Specifications

Version 01.00

April 2005

Vector Signal Generator R&S®SMJ100A

Specifications

ROHDE&SCHWARZ

CONTENTS

Key features

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. –133 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 typ. +69 dB with 3GPP FDD (test model 1, 64 DPCH)
- Very high level repeatability of typ. 0.05 dB
- High-stability reference oscillator as standard

Unrivaled 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 for I and Q and multisegment support
- Arbitrary waveform generator supported by Simulation Software R&S WinIQSIM™
- Internal 30 Gbyte hard disk as standard for storing waveforms and modulation data

Ideal for production

- Very short frequency setting times (<5 ms); only <450 µs in List mode
- Electronic attenuator up to 6 GHz over the full level range

Convenient connections

- Remote control via GPIB and LAN
- Three 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", "underrange" and data without tolerance limits is not binding.

EMC specifications are tested with properly 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.

Modulation

Possible modulation types

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

Simultaneous modulation

+ = compatible, – = not compatible, switches off each other

	AM	FM	φM	Pulse	BB-AM	I/Q	DM	ARB
Amplitude modulation (AM)	/	+	+	+	–	–	–	–
Frequency modulation (FM)	+	/	–	+	+	+	+	+
Phase modulation (φM)	+	–	/	+	+	+	+	+
Pulse modulation	+	+	+	/	+	+	+	+
Broadband AM (BB-AM)	–	+	+	+	/	–	–	–
Vector modulation (I/Q)	–	+	+	+	–	/	–	–
Digital modulation (DM)	–	+	+	+	–	–	/	–
ARB	–	+	+	+	–	–	–	/

RF characteristics

Frequency

Range	underrange R&S SMJ-B103 R&S SMJ-B106	100 kHz to <300 kHz up to 3 GHz up to 6 GHz
Resolution of setting		0.01 Hz
Resolution of synthesis	standard, fundamental frequency range 750 MHz to 1500 MHz	 5 µHz
Setting time	to within $<1\times10^{-7}$ 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	 <5 ms <7 ms <450 µs
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

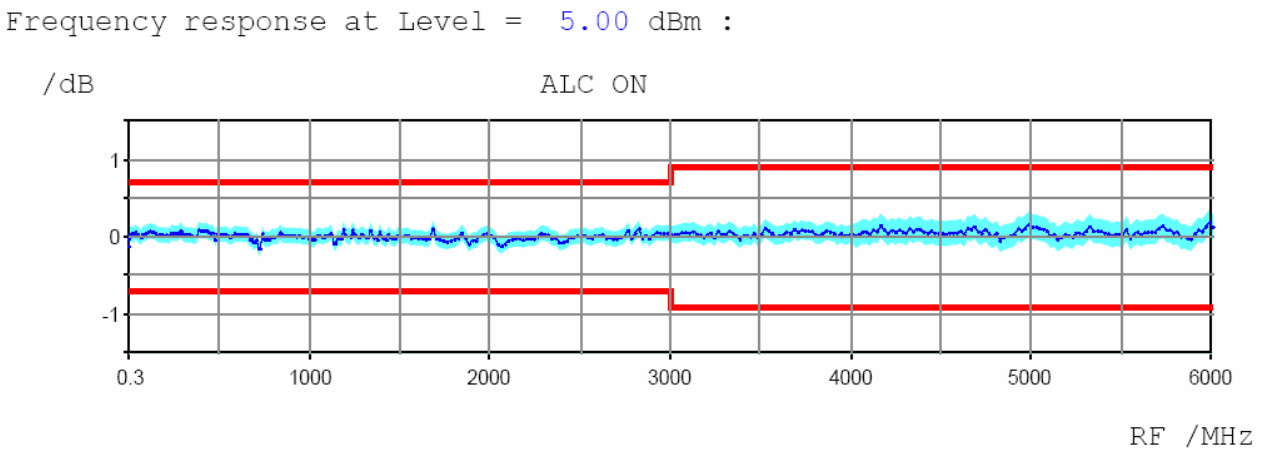
Aging	after 30 days of uninterrupted operation	$<1\times10^{-9}$/day, $<1\times10^{-7}$/year
Temperature effect	in operating temperature range	$<6\times10^{-8}$
Warm-up time	to nominal thermostat temperature	≤10 min
Output for internal reference signal	frequency (approx. sinewave) level source impedance	10 MHz or external input frequency typ. 5 dBm 50 Ω
Input for external reference	frequency maximum deviation input level, limits recommended input impedance	5, 10 or 13 MHz 3×10^{-6} ≥–6 dBm, ≤19 dBm 0 dBm to 19 dBm 50 Ω
Electronic tuning from input AUX I/O	sensitivity input voltage input impedance	typ. 1×10^{-8}/V to 3×10^{-8}/V –10 V to +10 V 10 kΩ

Level

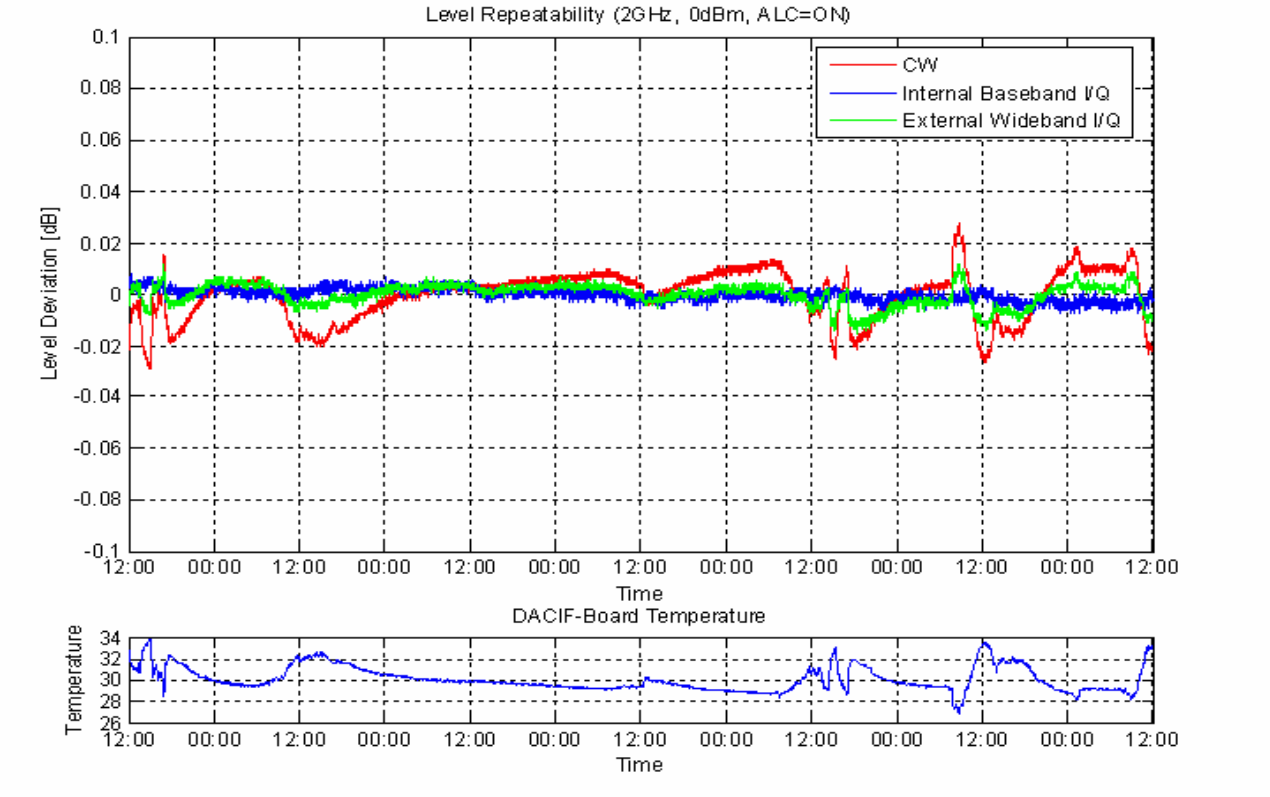
Setting range		−145 dBm to +20 dBm
Maximum level with option R&S SMJ-B103		+13 dBm (PEP)[1]
Maximum level with option R&S SMJ-B106		+8 dBm (PEP)
Resolution		0.01 dB
Level uncertainty	for levels >−120 dBm, attenuator mode "auto", temperature range 18 °C to 28 °C 0.3 MHz ≤ f ≤ 3 GHz f > 3 GHz	 <0.7 dB <0.9 dB
Additional uncertainty with ALC OFF, S&H	(This function is needed only in 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
Setting time	after IEC/IEEE bus delimiter, to <0.3 dB deviation from final value, with GUI update stopped, temperature range 18 °C to 28 °C f ≤ 5 GHz f > 5 GHz ALC state OFF f ≤ 5 GHz f > 5 GHz	 <5 ms typ. 5 ms <7 ms typ. 7 ms
Uninterrupted level setting	with attenuator mode fixed, ALC state on setting range	>20 dB
Back-feed (from ≥50 Ω source) with R&S SMJ-B103	maximum permissible RF power in output frequency range maximum permissible DC voltage	0.5 W continuous 20 V
Back-feed (from ≥50 Ω source) with R&S SMJ-B106	maximum permissible RF power in output frequency range maximum permissible DC voltage	0.5 W 10 V

[1] PEP = peak envelope power.

Measured level data



Measured level vs. frequency



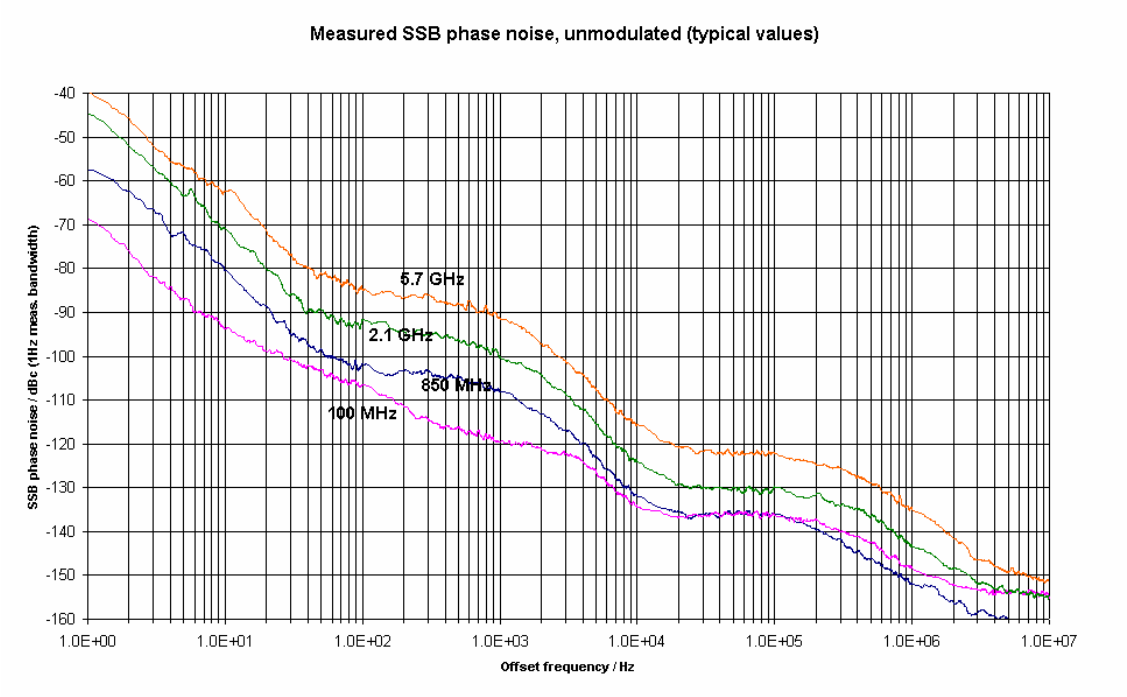
Level repeatability with random settings between measurements

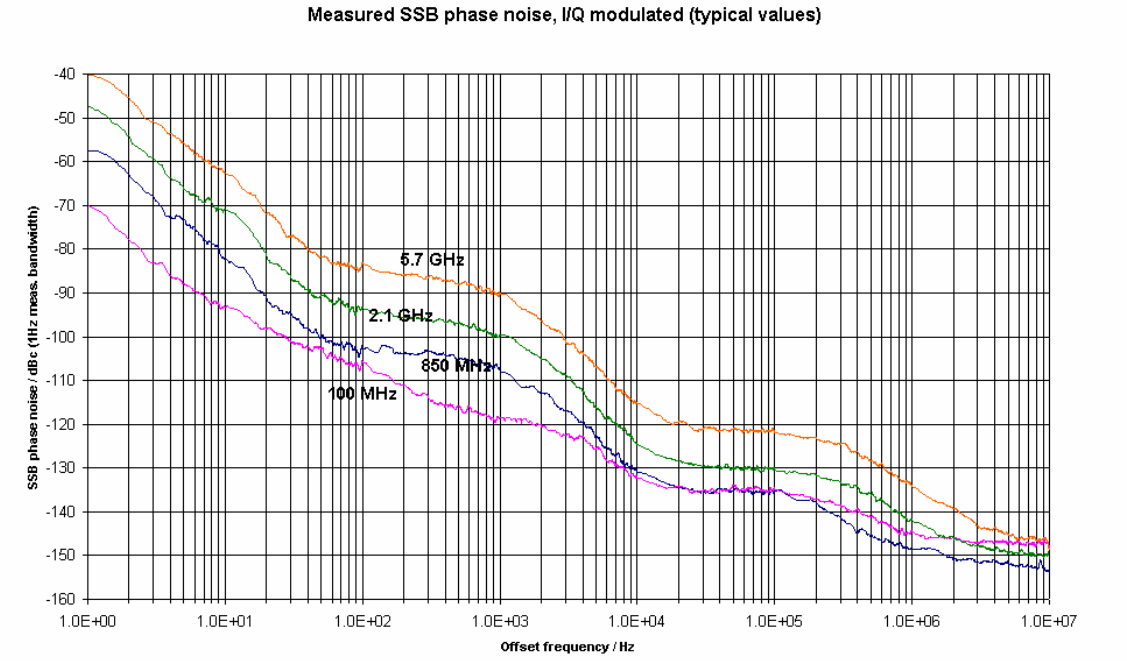
Level sweep

Digital sweep in discrete steps	operating modes	automatic, single sweep, manual or external trigger, logarithmic
	sweep range	level range of attenuator modes "normal", "high power" or "fixed"
	step width	0.1 to 20 dB per step

Spectral purity

Harmonics	with R&S SMJ-B103 levels ≤8 dBm, CW	 <–30 dBc
	with R&S SMJ-B106 levels ≤3 dBm, CW	 <–30 dBc
Nonharmonics	level > –50 dBm, CW, FM/φM, vector modulation (full-scale input), >10 kHz offset from carrier and outside the modulation spectrum	
	0.3 MHz ≤ f ≤ 200 MHz	<–77 dBc
	200 MHz < f ≤ 1500 MHz	<–80 dBc
	1500 MHz < f ≤ 3000 MHz	<–74 dBc
	f > 3000 MHz	<–68 dBc
	>850 kHz offset from carrier and outside the modulation spectrum	
	0.3 MHz ≤ f ≤ 200 MHz	<–77 dBc
	200 MHz < f ≤ 1500 MHz	<–86 dBc
	1500 MHz < f ≤ 3000 MHz	<–80 dBc
	f > 3000 MHz	<–74 dBc
Subharmonics	1500 MHz < f ≤ 3000 MHz	<–74 dBc
	3000 MHz < f ≤ 6000 MHz	<–50 dBc
Wideband noise	carrier offset >5 MHz, measurement bandwidth 1 Hz, FM/φM, CW	
	20 MHz ≤ f ≤ 200 MHz	<–146 dBc (typ. –149 dBc)
	200 MHz < f ≤ 1500 MHz	<–150 dBc (typ. –153 dBc)
	1.5 GHz < f ≤ 3 GHz	<–148 dBc (typ. –151 dBc)
	f > 3 GHz	<–146 dBc (typ. –149 dBc)
	vector modulation with full-scale DC input	
	20 MHz ≤ f ≤ 200 MHz	<–140 dBc (typ. –143 dBc)
	200 MHz < f ≤ 1500 MHz	<–143 dBc (typ. –146 dBc)
	1.5 GHz < f ≤ 3 GHz	<–142 dBc (typ. –145 dBc)
	f > 3 GHz	<–140 dBc (typ. –143 dBc)
SSB phase noise	carrier offset 20 kHz, measurement bandwidth 1 Hz, unmodulated	
	20 MHz ≤ f ≤ 200 MHz	<–126 dBc (typ. –130 dBc)
	f = 1 GHz	<–129 dBc (typ. –133 dBc)
	f = 2 GHz	<–123 dBc (typ. –127 dBc)
	f = 3 GHz	<–119 dBc (typ. –123 dBc)
	f = 4 GHz	<–117 dBc (typ. –121 dBc)
	f = 6 GHz	<–113 dBc (typ. –117 dBc)
Residual FM	rms value at f = 1 GHz	
	300 Hz to 3 kHz	<1 Hz
	20 Hz to 23 kHz	<4 Hz
Residual AM	rms value 20 Hz to 23 kHz	<0.02 %





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
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 Ω, level (V_p) 1 V	<0.1 %
Output voltage	V_p at LF connector, R_L > 200 Ω resolution setting uncertainty at 1 kHz	1 mV to 3 V 1 mV <(1 % of reading + 1 mV)
Output impedance		16 Ω
Frequency setting time	to within <1×10^{-7}, with GUI update stopped after IEC/IEEE bus delimiter	<3 ms
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 user-selectable user-selectable 0.01 to 100 %

Input for external modulation signals

Modulation input EXT MOD	input impedance input sensitivity (peak value for set modulation depth or deviation)	high (>100 kΩ), switchable to 50 Ω with option R&S SMJ-B20 1 V

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 ≤ 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	AC mode, 20 Hz to 500 kHz	<1 dB
Incidental φM 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

Frequency modulation (option R&S SMJ-B20)

Operating modes		internal, external, internal + external, AC/DC, "Normal", "Low Noise"
FM/ φM range multiplier	0.3 MHz ≤ f ≤ 200 MHz 200 MHz < f ≤ 750 MHz 750 MHz < f ≤ 1500 MHz 1500 MHz < f ≤ 3000 MHz f > 3000 MHz	m = 2 m = 1 m = 2 m = 4 m = 8
Maximum deviation	FM mode "normal" FM mode "low noise"	m × 5 MHz m × 50 kHz
Resolution		<1 %, min. 10 Hz
Setting uncertainty	f_{mod} = 10 kHz, deviation ≤ half of max. internal external	 <(1.5 % of reading + 20 Hz) <(2.0 % of reading + 20 Hz)
FM distortion	f_{mod} = 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_{mod} = 1 kHz, f > 5 MHz	<0.1 %
Carrier frequency offset at FM		<0.2 % of set deviation

Phase modulation (option R&S SMJ-B20)

Operating mode		internal, external, internal + external, AC/DC, "high bandwidth, "high deviation", "low noise"
Maximum deviation	φM mode "high deviation" φM mode "high bandwidth" φM mode "low noise"	m × 2.5 rad m × 0.5 rad m × 0.125 rad
Resolution		<1 %, min. 0.001 rad
Setting uncertainty	f_{mod} = 10 kHz, deviation ≤ half of max. internal external	 <(1.5 % of reading + 0.01 rad) <(2.0 % of reading + 0.01 rad)
φM 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

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

I/Q modulation

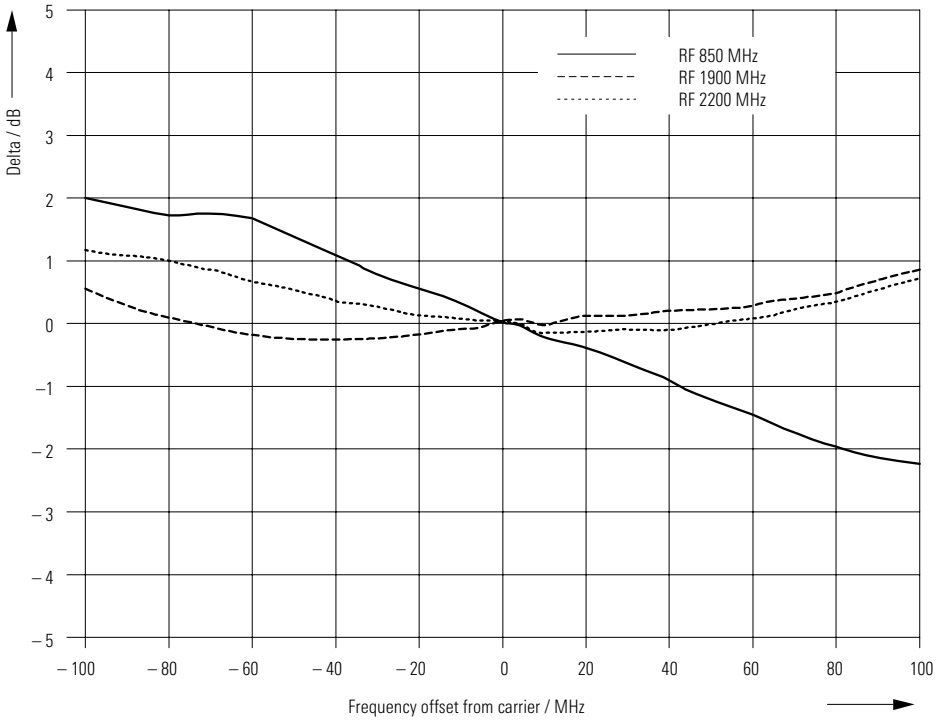
I/Q modulator

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

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 V 0.1 V
Modulation frequency range	I/Q wideband on	100 MHz
Carrier leakage	without input signal, referenced to full-scale input [2]	<–55 dBc, typ. <–65 dBc
Static error vector	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)

[2] 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 SMJ-B13)

The R&S SMJ-B13 converts the internal digital baseband signals of the R&S SMJ-B10/-B11 into analog signals for driving the I/Q modulator. It also generates the analog I/Q output signals.

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 [3]	up to 10 MHz up to 40 MHz	>44 dB, typ. 50 dB >34 dB, typ. 44 dB
Carrier leakage [3]	referenced to full-scale input	<–55 dBc, typ. <–65 dBc

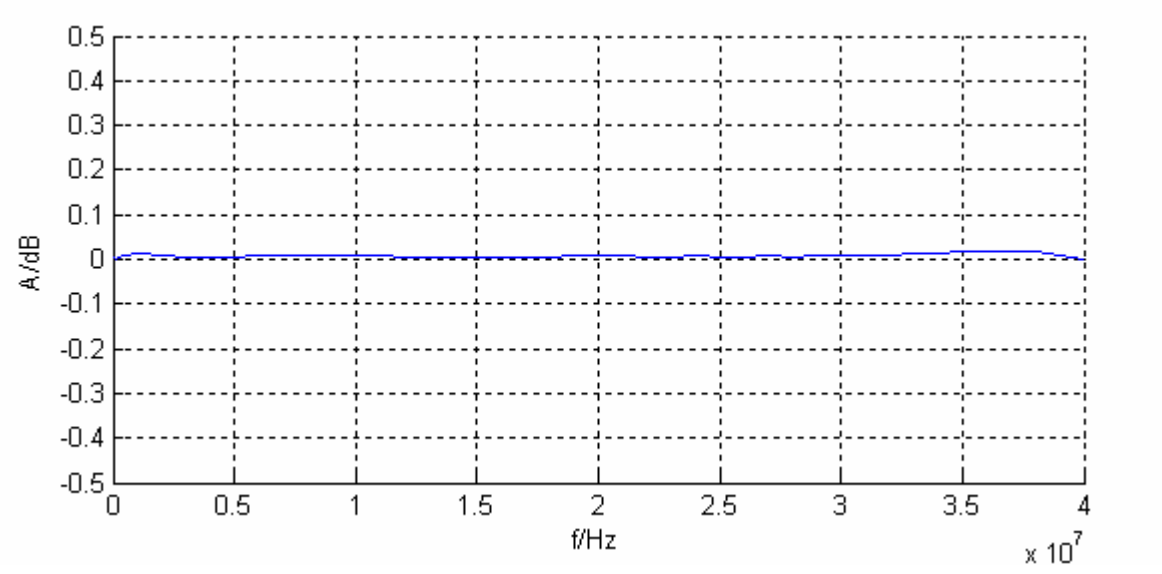
[3] Value applies after 1 hour warmup and recalibration for 4 hours operation and temperature variations of less than 5°C.

I/Q outputs		
Output impedance		50 Ω
Output voltage	EMF output voltage depends on set modulation signal	1 V (V_p)
Offset	EMF	<1 mV
Frequency response[4]	at R_L = 50 Ω 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[4]	at R_L = 50 Ω 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 Ω 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

[4] Optimize internal I/Q impairments for RF output switched off.

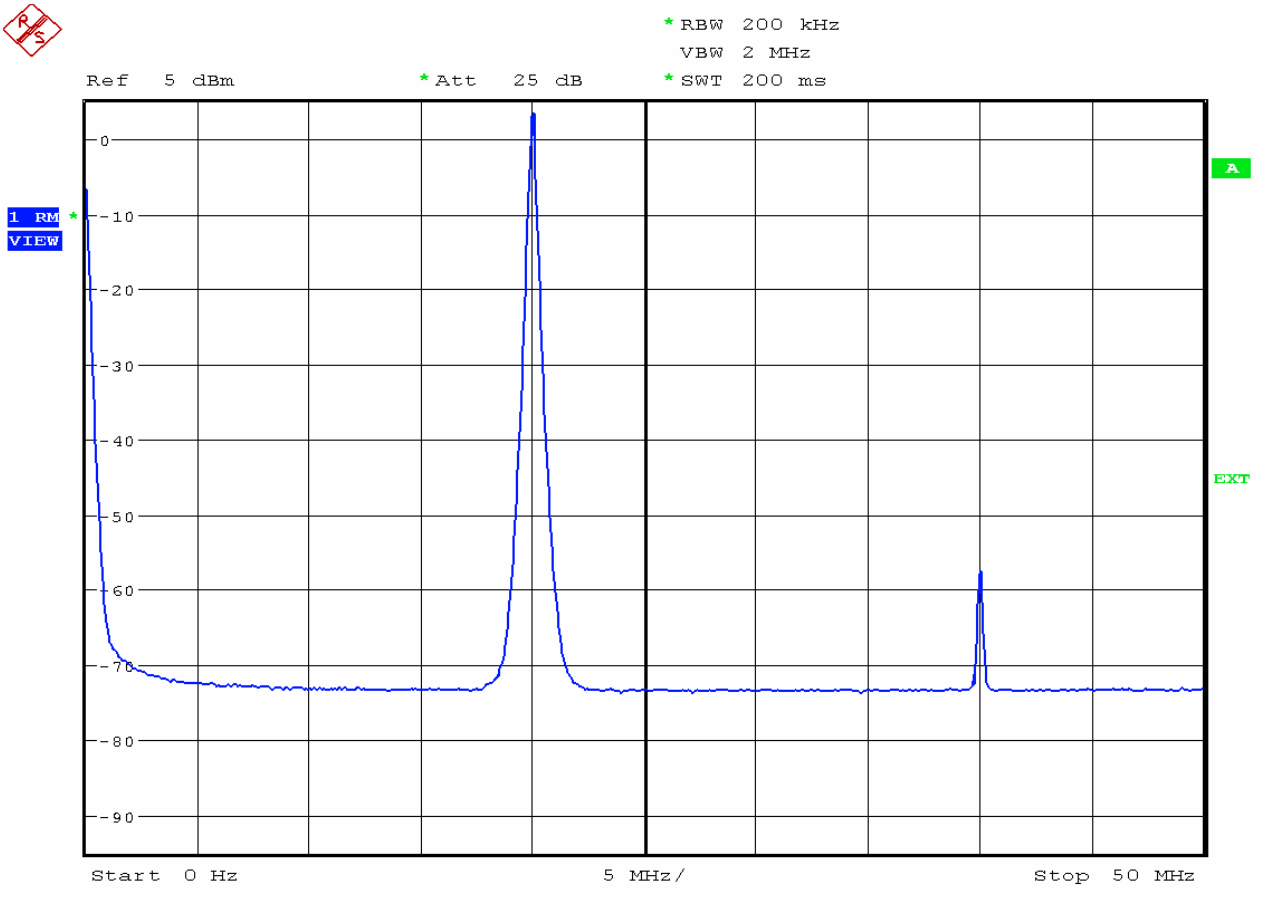
Differential I/Q output (option R&S SMJ-B16)

Additional specifications for I/Q outputs with option R&S SMJ-B16		
Output impedance Single-ended Differential		 50 Ω 100 Ω
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 % × bias voltage + 1 mV
Differential signal balance	at R_L = 50 Ω, 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[5]	at R_L = 50 Ω, 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 ° typ. 0.2 °



Frequency response of I/Q outputs

[5] Optimize internal I/Q impairments for RF output switched off.



SFDR of I/Q outputs

I/Q baseband generator (option R&S SMJ-B10/-B11) – arbitrary waveform mode

The Baseband Main Module R&S SMJ-B13 must be installed.

Waveform memory	output memory waveform length R&S SMJ-B10 waveform length R&S SMJ-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 µs 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 $< 5\times10^{-14}$ × 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 ≤100 MHz, drop to –0.1 dB	 40 MHz 0.31 × clock rate
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 × sampling rate
Marker outputs	number level operating modes marker delay setting range setting range without recalculation resolution of setting setting uncertainty	4 LVTTL 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 4.30, the software supports download of I/Q data and control of the R&S SMJ-B10/-B11.		

I/Q baseband generator (option R&S SMJ-B10/-B11) – realtime operation

The Baseband Main Module R&S SMJ-B13 must be installed.

Types of modulation	ASK modulation index resolution FSK deviation maximum resolution setting uncertainty PSK QAM	 0 % to 100 % 0.1 % 2FSK, 4FSK, MSK 0.1 to 1.5× f_{Sym} 10 MHz <0.1 Hz <0.5 % BPSK, QPSK, QPSK 45° offset, OQPSK, π/4-QPSK, π/2-DBPSK, π/4-DQPSK, π/8-D8PSK, 8PSK, 8PSK EDGE 16QAM, 32QAM, 64QAM, 256QAM, 1024QAM
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®[6], WCDMA
Baseband filter	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. cosine, root cosine filter parameter α Gaussian filter parameter B×T cdmaOne, cdmaOne + equalizer cdmaOne 705 kHz, cdmaOne 705 kHz + equalizer CDMA2000® 3X APCO25 C4FM rectangular split phase filter parameter B×T resolution of filter parameter	 0.05 to 1.00 0.15 to 2.50 0.15 to 2.5 0.01
Symbol rate	If an external clock is used, the applied clock rate may deviate from the set symbol rate by ±2 %. The external clock can be used for internal and external data. operating mode setting range ASK, PSK and QAM FSK resolution frequency uncertainty (internal) external clock clock divider K external clock rate	 internal, external 400 Hz to 25 MHz 400 Hz to 15 MHz 0.001 Hz <5×10^{-14} × symbol rate + reference frequency uncertainty symbol, K × symbol, bit clock 1 to 64 max. 100 MHz

[6] CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA -USA)

Data sources	**internal** ALL 0, ALL 1 PRBS sequence length pattern length data lists output memory R&S SMJ-B10 R&S SMJ-B11 nonvolatile memory **external** 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. serial word width bit rate parallel word width symbol rate	 9, 11, 15, 16, 20, 21, 23 1 to 64 bit 8 bit to 2 Gbit 8 bit to 512 Mbit hard disk 1 to 10 bit max. 60 MHz 1 to 10 bit max. 25 MHz
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 × sampling rate
Marker outputs	number level operating modes marker delay (in sample) setting range setting range without recalculation resolution of setting setting error	4 LVTTL control list, restart, pulse, pattern, ratio 0 to 2^{24} –1 0 to 2000 0.001 <10 ns
Level reduction	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. setting range additional level error in case of reduction up to 30 dB up to 50 dB	 0 to 60 dB <1 dB <3 dB

Burst	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. operating range rise/fall time setting range resolution ramp shape	 max. 5 MHz 0.5 to 16 symbols 0.1 symbol cosine, linear
Trigger / clock / data inputs	Input impedance and trigger threshold can be set separately for the trigger and the clock / data inputs. input impedance trigger threshold setting range resolution	 1 kΩ, 50 Ω 0.00 to 2.00 V 0.01 V
Clock / data outputs	level	LVTTL
Predefined settings	modulation, filter, symbol rate and coding to standard standards	 Bluetooth® [7], DECT, ETC, GSM, GSM EDGE, NADC, PDC, PHS, TETRA, WCDMA 3GPP, TD-SCDMA, CDMA2000® Forward, CDMA2000® Reverse, Worldspace
Modulation errors		
Deviation error with 2FSK, 4FSK	deviation 0.2 to 0.7 × symbol rate Gaussian filter with B×T = 0.2 to 0.7 symbol rate up to 2 MHz symbol rate up to 10 MHz	 <1.2 %, typ. 0.25 % typ. 0.75 %
Phase error with MSK	Gaussian filter with B×T = 0.2 to 0.7 bit rate up to 2 MHz bit rate up to 10 MHz	 <0.4°, typ. 0.15 ° typ. 0.3 °
EVM with QPSK, OQPSK, π/4-DQPSK, 8PSK, 16QAM, 32QAM, 64QAM	cosine, root cosine filter with α = 0.2 to 0.7 symbol rate up to 5 MHz symbol rate up to 20 MHz	 <0.8 %, typ. 0.2 % typ. 0.7 %

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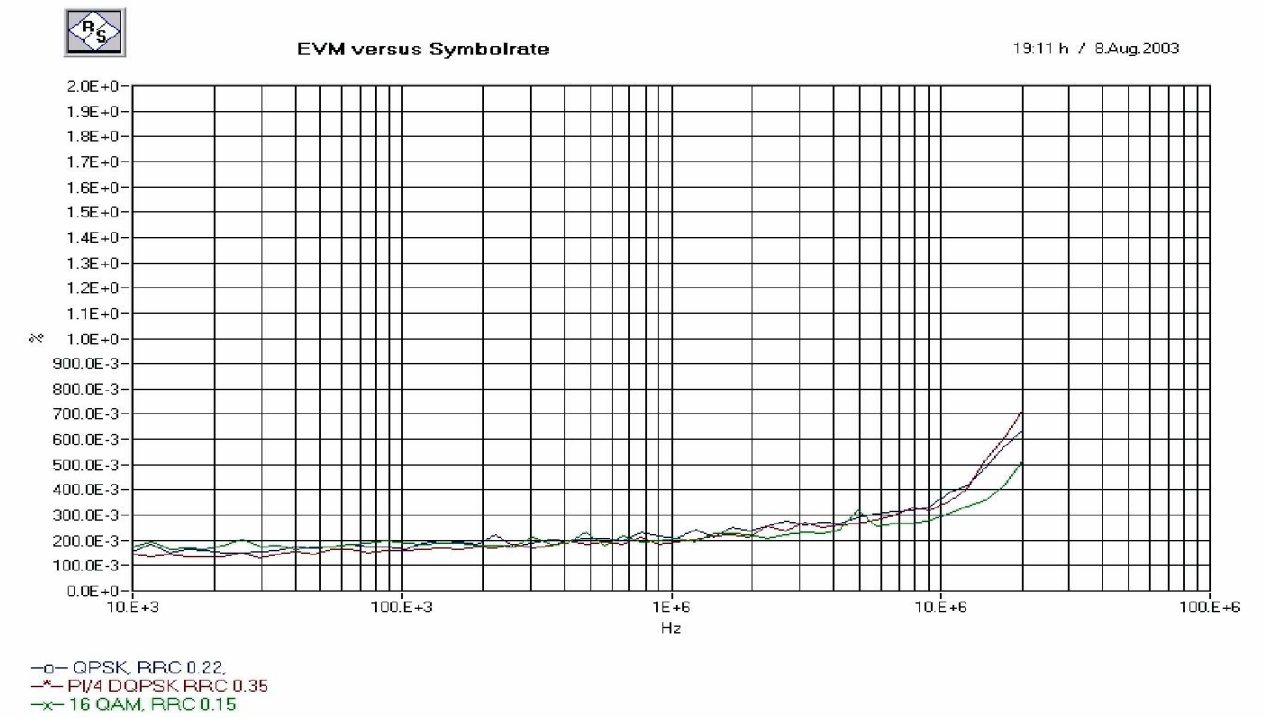


Measured EVM versus symbol rate

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									
In adjacent channel	–37	–38	–72	–80 offset 750 kHz, bandwidth 30 kHz	–	–77	–34	–71	–42 at 11 MHz
In alternate channel	–71	–71	–76	–93 offset 1.98 MHz, bandwidth 30 kHz	–	–80	–78	–77	–64 at 20 MHz
In 2nd alternate channel	–85	–85	–	–	–	–	–	–	–66 at 30 MHz

Digital modulation systems

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 SMJ-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 SMJ100A
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×T = 0.3 B×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 which 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 symbol –1.0 to 1.0 symbol –9 to 9 symbol –9 to 9 symbol
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 (option R&S SMJ-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×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 option R&S SMJ-B103 level ≤10.5 dBm with frequency option R&S SMJ-B106 level ≤5.5 dBm 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 SMJ-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 SMJ100A
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) • test model 1 with 16/32/64 channels • test model 2 • test model 3 with 16/32 channels • test model 4 • test model 5 with 8/4/2 HS-PDSCH channels uplink (not standardized) • DPCCH + 1 DPDCH at 60 ksps DPCCH + 1 DPDCH at 960 ksps	
Realtime component		
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 SMJ100A, 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.	
	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

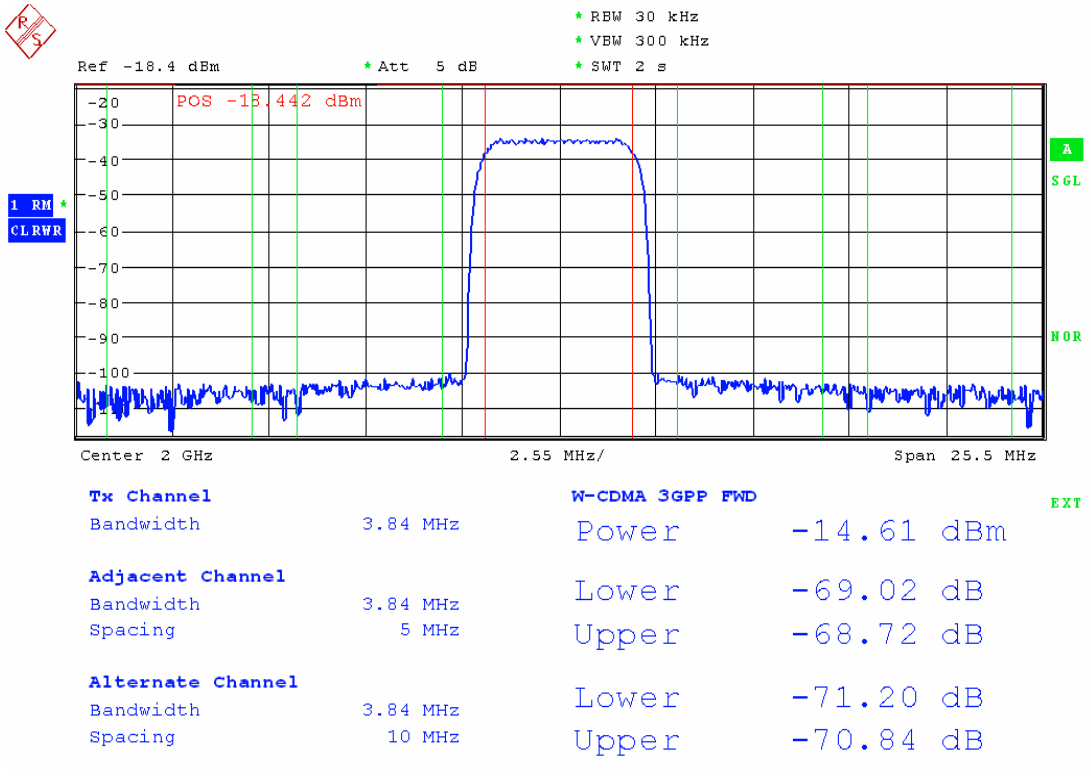
	possible settings of user-configurable channel coding: transport channels transport block size transport blocks rate matching attribute transport time interval CRC size error protection interleaver 1/2 state	 1 DCCH up to 6 DTCHs 1 to 4096 1 to 16 16 to 1024 10 ms, 20 ms, 40 ms, 80 ms none, 8, 12, 16, 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 SMJ-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	
General settings		
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	$\sqrt{\cos}$, α = 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	
Parameters of every BS		
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
Physical channels in downlink		
	• primary common pilot channel (P-CPICH) • secondary common pilot channel (S-CPICH) • primary sync channel (P-SCH) • secondary sync channel (S-SCH) • primary common control physical channel (P-CCPCH) • secondary common control physical channel (S-CCPCH) • page indication channel (PICH) • access preamble acquisition indication channel (AP-AICH) • collision detection acquisition indication channel (CD-AICH) • physical downlink shared channel (PDSCH) • dedicated physical control channel (DL-DPCCH) • dedicated physical channel (DPCH) • high-speed shared control channel (HS-SCCH) • high-speed physical downlink shared channel (HS-PDSCH), modulation QPSK or 16QAM	
Parameters of every downlink code channel that can be set independently		
State		OFF/ON
Slot format	depending on physical channel type	0 to 16
Symbol rate	depending on physical channel type	7.5 ksps to 960 ksps
Channelization code	value range depending on physical channel type and symbol rate	0 to 511
Power		–80 dB to 0 dB

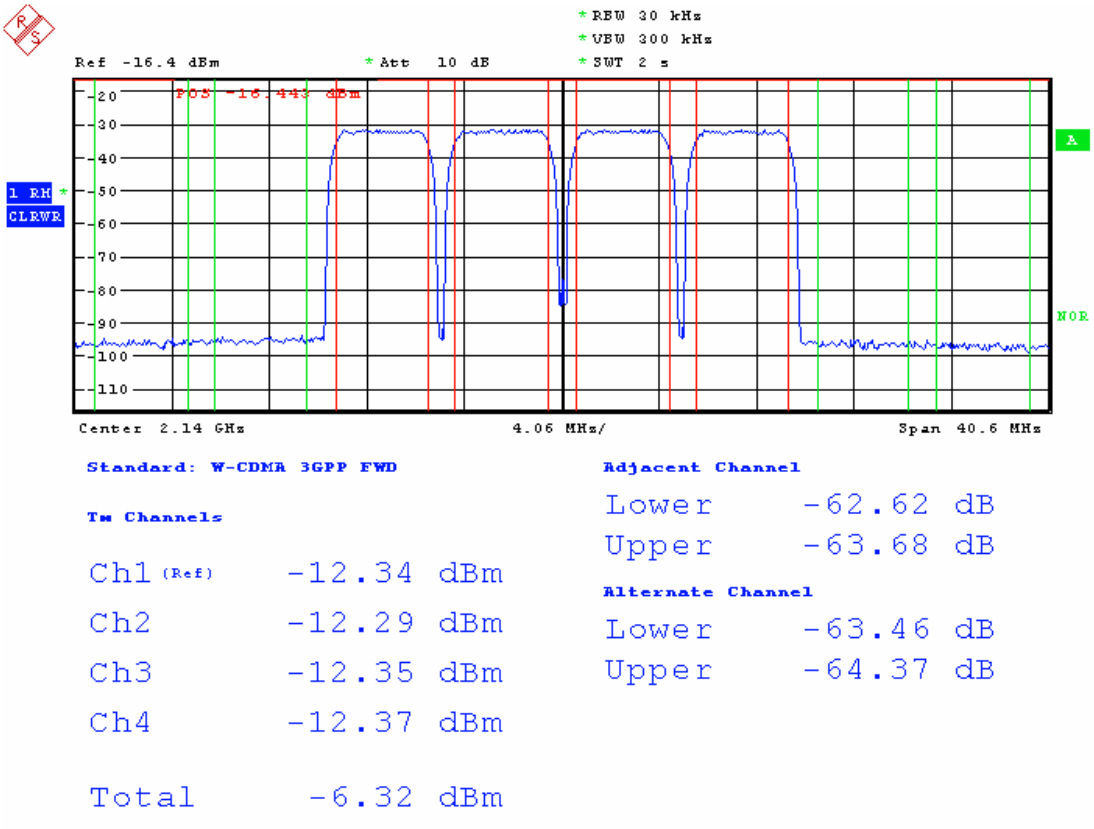
Payload data		PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 to 64 bit) data lists external LAN (for enhanced channels)
Multicode state		OFF/ON
Timing offset	time offset that can be separately set for each code channel	0 to 150 (in units of 256 chips)
Pilot length	depending on symbol 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
TFCI power offset	power offset of TFCI field relative to data fields	–10 dB to +10 dB
Parameters of every MS		
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
Physical channels in uplink		
	• physical random access channel (PRACH) • physical common packet channel (PCPCH) • dedicated physical control channel (DPCCH) • dedicated physical data channel (DPDCH)	
PRACH Only mode		
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 transmisson 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 external LAN (for enhanced channels)
Channel coding	reference measurement channel for UL RACH to TS 25.141 state transport block size	 ON/OFF 168, 360
PCPCH Only mode		
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 transmisson 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 external LAN (for enhanced channels)
Channel coding	reference measurement channel for UL CPCH to TS 25.141 state transport block size	 ON/OFF 168, 360

DPCCH + DPDCH Only mode		
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 external LAN (for enhanced channels)
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 option R&S SMJ-B103 level ≤10.5 dBm PEP with frequency option R&S SMJ-B106 level ≤5.5 dBm PEP offset 5 MHz offset 10 MHz	 >66 dB, typ. 69 dB >68 dB, typ. 71 dB



ACLR (typical values) for 3GPP test model 1, 64 DPCH)



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

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

The R&S SMJ-K42 must be installed.

General parameters	This option extends the R&S SMJ-K42 (Digital Standard 3GPP FDD) to full HSDPA support and dynamic power control. Therefore, all general parameters of the R&S SMJ-K42 such as frequency range or modulation are also valid for the R&S SMJ-K43.	
Downlink simulation		
HSDPA channels (HS-SCCH and HS-PDSCH)		
Enhancements	The R&S SMJ-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 SMJ-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 Inter-TTI distance	continuous, subframe 0 to subframe 4 (where first packet is sent) 1 to 16
Dynamic Power Control		
Enhancements	The R&S SMJ-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 SMJ-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 SMJ100A 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 direction power step up range down range	external, by TPC pattern, manual up, down 0.5 to 6 dB 0 to 20 dB 0 to 20 dB

Uplink simulation		
HS-DPCCH (high speed dedicated physical control channel)		
Enhancements	The R&S SMJ-K42 does not support HSDPA for uplink. The R&S SMJ-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 HDSPA	
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 SMJ-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 SMJ-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 SMJ100A 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

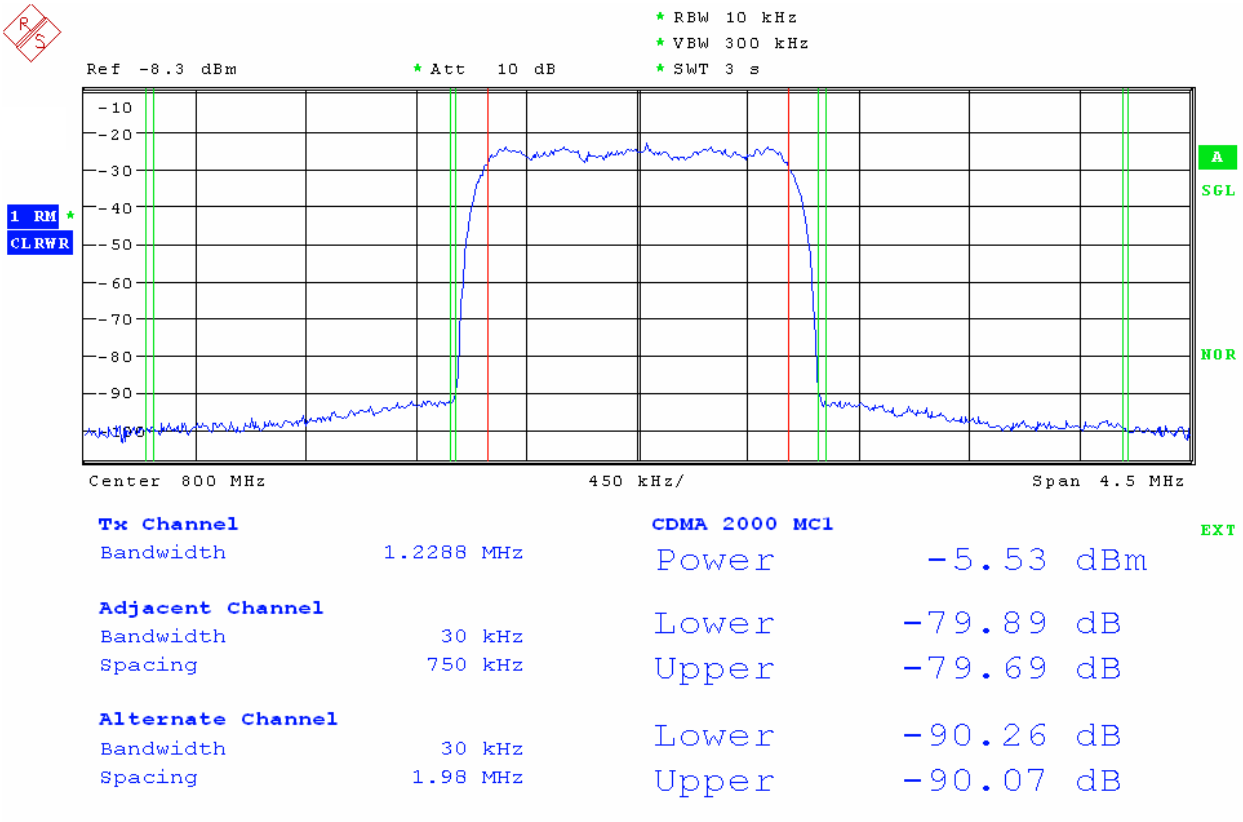
Digital standard CDMA2000® incl. 1xEV-DV (option R&S SMJ-K46)

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	
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 %.
Parameters of every BS		
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

Parameters of every forward link code channel that can be set independently		
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 external LAN
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	All stages of channel coding specified by IS-2000 (e.g. frame quality indicator, convolutional encoder / turbo coder, symbol puncture and interleaver) are available. All frame length and data rate combinations are supported. Four options are available: OFF: channel coding off complete: channel coding completely on without interleaving: channel coding on but without interleaver interleaving only: channel coding off, only interleaver is active	
Parameters of every MS		
State		OFF/ON
Radio configuration	chip rate 1.2288 Mcps (1X)	RC 1 to RC 4
Channel coding	All stages of channel coding specified by IS-2000 (e.g. frame quality indicator, convolutional encoder, symbol puncture and interleaver) are available. All frame length and data rate combinations are supported. Four options are available: OFF: channel coding off complete: channel coding completely on without interleaving: channel coding on but without interleaver interleaving only: channel coding off, only interleaver is active	
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
Parameters of every reverse link code channel that can be set independently		
State		OFF/ON
Channel types Reverse link	reverse pilot (R-PICH) access (R-ACH) enhanced access (R-EACH) reverse common control (R-CCCH) reverse dedicated control (R-DCCH) traffic channel: fundamental (R-FCH) supplemental code (R-SCCH) supplemental (R-SCH)	
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

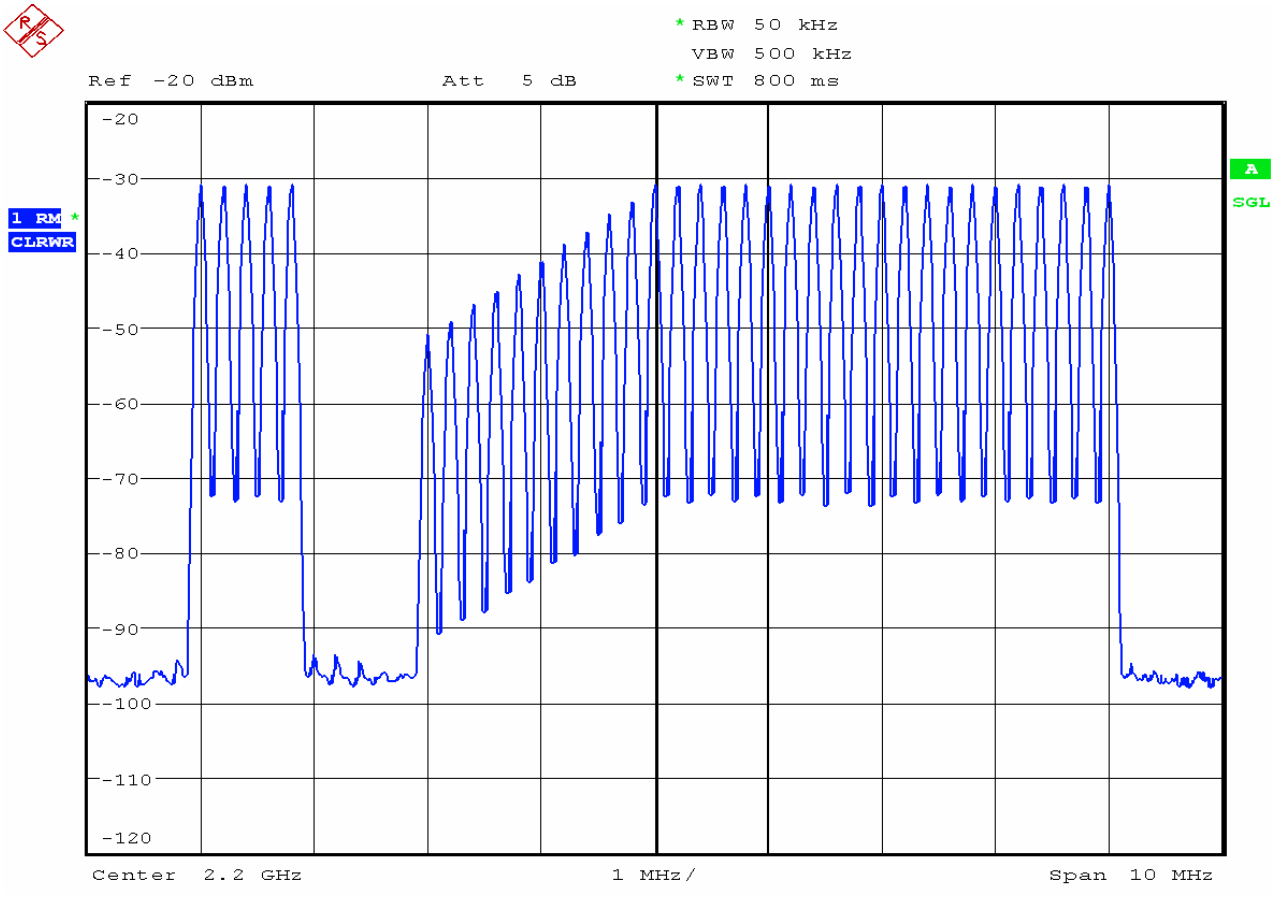
Data		all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists external LAN
Error vector magnitude (EVM)	F-PICH, F-SYNC and one F-FCH, rms	<0.8 %, typ. 0.3 %
Adjacent-channel leakage ratio (ACLR)	F-PICH, F-SYNC and one F-FCH carrier frequency 800 MHz channel spacing 0.75 MHz (bandwidth 30 kHz) channel spacing 1.98 MHz (bandwidth 30 kHz)	 typ. 79 dB typ. 90 dB



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

Multicarrier CW signal generation (option R&S SMJ-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: • off: no optimization, manual entry of phase possible • chirp: the phases of each carrier are set such that a chirp signal is obtained for the I and Q components • target crest: iterative variation of carrier start phases until a presettable crest factor is attained	
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^{16} sample 0.01 sample 1 sample <5 ns 0 to 2^{26} 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	4 LVTTL 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



Spectrum of multicarrier CW

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

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

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

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

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

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

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

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

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

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

Noise generation

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

The Baseband Main Module R&S SMJ-B13 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.

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 to +30 dB 0.1 dB <0.1 dB
System bandwidth	(bandwidth for determining the noise power) range resolution	 1 kHz to 80 MHz 100 Hz

Other options

BER measurement (option R&S SMJ-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 kΩ, 50 Ω 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^{31} 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

BLER measurement (option R&S SMJ-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 kΩ, 50 Ω 0.00 V 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	50 Hz to 60 Hz
	input current	5.0 A to 1.6 A
	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 DIN EN 60068-2-1, DIN EN 60068-2-2
	storage temperature range	–20 °C to +60 °C
	climatic resistance, 95 % rel. humidity, cyclic test at +25 °C/+40 °C	meets DIN EN 60068-2-3, DIN EN 60068-2-30
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 DIN EN 60068-2-6
	vibration, random	10 Hz to 300 Hz, acceleration 1.2 g (rms), meets DIN EN 60068-2-64
	shock	40 g shock spectrum, meets DIN EN 60068-2-27, MIL-STD-810E
Electrical safety		meets EN 61010-1
Dimensions	width x height x depth	435 mm x 192 mm x 560 mm
Weight	when fully equipped	18 kg
Recommended calibration interval		3 years

Ordering information

Vector Signal Generator[8]		R&S SMJ100A	1403.4507.02
including power cable, Quick Start Guide and CD-ROM (with operating and service manual)			
Options			
RF			
100 kHz to 3 GHz		R&S SMJ-B103	1403.8502.02
100 kHz to 6 GHz		R&S SMJ-B106	1403.8702.02
FM/φM Modulator		R&S SMJ-B20	1403.9209.02
Baseband			
Baseband Generator with ARB (64 Msample) and Digital Modulation (realtime)		R&S SMJ-B10	1403.8902.02
Baseband Generator with ARB (16 Msample) and Digital Modulation (realtime)		R&S SMJ-B11	1403.9009.02
Baseband Main Module		R&S SMJ-B13	1403.9109.02
Differential I/Q Output		R&S SMJ-B16	1403.9409.02
Digital modulation systems			
Digital Standard GSM/EDGE		R&S SMJ-K40	1404.0305.02
Digital Standard 3GPP FDD		R&S SMJ-K42	1404.0405.02
3GPP Enhanced MS/BS Tests incl. HSDPA		R&S SMJ-K43	1404.0505.02
Digital Standard CDMA2000® incl. 1xEV-DV		R&S SMJ-K46	1404.0605.02
Multicarrier CW Signal Generation		R&S SMJ-K61	1404.0705.02
Digital modulation systems using R&S WinIQSIM™[9]			
Digital Standard IS-95	(with R&S WinIQSIM™)	R&S SMJ-K11	1403.9509.02
Digital Standard CDMA2000®	(with R&S WinIQSIM™)	R&S SMJ-K12	1403.9609.02
Digital Standard 3GPP TDD	(with R&S WinIQSIM™)	R&S SMJ-K13	1403.9709.02
Digital Standard TD-SCDMA	(with R&S WinIQSIM™)	R&S SMJ-K14	1403.9809.02
User-Defined OFDM Signals	(with R&S WinIQSIM™ and R&S WinIQOFDM)	R&S SMJ-K15	1403.9909.02
Digital Standard 1xEV-DO	(with R&S WinIQSIM™)	R&S SMJ-K17	1404.0005.02
Digital Standard IEEE 802.11 (a/b/g)	(with R&S WinIQSIM™)	R&S SMJ-K19	1404.0105.02
Digital Standard 3GPP FDD incl. HSDPA	(with R&S WinIQSIM™)	R&S SMJ-K20	1404.0205.02
Noise generation			
Additive White Gaussian Noise (AWGN)		R&S SMJ-K62	1404.0805.02
Other options			
BER/BLER Measurement		R&S SMJ-K80	1404.0905.02
Rear Connectors		R&S SMJ-B81	1403.9309.02
Recommended extras			
Hardcopy manuals (in German)			1403.7458.31
Hardcopy manuals (in English, UK)			1403.7458.32
Hardcopy manuals (in English, USA)			1403.7458.39
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	1157.7060.03
External USB CD-RW Drive		R&S PSP-B6	1134.8201.12

[8] The base unit can only be ordered with an R&S SMJ-B10x frequency option.

[9] R&S WinIQSIM ™ requires an external PC.

For product brochure, see PD 5213.5074.12
and www.rohde-schwarz.com
(search term: SMJ)

Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM

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