Product brochure

Version 01.01

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# Vector Signal Generator R&S® SMU200A

The art of signal generation

ROHDE&SCHWARZ

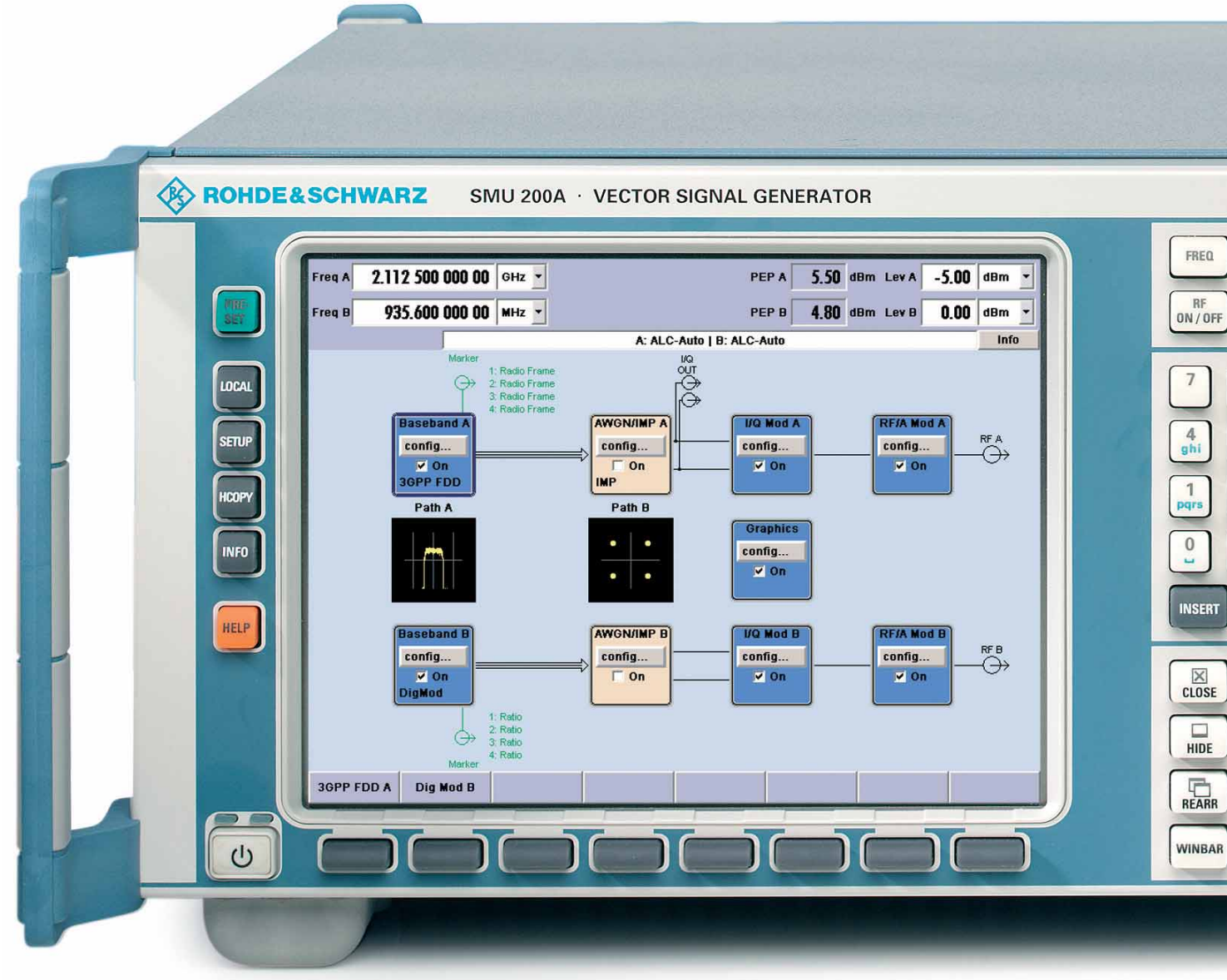
# Highlights of a new generation

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

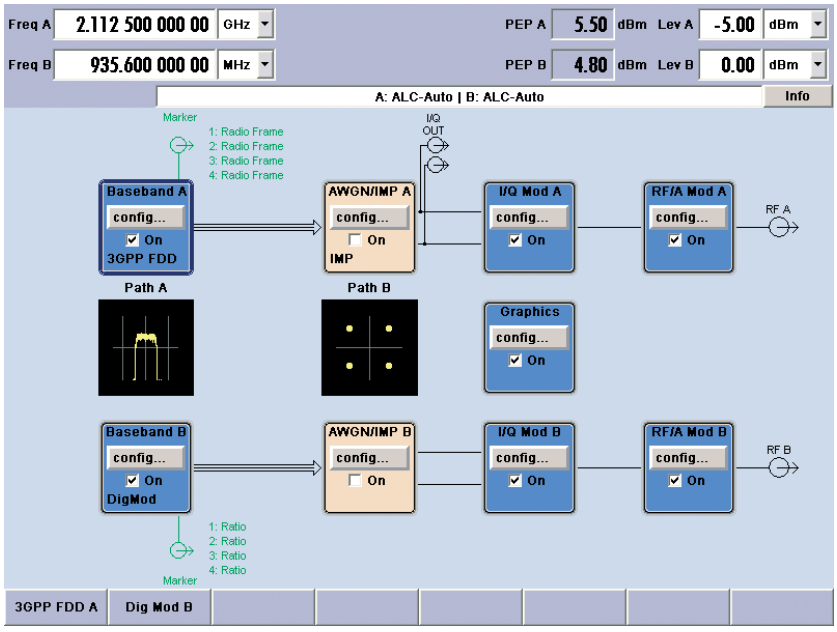
- Can be remote-controlled via GPIB and LAN
- USB connectors for keyboard, mouse and memory stick
- User-selectable trigger and marker signals

# Intuitive operation

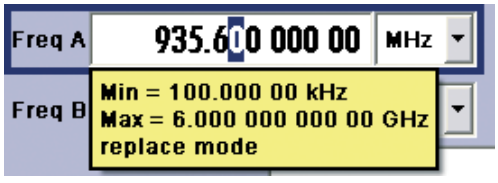
The R&S SMU200A is equipped with a modern and intuitive user interface. The signal flow from the baseband to the RF output is clearly shown in the block diagram. Each block represents a functional unit of the instrument. The generated signal can be seen at a glance, and whether it is affected by additive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

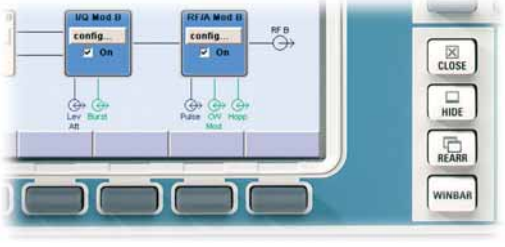



*Block diagram of the R&S SMU200A*




*Tool tip for permissible frequency setting range*


*Rotary knob for navigation in the menus*

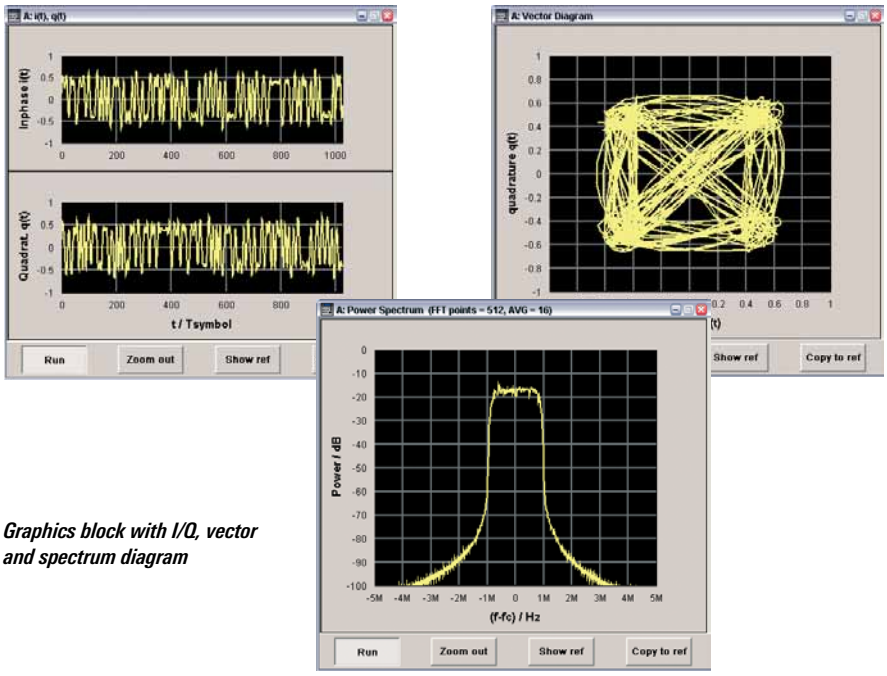



*Softkeys and hardkeys of the R&S SMU200A for windows management*

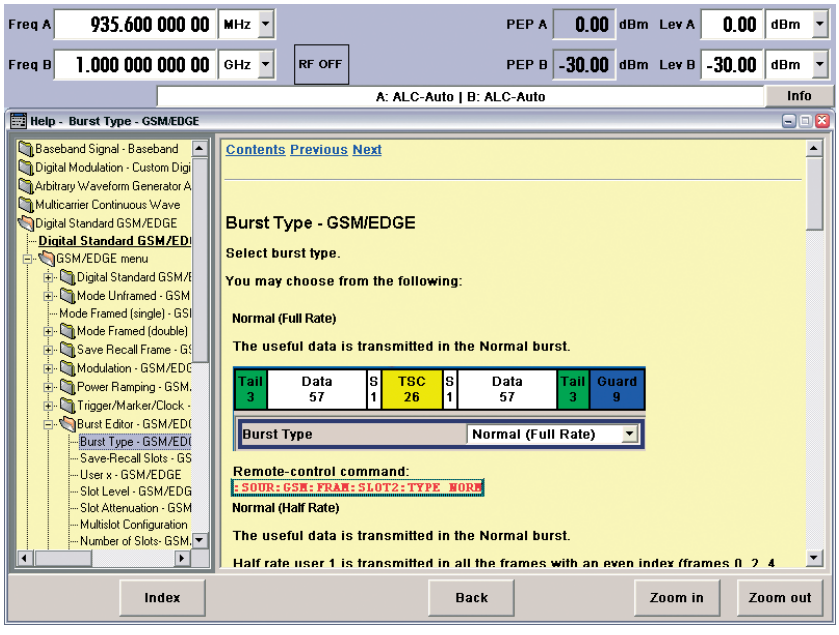
The baseband signal can be monitored in the graphics block. For instance, the vector or constellation diagram, the I/Q characteristic or the output spectrum of a signal can be displayed, making it possible to check whether the generated signal corresponds to the required signal. This is of great help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



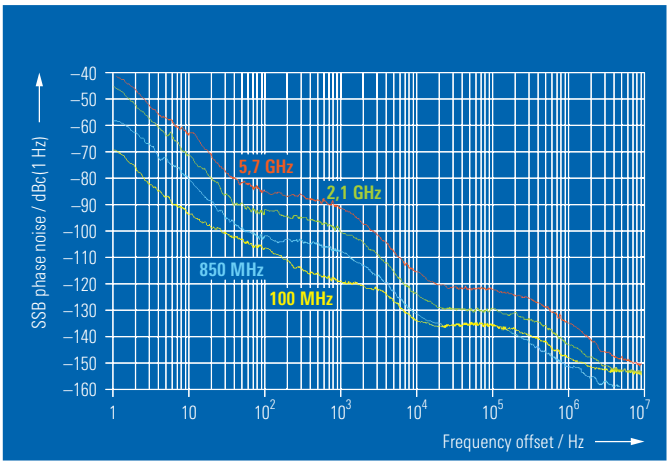

***Help system***

# Outstanding signal quality

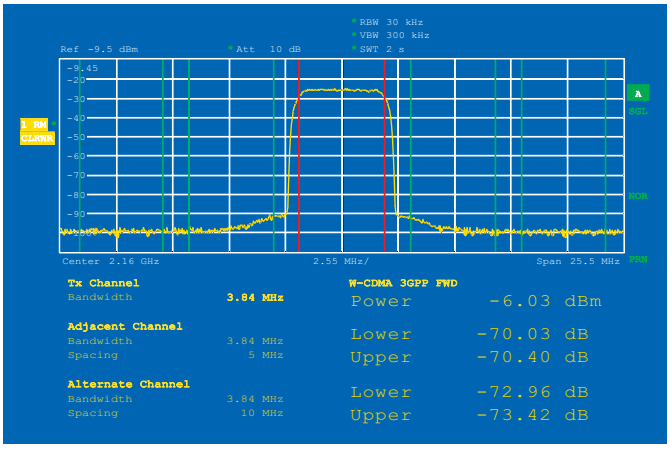
Owing to the sophisticated multiloop synthesizer concept, the R&S SMU200A features extremely low SSB phase noise and wideband noise. A high-stability oven-controlled reference oscillator is installed as standard, which provides excellent aging characteristics as well as minimum temperature drift. The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

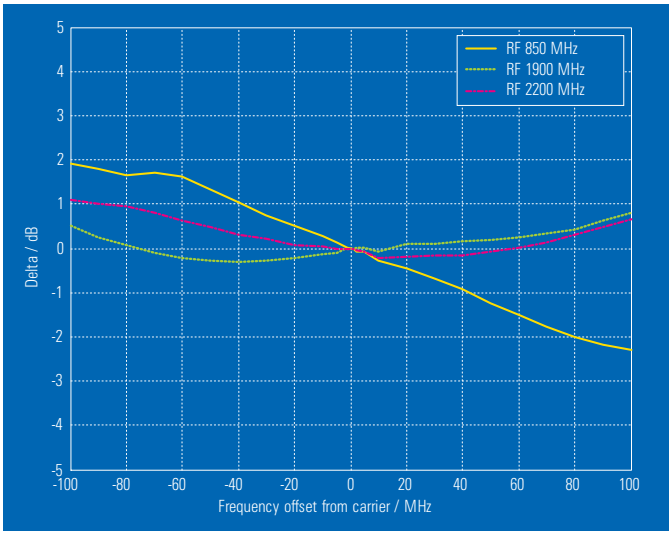
When external I/Q signals are applied, the R&S SMU200A features an RF bandwidth of 200 MHz. If the internal baseband is used, an RF bandwidth of 80 MHz is available, which is ideal for testing multicarrier amplifiers. The R&S SMU200A is thus well prepared for future broadband systems.




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



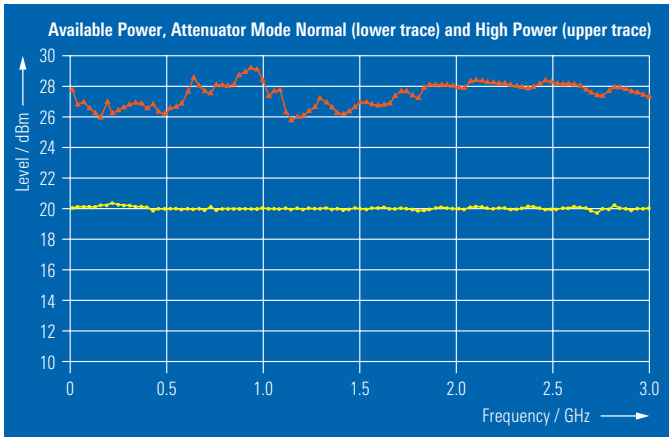

*Outstanding ACLR characteristics*



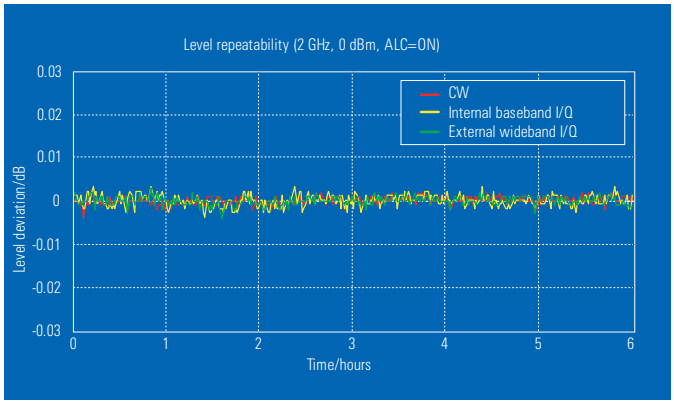

*Frequency response (mode: external wideband I/Q)*

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***

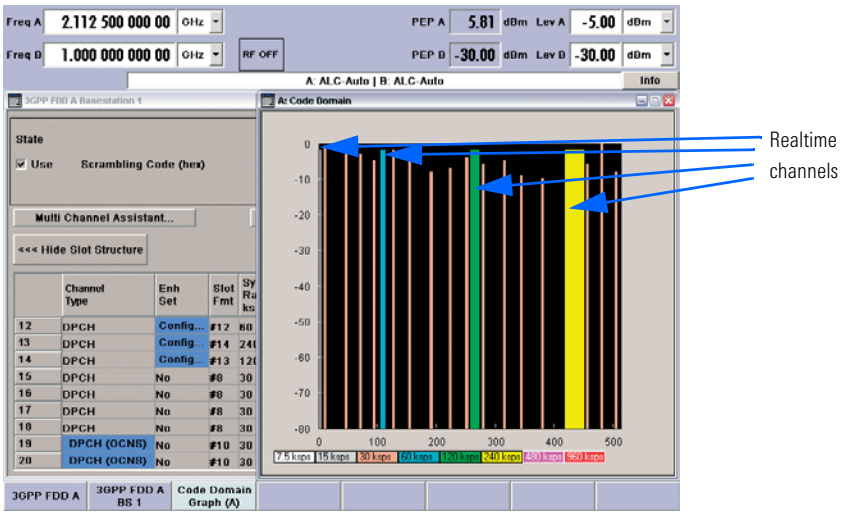
# Unrivalled flexibility

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.

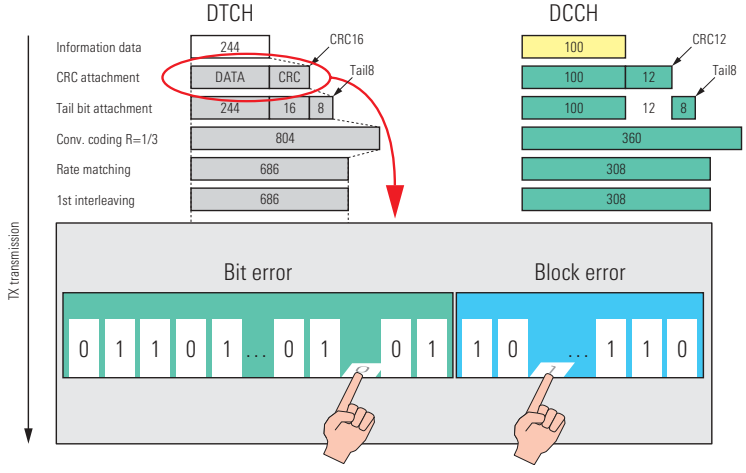
The R&S SMU200A is capable of inserting bit errors and block errors in the generated signal. This allows the internal bit error rate (BER) and block error rate (BLER) calculations of a base station to be




*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*



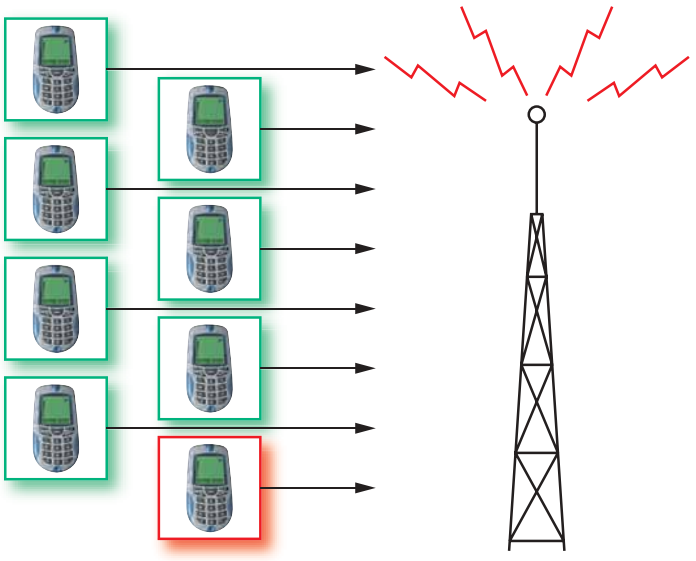

*Insertion of bit errors and block errors into the output signal*

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.

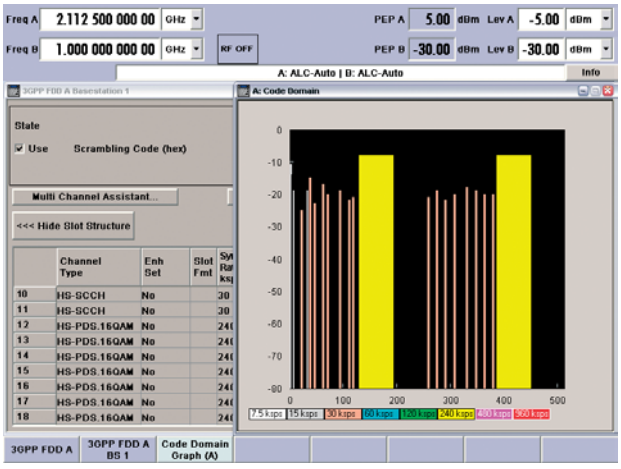
The receiver of a mobile phone must of course also function under real operating conditions. To check this, orthogonal background and interfering channels of a base station can be simulated in line with TS 25.101. The power of these channels is automatically configured so that the total output power 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.

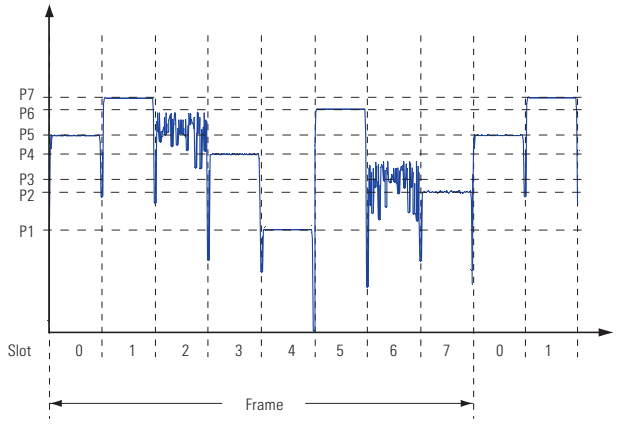
When the GSM/EDGE option is used, even the modulation can be changed between GMSK and 8PSK EDGE in realtime as may be the case in GSM/EDGE base stations. All burst types defined by the standard can be generated. In addition, up to eight different levels can be defined for the timeslots. A separate level 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***

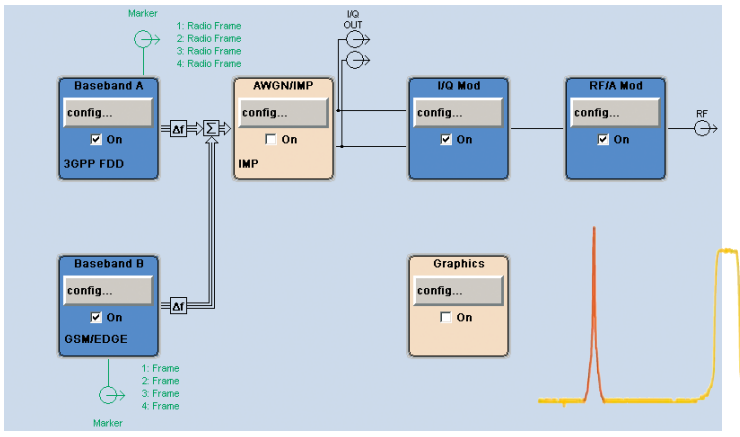
# Unrivalled flexibility (continued)

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.

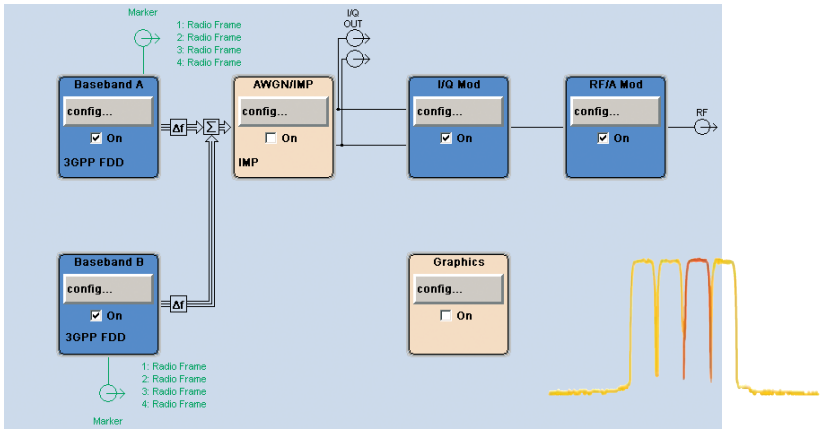
One baseband generator may be used for generating the 3GPP signal in realtime. The second baseband generator produces a realtime GSM/EDGE signal. The signals can then be added in the digital domain with a frequency offset, if desired. This allows modern multistandard base stations to be tested, for instance.

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.

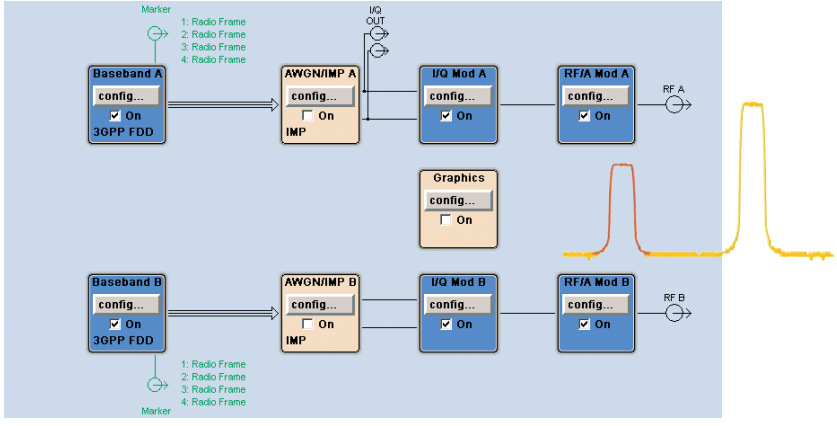
If the RF section is furthermore equipped with two paths, any requirement can be met. For instance, the wanted signal and the interfering signal needed for receiver tests can be generated with *one* instrument – even if the signals greatly differ in power and frequency offset as is the case when out-of-band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




***Generation of 3GPP and GSM/EDGE signals in realtime***




***Adding a realtime signal and a multicarrier signal***



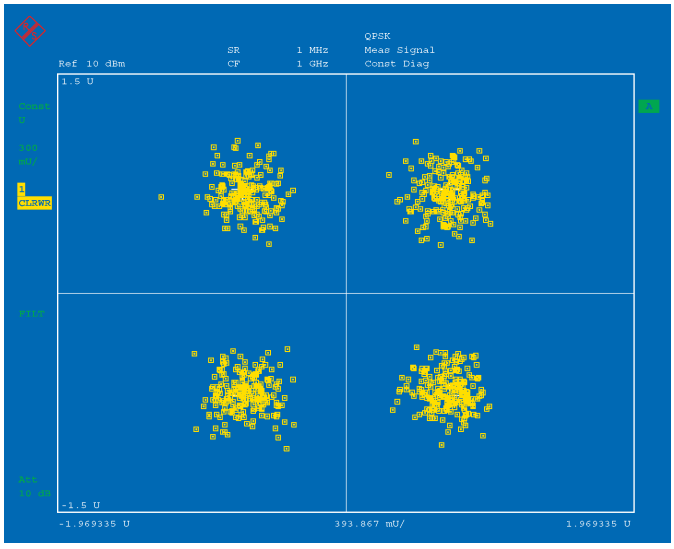

***Generation of wanted signal and interfering signal***

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.

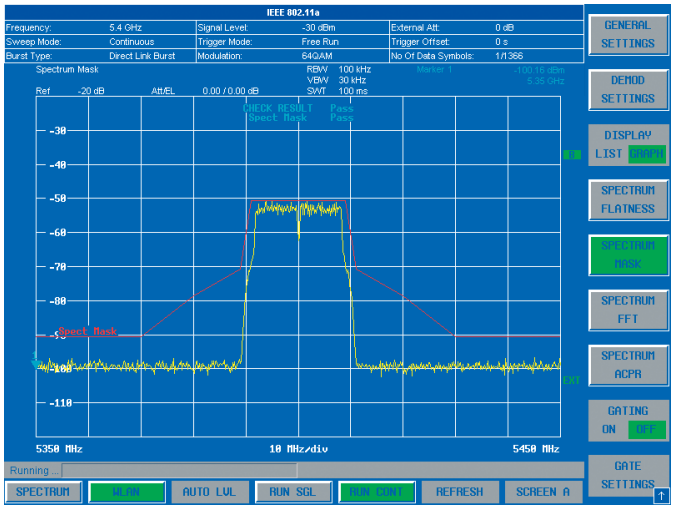
The internal arbitrary waveform generator (ARB) with its large 56 Msample memory for I and Q (and 4 marker bits per sample) and a clock rate of 100 Msample/s offers ideal conditions for generating complex signal scenarios. Due to the implemented hardware resampling, lower oversampling rates can be used 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.

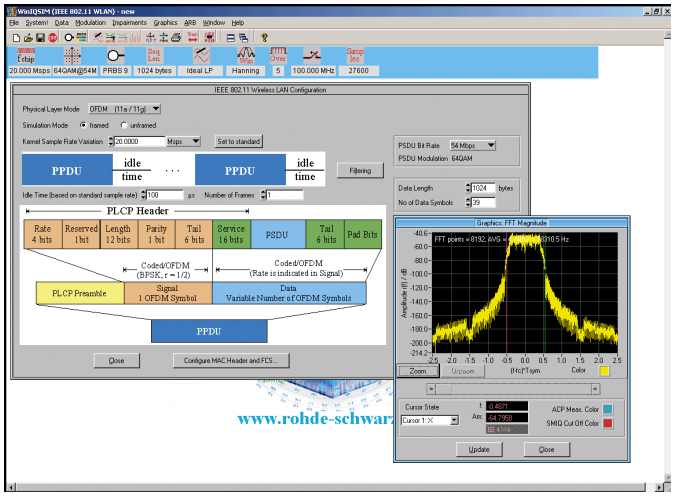
For more information refer to the data sheet for Simulation Software R&S WinIQSIM™ (PD 0757.6940).




***Constellation diagram of a noisy signal***



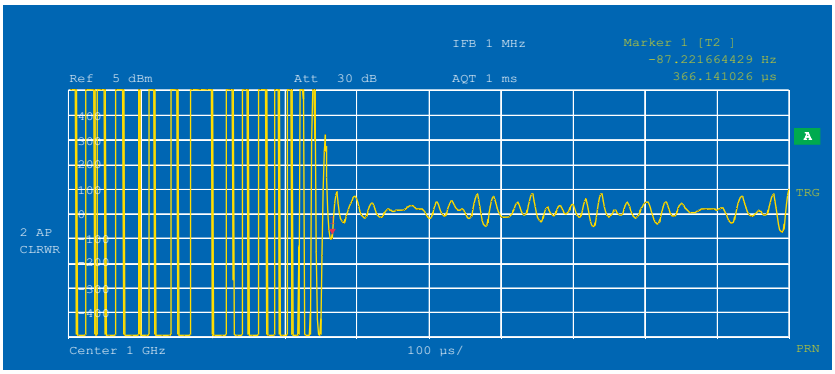

***802.11a signal generated by the ARB (measured with the R&S FSQ)***




***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.

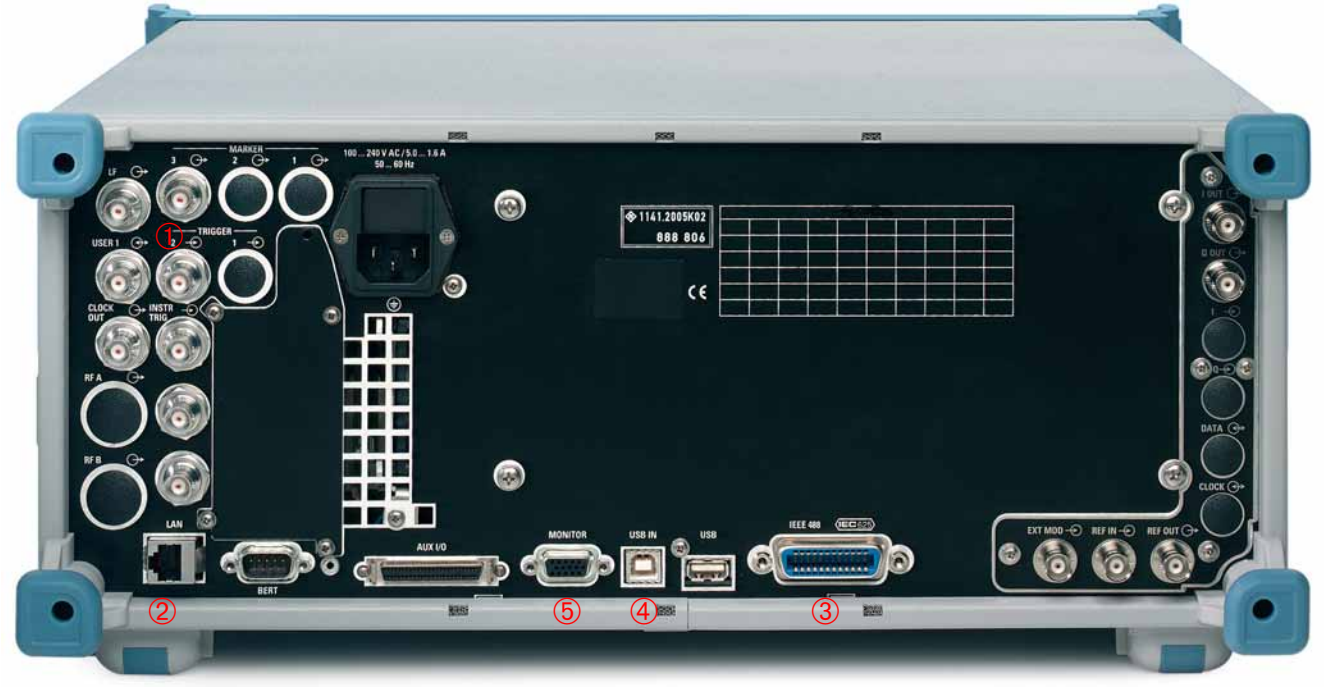

## Rear panel

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

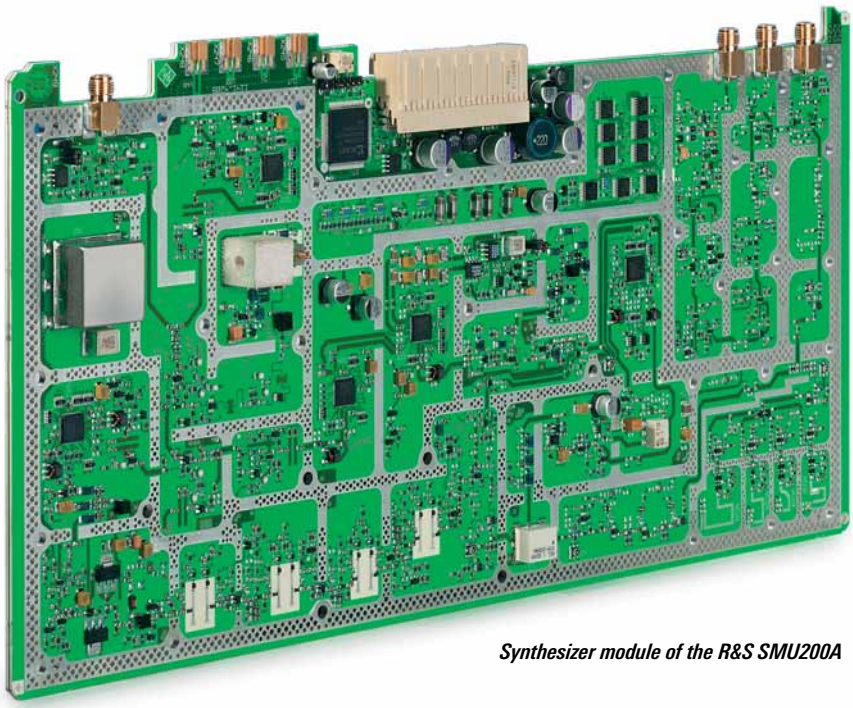
Owing to its modular design, the R&S SMU200A is a safe investment. Options can be added any time. This concept allows the R&S SMU200A to be tailored to specific applications. The user need not pay for functions not required.

## Convenient service

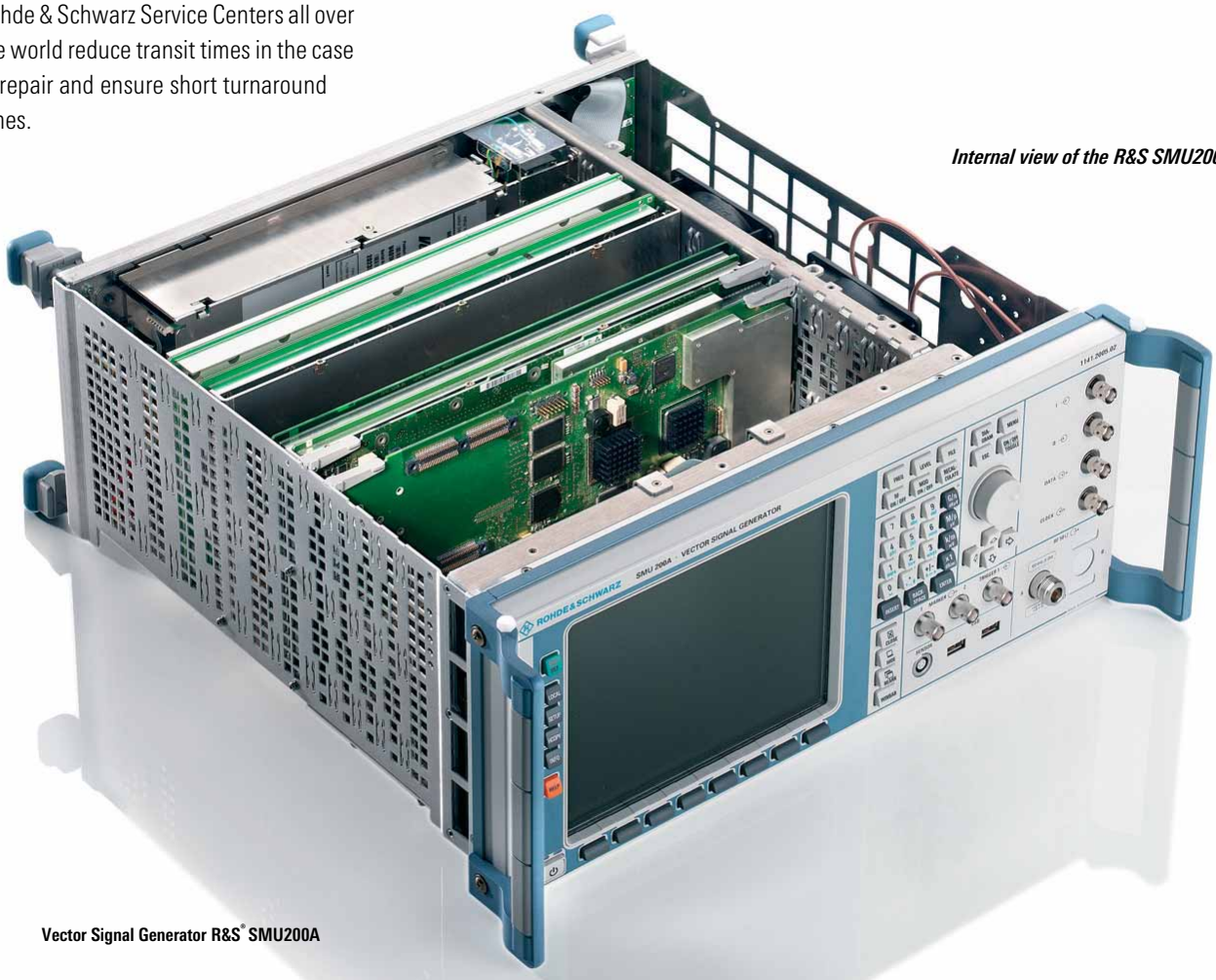
"Low cost of ownership" is more than just a motto – it is a fully fledged concept. The three-year calibration cycle considerably reduces costs.

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<br>Carrier offset >10 kHz<br>Carrier offset >850 kHz | <br><–80 dBc<br><–86 dBc |
| SSB phase noise<br>(20 kHz carrier offset, 1 Hz measurement bandwidth) | typ. –135 dBc |
| Wideband noise<br>(carrier offset >5 MHz, 1 Hz measurement bandwidth) | typ. –153 dBc (CW)<br>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,<br>π/2 DBPSK, π/4 DQPSK,<br>π/8 D8PSK, π/4 QPSK, 8PSK,<br>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.

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