Product brochure

Version 01.01

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Vector Signal Generator R&S® SMU200A

The art of signal generation

ROHDE&SCHWARZ

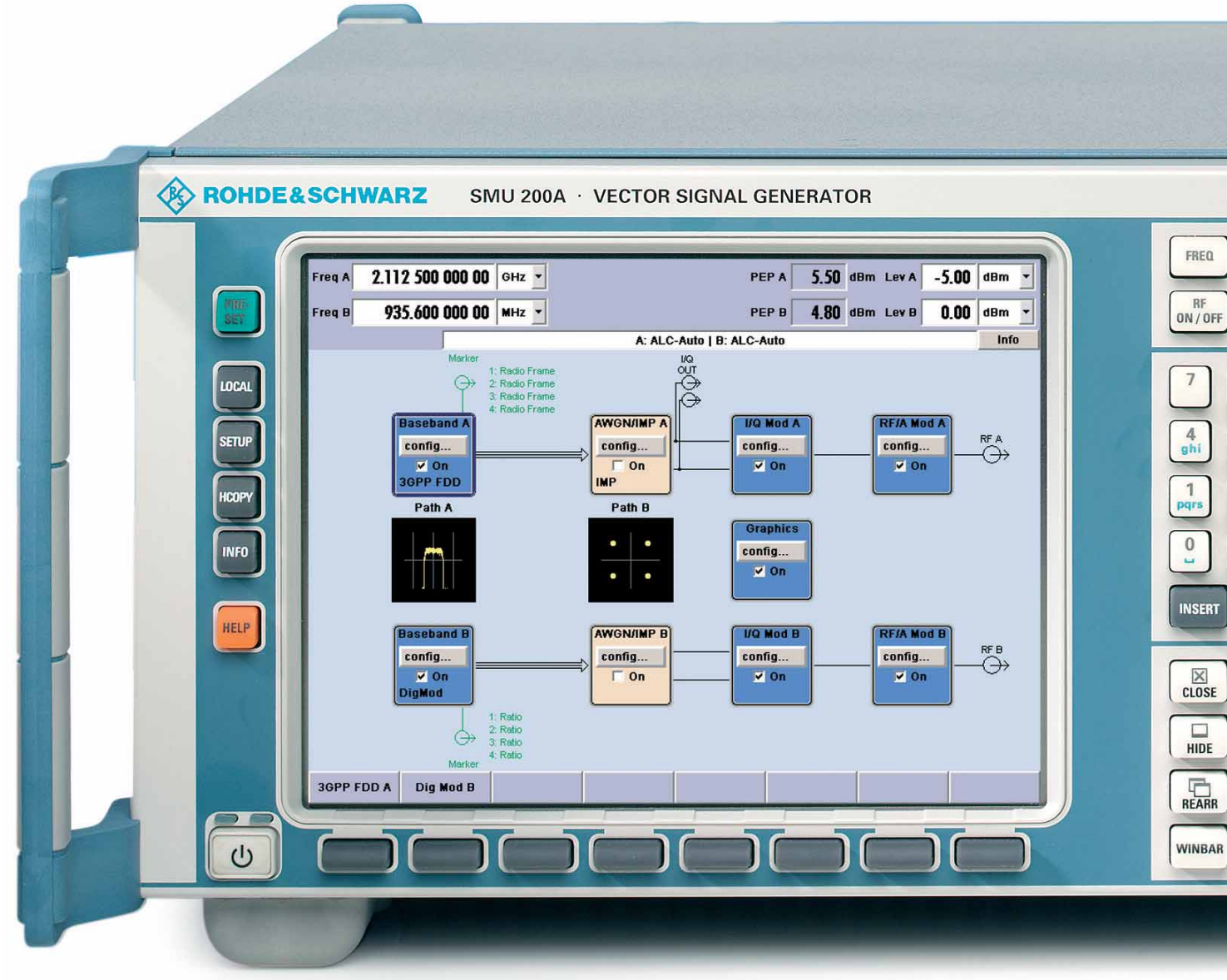
Highlights of a new generation

The Vector Signal Generator R&SS MU200A has been designed to meet all requirements encountered in research and development of modern communication systems as well as in their production. The R&S SMU200A not only combines two independent signal generators in one cabinet of only four height units, it also offers unrivalled 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. Frequency options with upper frequency limits of 2.2 GHz and 3 GHz are available for the second RF path. 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 56 Msample memory for I and Q and 4 marker bits per sample (256 Mbyte). The signals generated in the different basebands can be added. Frequency offset of the individual signals is possible.

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



Two signal generators in one

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

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 of typically +70 dB for 3GPP FDD (test model 1, 64 DPCH)
- Very high level repeatability of 0.05 dB
- High output power 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 56 Msample for I and Q and 4 marker bits per sample (256 Mbyte)
- Arbitrary waveform generator supported by Simulation Software R&S WinIQSIM™
- Internal 20 Gbyte hard disk provided as standard for storing waveforms and modulation data

Intuitive operation

- Colour 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

Ideal for production

- Very short frequency setting times (<3 ms);
  only 450 µs in List mode
- Electronic attenuator up to 6 GHz
- Minimum space required as two complete generators are accommodated in one cabinet of only four height units

Connectivity

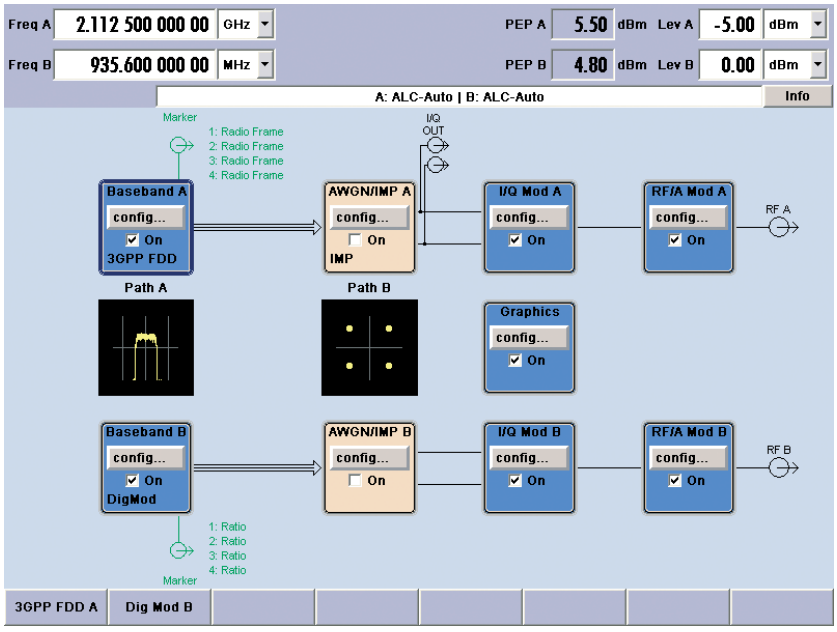
- Can be remote-controlled via GPIB and LAN
- USB connectors for keyboard, mouse and memory stick
- User-selectable trigger and marker signals

Intuitive operation

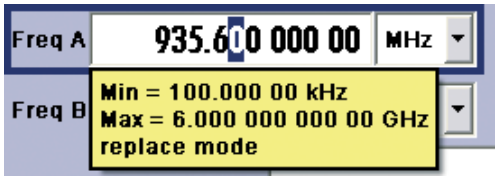
The R&S SMU200A is equipped with a modern and intuitive user interface. The signal flow from the baseband to the RF output is clearly shown in the block diagram. Each block represents a functional unit of the instrument. The generated signal can be seen at a glance, and whether it is affected by additive white Gaussian noise or other impairments.

The rotary knob plays a central role in R&S SMU200A operation. With the aid of this knob, the instrument can be operated with one hand. Any task – whether navigating in block diagram or menus, selecting of parameters or toggling between states – can be performed simply by turning or pressing the rotary knob.

Active windows are indicated by a labelled button in the Winbar at the bottom of the screen. With the softkey below, the respective window can be quickly brought to the foreground. This allows rapid navigation between different windows. It is possible, for instance, to simultaneously display two slots of a GSM/EDGE system and to toggle between them. Windows can of course also be automatically arranged (REARR), hidden (HIDE) or closed (CLOSE) by means of hardkeys.

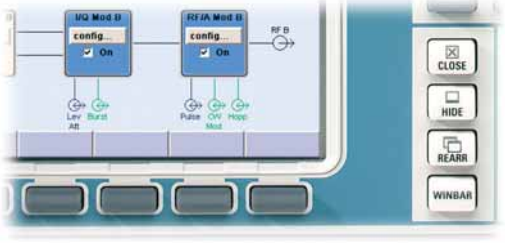


Block diagram of the R&S SMU200A



Tool tip for permissible frequency setting range

Rotary knob for navigation in the menus

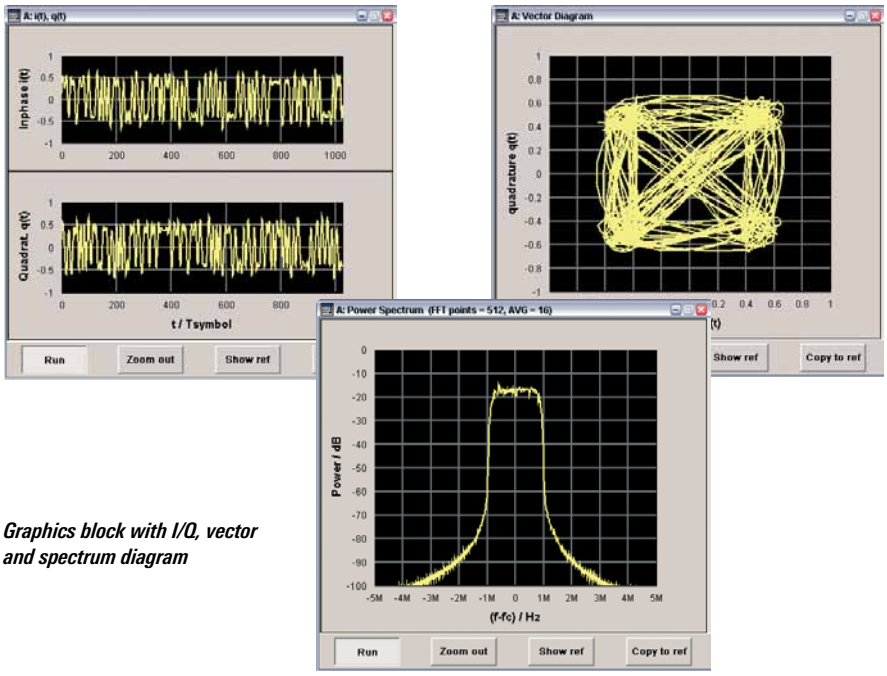


Softkeys and hardkeys of the R&S SMU200A for windows management

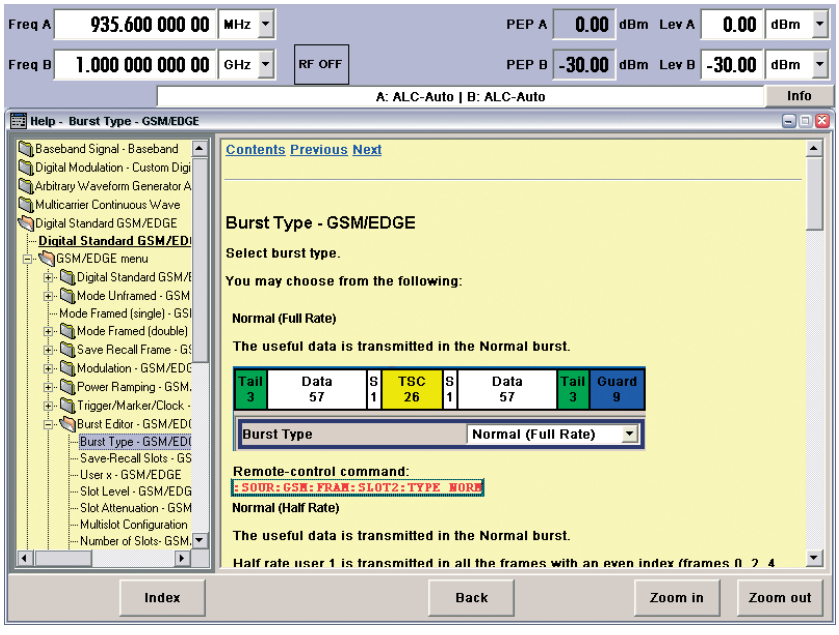
The baseband signal can be monitored in the graphics block. For instance, the vector or constellation diagram, the I/Q characteristic or the output spectrum of a signal can be displayed, making it possible to check whether the generated signal corresponds to the required signal. This is of great help particularly when complex signals are produced.

Another outstanding feature of the R&S SMU200A is its context-sensitive online help. If the exact function of a parameter is not known, simply pushing the help key instantaneously displays a help text with information about the selected parameter. Further information can be obtained through navigation with a browser-like system. The help system also specifies the relevant remote-control commands. Full-text searching in the help system, which contains the complete operating manual, comes in handy when complex measurement tasks are to be performed. Tool tips are provided in addition. If you pause on a parameter, the currently permissible setting range is displayed.

More information about the user interface at **http://www.smu.rohde-schwarz.com/.**



Graphics block with I/Q, vector and spectrum diagram



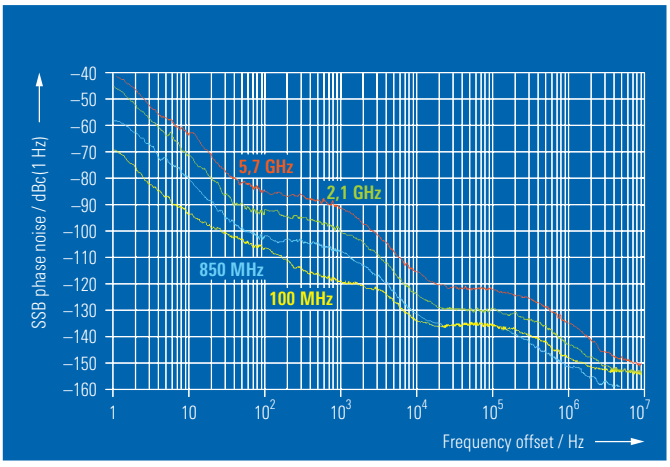
Help system

Outstanding signal quality

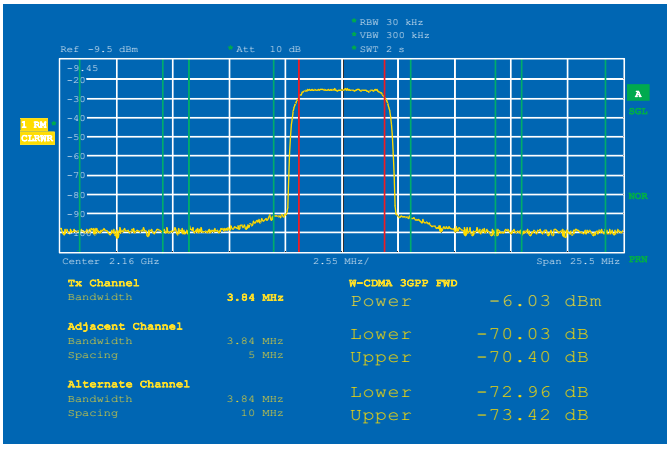
Owing to the sophisticated multiloop synthesizer concept, the R&S SMU200A features extremely low SSB phase noise and wideband noise. A high-stability oven-controlled reference oscillator is installed as standard, which provides excellent aging characteristics as well as minimum temperature drift. The R&S SMU200A is ideal, for instance, for LO or VCO substitution.

Amplifiers of 3GPP base stations require very good adjacent channel leakage ratio (ACLR) performance in order not to impair the adjacent channels of the transmission. To test this feature, the ACLR characteristics of the signal generator must be better than those of the amplifier. Presently, multicarrier power amplifiers are increasingly used. In this case, not only one but several neighbouring signals in the frequency range are amplified. Testing such amplifiers places even higher demands on signal generator capabilities. The outstanding ACLR characteristics of the R&S SMU200A more than qualify the generator for this task.

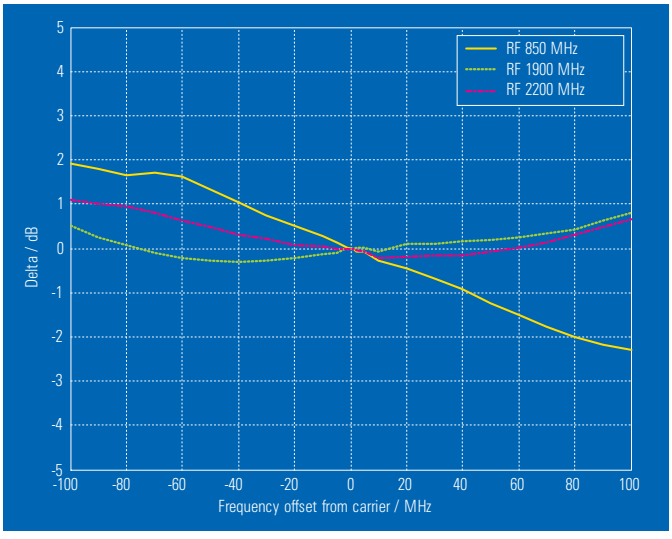
When external I/Q signals are applied, the R&S SMU200A features an RF bandwidth of 200 MHz. If the internal baseband is used, an RF bandwidth of 80 MHz is available, which is ideal for testing multicarrier amplifiers. The R&S SMU200A is thus well prepared for future broadband systems.



Typical SSB phase noise at 100 MHz, 850 MHz, 2.1 GHz and 5.7 GHz



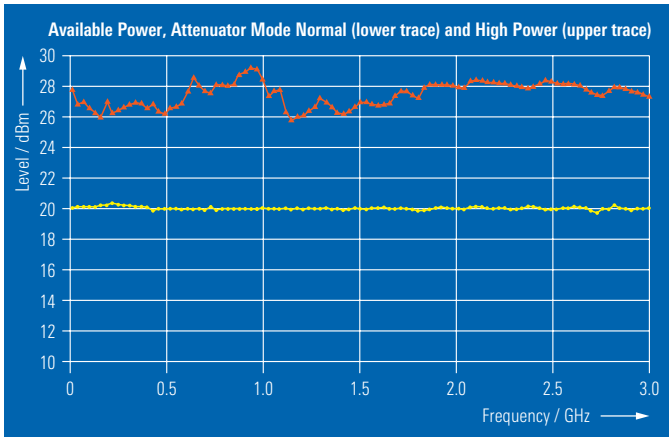
Outstanding ACLR characteristics



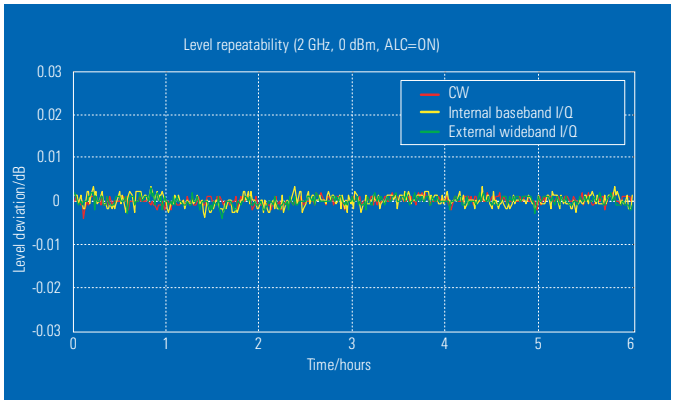
Frequency response (mode: external wideband I/Q)

The R&S SMU200A offers highly accurate output power of up to +13 dBm (PEP). A wear-and-tear-free electronic attenuator is used in the full level range. With the aid of the "high-power output" option, the output power can be increased to +26 dBm (PEP) in the overrange.

Digital ALC implemented in the R&S SMU200A together with a detector operating at constant temperature ensures high level linearity and repeatability. ALC may be on for most kinds of complex signal scenarios.



Typical maximum output power versus frequency (with and without high-power output option)



High level repeatability of the R&S SMU200A

Amplifier test with the R&S SMU200A

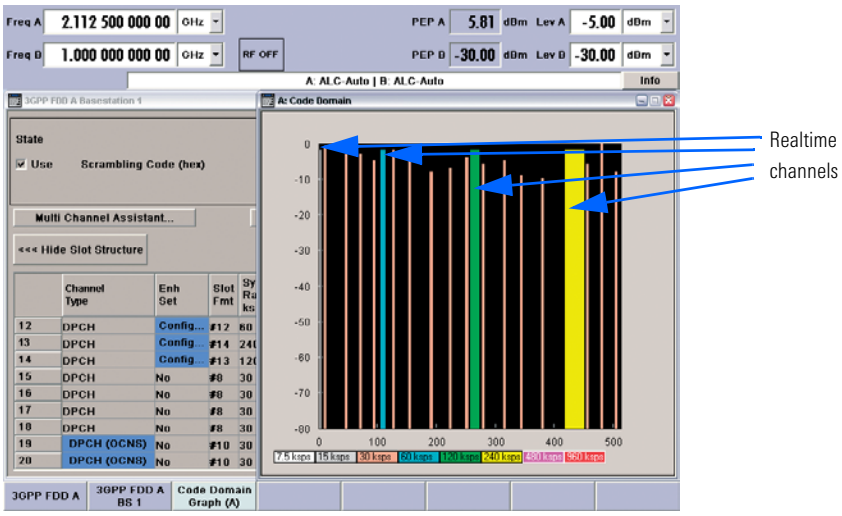
Unrivalled flexibility

The standards of the third mobile radio generation set considerably higher demands on signal generator functionality. Because of their good RF characteristics and their flexibility, signal generators are the instrument of choice particularly when base stations are tested. The universal coder in the baseband generator of the R&S SMU200A has been designed for easy implementation of new standards. The R&S SMU200A is therefore well prepared for present and future mobile radio standards.

In the case of 3GPP FDD, the R&S SMU200A can generate up to four fully coded channels in realtime. Up to four base stations with 128 code channels each or four mobile stations can be simulated. This allows any configuration to be set, from reference measurement channels in line with 3GPP TS 25.141 or TS 25.101 up to complex code channel scenarios for traffic simulation in the mobile radio network.

For the control channels, the transmit power control (TPC) field of the individual slots of a frame can be read from a data list. This allows long TPC profiles to be generated for power-level control in the DUT. With this feature, output power ramping or the maximum output power of a mobile phone can be measured, for instance. The TPC information can also be used for power-level control in the respective code channel of the signal to be output by the R&S SMU200A. This allows simulation of complex power scenarios as may occur for a mobile phone in motion.

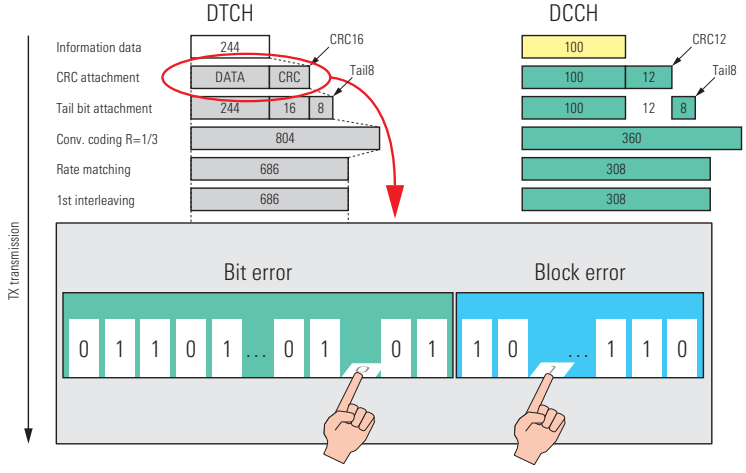
The R&S SMU200A is capable of inserting bit errors and block errors in the generated signal. This allows the internal bit error rate (BER) and block error rate (BLER) calculations of a base station to be



Four code channels in realtime with additional background channels

The mobile phone changes its output power in compliance with TPC information from the R&S SMU200A

The R&S SMU200A changes the code channel output power on the basis of the TPC field



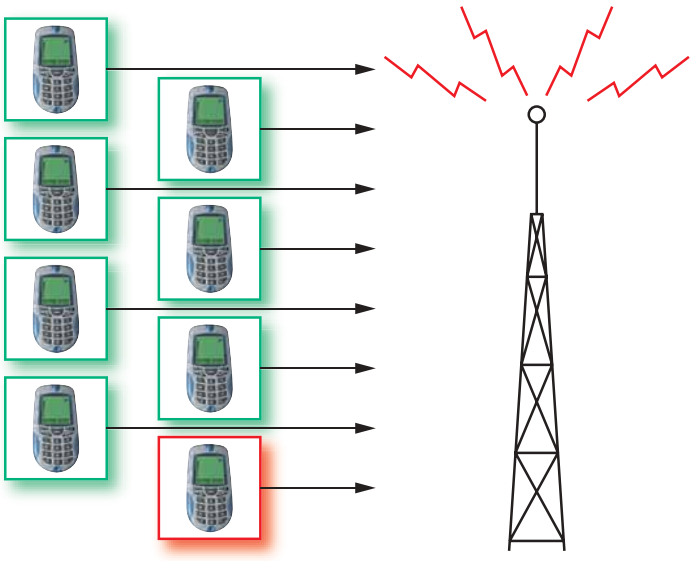
Insertion of bit errors and block errors into the output signal

checked in line with TS 25.141. The number of required bit and block errors can be set in the R&S SMU200A. Because of generation in realtime, continuous measurements of BER and BLER can be carried out without wrap-around problems.

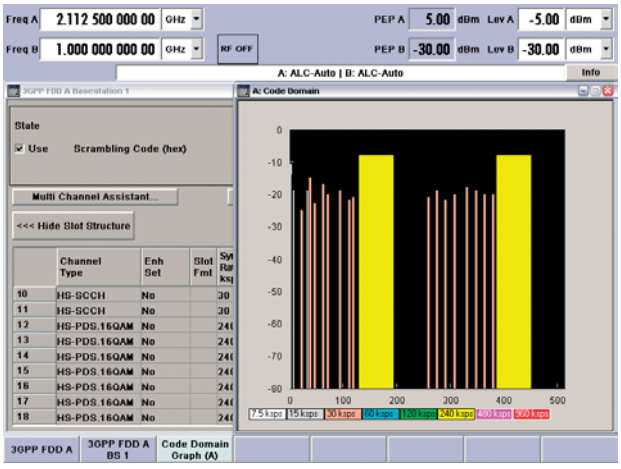
The receiver of a mobile phone must of course also function under real operating conditions. To check this, orthogonal background and interfering channels of a base station can be simulated in line with TS 25.101. The power of these channels is automatically configured so that the total output power of the base station remains unchanged. This allows measurements of the maximum input level in line with TS 25.101, for instance. The base station must also be tested under real conditions. In this case, up to 64 mobile phones can be configured in addition to the four user-configurable ones. The 64 mobiles use different scrambling codes.

Since the universal coder in the R&S SMU200A is extremely flexible, signals for high-speed downlink packet access (HSDPA) are generated without problems. Test model 5 with all its versions, as defined in TS 25.141 of the 3GPP specification, is also supported.

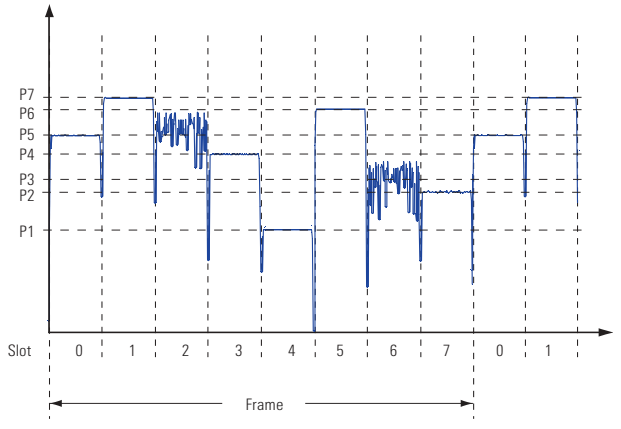
When the GSM/EDGE option is used, even the modulation can be changed between GMSK and 8PSK EDGE in realtime as may be the case in GSM/EDGE base stations. All burst types defined by the standard can be generated. In addition, up to eight different levels can be defined for the timeslots. A separate level can thus be assigned to each slot of a GSM frame. Furthermore, the R&S SMU200A permits two frames to be defined. The frame repetition rate can be set by the user as required. The change from GMSK to 8PSK EDGE modulation in a timeslot versus time can thus be simulated, for instance.



Additional mobile stations for testing a base station receiver (green: background, red: user)



Display of 3GPP FDD menu and code domain



Change of modulation and different power levels in each slot for GSM/EDGE

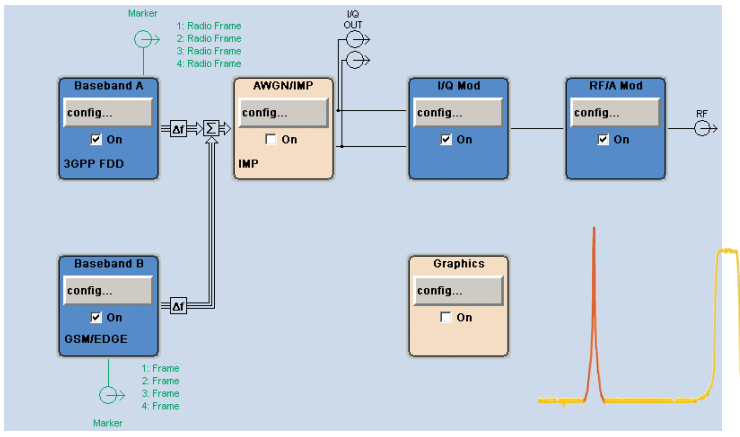
Unrivalled flexibility (continued)

All the strengths of the two-path concept of the R&S SMU200A become specially evident in the field of mobile radio. Since the baseband section of the R&S SMU200A is fully digital, the signals of the two baseband generators can be easily added without synchronization problems and without an external coupler or additional equipment being required. A frequency offset and the relative power of each signal can be accurately set.

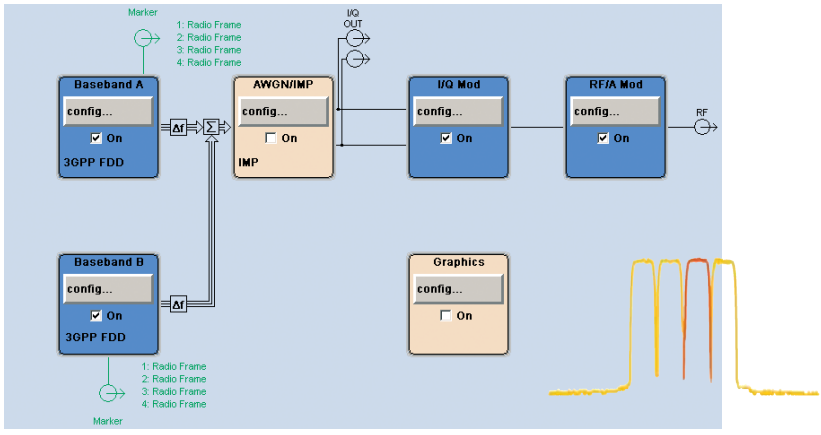
One baseband generator may be used for generating the 3GPP signal in realtime. The second baseband generator produces a realtime GSM/EDGE signal. The signals can then be added in the digital domain with a frequency offset, if desired. This allows modern multistandard base stations to be tested, for instance.

For receiver tests in multicarrier base stations with complex interfering signals, one baseband generator can produce the test signal to be evaluated. The second baseband generator produces a suitable multicarrier signal to be used as the background signal. Two transmit antennas (the transmit diversity) of a base station can also be simulated. Up to now, two signal generators have been required in this case, but only one instrument is needed when the R&S SMU200A is used.

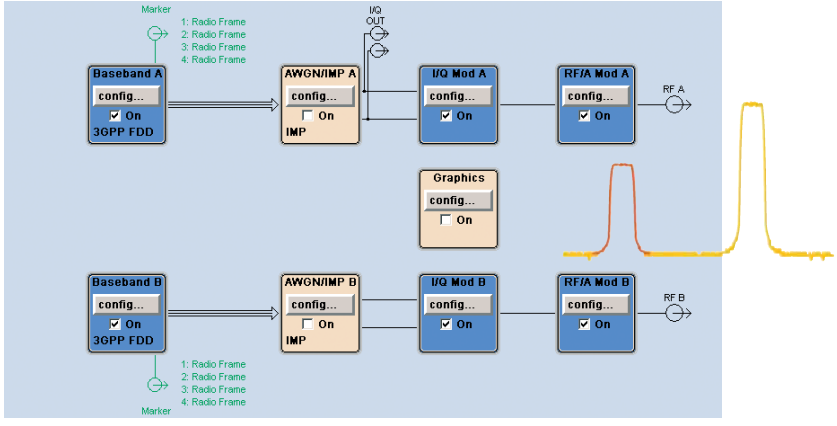
If the RF section is furthermore equipped with two paths, any requirement can be met. For instance, the wanted signal and the interfering signal needed for receiver tests can be generated with *one* instrument – even if the signals greatly differ in power and frequency offset as is the case when out-of-band blocking measurements are to be performed.



Generation of 3GPP and GSM/EDGE signals in realtime



Adding a realtime signal and a multicarrier signal



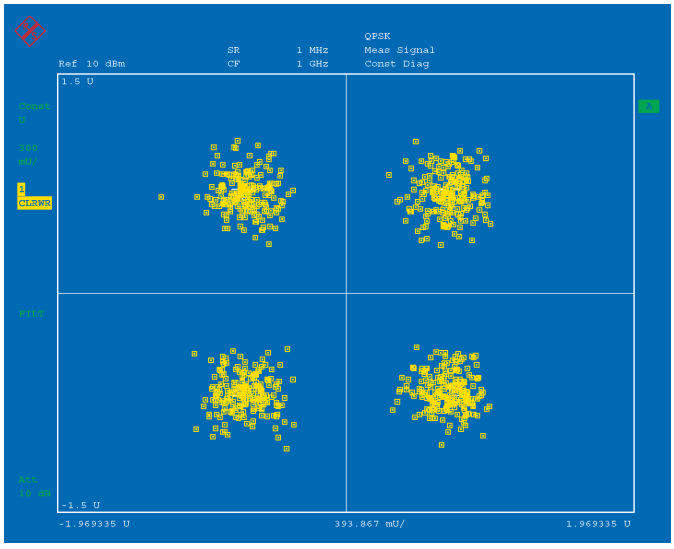
Generation of wanted signal and interfering signal

When receivers are tested, it must be possible to simulate real receive conditions. In the R&S SMU200A, additive white Gaussian noise (AWGN) can be superimposed on the wanted signal. The signal-to-noise ratio can be set in a wide range. Thus, highly accurate sensitivity measurements can be performed on receivers with a defined S/N ratio, in compliance with 3GPP specifications TS 25.141 and TS 25.101.

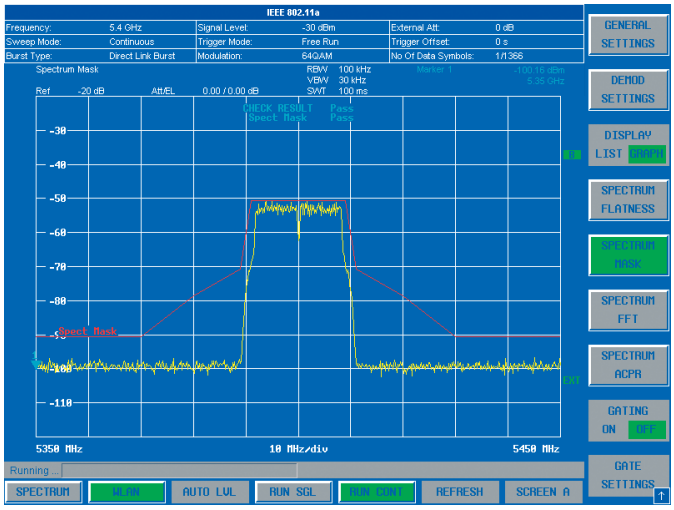
The internal arbitrary waveform generator (ARB) with its large 56 Msample memory for I and Q (and 4 marker bits per sample) and a clock rate of 100 Msample/s offers ideal conditions for generating complex signal scenarios. Due to the implemented hardware resampling, lower oversampling rates can be used so that less memory is required for storing waveforms. Therefore longer sequences are possible. The built-in 20 Gbyte hard disk allows a large number of generated signals to be stored. Externally generated signals can also be directly transmitted to the internal hard disk via IEEE bus and LAN.

The internal arbitrary waveform generator of the R&S SMU200A is supported by Simulation Software R&S WinIQSIM™. With R&S WinIQSIM™, signals can be easily generated for WLAN systems such as IEEE 802.11a/b/g, TDMA systems such as GSM/EDGE and even complex CDMA systems such as TD-SCDMA. Multicarrier signals can also be generated.

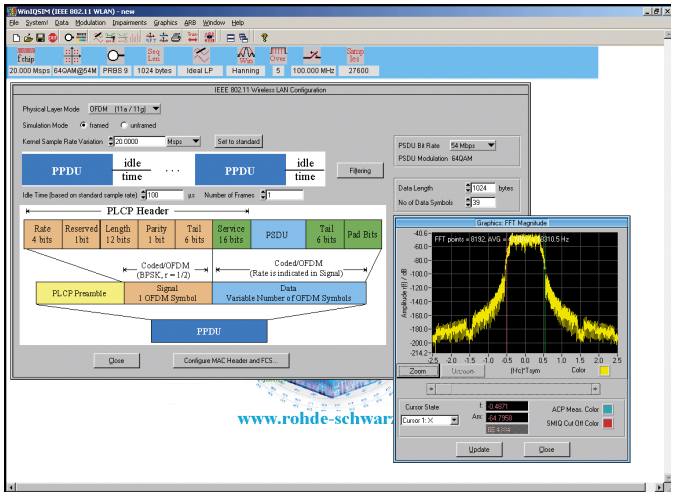
For more information refer to the data sheet for Simulation Software R&S WinIQSIM™ (PD 0757.6940).



Constellation diagram of a noisy signal



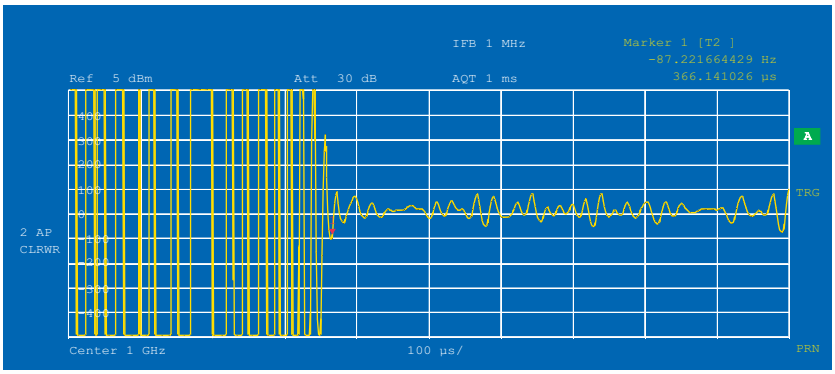
802.11a signal generated by the ARB (measured with the R&S FSQ)



Simulation Software R&S WinIQSIM™

Ideal for production

Short turnaround times and short test times are important particularly for automatic test sequences in production. Short setting times of a signal generator mean money in hand. The R&S SMU200A with its very short frequency setting time of <3 ms meets all requirements. In the List mode, where frequency variations have previously been stored in a list, the setting time is reduced to <450 µs. A built-in electronic attenuator ensures wear-and-tear-free switching. This prevents downtimes for replacing mechanical attenuators.



Setting time after frequency change in List mode (frequency deviation versus time)

Space is precious in production and this has also been taken into account. The R&S SMU200A combines two independent signal generators in one cabinet of only four height units. This reduces the space occupied in the rack to only half the space required by conventional signal generators.

The R&S SMU200A saves space in racks

Connectivity

Front panel

An external keyboard and a mouse or memory stick can be plugged to the USB connectors ① on the front panel.

Two marker outputs ② that can be used as required and a trigger input ③ are available in addition.

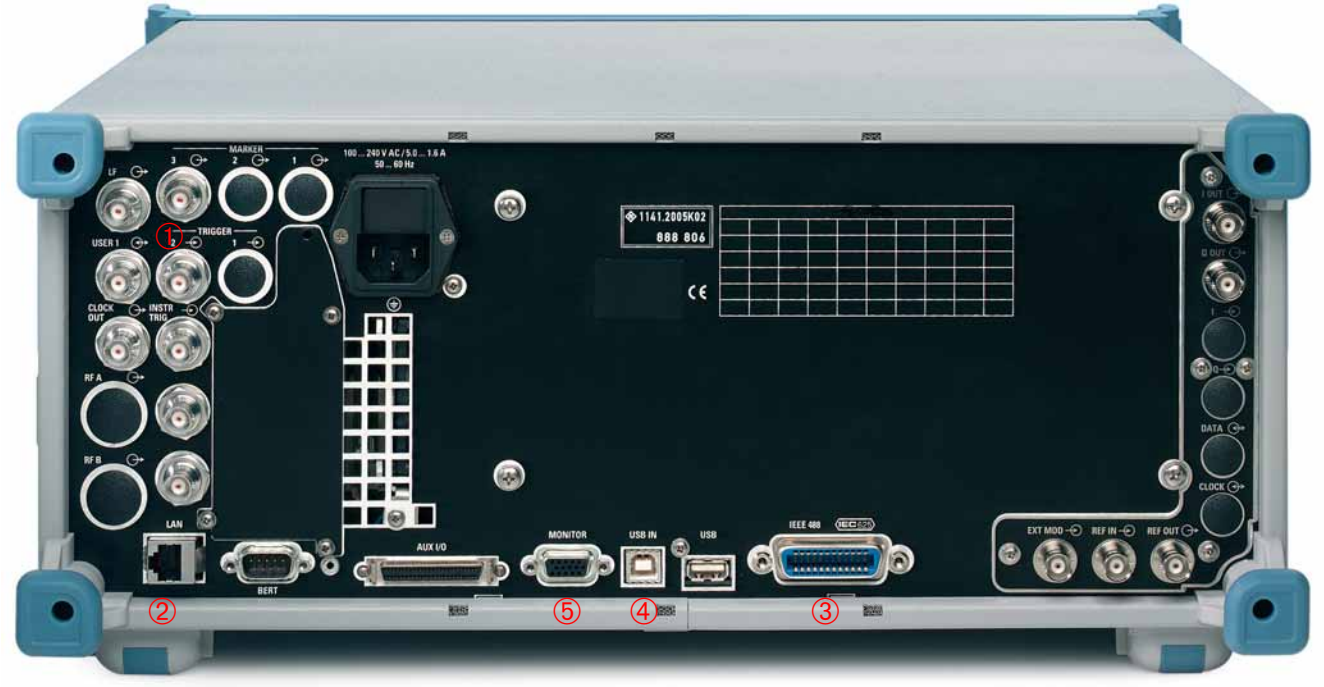
Rear panel

Additional marker and trigger connectors ①, a LAN (100BaseT) ② and a GPIB ③ interface as well as a USB slave connector ④ are available at the rear. Using the slave connector, the R&S SMU200A can be directly connected to a PC, e.g. for loading firmware updates in a fast and convenient way. Even modulation data from a PC can be fed in via this connector. An external monitor or a video beamer can be connected to the VGA connector ⑤.

Remote control of the R&S SMU200A via IEEE bus or LAN

Remote control

The R&S SMU200A is remote-controlled via GPIB or LAN. When the Windows Remote Desktop is used, the instrument can be remote-controlled from a PC.



Modular design

Future-oriented

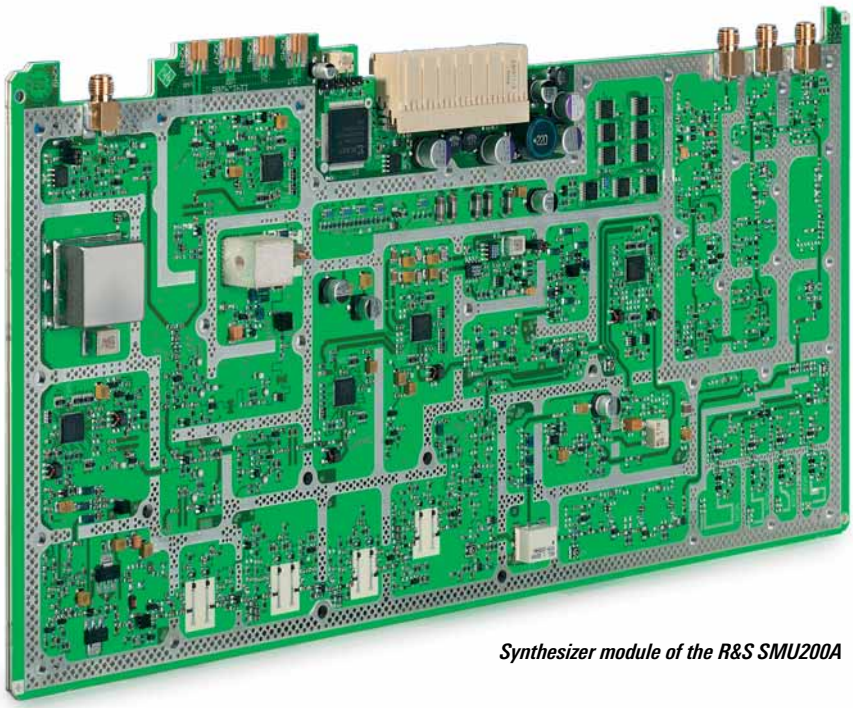
Owing to its modular design, the R&S SMU200A is a safe investment. Options can be added any time. This concept allows the R&S SMU200A to be tailored to specific applications. The user need not pay for functions not required.

Convenient service

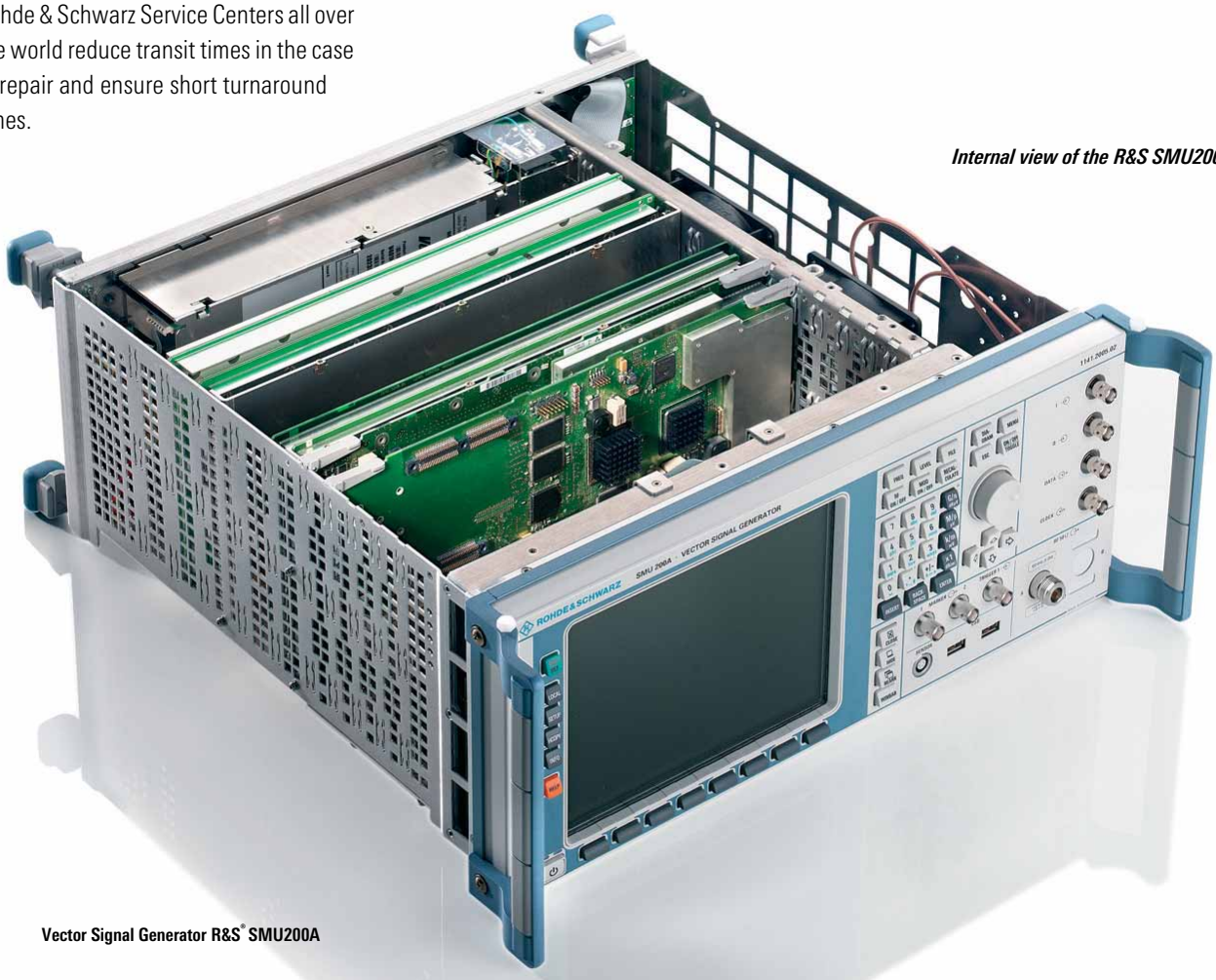
"Low cost of ownership" is more than just a motto – it is a fully fledged concept. The three-year calibration cycle considerably reduces costs.

A thermal management with oversized fans combined with large-scale integration ensures high reliability even under adverse environmental conditions.

Rohde & Schwarz Service Centers all over the world reduce transit times in the case of repair and ensure short turnaround times.



Synthesizer module of the R&S SMU200A



Internal view of the R&S SMU200A

Specification summary

Frequency	
Frequency range	100 kHz to 2.2 GHz / 3 GHz / 4 GHz / 6 GHz
Setting time	<3 ms
Setting time in List mode	<450 µs
Level	
Range	–145 dBm to +13 dBm (PEP, 3 GHz)
Range with high-power output option	–145 dBm to +19 dBm (PEP, 3 GHz)
Spectral purity (at f = 1 GHz)	
Nonharmonics Carrier offset >10 kHz Carrier offset >850 kHz	 <–80 dBc <–86 dBc
SSB phase noise (20 kHz carrier offset, 1 Hz measurement bandwidth)	typ. –135 dBc
Wideband noise (carrier offset >5 MHz, 1 Hz measurement bandwidth)	typ. –153 dBc (CW) typ. –149 dBc (I/Q modulation)
ACLR	
3GPP test model 1, 64 DPCH	typ. 70 dB
RF modulation bandwidth	
using external I/Q inputs	200 MHz
using internal baseband section	80 MHz
Supported modulation types	
AM	DC to 500 kHz
Pulse	0 to 100 kHz
ASK	0 to 100 %
FSK	MSK, 2FSK, 4FSK
PSK	BPSK, QPSK, OQPSK, π/2 DBPSK, π/4 DQPSK, π/8 D8PSK, π/4 QPSK, 8PSK, 8PSK EDGE
QAM	16QAM, 32QAM, 64QAM, 256QAM, 1024QAM
Supported standards and digital systems	GSM/EDGE, 3GPP FDD, 3GPP TDD, TD-SCDMA, cdmaOne, cdma2000, 1xEV-DO, IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, TETRA, Bluetooth®, AWGN, user-defined multicarrier CW
Interfaces	IEEE 488.2, LAN (100BaseT), 3 × USB, 1 × USB slave, VGA

For specifications see PD 0758.0197.22
and www.rohde-schwarz.com
(search term: SMU)

Ordering information

Vector Signal Generator[1]	R&S SMU200A	1141.2005.02
including power cable, Quick Start Guide and CD-ROM (with operating and service manual)		
Options		
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
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 (56 Msample) and Digital Modulation (realtime)	R&S SMU-B10	1141.7007.02
Baseband Main Module	R&S SMU-B13	1141.8003.02
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
Multicarrier CW Signal Generation	R&S SMU-K61	1160.8505.02
Digital modulation systems using R&S WinIQSIM‰ [2]		
Digital Standard IS-95 (with R&S WinIQSIM™)	R&S SMU-K11	1160.5335.02
Digital Standard cdma2000 (with R&S WinIQSIM™)	R&S SMU-K12	1160.5658.02
Digital Standard 3GPP TDD (with R&S WinIQSIM™)	R&S SMU-K13	1160.5906.02
Digital Standard TD-SCDMA (with R&S WinIQSIM™)	R&S SMU-K14	1160.6202.02
User-Defined OFDM Signals (with R&S WinIQSIM™ and R&S WinIQOFDM)	R&S SMU-K15	1160.6402.02
Digital Standard 1xEV-DO (with R&S WinIQSIM™)	R&S SMU-K17	1160.7009.02
Digital Standard IEEE 802.11 (a/b/g) (with R&S WinIQSIM™)	R&S SMU-K19	1160.8805.02
Noise		
Additive White Gaussian Noise (AWGN)	R&S SMU-K62	1159.8511.02
Recommended extras		
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 Board 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

[1] The base unit can only be ordered together with an R&S SMU-B10x frequency option.

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

ROHDE&SCHWARZ

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PD 0758.0197.12 · Vector Signal Generator R&S® SMU200A · Version 01.01 · December 2003 · Data without tolerance limits is not binding · Subject to change

Specifications

Version 01.00

September 2003

Vector Signal Generator R&S® SMU 200A

Specifications

ROHDE&SCHWARZ

CONTENTS

Introduction

The Vector Signal Generator R&S SMU200A has been designed to meet all requirements encountered in research and development of modern communication systems as well as in their production. The R&S SMU200A not only combines two independent signal generators in one cabinet of only four height units, it also offers unrivalled 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. Frequency options with upper frequency limits of 2.2 GHz and 3 GHz are available for the second RF path. 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 real-time and are equipped with an arbitrary waveform generator with 56 Msample memory for I and Q and 4 marker bits per sample (256 Mbyte). The signals generated in the different basebands can be added. Frequency offset of the individual signals is possible.

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
- Second RF path up to 2.2 GHz or 3 GHz
- Two complete baseband paths
- Lossless combination of baseband signals in the digital domain (e.g. for testing multistandard base stations)

Intuitive operation

- Colour 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 up to +19 dBm (PEP), overrange +26 dBm
- High-stability reference oscillator as standard

Unrivalled flexibility

- Four code channels in real-time for 3GPP FDD
- Change of modulation from slot to slot for GSM/EDGE
- Baseband generator with universal coder for real-time signal generation
- Arbitrary waveform generator with 56 Msample for I and Q and 4 marker bits per sample (256 Mbyte)
- 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 µs 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

- Can be remote-controlled via GPIB and LAN
- USB connectors for keyboard, mouse and memory stick
- User-selectable trigger and marker signals

Specifications

Specifications are valid 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 are not binding.

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.

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

RF options

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

R&S SMU-B30 and R&S SMU-B33 are not compatible with frequency options R&S SMU-B104, 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, vector modulation, digital modulation via internal baseband section (optional), pulse modulation, wideband amplitude modulation

RF path B

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

Simultaneous modulation

On the same RF path

	Amplitude modulation	Vector modulation	Digital modulation	Pulse modulation	Wideband AM
Amplitude modulation		X	X	V	X
Vector modulation	X		X	V	X
Digital modulation	X	X		(v)*	X
Pulse modulation	V	V	(v)*		V
Wideband AM	X	X	X	V	

V = compatible, X = not compatible, (v)* not with slot attenuation

Pulse modulation and slot attenuation only in case of ALC state auto.

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	5 µHz
Setting time	To within $<1 \cdot 10^{-7}$ for f >200 MHz or <124 Hz for f <200 MHz after IEC/IEEE bus delimiter in ALC OFF MODE S&H after trigger pulse in List mode	 <3 ms <5 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

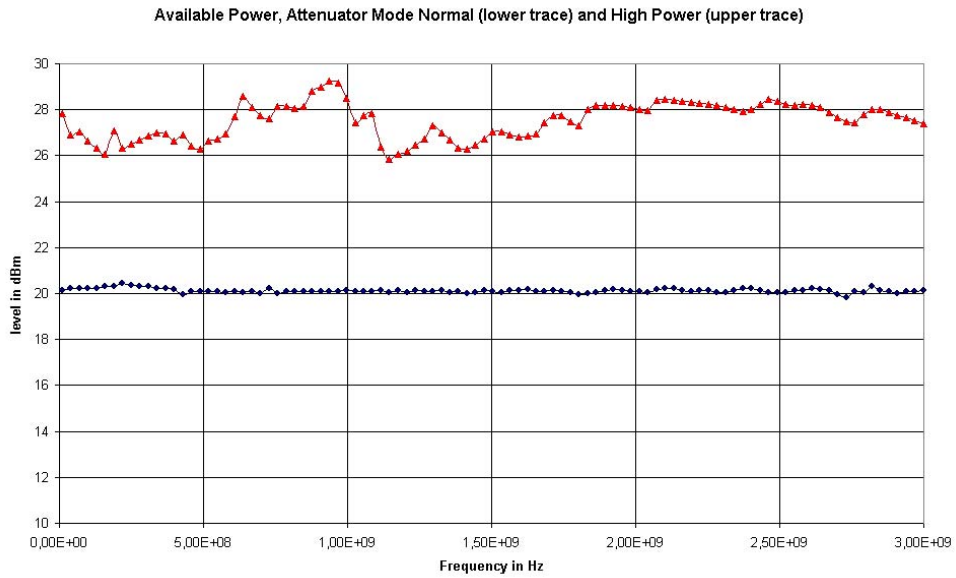
Aging	After 30 days uninterrupted operation	$<1 \cdot 10^{-9}$/day
Temperature effect	In operating temperature range	$<6 \cdot 10^{-8}$
Warm-up time	To nominal thermostat temperature	≤10 min
Output for internal reference signal	Frequency (approx. sinewave) Level Source impedance	10 MHz or external input frequency Typ. 5 dBm 50 Ω
Input for external reference	Frequency Maximum deviation Input level, limits recommended Input impedance	5, 10 or 13 MHz $3 \cdot 10^{-6}$ ≥–6 dBm, ≤19 dBm 0 dBm to 19 dBm 50 Ω
Electronic tuning from input AUX I/O	Steepness Input voltage Input impedance	$1 \cdot 10^{-8}$/V –10 to +10 V 10 kΩ

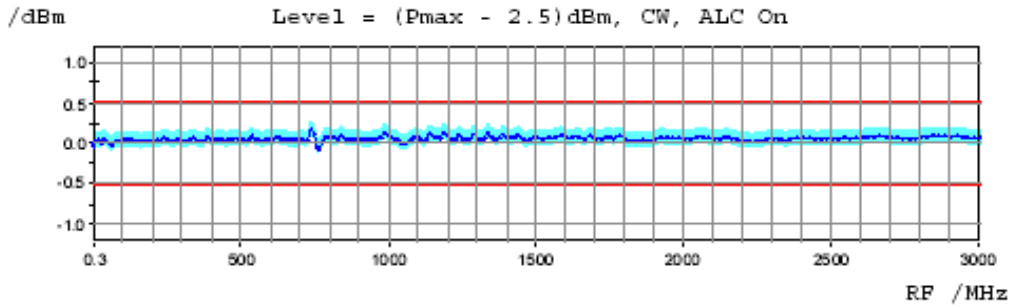
Level

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)[1] +19 dBm (PEP)
Maximum level with frequency options over 3 GHz	Standard With option R&S SMU-B31 or -B36	+11 dBm (PEP) +17 dBm (PEP)
Resolution		0.01 dB
Level accuracy	For levels >−120 dBm, attenuator mode "auto", temperature range 18 to 33 °C f ≤3 GHz f >3 GHz	 <0.5 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
	ALC state ON, with Options B31/B36 frequency options up to 3 GHz attenuator mode "normal" attenuator mode "high power" frequency options over 3 GHz attenuator mode "high power" attenautor mode "normal", f ≤3 GHz attenautor 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	After IEC/IEEE bus delimiter, to <0.3 dB deviation from final value ALC state OFF Range switch-over with option R&S SMU-B31, -B32, -B36 or -B37	 <3 ms <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-B102, -B103, -B202, -B203	Maximum permissible RF power in output frequency range of RF path Maximum permissible DC voltage with option SMU-B31 switched on	 1 W for max. 1 ms 0.5 W continuous 20 V 7 V
Back-feed (from ≥50 Ω source) with R&S SMU-B104, -B106	Maximum permissible RF power in output frequency range of RF path Maximum permissible DC voltage , with option SMU-B36 switched on	 0.5 W 10 V 7 V

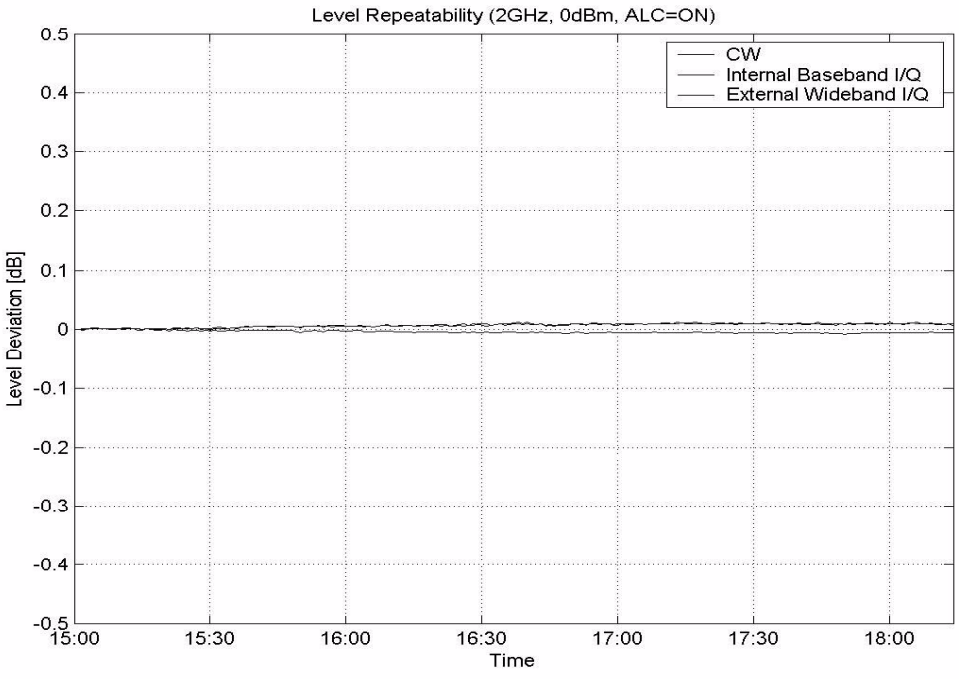
[1] PEP = peak envelope power

Measured level data





Measured level vs. frequency at 0.0 dBm



Level repeatability with random settings between measurements, modulation 3GPP test model 1, 64 channels

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
	With option R&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 at attenuator mode "auto".	

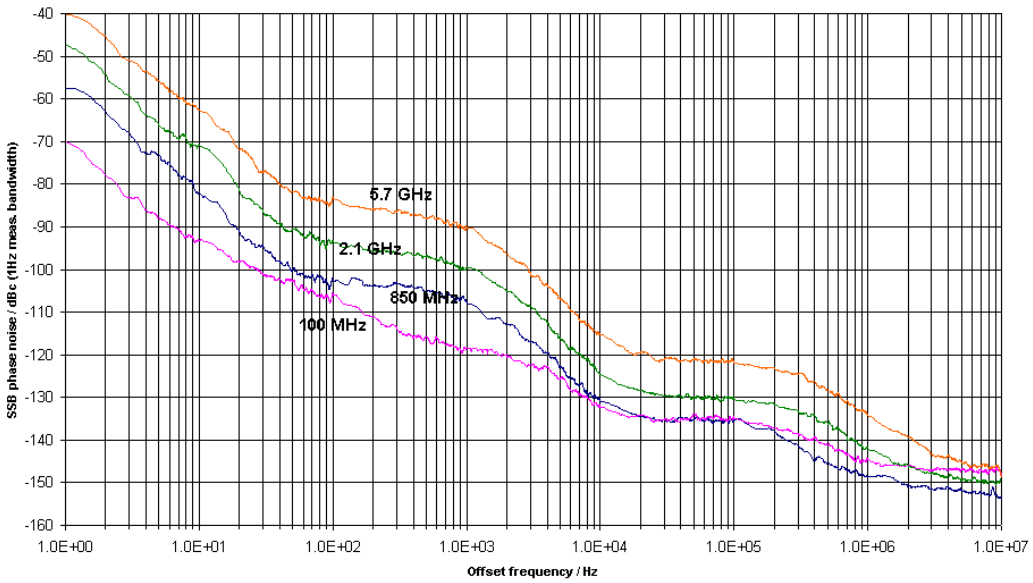
Overvoltage protection (option R&S SMU-B30 / -B32 / -B35 or -B37)

Protects the instrument against externally applied RF power from a 50 Ω source. Not available with options SMU-B104 and SMU-B106.		
Maximum permissible RF power	In the output frequency range of the RF path	50 W
Maximum permissible DC voltage		35 V
If an overvoltage protection option is installed, the output impedance (VSWR) in the respective RF path deteriorates.		
VSWR	up to 3 GHz, attenautor mode "normal"	<1.8. typ. <1.6

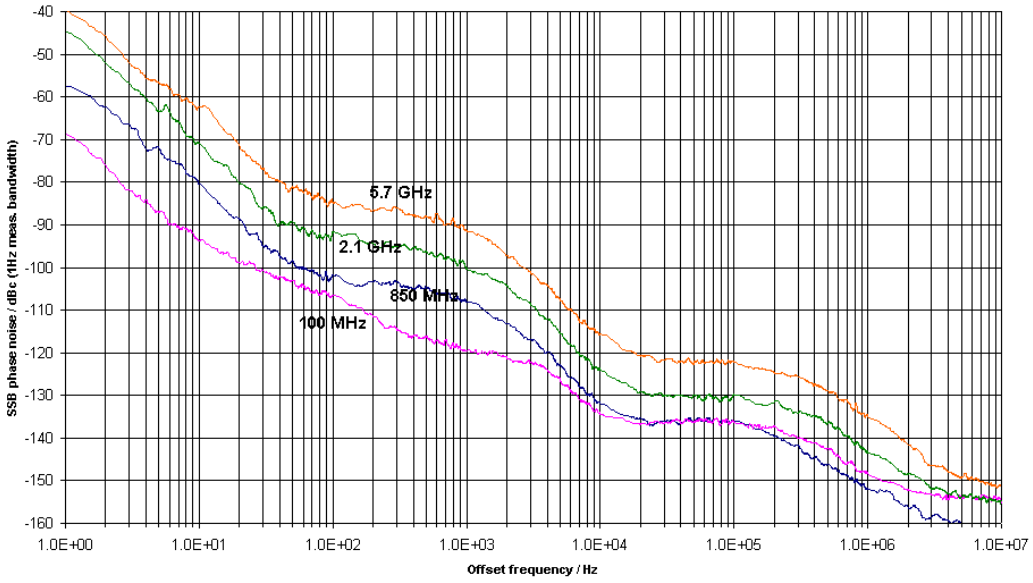
Spectral purity

Harmonics	With R&S SMU-B102/-B103/-B202/-B203 Levels ≤8 dBm , CW Levels ≤12 dBm with option R&S SMU-B31/-B32/ -B36 -B37, attenuator mode "high power" With R&S SMU-B104/-B106 Levels ≤6 dBm, CW Levels ≤10 dBm with options R&S SMU-B31 or -B36, attenuator mode "high power"	 <–30 dBc <–30 dBc <–30 dBc <–30 dBc
Nonharmonics	CW, vector modulation (full-scale input), >10 kHz offset from carrier and outside the modulation spectrum 0.3 MHz ≤ f ≤ 200 MHz 200 MHz < f ≤ 1500 MHz 1500 MHz < f ≤ 3000 MHz f > 3000 MHz >850 kHz offset from carrier and outside the modulation spectrum 0.3 MHz ≤ f ≤ 200 MHz 200 MHz < f ≤ 1500 MHz 1500 MHz < f ≤ 3000 MHz f > 3000 MHz	 <–77 dBc <–80 dBc <–74 dBc <–68 dBc <–77 dBc <–86 dBc <–86 dBc <–78 dBc
Subharmonics	f >1.5 to 3.0 GHz f >3.0 GHz to 6.0 GHz	<–74 dBc <–50 dBc
Wideband noise	Carrier offset >5 MHz, measurement bandwidth 1 Hz, CW 20 MHz ≤ f ≤ 200 MHz 200 MHz < f ≤ 1500 MHz 1.5 GHz < f ≤ 3 GHz f > 3 GHz Vector modulation with full-scale dc input, I/Q input gain 3 dB 20 MHz ≤ f ≤ 200 MHz 200 MHz < f ≤ 1500 MHz 1.5 GHz < f ≤ 3 GHz f > 3 GHz	 <–146 dBc (typ. –149 dBc) <–150 dBc (typ. –153 dBc) <–150 dBc (typ. –153 dBc) <–146 dBc (typ. –149 dBc) <–143 dBc (typ. –146 dBc) <–146 dBc (typ. –149 dBc) <–146 dBc (typ. –149 dBc) <–143 dBc (typ. –146 dBc)
SSB phase noise	Carrier offset 20 kHz, measurement bandwidth 1 Hz, unmodulated 20 MHz ≤ f ≤ 200 MHz f = 1 GHz f = 2 GHz f = 3 GHz f = 4 GHz f = 6 GHz	 <–128 dBc (typ. –132 dBc) <–131 dBc (typ. –135 dBc) <–125 dBc (typ. –129 dBc) <–121 dBc (typ. –125 dBc) <–119 dBc (typ. –123 dBc) <–115 dBc (typ. –119 dBc)
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)



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		2000
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 accuracy		<0.012 Hz + 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 (Vp) 1 V	<0.1%
Output voltage	V_p at LF connector, R_L >200 Ω Resolution Setting accuracy at 1 kHz	1 mV to 3 V 1 mV <(V·1% + 1 mV)
Output impedance		16 Ω
Frequency setting time	To within $<1*10^{-7}$, 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/deviation)	>10 kΩ 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 accuracy	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 response	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

Pulse modulation

Operating modes		External, internal (duty cycle ca. 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	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

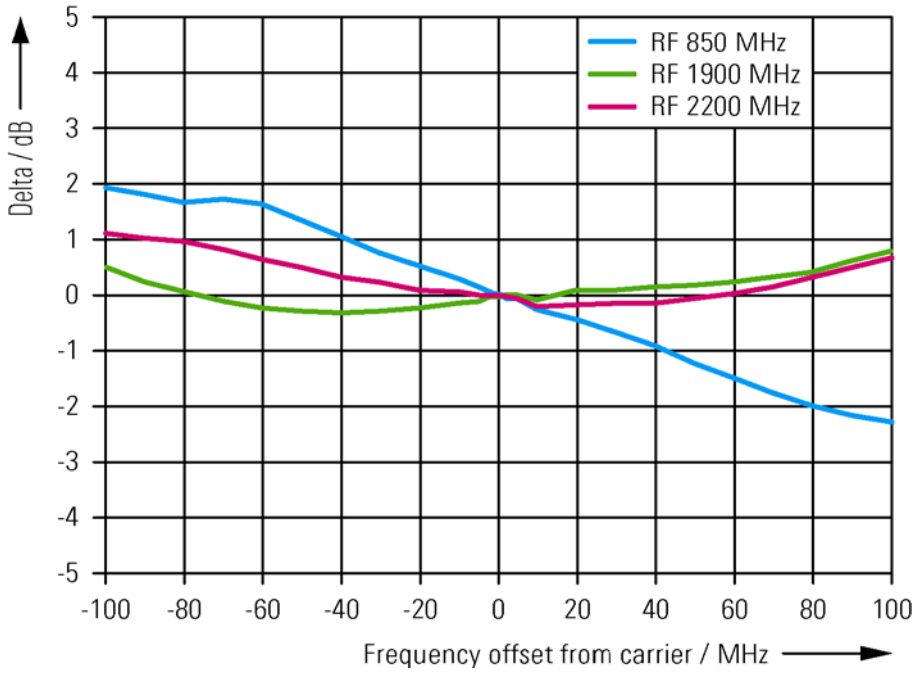
External wideband I/Q

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 $\sqrt{U_i^2 + U_q^2}$ = 0.5 V 0.1 V
Modulation frequency range [2]		100 MHz
Carrier leakage	Without input signal, referenced to full-scale input [3]	<–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] IQ Wideband on.

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



Frequency response of external wideband I/Q

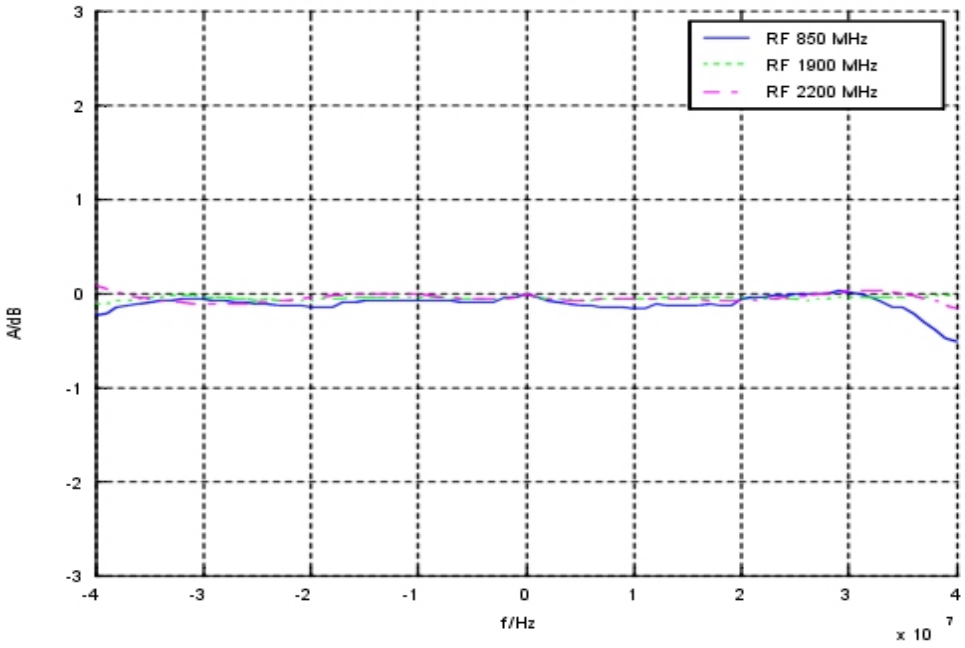
Internal baseband I/Q (with option R&S SMU-B13)

Option R&S SMU-B13 converts the internal digital baseband signals of 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 [4]	Up to 10 MHz Up to 40 MHz	<0.5 dB, typ 0.2 dB <2 dB, typ. 0.5 dB
Suppression of image sideband for entire instrument in modulation bandwidth [5]	Up to 10 MHz Up to 40 MHz	>50 dB, typ. 56 dB >40 dB, typ. 50 dB
Carrier leakage	Referenced to full-scale [5]	<–55 dBc, typ. <–65 dBc

[4] IQ Wideband on, Optimize internal I/Q Impairments for RF Output on.

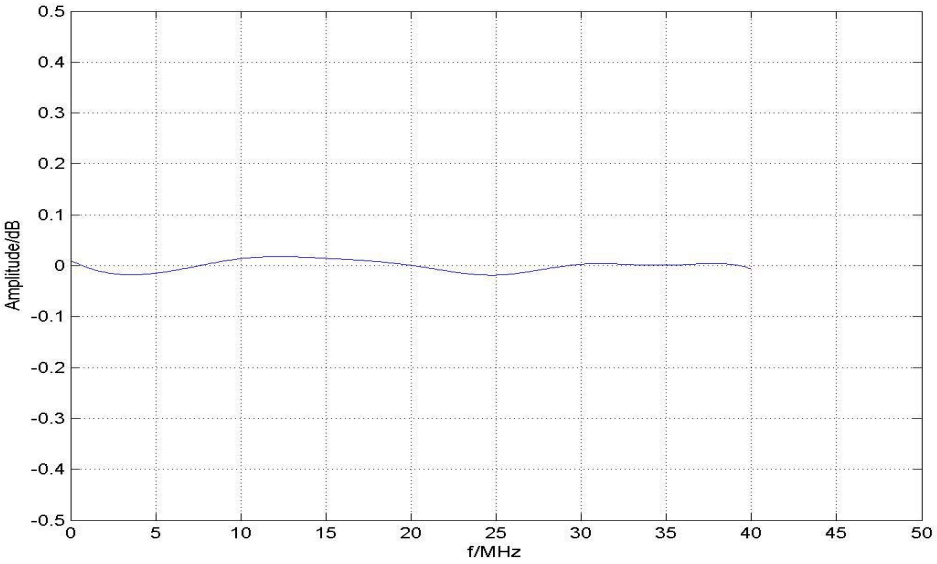
[5] Value applies after 1 hour warmup and recalibration for 4 hours operation and temperature variations of less than 5°C.



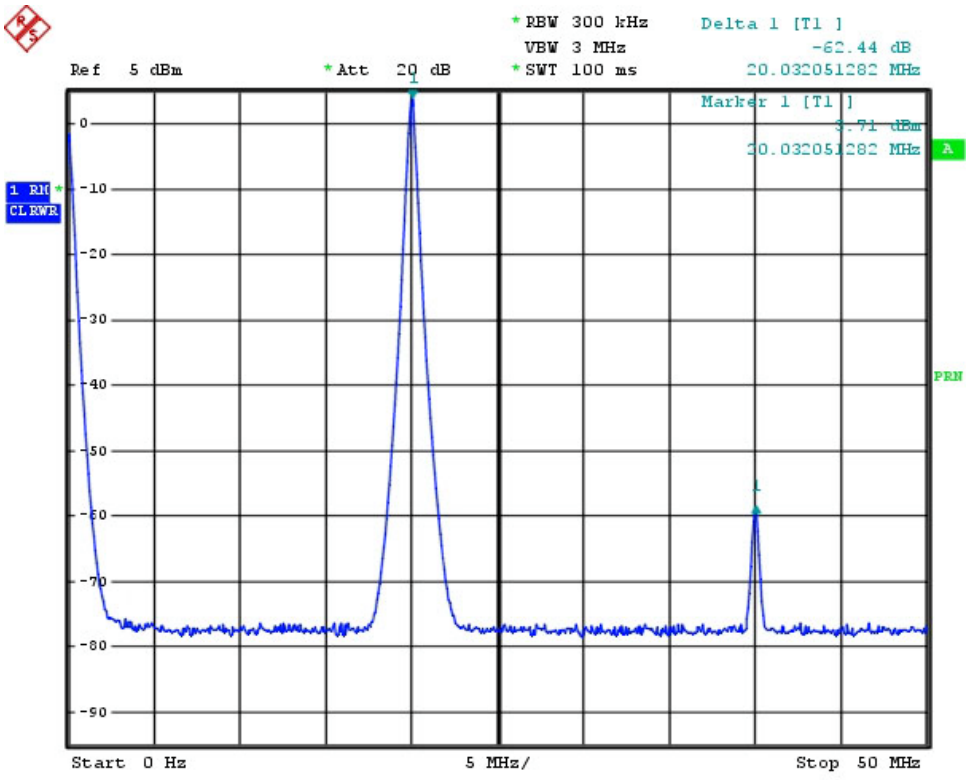
Frequency response of internal baseband I/Q

I/Q outputs		
Output impedance		50 Ω
Output voltage	At R_L = 50 Ω, the output voltage depends on the set modulation signal	0.5 V_p
Offset		<0.5 mV
Frequency response[6]	Magnitude up to 10 MHz up to 40 MHz Group delay up to 10 MHz up to 30 MHz	 typ.0.02 dB typ. 0.05 dB typ. 200 ps typ. 300 ps
I/Q balance[6]	Magnitude up to 10 MHz up to 40 MHz Group delay up to 10 MHz up to 30 MHz	 typ. 0.01 dB typ. 0.03 dB typ. 50 ps typ. 50 ps
Spectral purity	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

[6] Optimize internal I/Q Impairments for RF Output switched off.



Frequency response of I/Q outputs



SFDR of I/Q outputs

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

At least one Baseband Main Module R&S SMU-B13 must be installed. One or two R&S SMU-B10 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 Resolution Loading time 10 Msample Nonvolatile memory	 512 sample to 56 Msample in one-sample steps 16 bit 15 s Hard disk
Clock generation	Clock rate Resolution Operating mode Frequency accuracy (internal)	400 Hz to 100 MHz 0.001 Hz Internal, external < $5*10^{-14}$ *clock rate + accuracy of reference frequency
Interpolation	The sampling rate of the waveform is automatically interpolated to the internal 100 MHz data rate. At a sampling rate of 100 MHz, interpolation can be switched off, which increases the bandwidth. 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
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 accuracy	 –40 MHz to +40 MHz 0.01 Hz <$5*10^{-10}$ *frequency offset + ref. frequ. error
Triggering	In clock mode internal, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In clock mode external the trigger event is synchronized to the symbol clock. Operating mode Modes Setting accuracy for clock phase related to the trigger in clock mode intern External trigger delay Setting range Resolution Clock Mode intern Clock Mode extern Setting accuracy 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 Unchanged, Restart, Pulse, Pattern, Ratio Marker delay Setting range Setting range without recalculation Resolution of setting Setting accuracy	4 LVTTL 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 R&S SMU-B10.		

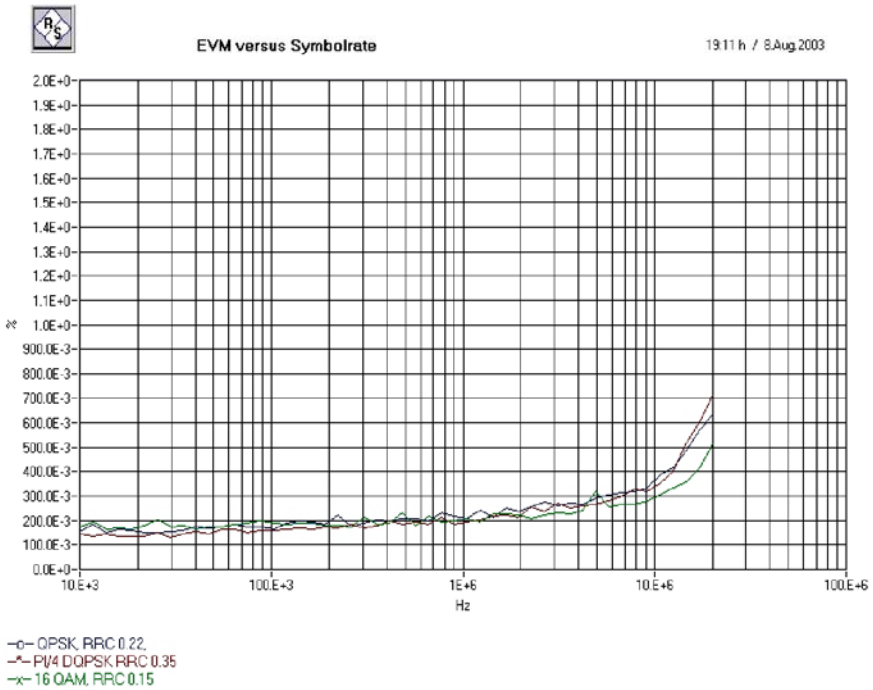
I/Q baseband generator (option R&S SMU-B10) – real-time operation

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

Types of modulation	ASK Modulation index Resolution FSK Deviation Maximum Resolution Setting accuracy 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, 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 data rate may deviate from the set clock 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 accuracy (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 accuracy symbol-, K*symbol-, bit clock 1 to 64 Max. 100 MHz

Frequency offset	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. Setting range Resolution Frequency uncertainty	 –40 MHz to +40 MHz 0.01 Hz <5*10^{-10} *frequency offset + reference frequency error
Data sources	**Internal** ALL 0, ALL 1 PRBS Sequence length Pattern Length Data lists Output memory 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 USB Word width Data rate	 9, 11, 15, 16, 20, 21, 23 1 to 64 bit 8 bit to 2 Gbit Hard disk 1 to 10 bit max. 60 MHz 1 to 10 bit max. 25 MHz 1 to 10 bit max. 2 Mbit/s
Triggering	In clock mode internal, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In clock mode external the trigger event is synchronized to the symbol clock. Operating mode Modes Setting accuracy for clock phase related to the trigger in clock mode intern External trigger delay Setting range Resolution Clock Mode intern Clock Mode extern Setting accuracy 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 Control list, Restart, Pulse, Pattern, Ratio Marker delay (in sample) Setting range Setting range without recalculation Resolution of setting Setting error	4 LVTTL 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 2.50 V 0.01 V
Clock / data outputs	Level	LVTTL
Predefined settings	Modulation, filter, symbol rate and coding to standard Standards	 Bluetooth™, 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%



Typical EVM versus symbol rate

Modulation accuracy for main standards

Typical values

Standard	GSM	EDGE	WCDMA 3GPP (1DPCH)	CdmaOne Reverse	DECT	TETRA	NADC	PDC
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
EVM / %	-	0.2	0.3	0.2	-	0.2	0.2	0.2
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 [7]								
In adjacent channel	–37	–38	–72 [8]	–85[9]	-	–74 [10]	–34	–74
In alternate channel	–71	–71	–78 [11]	–89[12]	-	–77 [10]	–80	–82
In 2nd alternate channel	–85	–85	-	–95[13]	-	-	-	-

[7] Level ≤ 10.5 dBm PEP with SMU-B102/103/202/203, ≤ 8.5 dBm PEP with SMU-B104/106.

[8] BB Gain Standard.

[9] 885 kHz offset and 30 kHz bandwidth.

[10] Measured with root cosine filter.

[11] BB Gain Low Noise.

[12] 1.25 MHz offset and 30 kHz bandwidth.

[13] 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 specifications apply 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·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 are possible simultaneously (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 SMU-B10) – real-time operation. Internal data sources External data source (asynchronous)	 All 0 All 1 PRBS 9, 11, 15, 16, 20, 21, 23 Pattern (length 1 to 64 bit) Data list USB
Training sequence	For normal burst (full rate), normal burst (half rate), EDGE burst For sync burst For access burst	TSC0 – 7 User TSC Standard CTS Compact User TS0 – TS2
Trigger	Source Modes	Internal, internal from other baseband, external 1 or 2 Auto, Armed Auto, Retrigger, Armed Retrigger
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	8 PSK EDGE, Gaussian linearized filter, rms	<0.5%, typ. 0.2%
Power density spectrum	Typical values, measured with 30 kHz resolution bandwidth, referenced to level in the band center Without power ramping [14] with 200 kHz offset with 400 kHz offset with 600 kHz offset	 <–34 dB, typ. –37 dB <–68 dB, typ. –71 dB <–80 dB, typ. –85 dB

[14] Level ≤ 10.5 dBm PEP with SMU-B102/103/202/203, ≤ 8.5 dBm PEP with SMU-B104/106.

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 real-time 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 real-time. 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 real-time (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 real-time 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 the downlink and in all channels of mobile station 1 on the uplink: Calculation in real-time, 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	
Real-time component		
WCDMA signal in real-time	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 the 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 SMU, 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 (UE power control steps) Measurement of maximum output power of a mobile (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	 1 DCCH up to 6 DTCHs
	Transport block size	1 to 4096
	Transport blocks	1 to 16
	Rate matching attribute	16 to 1024
	Transport time interval	10 ms, 20 ms, 40 ms, 80 ms
	CRC size	None, 8, 12, 16, 24
	Error protection	None, convolutional coding rate 1/3, convolutional coding rate 1/2, turbo coding rate 1/3
	Interleaver 1/2 state	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-B62) Test of decoder in the 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 rate	 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 rate	 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 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 mobiles 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		
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

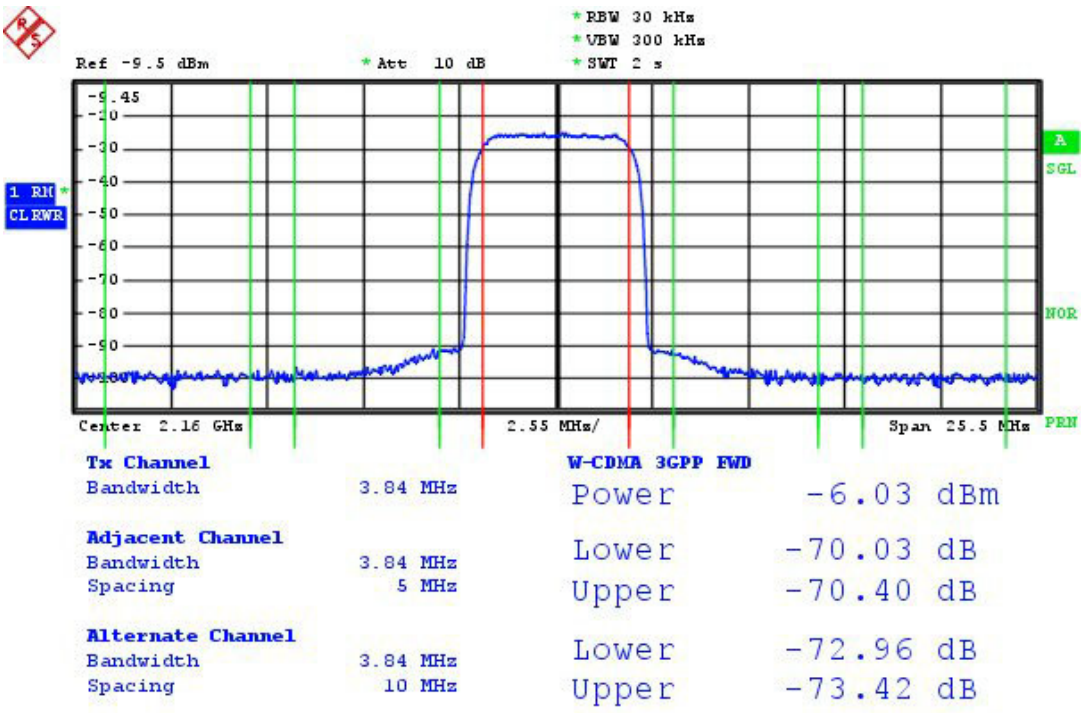
Clipping	Setting of clipping value relative to highest peak in percent. Clipping takes place prior to baseband filtering. Clipping reduces the crest factor. Modes Clipping level	 Vector |i + j q| Scalar |i|, |q| 1% to 100%
Code channels	Downlink: up to 512 data channels (plus special channels) divided 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. Simulation of up to 64 mobile stations in addition to the 4 user-configurable mobile stations.	
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 phys. channel (P-CCPCH) • Secondary common control phys. 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 USB or 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 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

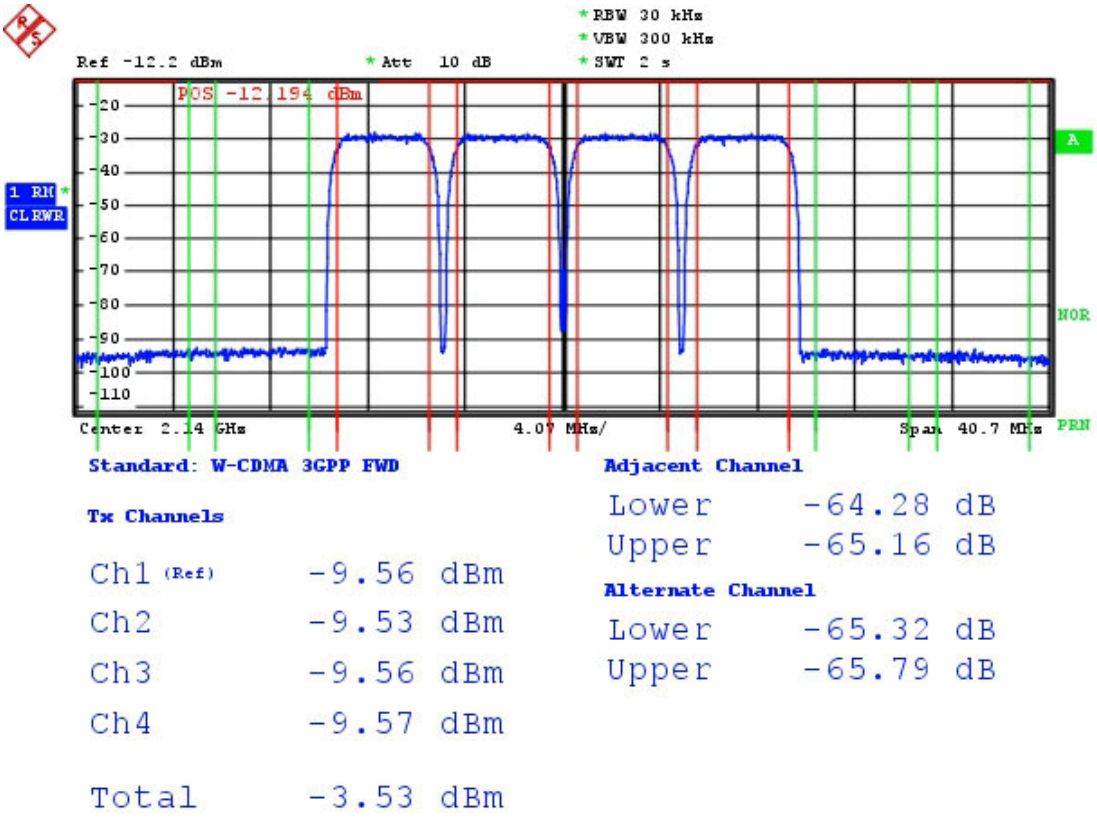
TFCI		0 to 1023
Payload data		PRBS: 9, 11, 15, 16, 20, 21, 23 All 0, All 1, pattern (length 1 to 64 bit), data lists, external USB or LAN (for enhanced channels)
Channel coding	Reference measurement channel for UL RACH to TS 25.141 State Transport block size	 ON/OFF 168, 360
PCPCH Only mode		
Submodes	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 USB or 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 x 960, 3 x 960, 4 x 960, 5 x 960, 6 x 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 USB oer LAN (for enhanced channels)
Graphical display		Domain conflicts, code domain ideal, channel graph, slot structure and formats offered in the graphics block
Error vector magnitude	1 DPCH, rms	<0.8 %, typ. 0.3 %
Adjacent-channel leakage ratio (ACLR)	Test model 1, 64 DPCHs [15] Offset 5 MHz (3GPP ACP) Offset 10 MHz (Low noise)	 >67 dB, typ. 70 dB >72 dB, typ. 74 dB

[15] Level ≤ 10.5 dBm PEP with SMU-B102/103/202/203, ≤ 8.5 dBm PEP with SMU-B104/106.



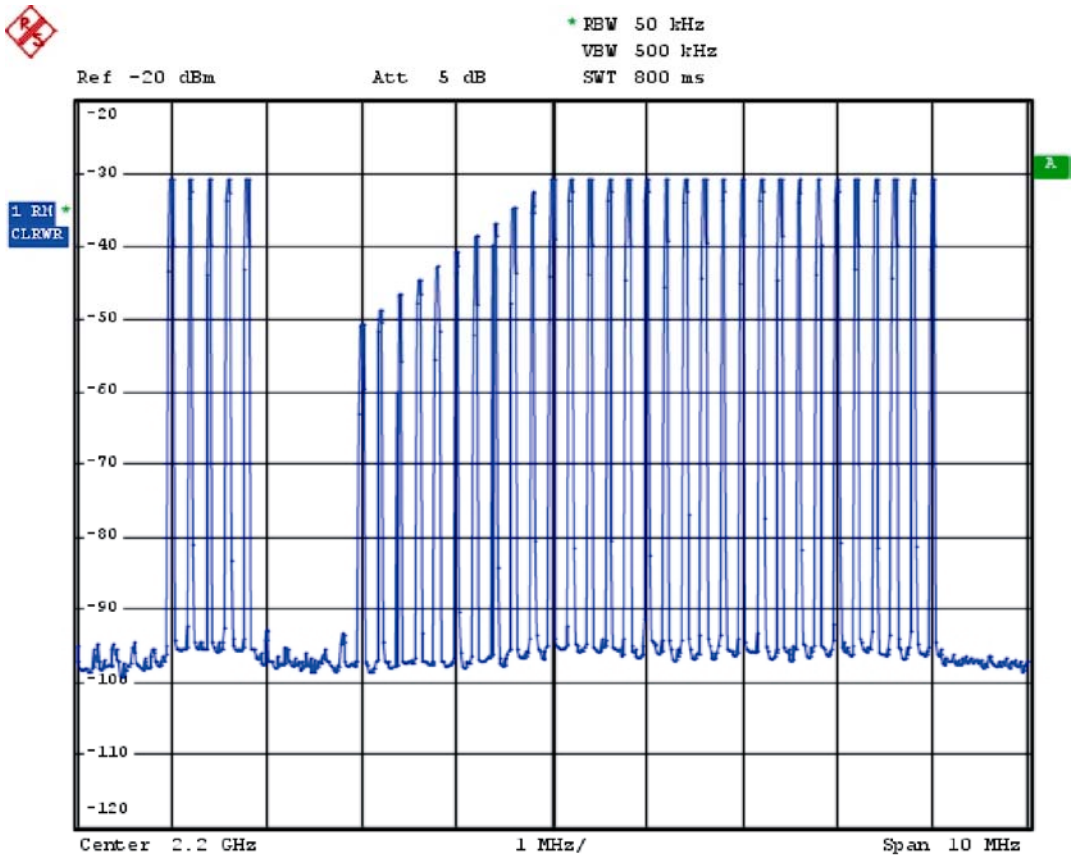
ACLR (mode 3GPP ACP, typical values) for 3GPP Test Model 1, 64 DPCH



ACLR (mode 3GPP ACP, typical values) for a 3GPP four carrier signal with Test Model 1, 64 DPCH on each carrier

Multi carrier CW signal generation (Option SMU-K61)

Signal generation	Simulation of unmodulated multicarrier signals in the arbitrary waveform mode	
Number of carriers		1 to 8192
Carrier spacing	User-settable, maximum spacing depends 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 • Fast: the phases of the individual carriers are set successively such that the power at the position of the previous power maximum is minimized • Slow: iterative variation of carrier start phases until a presettable crest factor is attained	
Trigger	In clock mode internal, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In clock mode external the trigger event is synchronized to the symbol clock. Operating mode Modes Setting accuracy for clock phase related to the trigger in clock mode intern External trigger delay Setting range Resolution Clock Mode intern Clock Mode extern Setting accuracy External trigger inhibit Setting range Resolution External trigger pulse width External trigger frequency	 Internal, external Auto, Retrig, Armed Auto, Armed Retrig Setting accuracy for clock phase related to the trigger in clock mode intern External trigger delay Setting range Resolution Clock Mode intern Clock Mode extern Setting accuracy External trigger inhibit Setting range Resolution External trigger pulse width External trigger frequency
Marker	Number Level Operating modes Unchanged, Restart, Pulse, Pattern, Ratio Marker delay (in sample) Setting range Setting range without recalculation Resolution of setting Setting accuracy	4 LVTTL 0 to waveform length − 1 0 to 2000 0.001 <10 ns
RF Frequency response	Up to 10 MHz Up to 40 MHz	<0.5 dB, typ 0.2 dB <2 dB, typ. 0.5 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 SMU-B10 ARB)

Digital standard cdmaOne (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)

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

Generation of Noise Signals

Additive white Gaussian noise (AWGN, option R&S SMU-BK2)

At least one Baseband Main Module R&S SMU-B13 must be installed. If two R&S SMU-B13 are installed (path 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-B62 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 and C/N <20 dB	−30 to +30 dB 0.1 dB <0.1 dB
System bandwidth	(bandwidth for determining the noise power) Range	 1 kHz to 80 MHz in steps of 2

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	to 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	–40°C to +70°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 460 mm
Weight	When fully equipped	25 kg
Recommended calibration interval		3 years
Standard warranty		3 years

Ordering Information

Vector Signal Generator[16]		R&S SMU200A	1141.2005.02
including power cable, Quick Start Guide and CD-ROM (with operating and service manual)			
Options			
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
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 (56 MSample) and Digital Modulation (real-time)		R&S SMU-B10	1141.7007.02
Baseband Main Module		R&S SMU-B13	1141.8003.02
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
Multicarrier CW Signal Generation		R&S SMU-K61	1160.8505.02
Digital modulation systems using R&S WinIQSIM™[17]			
Digital Standard IS-95	(with R&S WinIQSIM™)	R&S SMU-K11	1160.5335.02
Digital Standard CDMA2000	(with R&S WinIQSIM™)	R&S SMU-K12	1160.5658.02
Digital Standard 3GPP TDD	(with R&S WinIQSIM™)	R&S SMU-K13	1160.5906.02
Digital Standard TD-SCDMA	(with R&S WinIQSIM™)	R&S SMU-K14	1160.6202.02
User-Defined OFDM Signals	(with R&S WinIQSIM™ and R&S WinIQOFDM)	R&S SMU-K15	1160.6402.02
Digital Standard 1xEV-DO	(with R&S WinIQSIM™)	R&S SMU-K17	1160.7009.02
Digital Standard IEEE 802.11 (a/b/g)	(with R&S WinIQSIM™)	R&S SMU-K19	1160.8805.02
Noise			
Additive White Gaussian Noise (AWGN)		R&S SMU-K62	1159.8511.02
Recommended extras			
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

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

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

Product brochure see PD 0758.0197.12
and at www.rohde-schwarz.com
(search term: SMU)

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