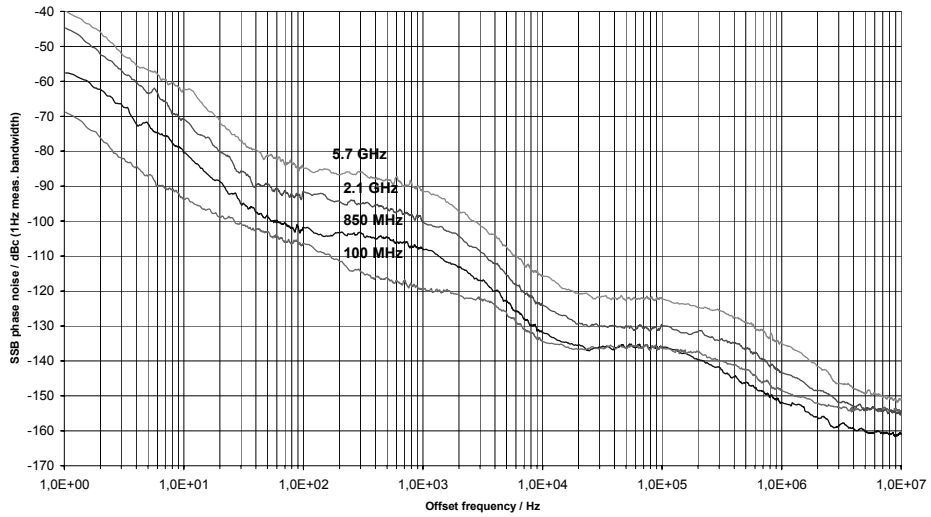
Harmonics	<p>max. level, unmodulated for <math>\leq -30</math> dBc with R&amp;S SMU-B102/-B103/-B202/-B203 with option R&amp;S SMU-B31, -B32, -B36 or -B37, attenuator mode "high power"</p> <p>with R&amp;S SMU-B104/-B106 with option R&amp;S SMU-B31 or -B36, attenuator mode "high power"</p>	<p>8 dBm</p> <p>12 dBm</p> <p>3 dBm</p> <p>10 dBm</p>
Nonharmonics	<p>level <math>&gt; -50</math> dBm, CW, vector modulation (full-scale DC input), <math>&gt;10</math> kHz offset from carrier and outside the modulation spectrum</p> <p><math>0.3 \text{ MHz} \leq f \leq 200 \text{ MHz}</math>  <math>200 \text{ MHz} &lt; f \leq 1500 \text{ MHz}</math>  <math>1500 \text{ MHz} &lt; f \leq 3000 \text{ MHz}</math>  <math>f &gt; 3000 \text{ MHz}</math></p> <p><math>&gt;850</math> kHz offset from carrier and outside the modulation spectrum</p> <p><math>0.3 \text{ MHz} \leq f \leq 200 \text{ MHz}</math>  <math>200 \text{ MHz} &lt; f \leq 1500 \text{ MHz}</math>  <math>1500 \text{ MHz} &lt; f \leq 3000 \text{ MHz}</math>  <math>f &gt; 3000 \text{ MHz}</math></p>	<p><math>\leq -77</math> dBc  <math>\leq -80</math> dBc  <math>\leq -74</math> dBc  <math>\leq -68</math> dBc</p> <p><math>\leq -77</math> dBc  <math>\leq -86</math> dBc  <math>\leq -80</math> dBc  <math>\leq -74</math> dBc</p>
Nonharmonics with option R&S SMU-B22	<p>level <math>&gt; -50</math> dBm, CW, vector modulation (full-scale DC input), <math>&gt;10</math> kHz offset from carrier and outside the modulation spectrum</p> <p><math>0.3 \text{ MHz} \leq f \leq 200 \text{ MHz}</math>  <math>200 \text{ MHz} &lt; f \leq 1500 \text{ MHz}</math>  <math>1500 \text{ MHz} &lt; f \leq 3000 \text{ MHz}</math>  <math>f &gt; 3000 \text{ MHz}</math></p>	<p><math>\leq -77</math> dBc (typ. <math>-87</math> dBc)  <math>\leq -90</math> dBc  <math>\leq -84</math> dBc  <math>\leq -78</math> dBc</p>
Power supply and mechanically related nonharmonics	<p>at RF = 1 GHz,  50 Hz to 10 kHz from carrier</p>	<p><math>\leq -70</math> dBc</p>
Subharmonics	<p><math>1500 \text{ MHz} &lt; f \leq 3000 \text{ MHz}</math>  <math>f &gt; 3000 \text{ MHz}</math></p>	<p><math>\leq -74</math> dBc  <math>\leq -50</math> dBc</p>
Wideband noise	<p>carrier offset <math>&gt;10</math> MHz, measurement bandwidth 1 Hz, CW</p> <p><math>20 \text{ MHz} \leq f \leq 200 \text{ MHz}</math>  <math>200 \text{ MHz} &lt; f \leq 1500 \text{ MHz}</math>  <math>1.5 \text{ GHz} &lt; f \leq 3 \text{ GHz}</math>  <math>f &gt; 3 \text{ GHz}</math></p> <p>vector modulation with full-scale DC input, I/Q input gain 3 dB</p> <p><math>20 \text{ MHz} \leq f \leq 200 \text{ MHz}</math>  <math>200 \text{ MHz} &lt; f \leq 1500 \text{ MHz}</math>  <math>1.5 \text{ GHz} &lt; f \leq 3 \text{ GHz}</math>  <math>f &gt; 3 \text{ GHz}</math></p>	<p><math>\leq -146</math> dBc (typ. <math>-149</math> dBc)  <math>\leq -150</math> dBc (typ. <math>-153</math> dBc)  <math>\leq -148</math> dBc (typ. <math>-151</math> dBc)  <math>\leq -146</math> dBc (typ. <math>-149</math> dBc)</p> <p><math>\leq -143</math> dBc (typ. <math>-146</math> dBc)  <math>\leq -146</math> dBc (typ. <math>-149</math> dBc)  <math>\leq -145</math> dBc (typ. <math>-148</math> dBc)  <math>\leq -143</math> dBc (typ. <math>-146</math> dBc)</p>
SSB phase noise	<p>carrier offset 20 kHz, measurement bandwidth 1 Hz, CW</p> <p><math>20 \text{ MHz} \leq f \leq 200 \text{ MHz}</math>  <math>f = 1 \text{ GHz}</math>  <math>f = 2 \text{ GHz}</math>  <math>f = 3 \text{ GHz}</math>  <math>f = 4 \text{ GHz}</math>  <math>f = 6 \text{ GHz}</math></p>	<p><math>\leq -128</math> dBc (typ. <math>-132</math> dBc)  <math>\leq -131</math> dBc (typ. <math>-135</math> dBc)  <math>\leq -125</math> dBc (typ. <math>-129</math> dBc)  <math>\leq -121</math> dBc (typ. <math>-125</math> dBc)  <math>\leq -119</math> dBc (typ. <math>-123</math> dBc)  <math>\leq -115</math> dBc (typ. <math>-119</math> dBc)</p>
SSB phase noise with option R&S SMU-B22	<p>carrier offset 20 kHz, measurement bandwidth 1 Hz, CW</p> <p><math>20 \text{ MHz} \leq f \leq 200 \text{ MHz}</math>  <math>f = 1 \text{ GHz}</math>  <math>f = 2 \text{ GHz}</math>  <math>f = 3 \text{ GHz}</math>  <math>f = 4 \text{ GHz}</math>  <math>f = 6 \text{ GHz}</math></p>	<p><math>\leq -135</math> dBc (typ. <math>-138</math> dBc)  <math>\leq -136</math> dBc (typ. <math>-139</math> dBc)  <math>\leq -130</math> dBc (typ. <math>-133</math> dBc)  <math>\leq -126</math> dBc (typ. <math>-129</math> dBc)  <math>\leq -124</math> dBc (typ. <math>-127</math> dBc)  <math>\leq -120</math> dBc (typ. <math>-123</math> dBc)</p>

Residual FM	rms value at f = 1 GHz 300 Hz to 3 kHz 20 Hz to 23 kHz	<1 Hz <4 Hz
Residual AM	rms value 20 Hz to 23 kHz	<0.02 %

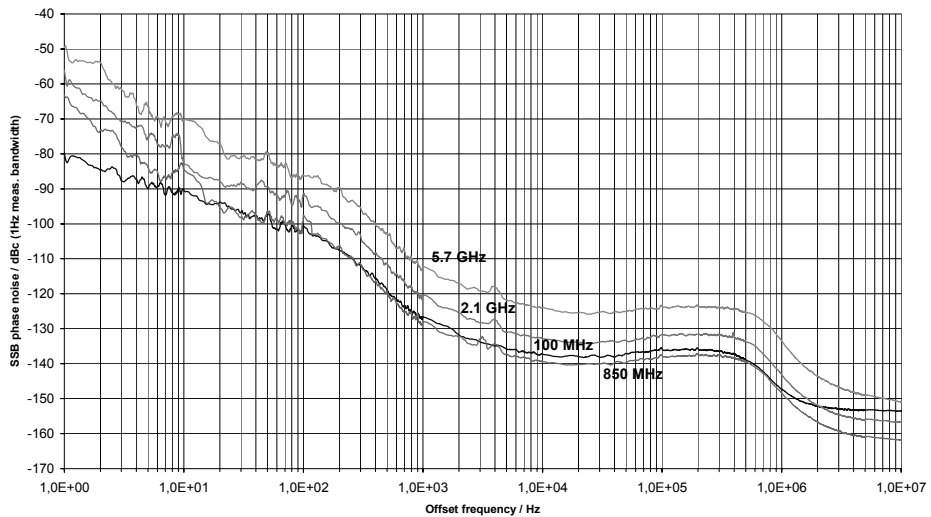
Measured SSB phase noise, I/Q modulated (typical values)



Measured SSB phase noise, unmodulated (typical values)



Measured SSB phase noise with Option B22, unmodulated (typical values)



## List mode

Frequency and level values can be stored in a list and set in an extremely short amount of time.		
Operating modes		automatic, single sweep, manual or external trigger, fast hopping with immediate and external trigger
Max. number of channels		10000
Dwell time Resolution		1 ms to 1 s 0.1 ms
Setting time	after external trigger	see frequency and level data

## Analog modulation

### Internal modulation generator

Frequency range		0.1 Hz to 1 MHz
Resolution of setting		0.1 Hz
Frequency uncertainty		<0.012 Hz + relative deviation of reference frequency
Frequency response	up to 100 kHz up to 1 MHz	<0.1 dB <1 dB
Distortion	up to 100 kHz at $R_L > 200 \Omega$ , level ( $V_p$ ) 1 V	<0.1 %
Output voltage	$V_p$ at LF connector, $R_L > 200 \Omega$ resolution setting uncertainty at 1 kHz	1 mV to 3 V 1 mV <(1 % of reading + 1 mV)
Output impedance		16 $\Omega$
Frequency setting time	to within $<1 \times 10^{-7}$ , with GUI update stopped, after IEC/IEEE bus delimiter	<3 ms
Sweep	digital sweep in discrete steps  operating modes  sweep range linear step width logarithmic step width	automatic, step, single, external single, external step, manual or external trigger, linear or logarithmic spacing full frequency range full frequency range 0.01 % to 100 % per step

### Input for external modulation signals

Modulation input EXT MOD	input impedance  input sensitivity (peak value for set modulation depth or deviation)	high (>100 k $\Omega$ ), switchable to 50 $\Omega$ with options R&S SMU-B20 or -B22 1 V
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### Amplitude modulation

Operating modes		internal, external AC/DC
Modulation depth	At high levels, modulation is clipped when the maximum PEP is reached	0 to 100 %
Resolution		0.1 %
Setting uncertainty	attenuator mode "auto", $f_{mod} = 1$ kHz and $m < 80$ %	<(1 % of reading + 1 %)
AM distortion	PEP in specified range, attenuator mode "auto" $f \leq 3$ GHz, at $f_{mod} = 1$ kHz, $m = 30$ % $m = 80$ % $f > 3$ GHz, at $f_{mod} = 1$ kHz, $m = 30$ % $m = 80$ %	<0.5 % <0.8 % <1 % <1.6 %
Modulation frequency range		DC, 20 Hz to 500 kHz
Modulation frequency response	mode AC, 20 Hz to 500 kHz	<1 dB
Incidental $\phi M$ at AM	$m = 30$ %, $f_{mod} = 1$ kHz, peak value	<0.1 rad

## Wideband amplitude modulation

Operating modes	modulation input I	external DC
Modulation frequency response	as with I/Q modulation – external wideband I/Q	
Input impedance Input sensitivity	peak voltage for 100 % AM	50 Ω 0.25 V

## Pulse modulation

Operating modes		external, internal (duty cycle approx. 1:1)
On/off ratio		>70 dB
Rise/fall time	10 % / 90 % of RF amplitude	typ. 1 μs
Pulse repetition frequency		0 to 100 kHz
Video crosstalk	spectral line of fundamental of 100 kHz squarewave modulation	<-30 dBc
Modulation input EXT MOD A/B	input level input impedance polarity	TTL-compatible >10 kΩ selectable

## Frequency modulation (option R&S SMU-B20 or R&S SMU-B22)

Operating modes		internal, external, internal + external, AC/DC, "normal", "low noise" (with R&S SMU-B22 only)
FM/φM range multiplier	0.3 MHz ≤ f ≤ 200 MHz 200 MHz < f ≤ 375 MHz 375 MHz < f ≤ 750 MHz 750 MHz < f ≤ 1500 MHz 1500 MHz < f ≤ 3000 MHz f > 3000 MHz	rm = 1 rm = 0.25 rm = 0.5 rm = 1 rm = 2 rm = 4
Maximum deviation	FM mode "normal" FM mode "low noise"	rm × 10 MHz rm × 100 kHz
Resolution		<0.2 %, min. rm × 1 MHz
Setting uncertainty	f <sub>mod</sub> = 10 kHz, deviation ≤ half of max. deviation internal external	<(1.5 % of reading + 20 Hz) <(2.0 % of reading + 20 Hz)
FM distortion	f <sub>mod</sub> = 10 kHz and 1 MHz deviation	<0.1 %
Modulation frequency response	FM mode "normal" 10 Hz to 100 kHz 10 Hz to 10 MHz FM mode "low noise" 10 Hz to 100 kHz	<0.5 dB <3 dB <3 dB
Synchronous AM	40 kHz deviation, f <sub>mod</sub> = 1 kHz, f > 5 MHz f > 3 GHz	<0.1 % <0.2 %
Carrier frequency offset at FM		<0.2 % of set deviation

### Phase modulation (option R&S SMU-B20 or R&S SMU-B22)

Operating mode		internal, external, internal + external, AC/DC, "high bandwidth", "high deviation", "low noise" (with R&S SMU-B22 only)
Maximum deviation	$\phi$ M mode "high deviation" $\phi$ M mode "high bandwidth" $\phi$ M mode "low noise"	$rm \times 5.0$ rad $rm \times 1.0$ rad $rm \times 0.25$ rad
Resolution		<0.2 %, min. $rm \times 0.3$ rad
Setting uncertainty	$f_{mod} = 10$ kHz, deviation $\leq$ half of max. deviation internal external	<(1.5 % of reading + 0.01 rad) <(2.0 % of reading + 0.01 rad)
$\phi$ M distortion	$f_{mod} = 10$ kHz, half of max. deviation	<0.2 %, typ. 0.1 %
Modulation frequency response	"high deviation", 10 Hz to 500 kHz "high bandwidth", 10 Hz to 10 MHz "low noise", 10 Hz to 100 kHz	<1 dB <3 dB <3 dB

## I/Q modulation

### I/Q modulator

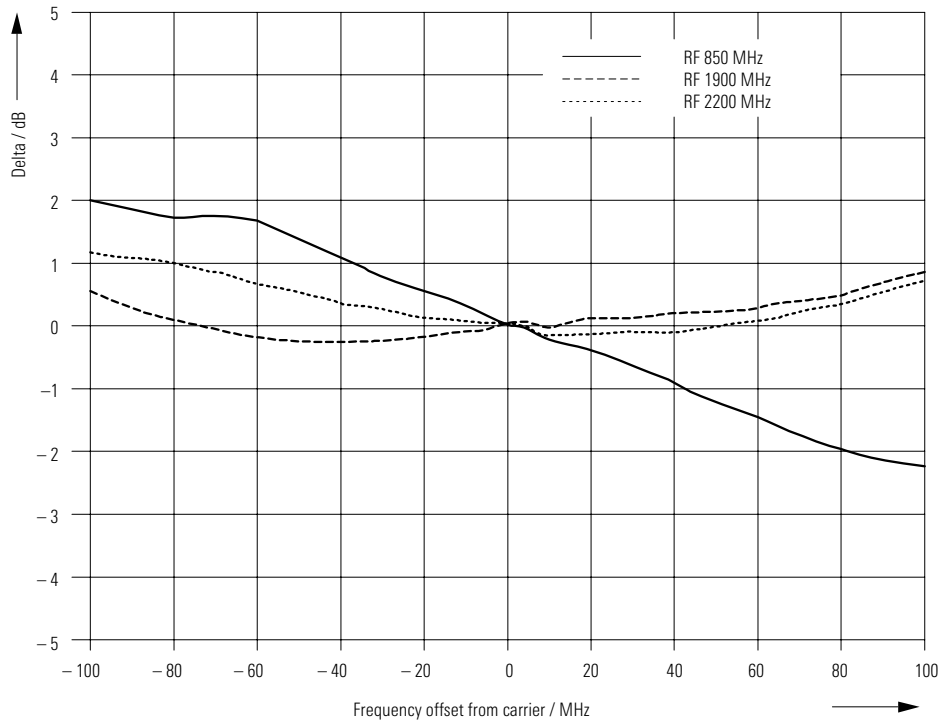
Operating modes		external wideband I/Q, internal baseband I/Q
I/Q impairments	I offset, Q offset setting range resolution gain imbalance setting range resolution quadrature offset setting range resolution	-10 % to +10 % 0.01 % -1.0 to +1.0 dB 0.001 dB -10° to +10° 0.01°
I/Q swap	I and Q signals swapped	off, on

### External wideband I/Q

This type of modulation is only possible in path A.

I/Q inputs	input impedance VSWR up to 50 MHz input voltage for full-scale input minimum input voltage for ALC state on	50 Ω <1.2 $\sqrt{V_i^2 + V_q^2} = 0.5 \text{ V}$ 0.1 V
Modulation frequency range	I/Q wideband on	100 MHz
RF frequency response for entire instrument in modulation bandwidth	I/Q wideband set to on up to 50 MHz up to 5 MHz	<6 dB <1.0 dB
Carrier leakage	without input signal, referenced to full-scale input <sup>4</sup>	<-55 dBc, typ. <-65 dBc
Error vector	measured with 16QAM, filter root cosine, $\alpha = 0.5$ , symbol rate 10 kHz rms value f ≤ 200 MHz f > 200 MHz peak value f ≤ 200 MHz f > 200 MHz	<0.3 % <(0.2 % + 0.1 % × f/GHz) <0.6 % <(0.4 % + 0.2 % × f/GHz)

<sup>4</sup> Value applies after 1 hour warm-up and recalibration for 4 hours operation and temperature variations of less than 5°C.



Measured frequency response of external wideband I/Q modulation

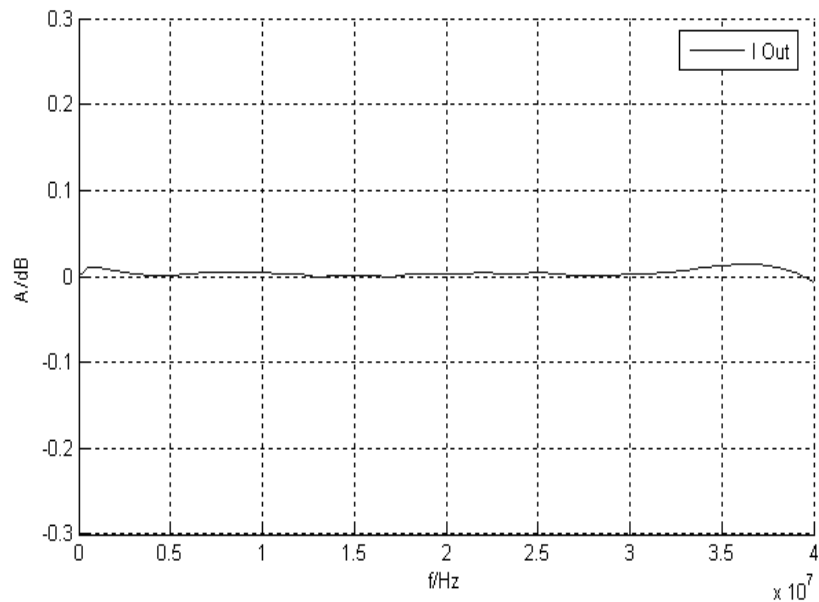
### Internal baseband I/Q (with option R&S SMU-B13)

The R&S SMU-B13 converts the internal digital baseband signals of the R&S SMU-B10 into analog signals for driving the I/Q modulator. It also generates the analog I/Q output signals. One or two R&S SMU-B13 can be installed. The first R&S SMU-B13 drives RF path A, the second RF path B. The I/Q output signals are available either for path A or B.

D/A converter	data rate resolution sampling rate	100 MHz 16 bit 400 MHz (internal interpolation × 4)
Aliasing filter	with amplitude, group-delay and Si correction bandwidth, roll-off to -0.1 dB D/A converter interpolation spectra up to 10 MHz up to 40 MHz	40 MHz  <-80 dBc <-73 dBc
I/Q impairment	carrier leakage setting range resolution I ≠ Q (imbalance) setting range resolution quadrature offset setting range resolution	-10 % to +10 % 0.01 %  -1 dB to +1 dB 0.001 dB  -10° to +10° 0.01°
RF frequency response for entire instrument in modulation bandwidth	I/Q wideband on, optimize internal I/Q impairments for RF output on up to 10 MHz up to 40 MHz	<1.5 dB, typ. 0.7 dB <4.5 dB, typ. 2.0 dB
Suppression of image sideband for entire instrument in modulation bandwidth <sup>3</sup>	up to 10 MHz up to 40 MHz	>50 dB, typ. 56 dB >40 dB, typ. 50 dB
Carrier leakage <sup>5</sup>	referenced to full-scale input	<-55 dBc, typ. <-65 dBc

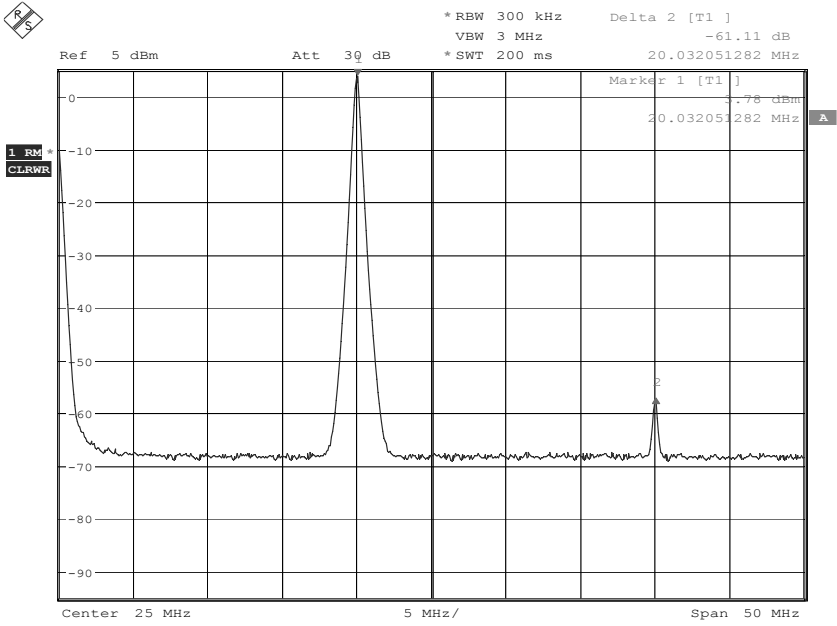
<sup>5</sup> Value applies after 1 hour warm-up and recalibration for 4 hours operation and temperature variations of less than 5°C.

Additional level uncertainty relating to CW	measured at 0 dBm with 16QAM, filter root cosine, $\alpha = 0.5$ , symbol rate 10 kHz	<0.2 dB
<b>I/Q outputs</b>		
Output impedance		50 $\Omega$
Output voltage	EMF output voltage depends on set modulation signal	1 V ( $V_P$ )
Offset	EMF	<1 mV
Frequency response <sup>6</sup>	at $R_L = 50 \Omega$ magnitude up to 10 MHz up to 40 MHz nonlinear phase up to 10 MHz up to 30 MHz	typ. 0.02 dB typ. 0.03 dB  typ. 0.1 ° typ. 0.2 °
I/Q balance <sup>6</sup>	at $R_L = 50 \Omega$ magnitude up to 10 MHz up to 40 MHz nonlinear phase up to 10 MHz up to 30 MHz	typ. 0.01 dB typ. 0.02 dB  typ. 0.1 ° typ. 0.2 °
Spectral purity	at $R_L = 50 \Omega$ SFDR (sine) up to 2 MHz up to 20 MHz phase noise 10 MHz sinewave at 20 kHz offset wideband noise 10 MHz sinewave at 1 MHz offset	>70 dB typ. 60 dB  typ. -150 dBc typ. -155 dBc



Frequency response of I/Q outputs

<sup>6</sup> Optimize internal I/Q impairments for RF output switched off.



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*SFDR of I/Q outputs*

## Differential I/Q output (option R&S SMU-B16)

One R&S SMU-B16 can be installed; the I/Q output signals are available either for path A or B.

Additional specifications for I/Q outputs with option R&S SMU-B16		
Output impedance Single-ended Differential		50 $\Omega$ 100 $\Omega$
Output voltage Single-ended Resolution Differential Resolution	output voltage depends on set modulation signal EMF EMF	0.02 V to 2 V ( $V_p$ ) 1 mV 0.04 V to 4 V ( $V_{pp}$ ) 2 mV
Bias voltage (single-ended and differential) Resolution Uncertainty	EMF	-3.6 V to 3.6 V 2 mV 1 % + 4 mV
Offset voltage Differential Resolution Uncertainty	EMF	-300 mV to 300 mV 0.2 mV 1 % + 0.1 % $\times$ bias voltage + 1 mV
Differential signal balance	at $R_L = 50 \Omega$ , output voltage > 0.5 V ( $V_p$ ) magnitude up to 10 MHz up to 40 MHz	<0.2 dB, typ. 0.05 dB typ 0.2 dB
Frequency response <sup>7</sup>	at $R_L = 50 \Omega$ , output voltage > 0.5 V ( $V_p$ ) magnitude up to 10 MHz up to 40 MHz nonlinear phase up to 10 MHz up to 30 MHz	typ. 0.02 dB typ. 0.03 dB  typ. 0.1 $^\circ$ typ. 0.2 $^\circ$

## Analog baseband input (option R&S SMU-B17)

At least one Baseband Main Module R&S SMU-B13 must be installed. With the R&S SMU-B17, external analog signals can be fed to the baseband section of the R&S SMU200A. The frequency of the signals can be shifted, and the signals can be added to the internally generated signal with variable level ratio. If the R&S SMU200A is equipped with a fading simulator, the input signals can also be faded.

Mode	see also simultaneous modulation	analog input
Input level	peak level setting range resolution crest factor setting range resolution The adjust level function automatically determines the peak level and crest factor of the input signal.	-10 dB to 0 dB referenced to full scale 0.01 dB  0 dB to 30 dB 0.01 dB
Frequency offset	With the aid of the frequency offset, the center frequency of the input signal can be shifted in the baseband. The restrictions caused by the modulation bandwidth apply.  setting range resolution frequency accuracy	-40 MHz to +40 MHz 0.01 Hz <5 $\times 10^{-10}$ $\times$ frequency offset + reference frequency error
I/Q swap	I and Q signals swapped	off, on

<sup>7</sup> Optimize internal I/Q impairments for RF output switched off.

<b>Analog I/Q inputs</b> All specifications apply to a peak level of 0 dB.		
I/Q inputs	input impedance VSWR up to 30 MHz  input voltage for full-scale input  I/Q skew setting range resolution	50 Ω <1.1, typ. 1.03  $\sqrt{V_i^2 + V_q^2} = 0.5 \text{ V}$  –1 ns to 1 ns 1 ps
A/D converter	sampling rate resolution	100 MHz 14 bit
Aliasing filter	with amplitude and group-delay correction  bandwidth, roll-off to –0.1dB stopband rejection, $f \geq 70 \text{ MHz}$	30 MHz typ. 80 dB
RF frequency response for entire instrument in modulation bandwidth	I/Q wideband on, optimize internal I/Q impairments for RF output on up to 10 MHz up to 30 MHz	typ. 0.2 dB typ. 0.4 dB
Carrier leakage	referenced to full scale	<–55 dBc, typ. <–65 dBc
Suppression of image sideband for entire instrument in modulation bandwidth	up to 10 MHz up to 30 MHz	typ. 56 dB typ. 50 dB
RF spectral purity	wideband noise, with full-scale DC input 20 MHz $\leq f \leq 200 \text{ MHz}$ 200 MHz $< f \leq 1.5 \text{ GHz}$ 1.5 GHz $< f \leq 3 \text{ GHz}$ $f > 1.5 \text{ GHz}$  ACLR with an ideal input signal 3GPP, test model 1, 64 DPCHs with frequency options up to 3 GHz level $\leq 10.5 \text{ dBm PEP}$ , $\leq 17.5 \text{ dBm PEP}$ with high- power output option with frequency options above 3 GHz level $\leq 5.5 \text{ dBm PEP}$ $\leq 14.5 \text{ dBm PEP}$ with high- power output option frequency 1800 MHz to 2200 MHz offset 5 MHz (baseband gain 3 dB) offset 10 MHz (baseband gain 6 dB)	typ. –145 dBc typ. –148 dBc typ. –148 dBc typ. –145 dBc            typ. 70 dB typ. 73 dB

## I/Q baseband generator (options R&S SMU-B10/-B11) – arbitrary waveform mode

At least one Baseband Main Module R&S SMU-B13 must be installed. One or two R&S SMU-B10/-B11 can be installed. Their I/Q signals can be assigned a frequency offset and/or be added in the digital domain.

Waveform memory	output memory waveform length R&S SMU-B10  waveform length R&S SMU-B11  resolution loading time 10 Msample nonvolatile memory	128 sample to 64 Msample in one-sample steps 128 sample to 16 Msample in one-sample steps 16 bit 15 s hard disk
Multisegment waveform	number of segments  changeover modes extended trigger modes  changeover time (external trigger, without clock change) seamless changeover	max. 100 segments  GUI, remote control, external trigger same segment, next segment, next segment seamless  typ. 5 $\mu$ s output up to end of current segment, followed by changeover to next segment
Clock generation	clock rate resolution operating mode frequency uncertainty (internal)	400 Hz to 100 MHz 0.001 Hz internal, external < $5 \times 10^{-14} \times$ clock rate + uncertainty of reference frequency
Interpolation	The sampling rate of the waveform is automatically interpolated to the internal 100 MHz data rate.  bandwidth clock rate = 100 MHz (no interpolation), roll-off to -0.1 dB clock rate $\leq$ 100 MHz, drop to -0.1 dB	40 MHz 0.31 $\times$ clock rate
Frequency offset	With the aid of the frequency offset, the center frequency of the wanted baseband signal can be shifted. The restrictions caused by the modulation bandwidth still apply. range resolution frequency uncertainty	-40 MHz to +40 MHz 0.01 Hz < $5 \times 10^{-10} \times$ frequency offset + reference frequency error
Triggering	In internal clock mode, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In external clock mode, the trigger event is synchronized to the symbol clock.  operating mode modes  setting uncertainty for clock phase related to trigger in internal clock mode external trigger delay setting range resolution internal clock mode external clock mode setting uncertainty external trigger inhibit setting range resolution external trigger pulse width external trigger frequency	internal, external Auto, Retrig, Armed Auto, Armed Retrig  <18 ns 0 to $2^{16}$ sample 0.01 sample 1 sample <5 ns 0 to $2^{26}$ sample 1 sample >15 ns <0.02 $\times$ sampling rate

Marker outputs	number level operating modes  marker delay setting range setting range without recalculation resolution of setting setting uncertainty	4 LVTTTL unchanged, restart, pulse, pattern, ratio  0 to (waveform length – 1) sample 0 to 2000 sample 0.001 sample <10 ns
Operation with R&S WinIQSIM™: As of version 4.10, the software supports download of I/Q data and control of the R&S SMU-B10/B11.		

## I/Q baseband generator (options R&S SMU-B10/-B11) – realtime operation

At least one Baseband Main Module R&S SMU-B13 must be installed. One or two R&S SMU-B10/B11 can be installed. Their I/Q signals can be assigned a frequency offset and/or be added.

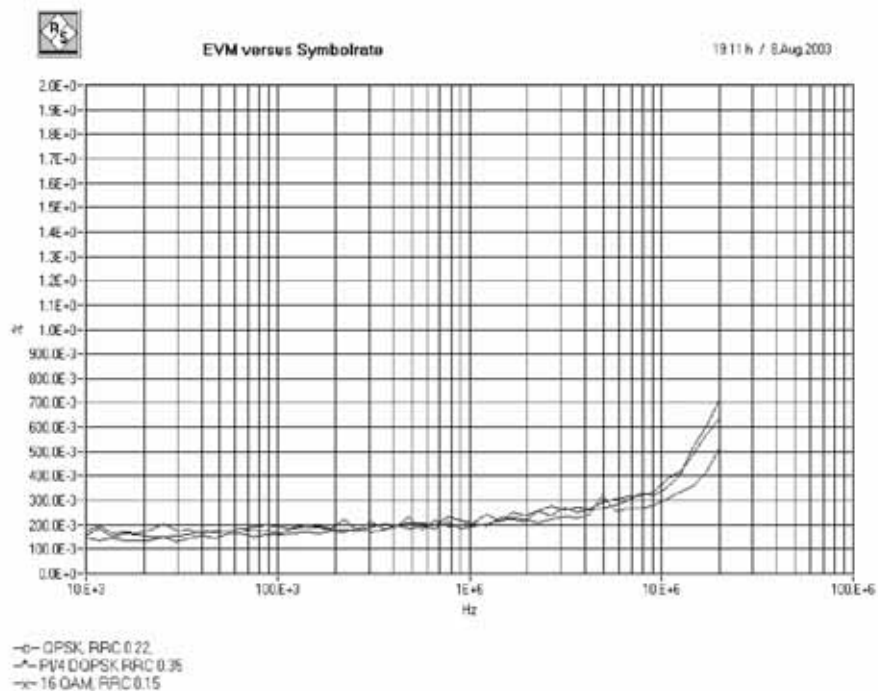
Types of modulation	<p>ASK modulation index resolution</p> <p>FSK deviation maximum resolution setting uncertainty</p> <p>variable FSK deviation maximum resolution</p> <p>PSK</p> <p>QAM</p>	<p>0 % to 100 % 0.1 %</p> <p>2FSK, 4FSK, MSK 0.1 to <math>1.5 \times f_{\text{Sym}}</math> 10 MHz &lt;0.1 Hz &lt;0.5 %</p> <p>4FSK, 8FSK, 16FSK <math>-1.5 \times f_{\text{Sym}}</math> to <math>+1.5 \times f_{\text{Sym}}</math> 10 MHz &lt;0.1 Hz</p> <p>BPSK, QPSK, QPSK 45° offset, OQPSK, <math>\pi/4</math>-QPSK, <math>\pi/2</math>-DBPSK, <math>\pi/4</math>-DQPSK, <math>\pi/8</math>-D8PSK, 8PSK, 8PSK EDGE</p> <p>16QAM, 32QAM, 64QAM, 256QAM, 1024QAM</p>
Coding	Not all coding methods can be used with every type of modulation.	Off, Differential, Diff. Phase, Diff.+Gray, Gray, GSM, NADC, PDC, PHS, TETRA, APCO25 (PSK), PWT, TFTS, INMARSAT, VDL, EDGE, APCO25(FSK), ICO, CDMA2000 <sup>®8</sup> , WCDMA
Baseband filter	<p>Any filter can be used with any type of modulation. The bandwidth of the modulation signal is max. 25 MHz; the signal is clipped when the bandwidth is exceeded.</p> <p>cosine, root cosine filter parameter <math>\alpha</math></p> <p>Gaussian filter parameter <math>B \times T</math></p> <p>cdmaOne, cdmaOne + equalizer cdmaOne 705 kHz, cdmaOne 705 kHz + equalizer CDMA2000<sup>®</sup> 3X APCO25 C4FM rectangular split phase filter parameter <math>B \times T</math></p> <p>resolution of filter parameter</p>	<p>0.05 to 1.00</p> <p>0.15 to 2.50</p> <p>0.15 to 2.5</p> <p>0.01</p>

<sup>8</sup> CDMA2000<sup>®</sup> is a registered trademark of the Telecommunications Industry Association (TIA -USA)

Symbol rate	<p>If an external clock is used, the applied data rate may deviate from the set clock rate by <math>\pm 2\%</math>. The external clock can be used for internal and external data.</p> <p>operating mode setting range ASK, PSK and QAM FSK resolution frequency uncertainty (internal)</p> <p>external clock clock divider K external clock rate</p>	<p>internal, external</p> <p>400 Hz to 25 MHz 400 Hz to 15 MHz 0.001 Hz <math>&lt; 5 \times 10^{-14} \times \text{symbol rate} + \text{reference}</math> frequency uncertainty symbol, K <math>\times</math> symbol, bit clock 1 to 64 max. 100 MHz</p>
Frequency offset	<p>With the aid of the frequency offset, the center frequency of the modulation signal in the baseband can be shifted. The restrictions caused by the modulation bandwidth apply.</p> <p>setting range resolution frequency uncertainty</p>	<p><math>-40</math> MHz to <math>+40</math> MHz 0.01 Hz <math>&lt; 5 \times 10^{-10} \times \text{frequency offset} + \text{reference}</math> frequency error</p>
Data sources	<p><b>internal</b> ALL 0, ALL 1 PRBS sequence length pattern length data lists output memory nonvolatile memory</p> <p><b>external</b> In the case of serial transmission, the symbol strobe marks the LSB of the symbol, and the maximum symbol rate is limited by the data rate of the interface.</p> <p>serial word width bit rate</p> <p>parallel word width symbol rate</p>	<p>9, 11, 15, 16, 20, 21, 23</p> <p>1 to 64 bit</p> <p>8 bit to 2 Gbit hard disk</p> <p>1 to 10 bit max. 60 MHz</p> <p>1 to 10 bit max. 25 MHz</p>
Triggering	<p>In internal clock mode, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In external clock mode, the trigger event is synchronized to the symbol clock.</p> <p>operating mode modes</p> <p>setting uncertainty for clock phase related to trigger in internal clock mode external trigger delay setting range resolution internal clock mode external clock mode setting uncertainty external trigger inhibit setting range resolution external trigger pulse width external trigger frequency</p>	<p>internal, external Auto, Retrig, Armed Auto, Armed Retrig</p> <p><math>&lt; 18</math> ns</p> <p>0 to <math>2^{16}</math> sample</p> <p>0.01 sample 1 sample <math>&lt; 5</math> ns</p> <p>0 to <math>2^{26}</math> sample 1 sample <math>&gt; 15</math> ns <math>&lt; 0.02 \times \text{sampling rate}</math></p>

Marker outputs	<p>number level operating modes</p> <p>marker delay (in sample) setting range setting range without recalculation resolution of setting setting uncertainty</p>	<p>4 LVTTTL control list, restart, pulse, pattern, ratio</p> <p>0 to <math>2^{24} - 1</math> 0 to 2000 0.001 &lt;10 ns</p>
Level reduction	<p>Internal or external via LEVATT input. The signal switches between nominal and reduced level (without edge shaping). When an internal LEVATT signal is used, the connector is used as an output.</p> <p>setting range additional level error in case of reduction up to 30 dB up to 50 dB</p>	<p>0 to 60 dB</p> <p>&lt;1 dB &lt;3 dB</p>
Burst	<p>Internal or external via BURST input. The signal triggers the beginning of a power ramp. The positive edge starts power ramping from blank to full level, the negative edge ramping in the opposite direction from full level to blanking. When an internal BURST GATE signal is applied, the connector is used as an output.</p> <p>operating range rise/fall time setting range resolution ramp shape</p>	<p>max. 5 MHz</p> <p>0.5 to 16 symbols 0.1 symbol cosine, linear</p>
Trigger / clock / data inputs	<p>Input impedance and trigger threshold can be set separately for the trigger and the clock / data inputs.</p> <p>input impedance trigger threshold setting range resolution</p>	<p>1 k<math>\Omega</math>, 50 <math>\Omega</math></p> <p>0.00 to 2.50 V 0.01 V</p>
Clock / data outputs	level	LVTTTL
Predefined settings	<p>modulation, filter, symbol rate and coding to standard</p> <p>standards</p>	<p>Bluetooth<sup>®9</sup>, DECT, ETC, GSM, GSM EDGE, NADC, PDC, PHS, TETRA, WCDMA 3GPP, TD-SCDMA, CDMA2000<sup>®</sup> Forward, CDMA2000<sup>®</sup> Reverse, Worldspace</p>
<b>Modulation errors</b>		
Deviation error with 2FSK, 4FSK	<p>deviation 0.2 to 0.7 <math>\times</math> symbol rate Gaussian filter with <math>B \times T = 0.2</math> to 0.7 symbol rate up to 2 MHz symbol rate up to 10 MHz</p>	<p>&lt;1.2 %, typ. 0.25 % typ. 0.75 %</p>
Phase error with MSK	<p>Gaussian filter with <math>B \times T = 0.2</math> to 0.7 bit rate up to 2 MHz bit rate up to 10 MHz</p>	<p>&lt;0.4°, typ. 0.15 ° typ. 0.3 °</p>
EVM with QPSK, OQPSK, $\pi/4$ -DQPSK, 8PSK, 16QAM, 32QAM, 64QAM	<p>cosine, root cosine filter with <math>\alpha = 0.2</math> to 0.7 symbol rate up to 5 MHz symbol rate up to 20 MHz</p>	<p>&lt;0.8 %, typ. 0.2 % typ. 0.7 %</p>

<sup>9</sup> The Bluetooth<sup>®</sup> word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by Rohde&Schwarz is under license.



Typical EVM versus symbol rate

## Modulation uncertainty for main standards

Typical values

Standard	GSM	EDGE	WCDMA 3GPP (1DPCH)	cdmaOne Reverse	DECT	TETRA	NADC	PDC	802.11a
Frequency / MHz	400 to 2000	400 to 2000	1800 to 2200	800 to 900 1850 to 2000	1880 to 1990	380 to 480	824 to 894 1850 to 2000	810 to 956 1429 to 1501	2400 to 2485 5150 to 5825
EVM / %	–	0.2	0.3	0.2	–	0.2	0.2	0.2	0.4
Phase error / °	0.15	–	–	–	–	–	–	–	–
Dev. error / kHz	–	–	–	–	0.5	–	–	–	–
Channel spacing	200 kHz	200 kHz	5 MHz	1.25 MHz	1.728 MHz	25 kHz	30 kHz	25 kHz	–
Adjacent channel power ratio (ACPR)/ dB <sup>10</sup>									
In adjacent channel	–37	–38	–72 <sup>11</sup>	–85 <sup>12</sup>	–	–74 <sup>13</sup>	–34	–74	–42 at 11 MHz
In alternate channel	–71	–71	–78 <sup>14</sup>	–89 <sup>15</sup>	–	–77 <sup>11</sup>	–80	–82	–64 at 20 MHz
In 2nd alternate channel	–85	–85	–	–95 <sup>16</sup>	–	–	–	–	–66 at 30 MHz

<sup>10</sup> Level restricted, see specs.

<sup>11</sup> Baseband gain 0 dB (standard).

<sup>12</sup> 885 kHz offset and 30 kHz bandwidth.

<sup>13</sup> Measured with root cosine filter.

<sup>14</sup> Baseband gain 6 dB (low noise).

<sup>15</sup> 1.25 MHz offset and 30 kHz bandwidth.

<sup>16</sup> 1.98 MHz offset and 30 kHz bandwidth.

## Digital modulation systems

At least one I/Q baseband generator (option R&S SMU-B10) must be installed. If two I/Q baseband generators are installed and two signals of the same standard (e.g. GSM/EDGE) are to be output simultaneously, two corresponding software options must also be installed (in this case R&S SMU-K40). If only one R&S SMU-K40 is installed and GSM/EDGE is selected in one I/Q baseband generator, the other I/Q baseband generator is disabled for GSM/EDGE. However, a software option is not tied to a specific I/Q baseband generator.

The data specified applies together with the parameters of the respective standard. The entire frequency range as well as filter parameters and symbol rates can be set by the user.

### Digital standard GSM/EDGE (option R&S SMU-K40)

Digital standard GSM/EDGE	to GSM standard	
Frequency range	frequency bands to GSM 05.05 in uplink and downlink  range	GSM 450 GSM 480 GSM 850 GSM 900 (P-GSM, E-GSM, R-GSM) DCS 1800 PCS 1900  as R&S SMU200A
Modes	unframed	generation of a signal without slot and frame structure and power ramping, with symbol rate and filtering to GSM standard; MSK or 8PSK EDGE modulation can be selected
	framed (single)	configuration of a signal via frame structure (see frame structure below)
	framed (double) application: simulation of modulation change in a slot versus time	configuration of simple multiframe scenarios by combining two frames (frame structure see below); a repetition factor can be specified for each of the two frames
Modulation		MSK, switchable to FSK with settable deviation for simulating frequency deviation errors  8PSK EDGE
Symbol rate	standard range	270.833 kHz 400 Hz to 300 kHz
Baseband filter	GSM, standard range EDGE, standard	Gaussian with $B \times T = 0.3$ $B \times T = 0.15$ to $2.5$ Gaussian linearized (EDGE)
Frame structure	Change between GSM and EDGE possible from slot to slot and frame to frame; half rate and GPRS at the physical layer. Slots 0 to 7 of the frames are user-defined for uplink and downlink. In the normal burst half-rate mode, the burst parameters can be defined independently for two users that alternate from frame to frame. burst types	normal (full rate) normal (half rate) EDGE synchronization frequency correction (normal + compact) dummy access all data (GSM) all data (EDGE)

Burst rise/fall time	standard  selectable: ramp time ramp delay rise delay fall delay	meets GSM power time template  0.3 to 4 symbols –1.0 to 1.0 symbol –9 to 9 symbols –9 to 9 symbols
Settable slot attenuation		0.0 to 60.0 dB, eight different levels simultaneously possible (full level and 7 attenuated levels)
Burst on/off ratio		>100 dB
Data sources	For characteristics of data sources, see section I/Q baseband generator (options R&S SMU-B10/-B11) – realtime operation. internal data sources	all 0 all 1 PRBS 9, 11, 15, 16, 20, 21, 23 pattern (length 1 to 64 bit) data list
Training sequence	for normal burst (full rate), normal burst (half rate), EDGE burst  for sync burst    for access burst	TSC0 to TSC7 user TSC  standard CTS compact user  TS0 to TS2
Triggering		see I/Q baseband generator
Markers		convenient graphics editor for defining marker signals, and in addition: frame, multiple frame slot, multiple slot pulse pattern on/off ratio
Phase error	MSK, Gaussian filter $B \times T = 0.3$ , rms peak	<0.4°, typ. 0.15° <1.2°, typ. 0.4°
Error vector magnitude	8PSK EDGE, Gaussian linearized filter, rms	<0.5 %, typ. 0.2 %
Power density spectrum	values measured with 30 kHz resolution bandwidth, referenced to level in band center without power ramping with frequency options up to 3 GHz level ≤10.5 dBm, ≤17.5 dBm with options R&S SMU-B31, -B36 with frequency options above 3 GHz level ≤5.5 dBm, ≤15.5 dBm with options R&S SMU-B31, -B36 frequency 400 MHz to 2 GHz 200 kHz offset 400 kHz offset 600 kHz offset	<–34 dB, typ. –37 dB <–68 dB, typ. –71 dB <–80 dB, typ. –85 dB

## Digital standard 3GPP FDD (option R&S SMU-K42)

Digital standard WCDMA 3GPP FDD	to 3GPP standard, release 5	
Frequency range	frequency bands to 3GPP TS 25.101 in uplink and downlink  range	UTRA FDD frequency bands I to III  as R&S SMU200A
Signal generation modes / sequence length	Combination of realtime operation (enhanced channels) and arbitrary waveform mode. In downlink mode, the P-CCPCH (BCCH with running SFN) and up to three DPCHs can be generated in realtime. All other channels (frame-cycle control channels such as SCH, OCNS simulation, other base stations, etc) can be added via the ARB. In uplink mode, one mobile station can be simulated in realtime (PRACH, PCPCH or DPCCH and up to 6 DPDCHs); further mobile stations (three user-configured and up to 64 of identical mode) can be simulated via the ARB and added to the realtime signal.  The sequence length of the ARB component can be entered in frames (10 ms each); the max. length depends on chip rate, mode and in some cases on oversampling.	
Enhanced channels	special capabilities in up to 4 channels of base station 1 on downlink and in all channels of mobile station 1 on uplink:  realtime calculation, optional channel coding, simulation of bit and block errors, data lists as sources for data and TPC fields	
Modulation	BPSK (uplink) QPSK (downlink) 16QAM (downlink HSDPA)	
Test models	downlink (to TS 25.141)  <ul style="list-style-type: none"> <li>• test model 1 with 16/32/64 channels</li> <li>• test model 2</li> <li>• test model 3 with 16/32 channels</li> <li>• test model 4</li> <li>• test model 5 with 8/4/2 HS-PDSCH channels</li> </ul> uplink (not standardized)  <ul style="list-style-type: none"> <li>• DPCCH + 1 DPDCH at 60 ksps</li> <li>• DPCCH + 1 DPDCH at 960 ksps</li> </ul>	
<b>Realtime component</b>		
WCDMA signal in realtime	generation of WCDMA signals with up to 4 active enhanced channels	
Applications	continuous measurement of BER and BLER (with channel coding) in a code channel with any (PN) data without wrap-around problems  use of user data (data lists) with externally processed long data sequences for enhanced channels	
Data lists for data and TPC field	The data fields and the transmit power control (TPC) field of the slots of enhanced channels can be filled from data lists. Externally generated data can thus be fed into the signal generation process of the R&S SMU200A, e.g. with payload information from higher layers, on transport or physical layer. Long power control profiles for power control of the DUT can also be generated.	
Applications	measurement of power control steps of a mobile station (UE power control steps)  measurement of maximum output power of a mobile station (UE max. output power)	

Channel coding	coding of up to 4 enhanced channels in accordance with the definition of reference measurement channels in TS25.101, TS25.104 and TS25.141; in addition, user-configurable channel coding for each enhanced channel station	
	predefined channel coding schemes for uplink and downlink	RMC 12.2 kbps AMR 12.2 kbps RMC 64 kbps RMC 144 kbps RMC 384 kbps
	possible settings of user-configurable channel coding: transport channels  transport block size  transport blocks  rate matching attribute  transport time interval  CRC size  error protection  interleaver 1/2 state	1 DCCH up to 6 DTCHs  1 to 4096  1 to 16  16 to 1024  10 ms, 20 ms, 40 ms, 80 ms  none, 8, 12, 16, 24  none, convolutional coding rate 1/3, convolutional coding rate 1/2, turbo coding rate 1/3  on, off
Applications	BER measurements to TS25.101/104/141 (radio transmission and reception), e.g.  adjacent channel selectivity  blocking characteristics  intermodulation characteristics  BLER measurements to TS25.101/104 (radio transmission and reception), e.g.  demodulation of dedicated channel under static propagation conditions (AWGN generation together with R&S SMU-K62)  test of decoder in receiver	
Bit error insertion	deliberate generation of bit errors by impairing the data stream prior to channel coding or at the physical layer bit error ratio	$10^{-1}$ to $10^{-7}$
Application	verification of internal BER calculation to TS25.141 (BS conformance testing)	
Block error insertion	deliberate generation of block errors by impairing the CRC during coding of enhanced channels block error ratio	$10^{-1}$ to $10^{-4}$
Application	verification of internal BLER calculation to TS25.141 (BS conformance testing)	
Add OCNS	Simulation of orthogonal background and interfering channels of a base station to TS25.101. The power of the OCNS channels is configured automatically so that the total power of the BS is 1.	
Applications	testing the receiver of the mobile station under real conditions; measuring the maximum input level to TS25.101	
Additional mobile stations	Simulation of up to 64 mobile stations in addition to the 4 user-configurable mobile stations. The additional mobile stations use different scrambling codes.	
Parameters	number of additional mobile stations scrambling code step power offset	1 to 50 1 to 1000 hex -20 dB to 20 dB
Applications	base station tests under real receive conditions	

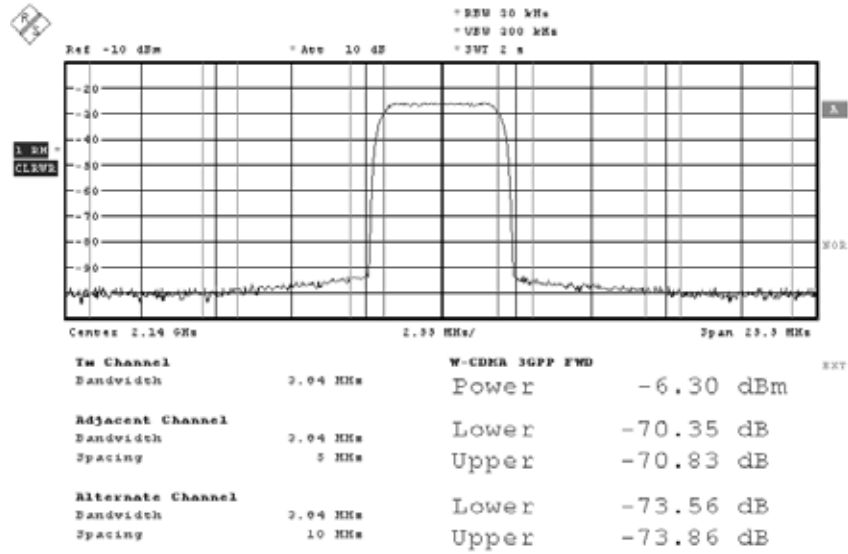
<b>General settings</b>		
Triggering		see I/Q baseband generator
Chip rate	standard range	3.840 Mcps (15 slots/frame) 1 Mcps to 5 Mcps
Link direction		uplink (reverse link) and downlink (forward link)
Baseband filter	standard other filters	$\sqrt{\cos}$ , $\alpha = 0.22$ $\sqrt{\cos}$ , $\cos$ , user filters
Clipping	Setting of clipping value relative to highest peak in percent. Clipping takes place prior to baseband filtering. Clipping reduces the crest factor.  modes  clipping level	vector $ i + j q $ scalar $ i ,  q $ 1 % to 100 %
Code channels	downlink: up to 512 data channels (plus special channels) divided among up to 4 base stations (BS) of 128 code channels each uplink: up to four user-configurable mobile stations (MS) and 64 additional MS of identical configuration in each of the modes PRACH only, PCPCH only, DPCCH + DPDCHs	
<b>Parameters of every BS</b>		
State		OFF/ON
Scrambling code		0 to 5FFF hex
2nd search code group		0 to 63
Page indicators per frame		18, 36, 72, 144
Time delay	The signals of the various base stations are delayed against each other.	0 to 38400 chips
Transmit diversity	The output signal can be generated either for antenna 1 or 2, as defined in the standard.	OFF/antenna 1/antenna 2
<b>Physical channels in downlink</b>		
	<ul style="list-style-type: none"> <li>• primary common pilot channel (P-CPICH)</li> <li>• secondary common pilot channel (S-CPICH)</li> <li>• primary sync channel (P-SCH)</li> <li>• secondary sync channel (S-SCH)</li> <li>• primary common control physical channel (P-CCPCH)</li> <li>• secondary common control physical channel (S-CCPCH)</li> <li>• page indication channel (PICH)</li> <li>• access preamble acquisition indication channel (AP-AICH)</li> <li>• collision detection acquisition indication channel (CD-AICH)</li> <li>• physical downlink shared channel (PDSCH)</li> <li>• dedicated physical control channel (DL-DPCCH)</li> <li>• dedicated physical channel (DPCH)</li> <li>• high-speed shared control channel (HS-SCCH)</li> <li>• high-speed physical downlink shared channel (HS-PDSCH), modulation QPSK or 16QAM</li> </ul>	

<b>Parameters of every downlink code channel that can be set independently</b>		
State		OFF/ON
Slot format	depending on physical channel type	0 to 16
Symbol rate	depending on physical channel type	7.5 ksp/s to 960 ksp/s
Channelization code	value range depending on physical channel type and symbol rate	0 to 511
Power		-80 dB to 0 dB
Payload data		PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 to 64 bit) data lists
Multicode state		OFF/ON
Timing offset	time offset that can be separately set for each code channel	0 to 150 (in units of 256 chips)
Pilot length	depending on symbol rate	2, 4, 8, 16 bit
Pilot power offset	power offset of pilot field against data fields	-10 dB to 10 dB
TPC pattern		all 0, all 1, pattern (length 1 to 32 bit), data lists
TPC pattern readout mode	application mode for TPC pattern	continuous, single + all 0, single + all 1, single + alt. 01, single + alt. 10
Use of TPC for dynamic output power control	If this function is active, the TPC pattern is used to vary the transmit power of the code channels versus time. state output power control step	OFF/ON -10 dB to +10 dB
TPC power offset	power offset of TPC field relative to data fields	-10 to +10 dB
TFCI state		OFF/ON
TFCI		0 dB to 1023 dB
TFCI power offset	power offset of TFCI field relative to data fields	-10 dB to +10 dB
<b>Parameters of every MS</b>		
State		OFF/ON
Mode		PRACH only, PCPCH only, DPCCH + DPDCHs
Scrambling code		0 to FF FFFF hex
Scrambling code mode		long, short
Time delay	The signals of the various mobile stations are delayed against each other.	0 to 38400 chips
<b>Physical channels in uplink</b>		
	<ul style="list-style-type: none"> <li>• physical random access channel (PRACH)</li> <li>• physical common packet channel (PCPCH)</li> <li>• dedicated physical control channel (DPCCH)</li> <li>• dedicated physical data channel (DPDCH)</li> </ul>	

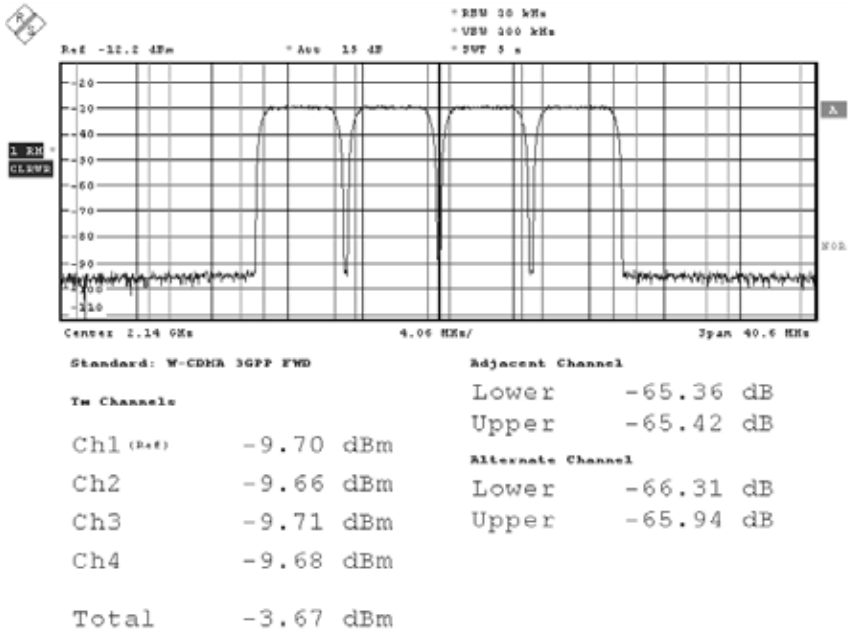
<b>PRACH Only mode</b>		
Submodes	Preamble only: Only preambles are generated. Application: Detection of RACH preamble to TS 25.141.	
	Standard: The message part of the PRACH is generated in addition to a settable number of preambles. It can also be channel-coded. Application: Demodulation of RACH message part to TS 25.141.	
Frame structure		preamble(s), message part consisting of data and control component
Slot format		0 to 3
Symbol rate		15, 30, 60, 120 ksps
Preamble part power		-80 dB to 0 dB
Preamble power step		0 dB to 10 dB
Preamble repetition		1 to 10
Data part power		-80 dB to 0 dB
Control part power		-80 dB to 0 dB
Signature		0 to 15
Access slot		0 to 14
AICH transmission timing		0 (3 access slots) or 1 (4 access slots)
Message part length		1, 2 frames
TFCI		0 to 1023
Payload data		PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 to 64 bit), data lists
Channel coding	reference measurement channel for UL RACH to TS 25.141 state transport block size	ON/OFF 168, 360
<b>PCPCH Only mode</b>		
Submodes	Preamble only: Only preambles are generated. Application: Detection of CPCH preamble to TS 25.141.	
	Standard: The message part of the PCPCH is generated in addition to a settable number of preambles. It can also be channel-coded. Application: Demodulation of CPCH message part to TS 25.141.	
Frame structure		access preamble(s), collision detection preamble, power control preamble, message part consisting of data and control component
Slot format control part		0 to 2
Symbol rate		15, 30, 60, 120, 240, 480, 960 ksps
Preamble part power		-80 dB to 0 dB
Preamble power step		0 dB to 10 dB
Preamble repetition		1 to 10
Data part power		-80 dB to 0 dB
Control part power		-80 dB to 0 dB
Signature		0 to 15
Access slot		0 to 14
AICH transmission timing		0 (3 access slots) or 1 (4 access slots)
Message part length		1 to 10 frames

Power control preamble length		0, 8 slots
FBI state		OFF/1 bit/2 bit
FBI pattern		pattern (length 1 to 32 bit)
Payload data		PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 to 64 bit) data lists
Channel coding	reference measurement channel for UL CPCH to TS 25.141 state transport block size	ON/OFF 168, 360

<b>DPCCH + DPDCH Only mode</b>		
DPCCH	dedicated physical control channel	
Symbol rate		15 ksps
Power		-80 dB to 0 dB
Channelization code		0, fixed
FBI state		OFF/1 bit/2 bit
FBI pattern		pattern (length 1 to 32 bit)
TFCI state		OFF/ON
TFCI		0 to 1023
TPC pattern		all 0, all 1, pattern (length 1 to 32 bit), data lists
TPC pattern readout mode	application mode for TPC pattern	continuous, single + all 1, single + all 1, single + alt. 01, single + alt. 10
Use TPC for dynamic output power control	If this function is active, the TPC pattern is used to vary the transmit power of the code channels of the MS versus time. state output power control step	OFF/ON -10 dB to +10 dB
DPDCH	dedicated physical data channel	
Overall symbol rate	total symbol rate of all uplink DPDCHs	15, 30, 60, 120, 240, 480, 960, 2 × 960, 3 × 960, 4 × 960, 5 × 960, 6 × 960 ksps
Active DPDCHs	depending on overall symbol rate	1 to 6
Symbol rate	depending on overall symbol rate	fixed for active DPDCHs
Channelization code	depending on overall symbol rate	fixed for active DPDCHs
Channel power	total for all DPDCHs	-80 dB to 0 dB
Payload data		PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 to 64 bit) data lists
Graphical display		domain conflicts, code domain, channel graph, slot structure and formats offered in graphics block
Error vector magnitude	1 DPCH, rms	<0.8 %, typ. 0.3 %
Adjacent-channel leakage ratio (ACLR)	test model 1, 64 DPCHs with frequency options up to 3 GHz level ≤10.5 dBm PEP, ≤17.5 dBm PEP with options R&S SMU-B31, -B36 with frequency options above 3 GHz level ≤5.5 dBm PEP, ≤14.5 dBm PEP with options R&S SMU-B31, -B36 frequency 1800 MHz to 2200 MHz offset 5 MHz (baseband gain 3 dB) offset 10 MHz (baseband gain 6 dB)	>67 dB, typ. 70 dB >72 dB, typ. 74 dB



ACLR (typical values) for 3GPP test model 1, 64 DPCH (baseband gain +3 dB)



ACLR (typical values) for a 3GPP four-carrier signal with test model 1, 64 DPCH on each carrier (baseband gain +3 dB)

### 3GPP FDD enhanced BS/MS test including HSDPA (option R&S SMU-K43)

At least one R&S SMU-K42 option must be installed.

General parameters	This option extends the R&S SMU-K42 (Digital Standard 3GPP FDD) to full HSDPA support and dynamic power control. Therefore, all general parameters of the R&S SMU-K42 such as frequency range or modulation are also valid for the R&S SMU-K43.	
<b>Downlink simulation</b>		
HSDPA channels (HS-SCCH and HS-PDSCH)		
Enhancements	The R&S SMU-K42 supports simulation of HSDPA channels in a continuous mode needed for TX measurements in accordance with TS25.141 (test model 5). The R&S SMU-K43 now supports simulation of HS-SCCH (high speed shared control channel) and HS-PDSCH (high speed physical downlink shared channel) in accordance with TS25.211. This implies the correct timing between these channels as well as the possibility to set start subframe and inter-TTI distance.	
Application	TX measurements on 3GPP FDD Node Bs with realistic statistics RX measurements on 3GPP FDD UEs with correct timing	
Ranges (valid for HS-SCCH and HS-PDSCH)	HSDPA mode	continuous, subframe 0 to subframe 4 (where first packet is sent)
	inter-TTI distance	1 to 16
<b>Dynamic power control</b>		
Enhancements	The R&S SMU-K42 provides a method to vary the output power of a code channel in arbitrary waveform mode by misusing its TPC pattern. The R&S SMU-K43 now allows the variation of the output power in realtime mode for up to 3 DPCHs in three submodes: external : UE provides TPC info to R&S SMU200A by external connector (TTL level) by TPC pattern: TPC pattern is used to control the output power manual: the output power is changed incrementally by pressing buttons or sending the corresponding remote control commands	
Application	RX measurements on 3GPP FDD UEs where closed loop power control is needed RX measurements on 3GPP FDD UEs with varied code channel power without dropouts in the signal	
Ranges	mode	external, by TPC pattern, manual
	direction	up, down
	power step	0.5 to 6 dB
	up range	0 to 20 dB
	down range	0 to 20 dB

<b>Uplink simulation</b>		
HS-DPCCH (high speed dedicated physical control channel)		
Enhancements	The R&S SMU-K42 does not support HSDPA for uplink. The R&S SMU-K43 now allows the simulation of a HS-DPCCH (high speed dedicated physical control channel) in realtime operation (UE1) and arbitrary waveform mode (UE2 to UE4).	
Application	TX measurements on 3GPP FDD UEs supporting HSDPA RX measurements on 3GPP FDD Node Bs supporting HSDPA	
Ranges	power	0 to – 80 dB
	start delay	101 to 250 (in units of 256 chips)
	inter-TTI distance	1 to 16 subframes
	CQI pattern	up to 10 CQI values sent periodically, support of DTX
	ACK/NACK pattern	up to 32 ACK/NACK commands sent periodically, support of DTX
Dynamic power control		
Enhancements	The R&S SMU-K42 provides a method to vary the output power of a code channel in arbitrary waveform mode by misusing its TPC pattern. The R&S SMU-K43 now allows the variation of the output power in realtime mode for UE1 in three submodes: external : Node B provides TPC info to R&S SMU200A by external connector (TTL level) by TPC pattern: TPC pattern is used to control the output power manual: the output power is changed incrementally by pressing buttons or sending the corresponding remote control commands	
Application	RX measurements on 3GPP FDD Node Bs where closed loop power control is needed RX measurements on 3GPP FDD Node Bs with varied UE power without dropouts in the signal	
Ranges	mode	external, by TPC pattern, manual
	direction	up, down
	power step	0.5 dB to 6 dB
	up range	0 dB to 20 dB
	down range	0 dB to 20 dB

## Digital standard GPS (option R&S SMU-K44)

Digital standard GPS	to ICD-GPS-200 revision C	
<b>General settings</b>		
Frequency		default L1 = 1575.42 MHz user-selectable in entire frequency range of R&S SMU200A
Output level		default -115 dBm user-selectable in entire output level range of R&S SMU200A
Modulation		BPSK (CDMA)
Symbol rate (chip rate)		1.023 MHz
Baseband filter		Gaussian filter parameter $B \times T = 1$
Simulation modes		generic mode localization mode (from release 1.50)
Marker		navigation data bit (20460 chips), navigation data word (30 data bits), navigation data subframe (10 data words), navigation page (5 data subframes), complete navigation message (25 data pages), pulse, pattern, on/off ratio
Triggering		see I/Q baseband generator
<b>Navigation data</b>		
Navigation data	identical for each satellite	all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists real navigation data
Real navigation data		support of SEM-Almanac, any valid date and time (GMT)
Navigation data rate		50 bps
<b>Satellite configurations</b>		
Number of channels		1 to 4 satellites
Use spreading code	identical for each satellite	on/off
State	separately settable for each satellite	on/off
Space vehicle ID	separately settable for each satellite	C/A codes: 37 Gold codes, 1023 chips each
Time shift	separately settable for each satellite	0 to 1023000 P code chips (from release 1.50)
Power	separately settable for each satellite	±10 dB
Doppler shift	separately settable for each satellite	±100 kHz (selectable in steps of 0.01 Hz)

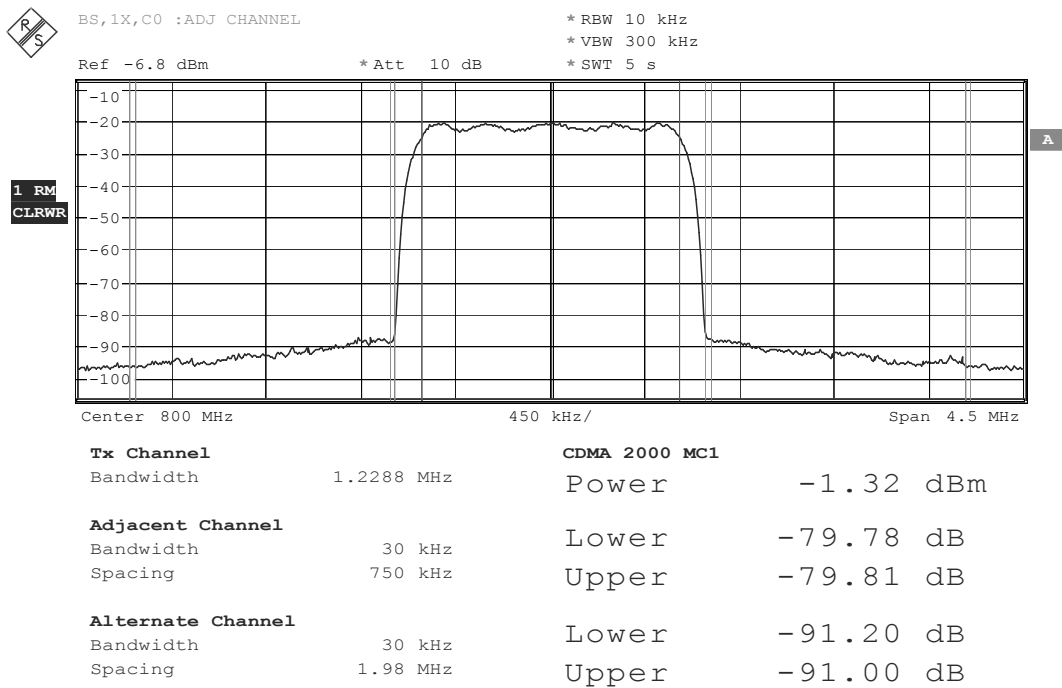
### Digital standard CDMA2000® incl. 1xEV-DV (option R&S SMU-K46)

Digital standard CDMA2000®	release C	meets 3GPP2 C.S0002-C
Frequency	band class 0 to band class 12	410 MHz to 2170 MHz
Chip rates	standard range	1.2288 MHz (1X) 1 MHz to 5 MHz
Modes	1X direct spread (spreading rate 1)	
Link direction		forward link and reverse link
Signal generation modes / sequence length	Combination of realtime mode and ARB mode. Up to eight code channels can be calculated in realtime including channel coding. In the downlink, the F-SYNC and the first traffic channel of BS 1 are available in realtime. In the uplink, the MS 1 is generated in realtime. To generate realistic scenarios, a cyclically output signal component from the ARB can be added. sequence length of ARB component entered in frames (80 ms each), max. length 511 frames with R&S SMU-B10, 160 frames with R&S SMU-B11	
Baseband filter	standard for reverse link standard for forward link  for enhanced ACLR: reverse link forward link	cdmaOne cdmaOne + equalizer  cdmaOne 705 kHz cdmaOne 705 kHz + equalizer
Code channels	forward link  reverse link	4 base stations with a maximum of 78 code channels each (depending on radio configuration)  4 mobile stations with a maximum of 8 code channels each (depending on radio configuration)
Clipping level	Setting of a limit value relative to the highest peak in percent. Limitation is effected prior to baseband filtering and reduces the crest factor.	The value range is 1 % to 100 %.
<b>Parameters of every BS</b>		
State		OFF/ON
Time delay	timing offset of signals of individual base stations	BS1: 0 chips (fixed) BS2 to BS4: 0 to 98304 chips
PN offset		0 to 511
Transmit diversity	If this function is activated, the output signal can be generated for either antenna 1 or 2, as defined in the standard.	OFF / antenna 1 / antenna 2
Diversity mode		OTD / STS
Quasi-orthogonal Walsh sets		set 1 to set 3

<b>Parameters of every forward link code channel that can be set independently</b>		
State		OFF/ON
Channel types Forward link	forward pilot (F-PICH) transmit diversity pilot (F-TDPICH) auxiliary pilot (F-APICH) auxiliary transmit diversity pilot (F-ATDPCH) sync (F-SYNC) paging (F-PCH) broadcast (F-BCH) quick paging (F-QPCH) common power control (F-CPCCH) common assignment (F-CACH) common control (F-CCCH) packet data control (F-PDCCH) packet data (F-PDCH) traffic channel: fundamental (F-FCH) supplemental (F-SCH) dedicated control (F-DCCH)	
Radio configuration	chip rate 1.2288 Mcps (1X)	RC 1 to RC 5 and RC 10
Frame length	depending on channel type and radio configuration	5 ms, 10 ms, 20 ms, 40 ms, 80 ms, 160 ms
Data rate	depending on channel type and radio configuration	1.2 kbps to 1036.8 kbps
Walsh code	depending on channel type and radio configuration	0 to 127
Quasi-orthogonal code		OFF/ON
Power		-80 dB to 0 dB
Data		all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists
Long code mask		0 to 3FF FFFF FFFF hex
Power control data source		all 0 all 1 pattern (up to 64 bit) data list
(Mis)use for output power control	If this function is active, the power control data is used to vary the transmit power of the code channels versus time. state output power control step	OFF/ON -10 dB to +10 dB

Channel coding	<p>All stages of channel coding specified by IS-2000 (e.g. frame quality indicator, convolutional encoder / turbo coder, symbol puncture and interleaver) are available.</p> <p>All frame length and data rate combinations are supported.</p> <p>Four options are available:</p> <p>OFF: channel coding off</p> <p>complete: channel coding completely on</p> <p>without interleaving: channel coding on but without interleaver</p> <p>interleaving only: channel coding off, only interleaver is active</p>	
<b>Parameters of every MS</b>		
State		OFF/ON
Radio configuration	chip rate 1.2288 Mcps (1X)	RC 1 to RC 4
Channel coding	<p>All stages of channel coding specified by IS-2000 (e.g. frame quality indicator, convolutional encoder, symbol puncture and interleaver) are available.</p> <p>All frame length and data rate combinations are supported.</p> <p>Four options are available:</p> <p>OFF: channel coding off</p> <p>complete: channel coding completely on</p> <p>without interleaving: channel coding on but without interleaver</p> <p>interleaving only: channel coding off, only interleaver is active</p>	
Operation mode	simulates MS operation mode and defines available channels	traffic access enhanced access common control
Long code mask		0 to 3FF FFFF FFFF hex
Power control data source	In reverse link, the power control data is used only for the misuse mode.	all 0 all 1 pattern (up to 64 bit) data list
(Mis)use for output power control	If this function is active, the power control data is used to vary the transmit power of the code channels versus time. state output power control step	OFF/ON -10 dB to +10 dB
<b>Parameters of every reverse link code channel that can be set independently</b>		
State		OFF/ON
Channel types Reverse link	<p>reverse pilot (R-PICH)</p> <p>access (R-ACH)</p> <p>enhanced access (R-EACH)</p> <p>reverse common control (R-CCCH)</p> <p>reverse dedicated control (R-DCCH)</p> <p>traffic channel:</p> <p>    fundamental (R-FCH)</p> <p>    supplemental code (R-SCCH)</p> <p>    supplemental (R-SCH)</p>	
Frame length	depending on channel type and radio configuration	5 ms, 10 ms, 20 ms, 40 ms, 80 ms
Data rate	depending on channel type and radio configuration	1.2 kbps to 1036.8 kbps
Power		-80 dB to 0 dB

Data		all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists
Error vector magnitude (EVM)	F-PICH, F-SYNC and one F-FCH, rms	<0.8 %, typ. 0.3 %
Adjacent-channel leakage ratio (ACLR)	F-PICH, F-SYNC and one F-FCH carrier frequency 800 MHz channel spacing 0.75 MHz (bandwidth 30 kHz) channel spacing 1.98 MHz (bandwidth 30 kHz)	typ. 79 dB typ. 91 dB



ACLR (typical values) for a CDMA2000<sup>®</sup> 1x signal consisting of F-PICH, F-SYNC and one F-FCH

## Digital standard IEEE 802.11a/b/g (option R&S SMU-K48)

Digital standard IEEE 802.11a/b/g		meets IEEE 802.11a-1999, IEEE 802.11b-1999, IEEE 802.11g-2003
<b>General settings</b>		
Modes	unframed	generation of a non-packet-oriented signal without frame structure, with the modulation modes and data rates defined by the IEEE 802.11 standard
	framed	generation of a sequence of data packets with the frame structure defined by the standard, interrupted by an idle time
Sequence length		1 to 511 frames (depending on frame duration)
Clipping		vector or scalar clipping, applied before filtering
Marker modes		restart, frame start, frame active part, pulse, pattern, on/off ratio
Triggering		see I/Q baseband generator
<b>Parameters in framed mode</b>		
Idle time	time between two successive packets (PPDUs) range	0 to 10000 µs
MAC header		activating and configuring the MAC header with the following parameters: frame control, duration/ID, address 1 to 4, sequence control
Frame check sequence		activating or deactivating a 32 bit (4 byte) check sum for protecting MAC header and user data (frame body)
<b>Settings for CCK (IEEE 802.11b / IEEE 802.11g)</b>		
Chip rate	standard range	11 Mcps as R&S SMU200A
Baseband filter		spectral mask in accordance with IEEE 802.11b-1999-Wireless LAN MAC and PHY specifications – Chapter 18.4.7.3
<b>Parameters in framed mode</b>		
PLCP preamble and header format		long PLCP and short PLCP
PSDU bit rate		1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps
PSDU modulation	depending on PSDU bit rate	DBPSK, DQPSK, CCK
PSDU data length	length of user data field in bytes of the packet to be transferred range	0 to 4095 byte
Scrambling		data scrambling can be activated or deactivated
<b>Parameters in unframed mode</b>		
PSDU bit rate		1, 2, 5.5 or 11 Mbps
PSDU modulation	depending on PSDU bit rate	DBPSK, DQPSK, CCK
Scrambling		data scrambling can be activated or deactivated

<b>Settings for OFDM (IEEE 802.11a / IEEE 802.11g)</b>		
Kernel sample rate	standard range	20 Msample/s as R&S SMU200A
Baseband filter		spectral mask in accordance with IEEE 802.11b-1999-Wireless LAN MAC and PHY specifications – Chapter 17.3.9.6.2
Parameters in framed mode		
PLCP preamble and header format		long PLCP and short PLCP
PLCP signal field		automatically calculated
PSDU bit rate		6, 9, 12, 18, 24, 36, 48 or 54 Mbps
PSDU modulation	depending on PSDU bit rate	BPSK, QPSK, 16QAM, 64QAM
PSDU data length	length of user data field in bytes of the packet to be transferred range	0 to 4095 byte
Number of data symbols	number of OFDM symbols in data portion of packet	directly proportional to PSDU data length
Scrambling		data scrambling can be activated or deactivated; initial scrambler state can be set randomly or to a user-defined value
Interleaver		can be activated or deactivated
Time domain windowing	transition times	0 to 1000 ns
Service field		user-defined service field value supported
Parameters in unframed mode		
PSDU bit rate		6, 9, 12, 18, 24, 36, 48 and 54 Mbps
PSDU modulation	depending on PSDU bit rate	BPSK, QPSK, 16QAM, 64QAM
PSDU data length	length of user data field in bytes of the packet to be transferred range	0 to 2312 byte
Number of data symbols	number of OFDM symbols to be generated	directly proportional to PSDU data length
Scrambling		data scrambling can be activated or deactivated; initial scrambler state can be set randomly or to a user-defined value
Interleaver		can be activated or deactivated
Time domain windowing	transition times	0 to 1000 ns
Service field		user-defined service field value supported

<b>Settings for PBCC (IEEE 802.11b / IEEE 802.11g)</b>		
Chip rate	standard range	11 Mcps as R&S SMU200A
Baseband filter		spectral mask in accordance with IEEE 802.11b-1999-Wireless LAN MAC and PHY specifications – Chapter 18.4.7.3
Parameters in framed mode		
PLCP preamble and header format		long PLCP and short PLCP
PSDU bit rate		1, 2, 5.5, 11, 22 or 33 Mbps
PSDU modulation	depending on PSDU bit rate	DBPSK, DQPSK, PBCC
PSDU data length	length of user data field in bytes of the packet to be transferred  range	0 to 4095 byte
Scrambling		data scrambling can be activated or deactivated
Power time template		automatic configuration of power ramping at the beginning and end of the data packets with shiftable start points of the ramps relative to the data packet
Parameters in unframed mode		
PSDU bit rate		1, 2, 5.5, 11, 22 or 33 Mbps
PSDU modulation	depending on PSDU bit rate	DBPSK, DQPSK, PBCC
Scrambling		data scrambling can be activated or deactivated

## Digital standard IEEE 802.16-2004 (option R&S SMU-K49)

Digital standard IEEE 802.16-2004		meets IEEE 802.16™-2004
<b>General settings</b>		
Physical layer modes		OFDM
Duplexing		TDD, FDD
Link direction		forward link and reverse link
Frame durations		2.5, 4, 5, 8, 10, 12.5, 20 ms, continuous, user-definable
Sequence length		1 to 511 frames (depending on frame duration)
Predefined frames		short-, mid- and long-length test messages for testing receivers with all modulation types and RS-CC rates
Level reference		preamble of FCH/burst level
Clipping		vector or scalar clipping, applied before filtering
Marker modes		restart, frame start, frame active part, pulse, pattern, on/off ratio
Triggering		see I/Q baseband generator
<b>Parameters in OFDM mode</b>		
Frequency bands		ETSI, MMDS, WCS, UN-II, User
Channel bandwidth		1.25 MHz to 30 MHz, depending on selected frequency band
Sampling rate		1.5 MHz to 32 MHz, depending on channel bandwidth
Baseband filter		spectral mask in accordance with IEEE 802.16-2004 – Chapter 8.5.2
Tg / Tb settings		1/4, 1/8, 1/16, 1/32
FFT size		256 (fixed)
Number of possible subchannels in subchannelization mode		1, 2, 4, 8, 16 (all)
Number of bursts per frame		0 to 8
Preamble / midamble modes		burst preamble / midambles off, burst preamble in downlink, midamble repetition 5, 9 or 17 in uplink
Modulation and RS-CC rates		BPSK 1/2, QPSK 1/2, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 2/3, 64QAM 3/4
Data		all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists
Burst power range		-80 dB to +10 dB
MAC functions		one generic MAC header + CRC available per burst

## Multicarrier CW signal generation (option R&S SMU-K61)

Signal generation	simulation of unmodulated multicarrier signals in arbitrary waveform mode	
Number of carriers		1 to 8192
Carrier spacing	user-settable, maximum spacing depending on number of carriers	1 Hz to 80 MHz
Parameters of each carrier	state power start phase	on/off –80 dB to 0 dB 0° to +360°
Crest factor	optimization of crest factor by varying the start phases of the carrier; available modes: <ul style="list-style-type: none"> <li>off: no optimization, manual entry of phase possible</li> <li>chirp: the phases of each carrier are set such that a chirp signal is obtained for the I and Q components</li> <li>target crest: iterative variation of carrier start phases until a presettable crest factor is attained</li> </ul>	
Trigger	In internal clock mode, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In external clock mode, the trigger event is synchronized to the symbol clock.  operating mode modes  setting uncertainty for clock phase related to trigger in internal clock mode external trigger delay setting range resolution internal clock mode external clock mode setting uncertainty external trigger inhibit setting range resolution external trigger pulse width external trigger frequency	internal, external Auto, Retrig, Armed Auto, Armed Retrig  <18 ns  0 to 2 <sup>16</sup> sample  0.01 sample 1 sample <5 ns  0 to 2 <sup>26</sup> sample 1 sample >15 ns <0.02 × sampling rate
Marker	number level operating modes marker delay (in sample) setting range setting range without recalculation resolution of setting setting uncertainty	4 LVTTTL unchanged, restart, pulse, pattern, ratio  0 to waveform length – 1 0 to 2000 0.001 <10 ns
RF frequency response	up to 10 MHz up to 40 MHz	<1.5 dB, typ. 0.7 dB <4.5 dB, typ. 2.0 dB
Suppression of unwanted carriers	up to 10 MHz up to 40 MHz	>50 dB, typ. 56 dB >40 dB, typ. 50 dB



## **Digital standards with R&S WinIQSIM™ (for R&S SMU-B10/-B11 ARB)**

Digital standard IS-95 (option R&S SMU-K11)

Digital standard CDMA2000® (option R&S SMU-K12)

Digital standard 3GPP TDD HDR (option R&S SMU-K13)

Digital standard 3GPP TDD LDR (TD-SCDMA) (option R&S SMU-K14)

OFDM with WinIQOFDM (option R&S SMU-K15)

Digital standard 1xEV-DO (option R&S SMU-K17)

Digital standard IEEE 802.11 a/b/g (option R&S SMU-K19)

Digital standard 3GPP FDD incl. HSDPA (option R&S SMU-K20)

The options are described in the R&S WinIQSIM™ data sheet (PD 0758.0800.32).


## Fading and noise

### Fading simulator (option R&S SMU-B14) and fading simulator extension (option R&S SMU-B15)

The R&S SMU-B10, -B11 or -B17 is required to generate input signals for the fading simulator.  
All frequency and time settings are coupled to the internal reference frequency.

Number of signal paths	with R&S SMU-B14 with R&S SMU-B14 and -B15	1 1 or 2
Signal routing	only possible with R&S SMU-B14 and -B15 input output	both signal paths split or combined split, one signal path only, or sum of both signal paths
Number of fading paths	depending on options and signal routing, see table on page 56	
Fading path loss	setting range resolution accuracy	0 dB to 50 dB 0.01 dB <0.01 dB
Fading path delay	setting range resolution with option R&S SMU-K71	0 ms to 2.56 ms 10 ns 0.01 ns
Delay groups	permitted delay differences within one group	max. 4 per signal path  <40 $\mu$ s
Speed range	at f = 1 GHz accuracy	0 to 1725 km/h <0.128 %
Doppler frequency	setting range accuracy	0 Hz to 1600 Hz <0.1 %
Restart	standard with option R&S SMU-B10/-B11 installed	auto auto, internal from baseband A or B, external
Total insertion loss	automatic or user-definable, with clipping indicator	0 dB to 18 dB
Correlation	fading paths in signal path A pairwise with fading paths in signal path B	
Correlation coefficient	setting range resolution	0 to 100 % 5 %
Correlation phase	setting range resolution	0° to 360° 1°
<b>Fading profiles</b>		
Rayleigh	pseudo-noise interval	>93 h
Pure Doppler	frequency ratio resolution	(-1 to +1) x current Doppler frequency 0.01 x current Doppler frequency
Rician	combination of Rayleigh and pure Doppler	
	power ratio	-30 dB to +30 dB
Lognormal	standard deviation resolution local constant at f = 1 GHz	0 dB to 12 dB 1 dB 12 m to 200 m
Static, constant phase	path loss phase resolution	0 dB to 50 dB 0° to 360° 1°

### Number of fading paths, RF bandwidth and timing resolution

 With R&S SMU-K71 only

With R&S SMU-B14			
Signal paths	Fading paths	RF bandwidth	Timing resolution
1	20	80 MHz	10 ns
1	12	30 MHz	0.01 ns
1	8	50 MHz	0.01 ns

With R&S SMU-B14 and -B15			
Signal paths	Fading paths	RF bandwidth	Timing resolution
1	40	80 MHz	10 ns
1	24	30 MHz	0.01 ns
1	16	50 MHz	0.01 ns
2	20	80 MHz	10 ns
2	12	30 MHz	0.01 ns
2	8	50 MHz	0.01 ns

### Dynamic fading and enhanced resolution (option R&S SMU-K71)

At least one Fading Simulator R&S SMU-B14 must be installed. If both the R&S SMU-B14 and the R&S SMU-B15 are installed (signal path A and B), dynamic fading and enhanced resolution can be used either on signal path A or B with one R&S SMU-K71 option. If dynamic fading and enhanced resolution is to be used on signal paths A and B simultaneously, two R&S SMU-K71 must be installed.

Moving delay mode		
System bandwidth		50 MHz
Number of fading paths		2 per signal path
Fading profiles		none
Basic delay	in steps of 10 ns	0 ms to 2.56 ms
Delay variation Variation period Variation speed	peak to peak	300 ns to 40 $\mu$ s 10 s to 500 s 0 to 500 $\mu$ s/s
Delay step size		<10 ps
Birth-death mode		
System bandwidth		50 MHz
Number of fading paths		2 per signal path
Fading profiles		pure Doppler
Delay range		0 $\mu$ s to 40 $\mu$ s
Delay grid		0 $\mu$ s to 20 $\mu$ s <sup>17</sup>
Positions		3 to 50 <sup>12</sup>
Hopping dwell Start offset	separately settable for each signal path	100 ms to 5 s 1 ms to 200 ms
Delay resolution		10 ns

<sup>17</sup> The maximum delay range of 40  $\mu$ s cannot be exceeded.

### Additive white Gaussian noise (AWGN, option R&S SMU-K62)

At least one Baseband Main Module R&S SMU-B13 must be installed. If two R&S SMU-B13 are installed (paths A and B), AWGN can be generated either on path A or B with one R&S SMU-K62 option. If AWGN is to be generated on paths A and B simultaneously, two R&S SMU-K62 must be installed.

Addition of an AWGN signal of settable bandwidth and settable C/N ratio or  $E_b/N_0$  to a wanted signal. If the noise generator is used, a frequency offset cannot be added to the wanted signal.

Noise	distribution density crest factor periodicity	Gaussian, statistical, separate for I and Q >18 dB >48 hours
C/N, $E_b/N_0$	setting range resolution uncertainty for system bandwidth = symbol rate, symbol rate <4 MHz, -24 dB < C/N < 30 dB and crest factor <12 dB	-30 dB to +30 dB 0.1 dB  <0.1 dB
System bandwidth	(bandwidth for determining noise power) range resolution	1 kHz to 80 MHz 100 Hz

## Other options

### Digital standard Bluetooth<sup>®18</sup> (external PC software) (option R&S SMU-K5)

Supported packet types		DH1, DH3, DH5, AUX1 in all data mode or with packet editor
Data sources (in all data mode)		all 0, all1, PRBS 7 to 23, user data
Data whitening		supported
Packet editor features	access code header bits  HEC payload data sources payload CRC	calculated from entered device address can be set individually, SEQN bit toggles with each generated packet calculated automatically all 0, all1, PRBS 7 to 23, pattern, user data calculated automatically
Sequence length		up to 53687 packets
Power ramping	ramp function ramp time rise offset, fall offset	cos <sup>2</sup> , linear 1 to 32 symbols 0 to 32 symbols
Modulation	defaults  2FSK frequency deviation 2FSK symbol rate	preset to Bluetooth <sup>®</sup> standard 2FSK, 160 kHz deviation, 1 MHz symbol rate 100 kHz to 200 kHz 400 Hz to 15 MHz
Filter	filter function B × T (for Gaussian filter)	Gaussian, rectangle 0.1 to 2.5

### BER measurement (option R&S SMU-K80)

The data supplied by the DUT is compared with a reference pseudo-random bit sequence.

Clock	supplied by DUT; a clock pulse is required for each valid bit	
Clock rate		100 Hz to 60 MHz
Data	PRBS sequence length pattern ignore data enable modes restart modes	9, 11, 15, 16, 20, 21, 23 off, ALL 0, ALL 1 external off, high, low external off, on
Synchronization time		28 clock cycles
Interface	9-pin D-Sub connector, D-Sub/BNC cable supplied with option	
Clock, data, enable and restart inputs	input impedance trigger threshold setting range resolution	1 k $\Omega$ , 50 $\Omega$ 0.00 to 2.50 V 0.01 V
Polarity	data, clock, data enable	normal, inverted
Measurement time	selectable through maximum number of data bits or bit errors (max. 2 <sup>31</sup> bits each), continuous measurement	
Measurement result	if selected number of data bits or bit errors is attained	BER in ppm, % or decade values
Status displays		not synchronized, no clock, no data

<sup>18</sup> The Bluetooth<sup>®</sup> word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by Rohde&Schwarz is under license.

### BLER measurement (option R&S SMU-K80)

In BLER measurement mode, arbitrary data can be provided by the DUT. A signal marking the block's CRC has to be provided on the data enable connector of the BER/BLER option.

Clock	supplied by DUT; a clock pulse is required for each valid bit	
Clock rate		100 Hz to 60 MHz
Data	input data data enable (marking the block's CRC) modes	arbitrary external high, low
CRC	CRC type CRC bit order	CCITT CRC16 ( $x^{16} + x^{12} + x^5 + 1$ ) MSB first, LSB first
Synchronization time		1 block
Interface	9-pin D-Sub connector, D-Sub/BNC cable supplied with option	
Clock, data, and enable inputs	input impedance trigger threshold setting range resolution	1 k $\Omega$ , 50 $\Omega$  0.00 to 2.50 V 0.01 V
Polarity	data, clock, data enable	normal, inverted
Measurement time	selectable through maximum number of received blocks or errors (max. $2^{31}$ blocks each), continuous measurement	
Measurement result	if selected number of received blocks or errors is attained	BLER in ppm, % or decade values
Status displays		not synchronized, no clock, no data

## General data

### Remote control

Systems	IEC/IEEE bus, IEC 60625 (IEEE 488) Ethernet
Command set	SCPI 1999.5
Connector	IEC: 24-contact Amphenol; Ethernet: Western
IEC/IEEE bus address	0 to 30
Interface functions	IEC: SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0

### Operating data

Power supply	input voltage range, AC, nominal	100 V to 240 V
	AC supply frequency	47 Hz to 63 Hz
	power factor correction	meets EN 61000-3-2
EMC		meets EN 55011 Class B, EN 61326
Immunity to interfering field strength		up to 10 V/m
Environmental conditions	operating temperature range	5 °C to 45 °C meets EN 60068-2-1, EN 60068-2-2
	storage temperature range	-20 °C to +60 °C
	climatic resistance	+95 % rel. humidity
Mechanical resistance	vibration, sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const., meets EN 60068-2-6
	vibration, random	10 Hz to 300 Hz, acceleration 1.2 g (rms), meets EN 60068-2-64
	shock	meets EN 60068-2-27, MIL-STD-810E 40 g shock spectrum
Electrical safety		meets EN 61010-1
Dimensions	width x height x depth	435 mm x 192 mm x 560 mm
Weight	when fully equipped	25 kg
Recommended calibration interval		3 years

# Ordering information

Designation	Type	Order No.
<b>Vector Signal Generator<sup>19</sup></b>	R&S SMU200A	1141.2005.02
including power cable, Quick Start Guide and CD-ROM (with operating and service manual)		
<b>Options</b>		
RF Path A		
100 kHz to 2.2 GHz	R&S SMU-B102	1141.8503.02
100 kHz to 3 GHz	R&S SMU-B103	1141.8603.02
100 kHz to 4 GHz	R&S SMU-B104	1141.8703.02
100 kHz to 6 GHz	R&S SMU-B106	1141.8803.02
FM/φM Modulator	R&S SMU-B20	1142.0006.02
FM/φM Modulator and Low Phase Noise	R&S SMU-B22	1160.5006.02
Overvoltage Protection	R&S SMU-B30	1159.7444.02
High-Power Output	R&S SMU-B31	1159.8011.02
Overvoltage Protection and High-Power Output	R&S SMU-B32	1160.0256.02
RF Path B		
100 kHz to 2.2 GHz	R&S SMU-B202	1141.9400.02
100 kHz to 3 GHz	R&S SMU-B203	1141.9500.02
Overvoltage Protection	R&S SMU-B35	1160.0633.02
High-Power Output	R&S SMU-B36	1160.1000.02
Overvoltage Protection and High-Power Output	R&S SMU-B37	1160.1400.02
Baseband		
Baseband Generator with ARB (64 Msample) and Digital Modulation (realtime)	R&S SMU-B10	1141.7007.02
Baseband Generator with ARB (16 Msample) and Digital Modulation (realtime)	R&S SMU-B11	1159.8411.02
Baseband Main Module	R&S SMU-B13	1141.8003.04
Differential I/Q Output	R&S SMU-B16	1161.0066.02
Analog Baseband Input	R&S SMU-B17	1142.2880.02
Digital modulation systems		
Digital Standard GSM/EDGE	R&S SMU-K40	1160.7609.02
Digital Standard 3GPP FDD	R&S SMU-K42	1160.7909.02
3GPP Enhanced MS/BS Tests incl. HSDPA	R&S SMU-K43	1160.9660.02
Digital Standard GPS	R&S SMU-K44	1161.0566.02
Digital Standard CDMA2000 <sup>®</sup> incl. 1xEV-DV	R&S SMU-K46	1160.9876.02
Digital Standard IEEE 802.11 (a/b/g)	R&S SMU-K48	1161.0266.02
Digital Standard IEEE 802.16	R&S SMU-K49	1161.0366.02
Multicarrier CW Signal Generation	R&S SMU-K61	1160.8505.02
Digital modulation systems using R&S WinIQSIM <sup>™20</sup>		
Digital Standard IS-95 (with R&S WinIQSIM <sup>™</sup> )	R&S SMU-K11	1160.5335.02
Digital Standard CDMA2000 <sup>®</sup> (with R&S WinIQSIM <sup>™</sup> )	R&S SMU-K12	1160.5658.02
Digital Standard 3GPP TDD (with R&S WinIQSIM <sup>™</sup> )	R&S SMU-K13	1160.5906.02
Digital Standard TD-SCDMA (with R&S WinIQSIM <sup>™</sup> )	R&S SMU-K14	1160.6202.02
User-Defined OFDM Signals (with R&S WinIQSIM <sup>™</sup> and R&S WinIQOFDM)	R&S SMU-K15	1160.6402.02
Digital Standard 1xEV-DO (with R&S WinIQSIM <sup>™</sup> )	R&S SMU-K17	1160.7009.02
Digital Standard IEEE 802.11 (a/b/g) (with R&S WinIQSIM <sup>™</sup> )	R&S SMU-K19	1160.8805.02
Digital Standard 3GPP FDD incl. HSDPA (with R&S WinIQSIM <sup>™</sup> )	R&S SMU-K20	1160.9460.02
Digital modulation systems using external PC software		
Digital Standard Bluetooth <sup>®</sup>	R&S SMU-K5	1161.0466.02

<sup>19</sup> The base unit can only be ordered with an R&S SMU-B10x frequency option.

<sup>20</sup> R&S WinIQSIM<sup>™</sup> requires an external PC.

Fading and noise		
Fading Simulator	R&S SMU-B14	1160.1800.02
Fading Simulator Extension	R&S SMU-B15	1160.2288.02
Additive White Gaussian Noise (AWGN)	R&S SMU-K62	1159.8511.02
Dynamic Fading and Enhanced Resolution	R&S SMU-K71	1160.9201.02
Other options		
BER/BLER Measurement	R&S SMU-K80	1159.8770.02
<b>Recommended extras</b>		
Hardcopy manuals (in German)		1007.9845.31
Hardcopy manuals (in English, UK)		1007.9845.32
Hardcopy manuals (in English, USA)		1007.9845.39
19" Rack Adapter	R&S ZZA-411	1096.3283.00
Adapter for Telescopic Sliders	R&S ZZA-T45	1109.3774.00
BNC Adapter for AUX I/O Connector	R&S SMU-Z5	1160.4545.02
Keyboard with USB Interface (US assignment)	R&S PSL-Z2	1157.6870.03
Mouse with USB Interface, optical	R&S PSL-Z10	1157.7060.02
External USB CD-RW Drive	R&S PSP-B6	1134.8201.12



For product brochure, see PD 0758.0197.12  
and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)  
(search term: SMU200A)



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

Europe: +49 1805 12 4242, [customersupport@rohde-schwarz.com](mailto:customersupport@rohde-schwarz.com)  
USA and Canada: 1-888-837-8772, [customer.support@rsa.rohde-schwarz.com](mailto:customer.support@rsa.rohde-schwarz.com)  
Asia: +65 68463710, [customersupport.asia@rohde-schwarz.com](mailto:customersupport.asia@rohde-schwarz.com)