



Version
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R&S® SMU200A Vector Signal Generator

Specifications

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

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

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

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Introduction

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

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

Two generators can also be installed in the baseband section. They generate complex signals in realtime and are equipped with an arbitrary waveform generator with 16 Msample, 64 Msample, or 128 Msample memory. The signals generated in the different basebands can be added, even with frequency offset.

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

Key features

Two signal generators in one

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

Intuitive operation

- Color display with 800 × 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, >10 MHz carrier offset, 1 Hz measurement bandwidth)
- Excellent ACLR performance of typically $+70$ dB with 3GPP FDD (test model 1, 64 DPCH)
- Very high level repeatability of 0.05 dB
- High output power of up to $+19$ dBm (PEP), overrange $+26$ dBm
- High-stability reference oscillator as standard

Unrivalled flexibility

- Support of EUTRA/LTE signal generation
- Support of WiMAX IEEE 802.16-2004/Corr1-2005, 802.16e-2005, and WiBro
- Four code channels in realtime for 3GPP FDD, support of HSDPA and HSUPA
- Change of modulation from slot to slot for GSM/EDGE
- Baseband generator with universal coder for realtime signal generation
- Arbitrary waveform generator with 16 Msample, 64 Msample, or 128 Msample
- Arbitrary waveform generator supported by R&S®WinIQSIM2™ and R&S®WinIQSIM™ simulation software
- Optional fading simulator with up to 40 fading paths

Ideal for production

- Very short frequency setting times (<2 ms); only 450 μ s in List mode
- Electronic attenuator up to 6 GHz over the full level range
- Flexible high speed measurements with RF List mode and multisegment waveforms
- Minimum space required as two complete generators are accommodated in one instrument of only four height units

Connectivity

- Remote control via LAN (Gigabit Ethernet, VXI11) and GPIB
- Remote operation via Windows Remote Desktop or VNC
- User-selectable trigger and marker signals
- USB connectors for keyboard, mouse, and memory stick
- LXI class C compliance

Frequency and enhancement options

Frequency options

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

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

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

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

| | |
|---------------------------|--------------------|
| R&S [®] SMU-B20 | 100 kHz to 2.2 GHz |
| R&S [®] SMU-B203 | 100 kHz to 3 GHz |

Enhancement options

Enhanced phase noise performance and FM/φM

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

| | |
|--------------------------|--|
| R&S [®] SMU-B20 | FM/φM Modulator |
| R&S [®] SMU-B22 | FM/φM Modulator and Enhanced Phase Noise Performance |

These options cannot be installed in RF path B.

High-power output and overvoltage protection

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

| | |
|--------------------------|--|
| R&S [®] SMU-B30 | Overvoltage Protection |
| R&S [®] SMU-B31 | High-Power Output |
| R&S [®] SMU-B32 | Overvoltage Protection and High-Power Output |

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

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

| | |
|--------------------------|--|
| R&S [®] SMU-B35 | Overvoltage Protection |
| R&S [®] SMU-B36 | High-Power Output |
| R&S [®] SMU-B37 | Overvoltage Protection and High-Power Output |

Modulation

Possible modulation types

RF path A

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

RF path B

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

Simultaneous modulation

On the same RF path

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

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

RF characteristics

Frequency

| | | |
|---------------------------|---|--------------------------|
| Range | underrange | 100 kHz to <300 kHz |
| | R&S [®] SMU-B102, R&S [®] SMU-B202 | up to 2.2 GHz |
| | R&S [®] SMU-B103, R&S [®] SMU-B203 | up to 3 GHz |
| | R&S [®] SMU-B104 | up to 4 GHz |
| | R&S [®] SMU-B106 | up to 6 GHz |
| Resolution of setting | | 0.01 Hz |
| Resolution of synthesis | standard, fundamental frequency range 750 MHz to 1500 MHz | 5 μ Hz |
| | with R&S [®] SMU-B22 option | 0.2 μ Hz |
| Setting time ¹ | to within $<1 \times 10^{-7}$ for $f > 200$ MHz or <124 Hz for $f < 200$ MHz, with GUI update stopped after IEC/IEEE bus delimiter | <2 ms, typ. 1 ms |
| | in ALC OFF MODE S&H | <4 ms, typ. 3 ms |
| | after trigger pulse in List mode | <450 μ s |
| Phase offset | | adjustable in 0.1° steps |

Frequency sweep

| | | |
|-----------------|---------------------------------|---|
| Operating modes | digital sweep in discrete steps | automatic, step, single, external single, external step, manual or external trigger, spacing linear or logarithmic |
| Sweep range | | full frequency range |
| Step width | linear | full frequency range |
| | logarithmic | 0.01 % to 100 % per step |
| Dwell time | range | 10 ms to 10 s |
| | resolution | 0.1 ms |

Reference frequency

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

¹ Installation of software that is not authorized by Rohde & Schwarz for use on the R&S[®]SMU200A or installation of antivirus software can deteriorate the setting time performance.

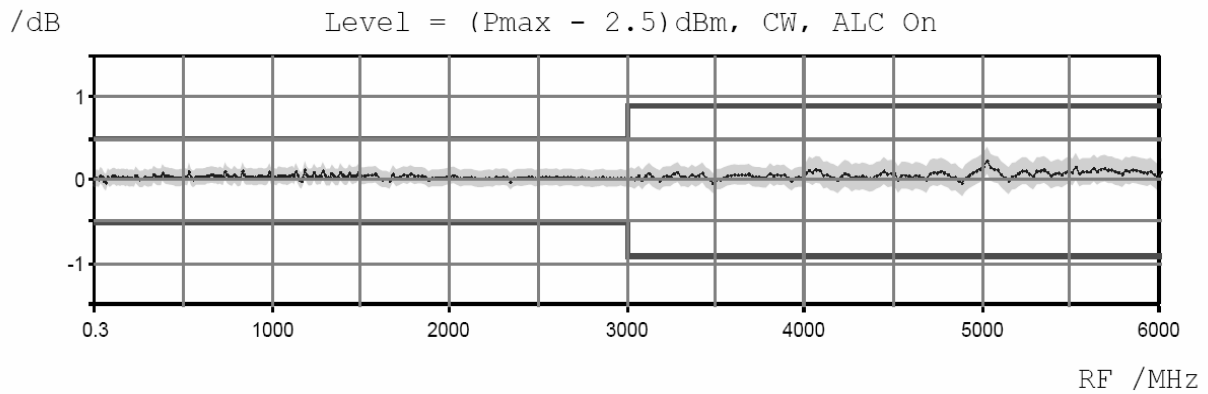
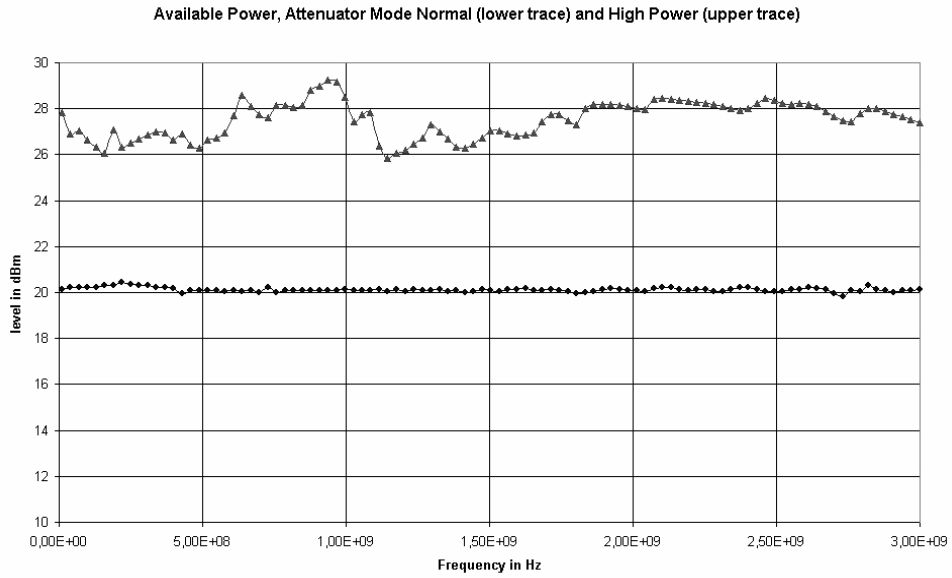
Level

| | | |
|--|--|----------------------------|
| Setting range | standard | -145 dBm to +20 dBm |
| | with R&S [®] SMU-B31, R&S [®] SMU-B32, R&S [®] SMU-B36, or R&S [®] SMU-B37 option | to +30 dBm |
| Maximum level for units equipped with R&S [®] SMU-B102, R&S [®] SMU-B103, R&S [®] SMU-B202, R&S [®] SMU-B203 frequency options | standard | +13 dBm (PEP) ² |
| | with R&S [®] SMU-B31, R&S [®] SMU-B32, R&S [®] SMU-B36, or R&S [®] SMU-B37 option | +19 dBm (PEP) |
| Maximum level for units equipped with R&S [®] SMU-B104 R&S [®] SMU-B106 frequency options | standard | +8 dBm (PEP) |
| | with R&S [®] SMU-B31 or R&S [®] SMU-B36 option | +17 dBm (PEP) |
| Resolution | | 0.01 dB |
| Level uncertainty | for levels >-120 dBm, attenuator mode Auto, temperature range +18 °C to +28 °C | |
| | 0.3 MHz ≤ f ≤ 3 GHz | <0.5 dB |
| | f > 3 GHz | <0.9 dB |
| Additional uncertainty with ALC OFF, S&H | This function is needed only for some special applications. | <0.2 dB |
| Output impedance VSWR in 50 Ω system | ALC state ON, standard | |
| | f ≤ 3 GHz | <1.6, typ. <1.4 |
| | f > 3 GHz | <1.85, typ. <1.6 |
| | ALC state ON, with R&S [®] SMU-B31 or R&S [®] SMU-B36 option frequency options up to 3 GHz | |
| | attenuator mode Normal | <1.65, typ. <1.45 |
| | attenuator mode High Power | <1.7, typ. <1.5 |
| | frequency options above 3 GHz | |
| | attenuator mode High Power | <1.9, typ. <1.65 |
| Setting time ³ | after IEC/IEEE bus delimiter, to <0.3 dB deviation from final value, with GUI update stopped, temperature range +18 °C to +28 °C | |
| | f ≤ 5 GHz | <3 ms |
| | f > 5 GHz | typ. 3 ms |
| | ALC state OFF | |
| | f ≤ 5 GHz | <5 ms |
| | f > 5 GHz | typ. 5 ms |
| | range switchover with R&S [®] SMU-B31, R&S [®] SMU-B32, R&S [®] SMU-B36, or R&S [®] SMU-B37 option | <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, R&S [®] SMU-B103, R&S [®] SMU-B202, R&S [®] SMU-B203 options | maximum permissible RF power in output frequency range of RF path | 0.5 W continuous |
| | maximum permissible DC voltage | 36 V |
| | attenuator mode High Power | 10 V |
| Back-feed (from ≥50 Ω source) with R&S [®] SMU-B104, R&S [®] SMU-B106 options | maximum permissible RF power in output frequency range of RF path | 0.5 W |
| | maximum permissible DC voltage | 10 V |

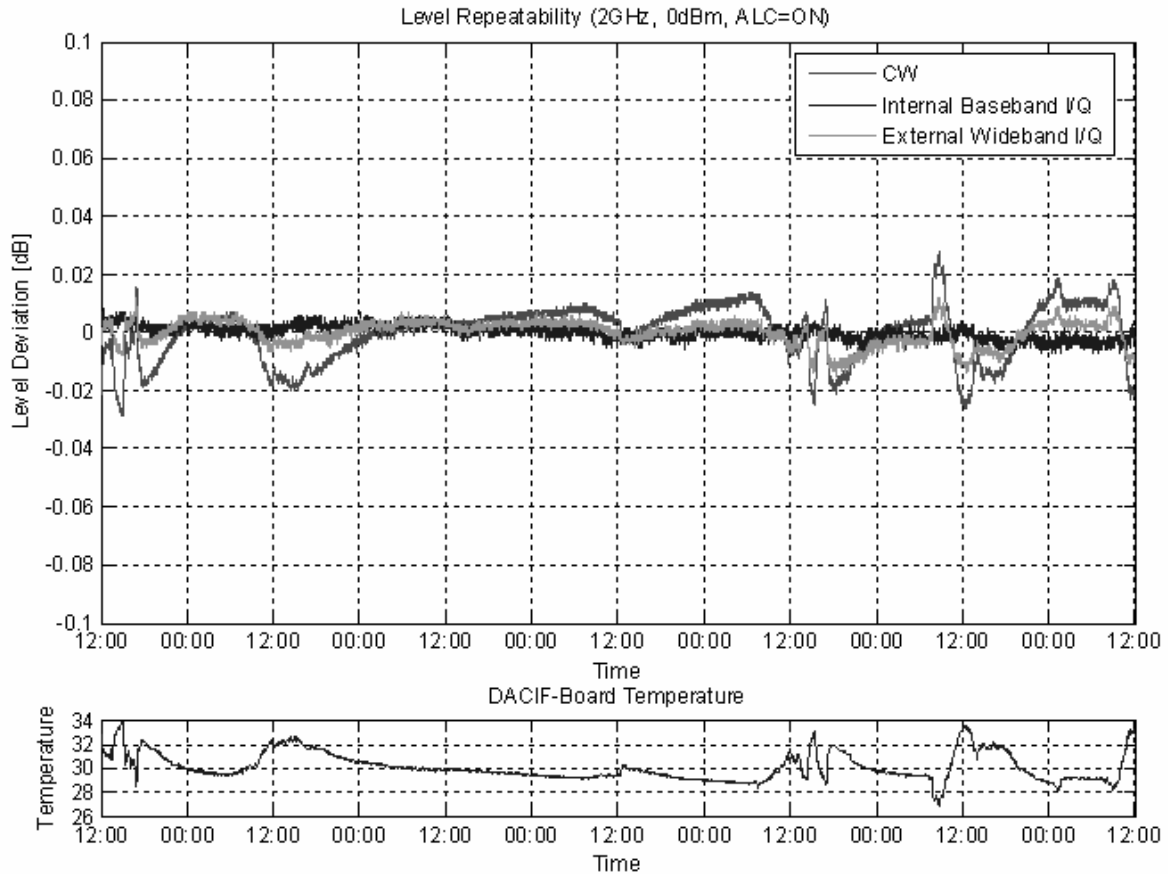
² PEP = peak envelope power.

³ Installation of software that is not authorized by Rohde & Schwarz for use on the R&S[®]SMU200A or installation of antivirus software can deteriorate the setting time performance.

Measured level data



Measured level uncertainty versus frequency



Level repeatability over 6 days with random settings between measurements
 (DACIF board temperature: internal temperature test point, variations caused by changes of ambient temperature)

Level sweep

| | | |
|-----------------|---------------------------------|---|
| Operating modes | digital sweep in discrete steps | auto, single, step, extern single, extern step, manual, or external trigger |
| Sweep range | | level range of attenuator modes Normal or High Power |
| Step width | logarithmic | 0.1 dB to 20 dB per step |
| Dwell time | range | 10 ms to 10 s |
| | resolution | 0.1 ms |

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

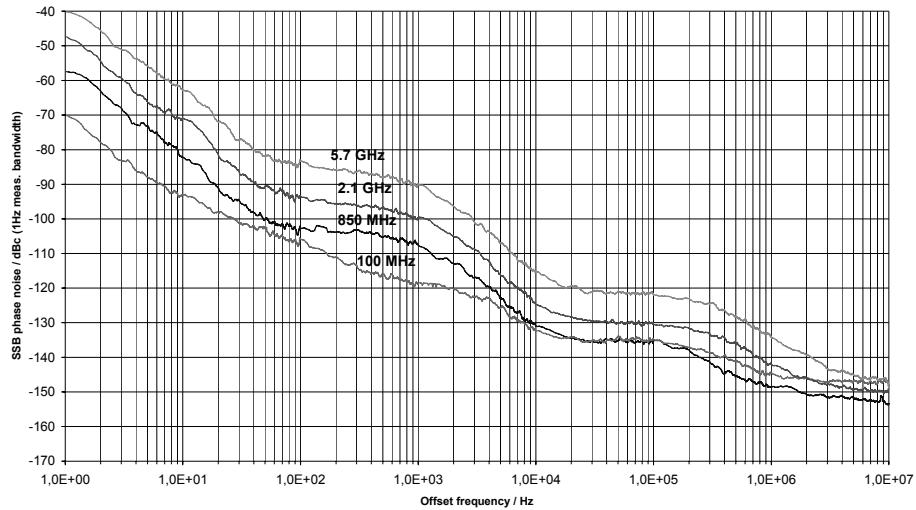
| | | |
|---|----------------------------|-----------------|
| Protects the instrument against externally applied RF power from a 50 Ω source. Not available with R&S [®] SMU-B104 and R&S [®] SMU-B106 options. | | |
| Maximum permissible back feed RF power (from ≥50 Ω source) | 1 MHz < f ≤ 1 GHz | 50 W |
| | 1 GHz < f ≤ 2 GHz | 25 W |
| | 2 GHz < f ≤ 3 GHz | 10 W |
| Maximum permissible back feed DC voltage (from ≥50 Ω source) | | 36 V |
| If an overvoltage protection option is installed, the output impedance (VSWR) in the respective RF path deteriorates. | | |
| VSWR | up to 3 GHz | |
| | attenuator mode Normal | <1.8, typ. <1.6 |
| | attenuator mode High Power | <1.9, typ. <1.7 |

Spectral purity

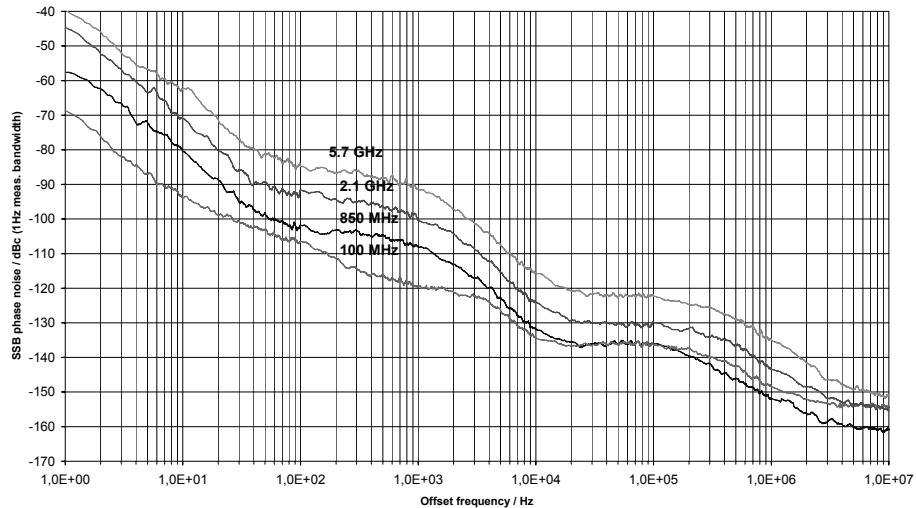
| | | |
|--|---|---------------------------|
| Harmonics | with R&S [®] SMU-B102, R&S [®] SMU-B103, R&S [®] SMU-B202, R&S [®] SMU-B203 options, unmodulated | |
| | level <8 dBm | <-30 dBc |
| | level <12 dBm with R&S [®] SMU-B31, R&S [®] SMU-B32, R&S [®] SMU-B36, or R&S [®] SMU-B37 option, attenuator mode High Power | <-30 dBc |
| | with R&S [®] SMU-B104 R&S [®] SMU-B106 options, unmodulated | |
| | level <3 dBm | <-30 dBc |
| Nonharmonics | level >-50 dBm, CW, vector modulation (full-scale DC input), >10 kHz offset from carrier and outside the modulation spectrum | |
| | 0.3 MHz ≤ f ≤ 200 MHz | <-77 dBc |
| | 200 MHz < f ≤ 1500 MHz | <-80 dBc |
| | 1500 MHz < f ≤ 3000 MHz | <-74 dBc |
| | f > 3000 MHz | <-68 dBc |
| | >850 kHz offset from carrier and outside the modulation spectrum | |
| | 0.3 MHz ≤ f ≤ 200 MHz | <-77 dBc |
| | 200 MHz < f ≤ 1500 MHz | <-86 dBc |
| | 1500 MHz < f ≤ 3000 MHz | <-80 dBc |
| | f > 3000 MHz | <-74 dBc |
| Nonharmonics with R&S [®] SMU-B22 option | level >-50 dBm, CW, vector modulation (full-scale DC input), >10 kHz offset from carrier and outside the modulation spectrum | |
| | 0.3 MHz ≤ f ≤ 200 MHz | <-77 dBc (typ. -87 dBc) |
| | 200 MHz < f ≤ 1500 MHz | <-90 dBc |
| | 1500 MHz < f ≤ 3000 MHz | <-84 dBc |
| | f > 3000 MHz | <-78 dBc |
| Power supply and mechanically related nonharmonics | at RF = 1 GHz, 50 Hz to 10 kHz from carrier | <-70 dBc |
| Subharmonics | 1500 MHz < f ≤ 3000 MHz | <-74 dBc |
| | f > 3000 MHz | <-50 dBc |
| Wideband noise | carrier offset >10 MHz, measurement bandwidth 1 Hz, CW | |
| | 20 MHz ≤ f ≤ 200 MHz | <-146 dBc (typ. -149 dBc) |
| | 200 MHz < f ≤ 1500 MHz | <-150 dBc (typ. -153 dBc) |
| | 1.5 GHz < f ≤ 3 GHz | <-148 dBc (typ. -151 dBc) |
| | f > 3 GHz | <-146 dBc (typ. -149 dBc) |
| | vector modulation with full-scale DC input, I/Q input gain 3 dB | |
| | 20 MHz ≤ f ≤ 200 MHz | <-143 dBc (typ. -146 dBc) |
| | 200 MHz < f ≤ 1500 MHz | <-146 dBc (typ. -149 dBc) |
| | 1.5 GHz < f ≤ 3 GHz | <-145 dBc (typ. -148 dBc) |
| | f > 3 GHz | <-143 dBc (typ. -146 dBc) |
| SSB phase noise | carrier offset 20 kHz, measurement bandwidth 1 Hz, CW | |
| | 20 MHz ≤ f ≤ 200 MHz | <-128 dBc (typ. -132 dBc) |
| | f = 1 GHz | <-131 dBc (typ. -135 dBc) |
| | f = 2 GHz | <-125 dBc (typ. -129 dBc) |
| | f = 3 GHz | <-121 dBc (typ. -125 dBc) |
| | f = 4 GHz | <-119 dBc (typ. -123 dBc) |
| | f = 6 GHz | <-115 dBc (typ. -119 dBc) |

| | | |
|--|---|---------------------------|
| SSB phase noise with R&S [®] SMU-B22 option | carrier offset 20 kHz, measurement bandwidth 1 Hz, CW | |
| | 20 MHz ≤ f ≤ 200 MHz | <-135 dBc (typ. -138 dBc) |
| | f = 1 GHz | <-136 dBc (typ. -139 dBc) |
| | f = 2 GHz | <-130 dBc (typ. -133 dBc) |
| | f = 3 GHz | <-126 dBc (typ. -129 dBc) |
| | f = 4 GHz | <-124 dBc (typ. -127 dBc) |
| | f = 6 GHz | <-120 dBc (typ. -123 dBc) |
| Residual FM | rms value at f = 1 GHz | |
| | 300 Hz to 3 kHz | <1 Hz |
| | 20 Hz to 23 kHz | <4 Hz |
| Residual AM | rms value 20 Hz to 23 kHz | <0.02 % |

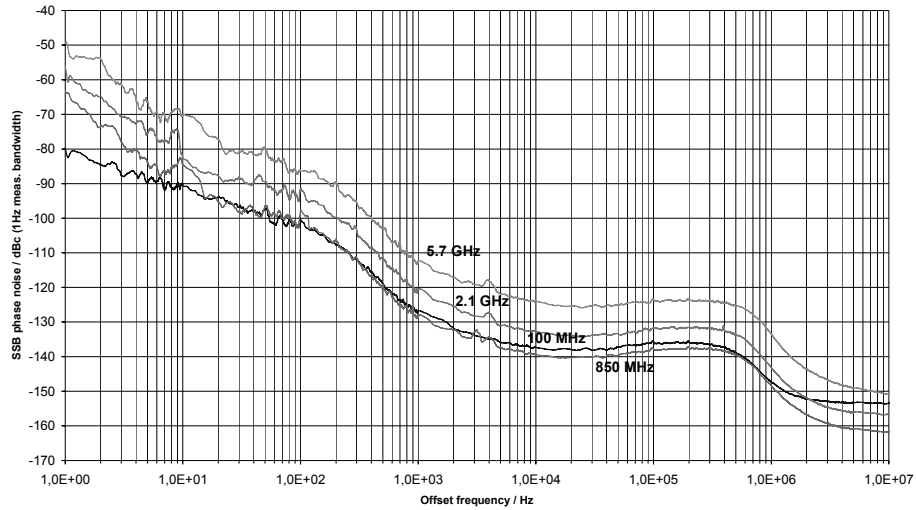
Measured SSB phase noise, I/Q modulated (typical values)



Measured SSB phase noise, unmodulated (typical values)



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



List mode

Frequency and level values can be stored in a list and set in an extremely short amount of time.

| | | |
|-------------------------|--|--|
| Operating modes | | automatic, single sweep, manual, or external trigger, fast hopping with immediate and external trigger |
| Max. number of channels | | 10000 |
| Dwell time | | 1 ms to 1 s |
| Resolution | | 0.1 ms |
| Setting time | after external trigger | see frequency and level data |
| | additional trigger delay in two-path units, both paths operated in List mode | <200 μ s |

Analog modulation

Internal modulation generator

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

Input for external modulation signals

| | | |
|-----------------------------|--|---|
| Modulation input EXT MOD | input impedance | high (>100 k Ω), switchable to 50 Ω with R&S [®] SMU-B20 or R&S [®] SMU-B22 option |
| | input sensitivity (peak value for set modulation depth or deviation) | 1 V |
| | absolute maximum rating | 10 V |

Amplitude modulation

| | | |
|-------------------------------|---|--------------------------|
| Operating modes | | internal, external AC/DC |
| Modulation depth | at high levels, modulation is clipped if the maximum PEP is reached | 0 % to 100 % |
| Resolution | | 0.1 % |
| Setting uncertainty | attenuator mode Auto, $f_{mod} = 1$ kHz and $m < 80$ % | <(1 % of reading + 1 %) |
| AM distortion | PEP in specified range, attenuator mode Auto | |
| | $f \leq 3$ GHz, at $f_{mod} = 1$ kHz, $m = 30$ % | <0.5 % |
| | $m = 80$ % | <0.8 % |
| | $f > 3$ GHz, at $f_{mod} = 1$ kHz, $m = 30$ % | <1 % |
| | $m = 80$ % | <1.6 % |
| Modulation frequency range | | DC, 20 Hz to 500 kHz |
| Modulation frequency response | mode AC, 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 | | 50 Ω |
| Input sensitivity | peak voltage for 100 % AM | 0.25 V |

Pulse modulation

| | | |
|---------------------------------|---|--|
| Operating modes | | external, internal (duty cycle approx. 1:1) |
| ON/OFF ratio | | >70 dB |
| Rise/fall time | 10 %/90 % of RF amplitude | typ. 1 μ s |
| Pulse repetition frequency | | 0 Hz to 100 kHz |
| Video crosstalk | spectral line of fundamental of 100 kHz squarewave modulation | <-30 dBc |
| Modulation input EXT MOD A/B | input level | rising 1.7 V, falling typ. 1.1 V |
| | input impedance | >10 k Ω |
| | polarity | selectable |

Frequency modulation (R&S[®] SMU-B20 or R&S[®] SMU-B22 option)

| | | |
|--------------------------------|--|--|
| Operating modes | | internal, external, internal + external, AC/DC, Normal, Low Noise (with R&S [®] SMU-B22 only) |
| FM/ ϕ M range multiplier | $0.3 \text{ MHz} \leq f \leq 200 \text{ MHz}$ | rm = 1 |
| | $200 \text{ MHz} < f \leq 375 \text{ MHz}$ | rm = 0.25 |
| | $375 \text{ MHz} < f \leq 750 \text{ MHz}$ | rm = 0.5 |
| | $750 \text{ MHz} < f \leq 1500 \text{ MHz}$ | rm = 1 |
| | $1500 \text{ MHz} < f \leq 3000 \text{ MHz}$ | rm = 2 |
| | $f > 3000 \text{ MHz}$ | rm = 4 |
| Maximum deviation | FM mode Normal | rm \times 10 MHz |
| | FM mode Low Noise | rm \times 100 kHz |
| Resolution | | <200 ppm, min. rm \times 0.1 Hz |
| Setting uncertainty | $f_{\text{mod}} = 10 \text{ kHz}$, deviation \leq half of maximum | |
| | internal | <(1.5 % of reading + 20 Hz) |
| | external | <(2.0 % of reading + 20 Hz) |
| FM distortion | $f_{\text{mod}} = 10 \text{ kHz}$ and 1 MHz deviation | <0.1 % |
| Modulation frequency response | FM mode Normal | |
| | 10 Hz to 100 kHz | <0.5 dB |
| | 10 Hz to 10 MHz | <3 dB |
| | FM mode Low Noise | |
| | 10 Hz to 100 kHz | <3 dB |
| Synchronous AM | 40 kHz deviation, $f_{\text{mod}} = 1 \text{ kHz}$, $f > 5 \text{ MHz}$ | <0.1 % |
| | $f > 3 \text{ GHz}$ | <0.2 % |
| Carrier frequency offset at FM | | <0.2 % of set deviation |

Phase modulation (R&S[®] SMU-B20 or R&S[®] SMU-B22 option)

| | | |
|-------------------------------|--|---|
| Operating mode | | internal, external, internal + external, AC/DC, High Bandwidth, High Deviation, Low Noise (with R&S [®] SMU-B22 only) |
| Maximum deviation | ϕ M mode High Deviation | rm \times 20.0 rad |
| | ϕ M mode High Bandwidth | rm \times 1.0 rad |
| | ϕ M mode Low Noise | rm \times 0.25 rad |
| Resolution | ϕ M mode High Deviation | <200 ppm, min. rm \times 20 μ rad |
| | ϕ M mode High Bandwidth | <0.1 %, min. rm \times 20 μ rad |
| | ϕ M mode Low Noise | <200 ppm, min. rm \times 20 μ rad |
| Setting uncertainty | $f_{\text{mod}} = 10 \text{ kHz}$, deviation \leq half of maximum | |
| | internal | <(1.5 % of reading + 0.01 rad) |
| | external | <(2.0 % of reading + 0.01 rad) |
| ϕ M distortion | $f_{\text{mod}} = 10 \text{ kHz}$, half of max. deviation | <0.2 %, typ. 0.1 % |
| Modulation frequency response | High Deviation, 10 Hz to 500 kHz | <1 dB |
| | High Bandwidth, 10 Hz to 10 MHz | <3 dB |
| | Low Noise, 10 Hz to 100 kHz | <3 dB |

I/Q modulation

I/Q modulator

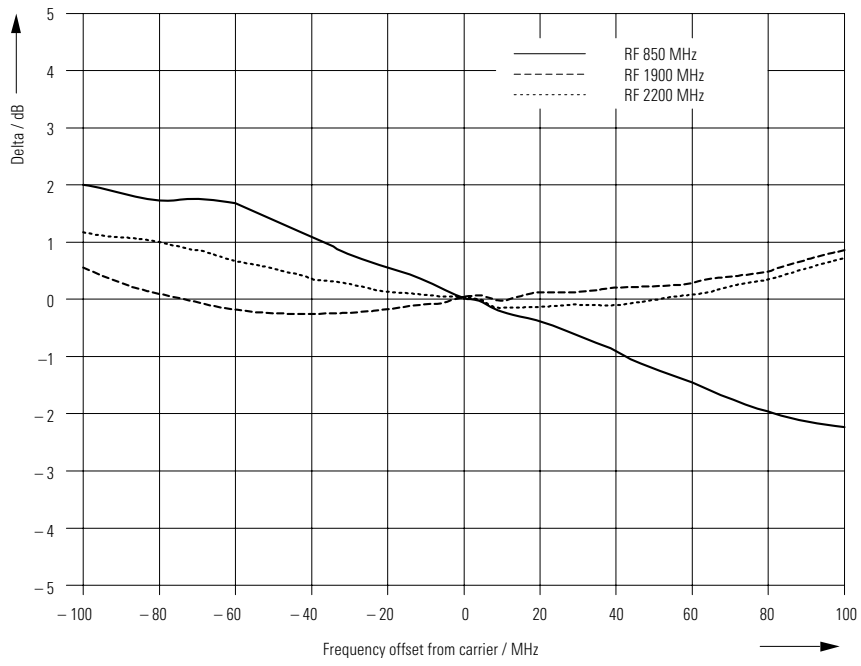
| | | |
|-----------------|-------------------------|---|
| Operating modes | | external wideband I/Q, internal baseband I/Q |
| I/Q impairments | I offset, Q offset | |
| | setting range | -10 % to +10 % |
| | resolution | 0.01 % |
| | gain imbalance | |
| | setting range | -1.0 dB to +1.0 dB |
| |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

External wideband I/Q

This type of modulation is possible only in path A.

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

⁴ Value applies after 1 hour warm-up time and recalibration for 4 hours operation and temperature variations of less than +5 °C.



Measured frequency response of external wideband I/Q modulation

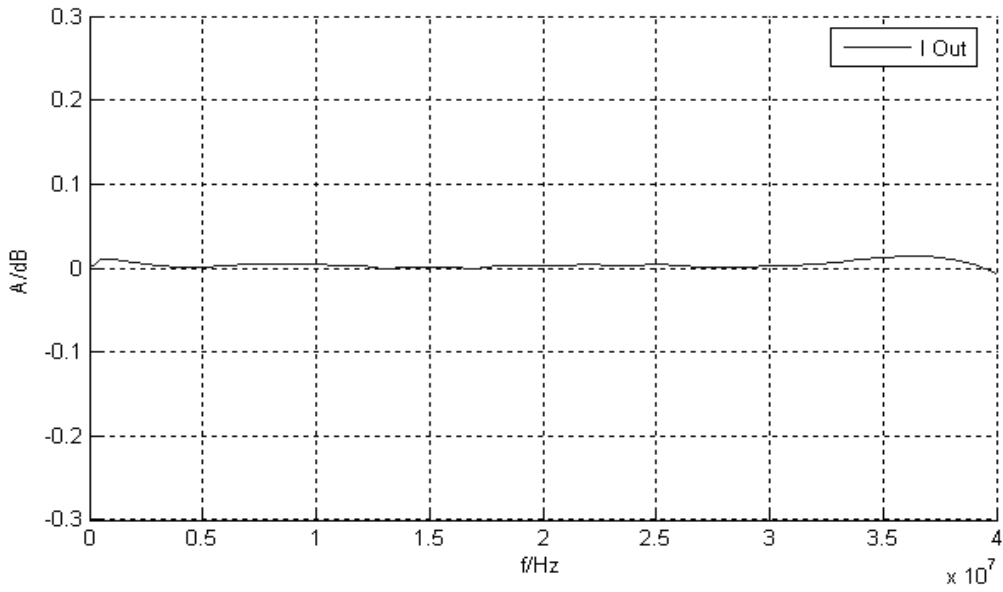
Internal baseband I/Q (with R&S® SMU-B13 option)

The R&S®SMU-B13 converts the internal digital baseband signals of the R&S®SMU-B9/-B10/-B11 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.

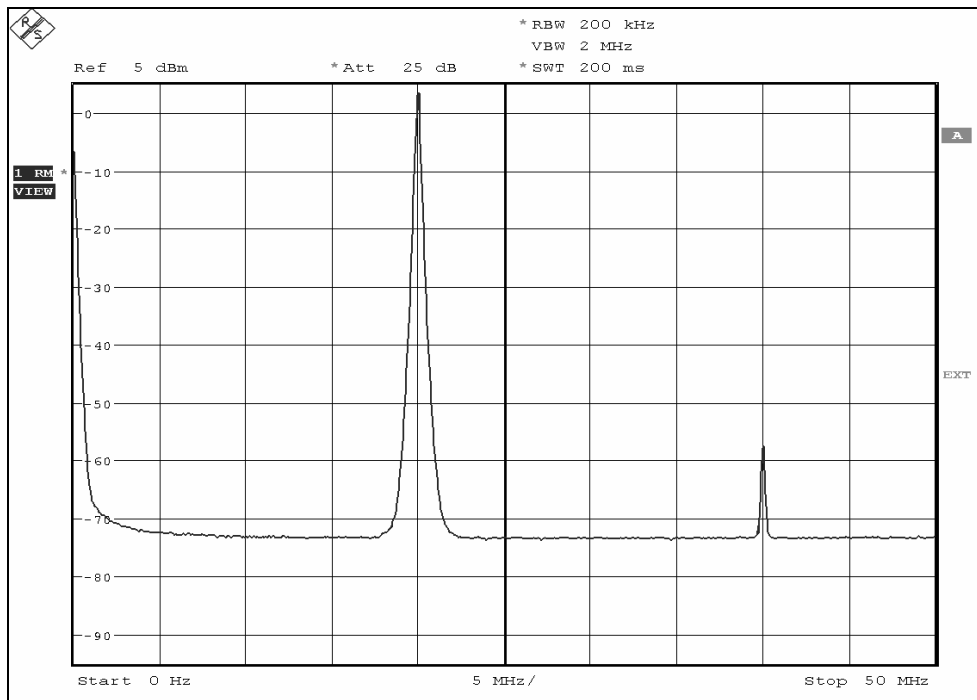
| | | |
|--|---|--------------------------------------|
| D/A converter | data rate | 100 MHz |
| | resolution | 16 bit |
| | sampling rate | 400 MHz (internal interpolation × 4) |
| Aliasing filter | with amplitude, group-delay and Si correction | |
| | bandwidth, roll-off to -0.1 dB | 40 MHz |
| | D/A converter interpolation spectra | |
| | up to 10 MHz | <-80 dBc |
| up to 40 MHz | <-73 dBc | |
| I/Q impairment | carrier leakage | |
| | setting range | -10 % to +10 % |
| | resolution | 0.01 % |
| | I ≠ Q (imbalance) | |
| | setting range | -1 dB to +1 dB |
| | resolution | 0.001 dB |
| | quadrature offset | |
| | setting range | -10° to +10° |
| resolution | 0.01° | |
| RF frequency response for entire instrument in modulation bandwidth | I/Q wideband ON, optimize internal I/Q impairments for RF output ON | |
| | up to 10 MHz | <1.5 dB, typ. 0.7 dB |
| | up to 40 MHz | <4.5 dB, typ. 2.0 dB |
| Suppression of image sideband for entire instrument in modulation bandwidth ⁵ | up to 10 MHz | >50 dB, typ. 56 dB |
| | up to 40 MHz | >40 dB, typ. 50 dB |
| Carrier leakage ⁵ | referenced to full-scale input | <-55 dBc, typ. <-65 dBc |
| Additional level uncertainty referenced to CW | measured at 0 dBm with 16QAM, filter root cosine, $\alpha = 0.5$, symbol rate 10 kHz | <0.2 dB |
| I/Q outputs | | |
| Output impedance | | 50 Ω |
| Output voltage | EMF (output voltage depends on set modulation signal) | 1 V (V_p) |
| Offset | EMF | <1 mV |
| Frequency response ⁶ | at $R_L = 50 \Omega$ | |
| | magnitude | |
| | up to 10 MHz | typ. 0.02 dB |
| | up to 40 MHz | typ. 0.03 dB |
| | nonlinear phase | |
| | up to 10 MHz | typ. 0.1° |
| up to 30 MHz | typ. 0.2° | |
| I/Q balance ⁶ | at $R_L = 50 \Omega$ | |
| | magnitude | |
| | up to 10 MHz | typ. 0.01 dB |
| | up to 40 MHz | typ. 0.02 dB |
| | nonlinear phase | |
| | up to 10 MHz | typ. 0.1° |
| up to 30 MHz | typ. 0.2° | |
| Spectral purity | at $R_L = 50 \Omega$ | |
| | SFDR (sine) | |
| | up to 2 MHz | >70 dB |
| | up to 20 MHz | typ. 60 dB |
| | phase noise | |
| | 10 MHz sinewave at 20 kHz offset | typ. -150 dBc |
| | wideband noise | |
| 10 MHz sinewave at 1 MHz offset | typ. -155 dBc | |

⁵ Value applies after 1 hour warm-up time and recalibration for 4 hours operation and temperature variations of less than +5 °C.

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



Frequency response of I/Q outputs



SFDR of I/Q outputs

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

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

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

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

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

At least one R&S®SMU-B13 baseband main module and at least one R&S®SMU-B9/-B10/-B11 I/Q baseband generator must be installed. With the R&S®SMU-B17, external analog signals can be fed to the baseband section of the R&S®SMU200A. The frequency of the signals can be shifted, and the signals can be added to the internally generated signal with settable level ratio. If the R&S®SMU200A is equipped with a fading simulator, the input signals can also be faded.

| | | |
|---|---|--|
| Mode | see also simultaneous modulation | analog input |
| Input level | peak level | |
| | setting range | -10 dB to 0 dB referenced to full scale |
| | resolution | 0.01 dB |
| | crest factor | |
| | setting range | 0 dB to 30 dB |
| | resolution | 0.01 dB |
| | The adjust level function automatically determines the peak level and crest factor of the input signal. | |
| Frequency offset | With the aid of the frequency offset, the center frequency of the input signal can be shifted in the baseband. The restrictions caused by the modulation bandwidth apply. | |
| | setting range | -40 MHz to +40 MHz |
| | resolution | 0.01 Hz |
| | frequency accuracy | $<5 \times 10^{-10} \times \text{frequency offset} + \text{reference frequency error}$ |
| I/Q swap | I and Q signals swapped | ON/OFF |
| Analog I/Q inputs | | |
| All specifications apply to a peak level of 0 dB. | | |
| I/Q inputs | input impedance | 50 Ω |
| | VSWR up to 30 MHz | <1.1, typ. 1.03 |
| | input voltage for full-scale input | $\sqrt{V_i^2 + V_q^2} = 0.5 \text{ V}$ |
| | I/Q skew | |
| | setting range | -1 ns to 1 ns |
| | resolution | 1 ps |
| A/D converter | sampling rate | 100 MHz |
| | resolution | 14 bit |
| Aliasing filter | with amplitude and group-delay correction | |
| | bandwidth, roll-off to -0.1 dB | 30 MHz |
| | stopband rejection, $f \geq 70 \text{ MHz}$ | typ. 80 dB |
| RF frequency response for entire instrument in modulation bandwidth | I/Q wideband ON, optimize internal I/Q impairments for RF output ON | |
| | up to 10 MHz | typ. 0.2 dB |
| | up to 30 MHz | typ. 0.4 dB |
| Carrier leakage | referenced to full scale | <-55 dBc, typ. <-65 dBc |
| Suppression of image sideband for entire instrument in modulation bandwidth | up to 10 MHz | typ. 56 dB |
| | up to 30 MHz | typ. 50 dB |

| | | |
|--------------------|---|---------------|
| RF spectral purity | wideband noise, with full-scale DC input | |
| | 20 MHz \leq f \leq 200 MHz | typ. -145 dBc |
| | 200 MHz < f \leq 1.5 GHz | typ. -148 dBc |
| | 1.5 GHz < f \leq 3 GHz | typ. -148 dBc |
| | f > 1.5 GHz | typ. -145 dBc |
| | ACLR with an ideal input signal 3GPP, test model 1, 64 DPCHs with R&S [®] SMU-B102, R&S [®] SMU-B103, R&S [®] SMU-B202, R&S [®] SMU-B203 level \leq 10.5 dBm PEP, \leq 17.5 dBm PEP with high-power output option with R&S [®] SMU-B104, R&S [®] SMU-B106 level \leq 5.5 dBm PEP \leq 14.5 dBm PEP with high-power output option frequency 1800 MHz to 2200 MHz | |
| | offset 5 MHz (baseband gain 3 dB) | typ. 70 dB |
| | offset 10 MHz (baseband gain 6 dB) | typ. 73 dB |

I/Q baseband generator (R&S® SMU-B9/-B10/-B11 option) – arbitrary waveform mode

At least one R&S® SMU-B13 baseband main module must be installed. One or two R&S® SMU-B9/-B10/-B11 can be installed. Their I/Q signals can be assigned a frequency offset and/or be added in the digital domain with settable level ratio.

| | | |
|-----------------------|---|---|
| Waveform memory | output memory | |
| | waveform length R&S® SMU-B9 | 128 sample to 128 Msample in one-sample steps |
| | waveform length R&S® SMU-B10 | 128 sample to 64 Msample in one-sample steps |
| | waveform length R&S® SMU-B11 | 128 sample to 16 Msample in one-sample steps |
| | resolution | 16 bit |
| | loading time 10 Msample | 15 s |
| | nonvolatile memory | hard disk |
| Multisegment waveform | number of segments | max. 100 segments |
| | changeover modes | GUI, remote control, external trigger |
| | extended trigger modes | same segment, next segment, next segment seamless |
| | changeover time (external trigger, without clock change) | typ. 5 µs at 50 MHz clock rate |
| | seamless changeover | output up to end of current segment, followed by changeover to next segment |
| Multicarrier waveform | number of carriers | max. 32 |
| | total RF bandwidth | max. 80 MHz |
| | crest factor modes | maximize, minimize, OFF |
| | signal period modes | longest file, shortest file, user (max. 1 s) |
| | single carrier gain | -80 dB to 0 dB |
| | single carrier start phase | 0° to 360° |
| | single carrier delay | 0 s to 1 s |
| Clock generation | clock rate | 400 Hz to 100 MHz |
| | resolution | 0.001 Hz |
| | operating mode | internal, external |
| | frequency uncertainty (internal) | $<5 \times 10^{-14} \times \text{clock rate} + \text{uncertainty of reference frequency}$ |
| Interpolation | The sampling rate of the waveform is automatically interpolated to the internal 100 MHz data rate. | |
| | bandwidth | |
| | clock rate = 100 MHz (no interpolation), roll-off to -0.1 dB | 40 MHz |
| | clock rate ≤ 100 MHz, drop to -0.1 dB | 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 | -40 MHz to +40 MHz |
| | resolution | 0.01 Hz |
| | frequency uncertainty | $<5 \times 10^{-10} \times \text{frequency offset} + \text{reference frequency error}$ |

| | | |
|--|---|---|
| Triggering | In internal clock mode, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In external clock mode, the trigger event is synchronized to the symbol clock. | |
| | operating mode | internal, external |
| | modes | Auto, Retrig, Armed Auto, Armed Retrig |
| | setting uncertainty for clock phase related to trigger in internal clock mode | <18 ns |
| | external trigger delay | |
| | setting range | 0 sample to $(2^{16} - 1)$ sample |
| | resolution | |
| | internal clock mode | 0.01 sample |
| | external clock mode | 1 sample |
| | setting uncertainty | <5 ns |
| | external trigger inhibit | |
| | setting range | 0 sample to $(2^{26} - 1)$ sample |
| | resolution | 1 sample |
| | external trigger pulse width | >15 ns |
| | external trigger frequency | <0.02 × sampling rate |
| Marker outputs | number | 4 |
| | level | LVTTTL |
| | operating modes | unchanged, restart, pulse, pattern, ratio |
| | marker delay | |
| | setting range | 0 sample to (waveform length – 1) sample |
| | setting range without recalculation | 0 sample to 2000 sample |
| | resolution of setting | 0.001 sample |
| | setting uncertainty | <10 ns |
| Operation with R&S®WinIQSIM2™: As of version 1.00, the software supports download of I/Q data and control of the R&S®SMU-B9/-B10/-B11. | | |
| Operation with R&S®WinIQSIM™: As of version 4.40, the software supports download of I/Q data and control of the R&S®SMU-B9/-B10/-B11. | | |

I/Q baseband generator (R&S® SMU-B9/-B10/-B11 option) – realtime operation

At least one R&S® SMU-B13 baseband main module must be installed. One or two R&S® SMU-B9/-B10/-B11 can be installed. Their I/Q signals can be assigned a frequency offset and/or be added in the digital domain with settable level ratio.

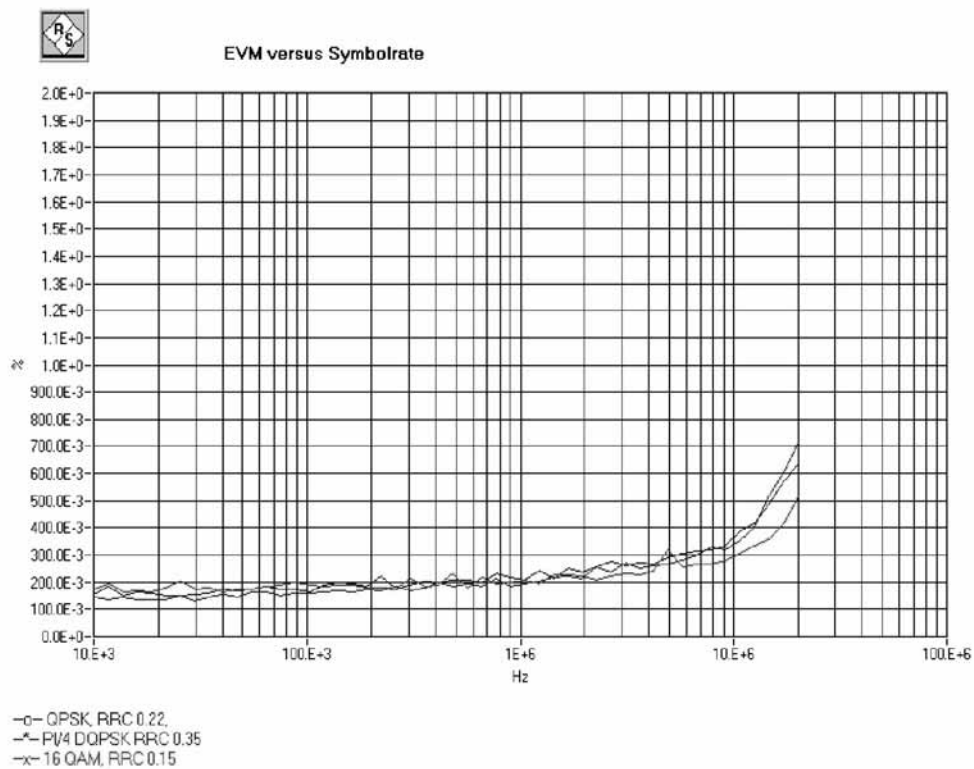
| | | |
|---------------------|--|--|
| Types of modulation | ASK | |
| | modulation index | 0 % to 100 % |
| | resolution | 0.1 % |
| | FSK | 2FSK, 4FSK, MSK |
| | deviation | 0.1 to $1.5 \times f_{\text{sym}}$ |
| | maximum | 10 MHz |
| | resolution | <0.1 Hz |
| | setting uncertainty | <0.5 % |
| | variable FSK | 4FSK, 8FSK, 16FSK |
| | deviations | $-1.5 \times f_{\text{sym}}$ to $+1.5 \times f_{\text{sym}}$ |
| | maximum | 10 MHz |
| | resolution | <0.1 Hz |
| | PSK | BPSK, QPSK, QPSK 45° offset, OQPSK, $\pi/4$ -QPSK, $\pi/2$ -DBPSK, $\pi/4$ -DQPSK, $\pi/8$ -D8PSK, 8PSK, 8PSK EDGE |
| | QAM | 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 ^{®8} , 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 if the bandwidth is exceeded. | |
| | cosine, root cosine | |
| | filter parameter α | 0.05 to 1.00 |
| | Gaussian | |
| | filter parameter $B \times T$ | 0.15 to 2.50 |
| | cdmaOne, cdmaOne + equalizer cdmaOne 705 kHz, cdmaOne 705 kHz + equalizer CDMA2000 [®] 3x APCO25 C4FM rectangular split phase | |
| | filter parameter $B \times T$ | 0.15 to 2.5 |
| | resolution of filter parameter | 0.01 |

⁸ CDMA2000[®] is a registered trademark of the Telecommunications Industry Association (TIA – USA).

| | | |
|------------------|--|--|
| Symbol rate | If an external clock is used, the applied data rate may deviate from the set clock rate by $\pm 2\%$. The external clock can be used for internal and external data. | |
| | operating mode | internal, external |
| | setting range | |
| | ASK, PSK, and QAM | 400 Hz to 25 MHz |
| | FSK | 400 Hz to 15 MHz |
| | resolution | 0.001 Hz |
| | frequency uncertainty (internal) | $< 5 \times 10^{-14} \times \text{symbol rate} + \text{reference frequency uncertainty}$ |
| | external clock | symbol, $K \times \text{symbol}$, bit clock |
| | clock divider K | 1 to 64 |
| | external clock rate | 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 | -40 MHz to +40 MHz |
| | resolution | 0.01 Hz |
| | frequency uncertainty | $< 5 \times 10^{-10} \times \text{frequency offset} + \text{reference frequency error}$ |
| Data sources | internal | |
| | all 0, all 1 | |
| | PRBS | |
| | sequence length | 9, 11, 15, 16, 20, 21, 23 |
| | pattern | |
| | length | 1 bit to 64 bit |
| | data lists | |
| | output memory R&S [®] SMU-B9 | 8 bit to 4 Gbit |
| | output memory R&S [®] SMU-B10 | 8 bit to 2 Gbit |
| | output memory R&S [®] SMU-B11 | 8 bit to 512 Mbit |
| | nonvolatile memory | hard disk |
| | 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 | 1 bit to 10 bit |
| | bit rate | max. 60 MHz |
| | parallel | |
| word width | 1 bit to 10 bit | |
| symbol rate | max. 25 MHz | |

| | | |
|---------------------------|---|--|
| Triggering | In internal clock mode, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In external clock mode, the trigger event is synchronized to the symbol clock. | |
| | operating mode | internal, external |
| | modes | Auto, Retrig, Armed Auto, Armed Retrig |
| | setting uncertainty for clock phase related to trigger in internal clock mode | <18 ns |
| | external trigger delay | |
| | setting range | 0 sample to $(2^{16} - 1)$ sample |
| | resolution | |
| | internal clock mode | 0.01 sample |
| | external clock mode | 1 sample |
| | setting uncertainty | <5 ns |
| | external trigger inhibit | |
| | setting range | 0 sample to $(2^{26} - 1)$ sample |
| | resolution | 1 sample |
| | external trigger pulse width | >15 ns |
| | external trigger frequency | <0.02 × sampling rate |
| Marker outputs | number | 4 |
| | level | LVTTL |
| | operating modes | control list, restart, pulse, pattern, ratio |
| | marker delay (in sample) | |
| | setting range | 0 to $2^{24} - 1$ |
| | setting range without recalculation | 0 to 2000 |
| | resolution of setting | 0.001 |
| setting uncertainty | <10 ns | |
| Level reduction | Internal or external via LEVATT input. The signal switches between nominal and reduced level (without edge shaping). If an internal LEVATT signal is used, the connector is used as an output. | |
| | setting range | 0 dB to 60 dB |
| | additional level error in case of reduction | |
| | up to 30 dB | <1 dB |
| up to 50 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. If an internal BURST GATE signal is applied, the connector is used as an output. | |
| | operating range | max. 5 MHz |
| | rise/fall time | |
| | setting range | 0.5 symbol to 16 symbol |
| | resolution | 0.1 symbol |
| ramp shape | 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 | 1 k Ω , 50 Ω |
| | trigger threshold | |
| | setting range | 0.00 V to 2.50 V |
| resolution | 0.01 V | |
| Clock/data outputs | level | LVTTL |

| | | |
|---|--|---|
| Predefined settings | modulation, filter, symbol rate and coding in line with standard | |
| | standards | Bluetooth ^{®9} , 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 $B \times T = 0.2$ to 0.7 | |
| | symbol rate up to 2 MHz | <1.2 %, typ. 0.25 % |
| | symbol rate up to 10 MHz | typ. 0.75 % |
| Phase error with MSK | Gaussian filter with $B \times T = 0.2$ to 0.7 | |
| | bit rate up to 2 MHz | <0.4°, typ. 0.15° |
| | bit rate up to 10 MHz | typ. 0.3° |
| | | |
| EVM with QPSK, OQPSK, $\pi/4$ -DQPSK, 8PSK, 16QAM, 32QAM, 64QAM | cosine, root cosine filter with $\alpha = 0.2$ to 0.7 | |
| | symbol rate up to 5 MHz | <0.8 %, typ. 0.2 % |
| | symbol rate up to 20 MHz | typ. 0.7 % |
| | | |



Typical EVM versus symbol rate

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

Modulation uncertainty for main standards

Typical values

| Standard | GSM | EDGE | WCDMA 3GPP (1DPCH) | cdmaOne Reverse | DECT | TETRA | NADC | PDC | IEEE 802.11a |
|---|----------------|----------------|--------------------------|--------------------|-----------------|-------------------|-----------------|-----------------|------------------|
| Frequency in MHz | 400 to 2000 | 400 to 2000 | 1800 to 2200 | 800 to 900 | 1880 to 1990 | 380 to 480 | 824 to 894 | 810 to 956 | 2400 to 2485 |
| | | | | 1850 to 2000 | | | 1850 to 2000 | 1429 to 1501 | 5150 to 5825 |
| EVM in % | – | 0.2 | 0.3 | 0.2 | – | 0.2 | 0.2 | 0.2 | 0.4 |
| Phase error in ° | 0.15 | – | – | – | – | – | – | – | – |
| Dev. error in 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) in dB¹⁰ | | | | | | | | | |
| In adjacent channel | –37 | –38 | –72 ¹¹ | –85 ¹² | – | –74 ¹³ | –34 | –74 | –42 at 11 MHz |
| In alternate channel | –71 | –71 | –78 ¹⁴ | –89 ¹⁵ | – | –77 ¹¹ | –80 | –82 | –64 at 20 MHz |
| In 2nd alternate channel | –85 | –85 | – | –95 ¹⁶ | – | – | – | – | –66 at 30 MHz |

¹⁰ Level restricted, see specs.

¹¹ Baseband gain 0 dB (standard).

¹² 885 kHz offset and 30 kHz bandwidth.

¹³ Measured with root cosine filter.

¹⁴ Baseband gain 6 dB (low noise).

¹⁵ 1.25 MHz offset and 30 kHz bandwidth.

¹⁶ 1.98 MHz offset and 30 kHz bandwidth.

Digital modulation systems

At least one I/Q baseband generator (R&S®SMU-B9/-B10/-B11 options) must be installed. If two I/Q baseband generators are installed and two signals of the same standard (e.g. GSM/EDGE) are to be output simultaneously, two corresponding software options must also be installed (in this case R&S®SMU-K40). If only one R&S®SMU-K40 is installed and GSM/EDGE is selected in one I/Q baseband generator, the other I/Q baseband generator is disabled for GSM/EDGE. However, a software option is not tied to a specific I/Q baseband generator.

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

GSM/EDGE digital standard (R&S®SMU-K40 option)

| GSM/EDGE digital standard | | in line with GSM standard |
|---------------------------|---|--|
| Frequency range | frequency bands to GSM 05.05 in uplink and downlink | GSM 450 GSM 480 GSM 850 GSM 900 (P-GSM, E-GSM, R-GSM) DCS 1800 PCS 1900 |
| | range | as R&S®SMU200A |
| Modes | unframed | generation of a signal without slot and frame structure and power ramping, with symbol rate and filtering in line with 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) | configuration of simple multiframe |
| | application: simulation of modulation change in a slot versus time | 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 | 270.833 kHz |
| | range | 400 Hz to 300 kHz |
| Baseband filter | GSM, standard | Gaussian with $B \times T = 0.3$ |
| | range | $B \times T = 0.15$ to 2.5 |
| | EDGE, standard | Gaussian linearized (EDGE) |
| Frame structure | Change between GSM and EDGE possible from slot to slot and frame to frame; half rate and GPRS at the physical layer. Slots 0 to 7 of the frames are user-defined for uplink and downlink. In the normal burst half-rate mode, the burst parameters can be defined independently for two users that alternate from frame to frame. | |
| | burst types | normal (full rate) normal (half rate) EDGE synchronization frequency correction (normal + compact) dummy access all data (GSM) all data (EDGE) |

| | | |
|---------------------------|--|--|
| Burst rise/fall time | standard | in line with GSM power time template |
| | selectable | |
| | ramp time | 0.3 symbol to 4 symbol |
| | ramp delay | -1.0 symbol to 1.0 symbol |
| | rise delay | -9 symbol to 9 symbol |
| Settable slot attenuation | fall delay | -9 symbol to 9 symbol |
| | | 0.0 dB to 60.0 dB, 8 different levels simultaneously possible (full level and 7 attenuated levels) |
| Burst ON/OFF ratio | | >100 dB |
| Data sources | For characteristics of data sources, see section I/Q baseband generator (R&S®SMU-B9/-B10/-B11 option) – realtime operation. | |
| | internal data sources | |
| Training sequence | for normal burst (full rate), normal burst (half rate), EDGE burst | TSC0 to TSC7 user TSC |
| | for sync burst | standard CTS compact user |
| | for access burst | TS0 to TS2 |
| Triggering | | see I/Q baseband generator |
| Markers | | convenient graphics editor for defining marker signals, and in addition: frame, multiple frame slot, multiple slot pulse pattern ON/OFF ratio |
| Phase error | MSK, Gaussian filter $B \times T = 0.3$ | |
| | rms | <0.4°, typ. 0.15° |
| | peak | <1.2°, typ. 0.4° |
| Error vector magnitude | 8PSK EDGE, Gaussian linearized filter, rms | <0.5 %, typ. 0.2 % |
| Power density spectrum | values measured with 30 kHz resolution bandwidth, referenced to level in band center without power ramping with frequency options up to 3 GHz level ≤10.5 dBm, ≤17.5 dBm with R&S®SMU-B31, R&S®SMU-B36 options with frequency options above 3 GHz level ≤5.5 dBm, ≤15.5 dBm with R&S®SMU-B31 R&S®SMU-B36 options, frequency 400 MHz to 2 GHz | |
| | 200 kHz offset | <-34 dB, typ. -37 dB |
| | 400 kHz offset | <-68 dB, typ. -71 dB |
| | 600 kHz offset | <-80 dB, typ. -85 dB |

3GPP FDD digital standard (R&S[®]SMU-K42 option)

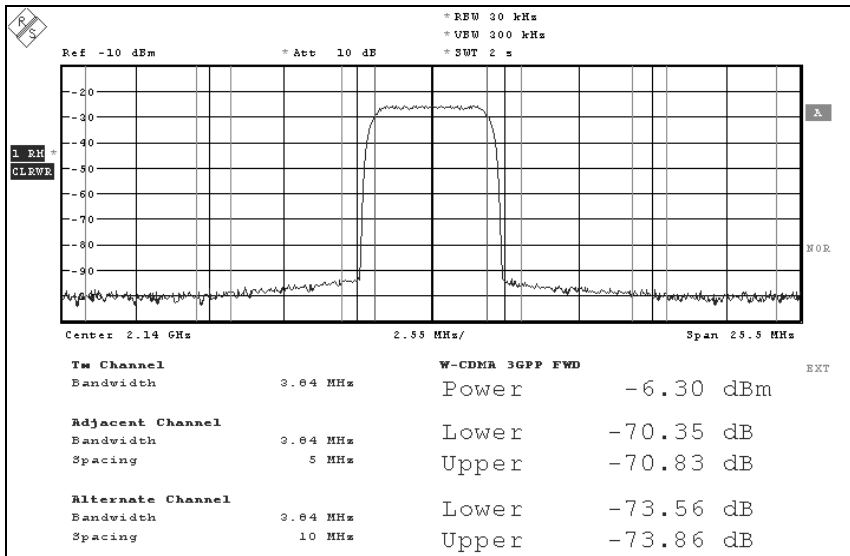
| | | |
|---|---|--|
| WCDMA 3GPP FDD digital standard | | in line with 3GPP standard, release 6 |
| Frequency range | frequency bands in line with 3GPP TS 25.101 in uplink and downlink | UTRA FDD frequency bands I to III |
| | range | as R&S [®] SMU200A |
| Signal generation modes/sequence length | Combination of realtime operation (enhanced channels) and arbitrary waveform mode. In downlink mode, the P-CCPCH (BCCH with running SFN) and up to three DPCHs can be generated in realtime. All other channels (frame-cycle control channels such as SCH, OCNS simulation, other base stations, etc) can be added via the ARB. In uplink mode, one mobile station can be simulated in realtime (PRACH, PCPCH or DPCCH, and up to 6 DPDCHs); further mobile stations (three user-configured and up to 64 of identical mode) can be simulated via the ARB and added to the realtime signal. The sequence length of the ARB component can be entered in frames (10 ms each); the max. length depends on chip rate, mode, and in some cases on oversampling. | |
| Enhanced channels | special capabilities in up to 4 channels of base station 1 on downlink and in all channels of mobile station 1 on uplink: realtime calculation, optional channel coding, simulation of bit and block errors, data lists as sources for data and TPC fields | |
| Modulation | | BPSK (uplink) QPSK (downlink) 16QAM (downlink HSDPA) |
| Test models | downlink (in line with 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 kspcs DPCCH + 1 DPDCH at 960 kspcs |
| Test case wizard | shortcut in line with TS 25.141 test cases | |
| Generate waveform file | filtering of data generated in ARB mode and saving it as waveform file | |
| Realtime component | | |
| WCDMA signal in realtime | generation of WCDMA signals with up to 4 active enhanced channels | |
| Applications | continuous measurement of BER and BLER (with channel coding) in a code channel with any (PN) data without wrap-around problems use of user data (data lists) with externally processed long data sequences for enhanced channels | |
| Data lists for data and TPC field | The data fields and the transmit power control (TPC) field of the slots of enhanced channels can be filled from data lists. Externally generated data can thus be fed into the signal generation process of the R&S [®] SMU200A, e.g. with payload information from higher layers, on transport or physical layer. Long power control profiles for power control of the DUT can also be generated. | |
| Applications | measurement of power control steps of a mobile station (UE power control steps) measurement of maximum output power of a mobile station (UE max. output power) | |

| | | |
|----------------------------|---|---|
| Channel coding | coding of up to 4 enhanced channels in line with the definition of reference measurement channels in TS 25.101, TS 25.104, and TS 25.141; in addition, user-configurable channel coding for each enhanced channel station | |
| | predefined channel coding schemes for uplink and downlink | RMC 12.2 kbps AMR 12.2 kbps RMC 64 kbps RMC 144 kbps RMC 384 kbps |
| | possible settings of user-configurable channel coding | |
| | transport channels | 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 in line with TS 25.101/104/141 (radio transmission and reception), e.g. adjacent channel selectivity blocking characteristics intermodulation characteristics BLER measurements in line with TS 25.101/104 (radio transmission and reception), e.g. demodulation of dedicated channel under static propagation conditions (AWGN generation together with R&S [®] SMU-K62) test of decoder in receiver | |
| Bit error insertion | deliberate generation of bit errors by impairing the data stream prior to channel coding or at the physical layer | |
| | bit error ratio | 0.5 to 10 ⁻⁷ |
| Application | verification of internal BER calculation in line with TS 25.141 (BS conformance testing) | |
| Block error insertion | deliberate generation of block errors by impairing the CRC during coding of enhanced channels | |
| | block error ratio | 0.5 to 10 ⁻⁴ |
| Application | verification of internal BLER calculation in line with TS 25.141 (BS conformance testing) | |
| Add OCNS | Simulation of orthogonal background and interfering channels of a base station in line with TS 25.101. The power of the OCNS channels is configured automatically so that the total power of the BS is 1. | |
| Applications | testing the receiver of the mobile station under real conditions; measuring the maximum input level in line with TS 25.101 | |
| Additional mobile stations | Simulation of up to 64 mobile stations in addition to the 4 user-configurable mobile stations. The additional mobile stations use different scrambling codes. | |
| Parameters | number of additional mobile stations | 1 to 50 |
| | scrambling code step | 1 to 1000 hex |
| | power offset | -20 dB to 20 dB |
| Applications | base station tests under real receive conditions | |
| General settings | | |
| Triggering | | see I/Q baseband generator |
| Chip rate | standard | 3.840 Mcps (15 slots/frame) |
| | range | 1 Mcps to 5 Mcps |
| Link direction | | uplink (reverse link) and downlink (forward link) |
| Baseband filter | standard | $\sqrt{\cos}$, $\alpha = 0.22$ |
| | other filters | $\sqrt{\cos}$, cos, user filters |

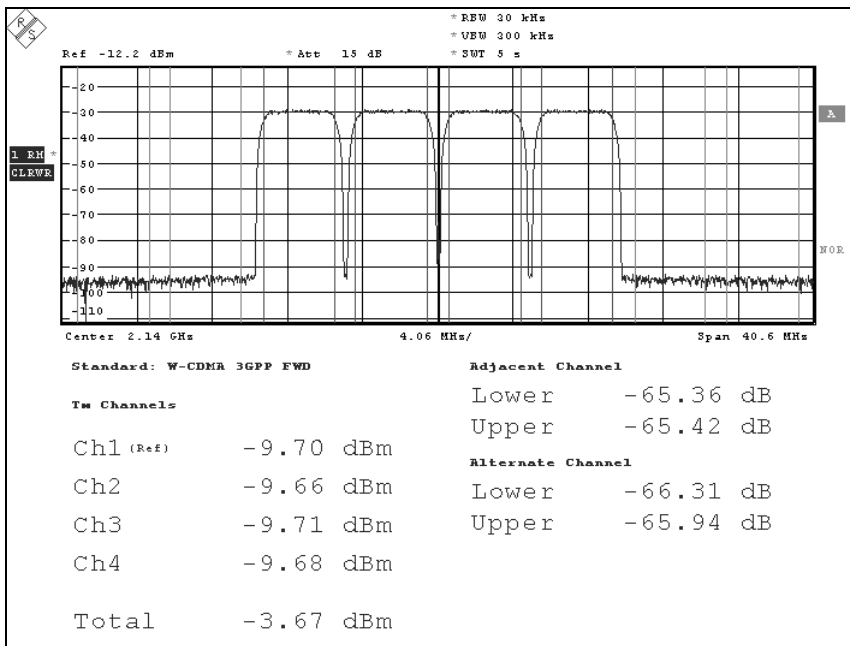
| | | |
|--|---|--|
| Clipping | Setting of clipping value relative to highest peak in percent. Clipping takes place prior to baseband filtering. Clipping reduces the crest factor. | |
| | modes | vector i + j q scalar i , q |
| | clipping level | 1 % to 100 % |
| Code channels | downlink | up to 512 data channels (plus special channels) divided among up to 4 base stations (BS) of 128 code channels each |
| | uplink | up to 4 user-configurable mobile stations (MS) and 64 additional MS of identical configuration in each of the modes PRACH Only, PCPCH Only, DPCCH + DPDCHs |
| Parameters of every BS | | |
| State | | ON/OFF |
| 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 chips to 38400 chips |
| Transmit diversity | The output signal can be generated either for antenna 1 or 2, as defined in the standard. | OFF/antenna 1/antenna 2 |
| Physical channels in downlink | | |
| | primary common pilot channel (P-CPICH) | |
| | secondary common pilot channel (S-CPICH) | |
| | primary sync channel (P-SCH) | |
| | secondary sync channel (S-SCH) | |
| | primary common control physical channel (P-CCPCH) | |
| | secondary common control physical channel (S-CCPCH) | |
| | page indication channel (PICH) | |
| | access preamble acquisition indication channel (AP-AICH) | |
| | collision detection acquisition indication channel (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 | | ON/OFF |
| 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 bit to 64 bit) data lists |
| Multicode state | | ON/OFF |
| 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 bit, 4 bit, 8 bit, 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 bit 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 | ON/OFF |
| | output power control step | -10 dB to +10 dB |

| | | |
|------------------------------------|---|---|
| TPC power offset | power offset of TPC field relative to data fields | -10 to +10 dB |
| TFCI state | | ON/OFF |
| TFCI | | 0 dB to 1023 dB |
| TFCI power offset | power offset of TFCI field relative to data fields | -10 dB to +10 dB |
| Parameters of every MS | | |
| State | | ON/OFF |
| 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 chips 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 | <p>Preamble Only: Only preambles are generated. Application: Detection of RACH preamble in line with TS 25.141.</p> <p>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 in line with TS 25.141.</p> | |
| Frame structure | | preamble(s), message part consisting of data and control component |
| Slot format | | 0 to 3 |
| Symbol rate | | 15 ksps, 30 ksps, 60 ksps, 120 ksps |
| Preamble part power | | -80 dB to 0 dB |
| Preamble power step | | 0 dB to 10 dB |
| Preamble repetition | | 1 to 10 |
| Data part power | | -80 dB to 0 dB |
| Control part power | | -80 dB to 0 dB |
| Signature | | 0 to 15 |
| Access slot | | 0 to 14 |
| AICH transmission timing | | 0 (3 access slots) or 1 (4 access slots) |
| Message part length | | 1, 2 frames |
| TFCI | | 0 to 1023 |
| Payload data | | PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 to 64 bit), data lists |
| Channel coding | reference measurement channel for UL RACH in line with TS 25.141 | |
| | state | ON/OFF |
| | transport block size | 168, 360 |
| PCPCH Only mode | | |
| Submodes | <p>Preamble Only: Only preambles are generated. Application: Detection of CPCH preamble in line with TS 25.141.</p> <p>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 in line with TS 25.141.</p> | |
| 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 ksps, 30 ksps, 60 ksps, 120 ksps, 240 ksps, 480 ksps, 960 ksps |
| Preamble part power | | -80 dB to 0 dB |
| Preamble power step | | 0 dB to 10 dB |
| Preamble repetition | | 1 to 10 |
| Data part power | | -80 dB to 0 dB |
| Control part power | | -80 dB to 0 dB |

| | | |
|---|---|--|
| Signature | | 0 to 15 |
| Access slot | | 0 to 14 |
| AICH transmission timing | | 0 (3 access slots) or 1 (4 access slots) |
| Message part length | | 1 to 10 frames |
| Power control preamble length | | 0, 8 slots |
| FBI state | | OFF/1 bit/2 bit |
| FBI pattern | | pattern (length 1 bit to 32 bit) |
| Payload data | | PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 to 64 bit) data lists |
| Channel coding | reference measurement channel for UL CPCH in line with TS 25.141 | |
| | state | ON/OFF |
| | transport block size | 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 | ON/OFF |
| | TFCI | 0 to 1023 |
| | TPC pattern | all 0, all 1, pattern (length 1 bit 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 |
| | 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 | ON/OFF |
| | output power control step | -10 dB to +10 dB |
| DPDCH (dedicated physical data channel) | overall symbol rate (total symbol rate of all uplink DPDCHs) | 15 ksps, 30 ksps, 60 ksps, 120 ksps, 240 ksps, 480 ksps, 960 ksps, 2 × 960 ksps, 3 × 960 ksps, 4 × 960 ksps, 5 × 960 ksps, 6 × 960 ksps |
| | depending on overall symbol rate: | |
| | active DPDCHs | 1 to 6 |
| | symbol rate | fixed for active DPDCHs |
| | channelization code | fixed for active DPDCHs |
| | channel 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 |
| Graphical display | | domain conflicts, code domain, channel graph, slot structure and formats offered in graphics block |
| Error vector magnitude | 1 DPCH, rms | <0.8 %, typ. 0.3 % |
| Adjacent-channel leakage ratio (ACLR) | test model 1, 64 DPCHs with frequency options up to 3 GHz level ≤10.5 dBm PEP, ≤17.5 dBm PEP with R&S [®] SMU-B31, R&S [®] SMU-B36 options with frequency options above 3 GHz level ≤5.5 dBm PEP, ≤14.5 dBm PEP with R&S [®] SMU-B31, R&S [®] SMU-B36 options frequency 1800 MHz to 2200 MHz | |
| | offset 5 MHz (baseband gain 3 dB) | >67 dB, typ. 70 dB |
| | offset 10 MHz (baseband gain 6 dB) | >72 dB, typ. 74 dB |



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



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

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

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

| | | |
|--|---|--|
| General parameters | This option extends the R&S [®] SMU-K42 (3GPP FDD digital standard) to full HSDPA support and dynamic power control. Therefore, all general parameters of the R&S [®] SMU-K42 such as frequency range or modulation are also valid for the R&S [®] SMU-K43. | |
| Downlink simulation | | |
| HSDPA channels (HS-SCCH, HS-PDSCH, and F-DPCH) | | |
| Enhancements | The R&S [®] SMU-K42 supports simulation of HSDPA channels in a continuous mode needed for TX measurements in line with TS 25.141 (test model 5). The R&S [®] SMU-K43 now supports simulation of HS-SCCH (high speed shared control channel) and HS-PDSCH (high speed physical downlink shared channel) in line with TS 25.211. This implies the correct timing between these channels as well as the possibility to set start subframe and inter-TTI distance. In addition, several F-DPCHs (fractional dedicated physical channel) can be generated. | |
| Application | TX measurements on 3GPP FDD Node Bs with realistic statistics RX measurements on 3GPP FDD UEs with correct timing | |
| Ranges (valid for HS-SCCH and HS-PDSCH) | HSDPA mode | continuous, subframe 0 to subframe 4 (where first packet is sent), H-Set |
| | inter-TTI distance | 1 to 16 |
| | Burst mode | ON: DTX between two HS-PDSCH packets OFF: transmission of dummy data between two HS-PDSCH packets |
| Fixed reference channel definition H-Set | | |
| Enhancements | The R&S [®] SMU-K43 allows HSDPA downlink channels with channel coding to be generated in line with the definition of the fixed reference channels (H-Set) in TS 25.101; in addition, user-configurable bit/block error insertion is possible. | |
| Ranges | H-Set | H-Set 1 to H-Set 5 |
| | slot format | QPSK, 16QAM (H-Set 1 to H-Set 3) |
| | RV parameter | 0 to 7 |
| | UEID | 0 to 65535 |
| | bit error insertion | 0.5 to 10^{-7} (insertion prior to channel coding or at the physical layer) |
| | block error insertion | 0.5 to 10^{-4} |
| Dynamic power control | | |
| Enhancements | The R&S [®] SMU-K42 provides a method to vary the output power of a code channel in arbitrary waveform mode by misusing its TPC pattern. The R&S [®] SMU-K43 now allows the variation of the output power in realtime mode for up to 3 DPCHs in three submodes: | |
| | External | UE provides TPC info to R&S [®] SMU200A by external connector (TTL level) |
| | by TPC pattern | TPC pattern is used to control the output power |
| | manual | the output power is changed incrementally by pressing buttons or sending the corresponding remote control commands |
| Application | RX measurements on 3GPP FDD UEs where closed loop power control is needed RX measurements on 3GPP FDD UEs with varied code channel power without dropouts in the signal | |
| Ranges | mode | external, by TPC pattern, manual |
| | direction | up, down |
| | power step | 0.5 dB to 6 dB |
| | up range | 0 dB to 20 dB |
| | down range | 0 dB to 20 dB |

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

GPS digital standard (R&S® SMU-K44 option)

| | | |
|---------------------------------|--|---|
| GPS digital standard | | in line with ICD-GPS-200 revision C |
| General settings | | |
| Frequency | | default L1 = 1575.42 MHz user-selectable in entire frequency range of R&S® SMU200A |
| Output level | | default -115 dBm user-selectable in entire output level range of R&S® SMU200A |
| Modulation | | BPSK (CDMA) |
| Symbol rate (chip rate) | | 1.023 MHz |
| Baseband filter | | Gaussian filter parameter $B \times T = 1$ |
| Simulation modes | | generic mode localization mode |
| Marker | | navigation data bit (20460 chips) navigation data word (30 data bits) navigation data subframe (10 data words) navigation page (5 data subframes) complete navigation message (25 data pages) pulse pattern ON/OFF radio |
| Triggering | | see I/Q baseband generator |
| Navigation data | | |
| Navigation data | identical for each satellite | all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists real navigation data |
| Real navigation data | | support of SEM-Almanac, any valid date and time (GMT) |
| Navigation data rate | | 50 bps |
| Satellite configurations | | |
| Number of channels | | 1 to 4 satellites |
| Use spreading code | identical for each satellite | ON/OFF |
| State | separately settable for each satellite | ON/OFF |
| Space vehicle ID | separately settable for each satellite | C/A codes: 37 Gold codes, 1023 chips each |
| Time shift | separately settable for each satellite | 0 to 10000000 (C/A code chip)/16 |
| Power | separately settable for each satellite | ±10 dB |
| Doppler shift | separately settable for each satellite | ±100 kHz (selectable in steps of 0.01 Hz) |
| Localization mode | | |
| Latitude | latitude of simulated location | ±90° (selectable in steps of 0.1 s) |
| Longitude | longitude of simulated location | ±180° (selectable in steps of 0.1 s) |
| Altitude | altitude of simulated location | ±10000 m (selectable in steps of 0.1 m) |

3GPP FDD HSUPA (R&S[®]SMU-K45 option)

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

| | | |
|---|--|---|
| General parameters | This option extends the R&S [®] SMU-K42 (3GPP FDD digital standard) to full HSUPA support. Therefore, all general parameters of the R&S [®] SMU-K42 such as frequency range or modulation are also valid for the R&S [®] SMU-K45. | |
| Downlink simulation | | |
| HSUPA channels (E-AGCH, E-RGCH, E-HICH) | | |
| Enhancements | The R&S [®] SMU-K45 in downlink supports simulation of HSUPA control channels E-AGCH (E-DCH absolute grant channel), E-RGCH (E-DCH relative grant channel), and E-HICH (E-DCH hybrid ARQ indicator channel) in line with TS 25.211. | |
| Application | RX measurements on 3GPP FDD UEs with correct timing | |
| Ranges (valid for E-RGCH and E-HICH) | type of cell | -serving cell, non-serving cell |
| | E-DCH TTI | 2 ms, 10 ms |
| | signature sequence index | 0 to 39 (in line with TS 25.211) |
| | relative grant pattern | up to 32 UP/DOWN/HOLD commands sent periodically |
| | ACK/NACK pattern | up to 32 ACK/NACK commands sent periodically |
| Uplink simulation | | |
| E-DPCCH (E-DCH dedicated physical control channel), E-DPDCH (E-DCH dedicated physical data channel) | | |
| Enhancements | The R&S [®] SMU-K45 in uplink supports simulation of an E-DPCCH and up to four E-DPDCHs with channel coding in line with the definition of the fixed reference channels in TS 25.104 and TS 25.141. Furthermore, a method is provided to control the output of the FRC HARQ processes in realtime by means of a feedback line (TTL) sending ACKs and NACKs in order to fulfill the requirements defined in 3GPP TS 25.141, chapter 8.12 and 8.13. | |
| Application | RX measurements on 3GPP FDD Node BS supporting HSUPA | |
| E-DPCCH | power | -80 dB to 0 dB |
| | retransmission sequence number | 0 to 3 |
| | E-TFCI information | 0 to 127 |
| | happy bit | 0, 1 |
| | E-DCH TTI | 2 ms, 10 ms |
| | DTX pattern | up to 32 TX/DTX commands sent periodically |
| E-DPDCH | overall symbol rate (total symbol rate of all uplink E-DPDCHs) | 60 ksps, 120 ksps, 240 ksps, 480 ksps, 960 ksps, 2 × 960 ksps, 2 × 1920 ksps, 2 × 960 ksps, 2 × 1920 ksps |
| | depending on overall symbol rate | |
| | active E-DPDCHs | 1 to 4 |
| | symbol rate | fixed for active E-DPDCHs |
| | channelization code | fixed for active E-DPDCHs |
| | common for all E-DPDCHs | |
| | channel power | -80 dB to 0 dB |
| | payload data | PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 bit to 64 bit) data lists |
| | E-DCH TTI | 2 ms, 10 ms |
| | DTX pattern | up to 32 TX/DTX commands sent periodically |

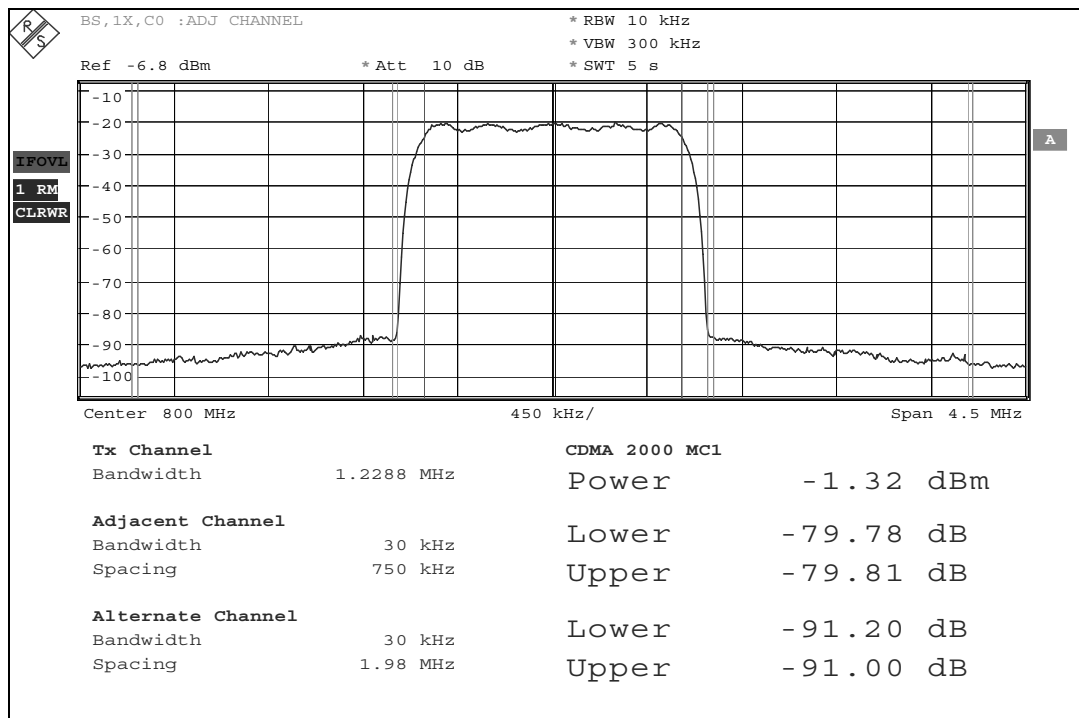
| | | |
|-------------|---|--|
| HSUPA FRC | channel coding in line with the definition of fixed reference channels in TS 25.104 and TS 25.141; in addition, user-configurable Virtual HARQ mode and bit/block error insertion | |
| | fixed reference channel (FRC) (predefined channel coding schemes) | FRC 1 to FRC 7 |
| | DTX pattern | up to 32 TX/DTX commands sent periodically |
| | HARQ feedback simulation: feedback (TTL) connected to LEVATT | |
| | always use RV 0 | ON/OFF |
| | max. number of retransmissions | 0 to 20 |
| | ACK definition | high, low |
| | additional user delay | -50 to +50 (in units of 256 chips) |
| | HARQ ACK/NACK pattern (individual ACK/NACK pattern for each HARQ process) | up to 32 ACK/NACK commands sent periodically |
| | bit error insertion (deliberate generation of bit errors by impairing the data stream prior to channel coding or at the physical layer) | |
| | bit error ratio | 0.5 to 10^{-7} |
| | application | verification of internal BER calculation in line with TS 25.141 (BS conformance testing) |
| | block error insertion (deliberate generation of block errors by impairing the CRC during coding of enhanced channels) | |
| | block error ratio | 0.5 to 10^{-4} |
| application | verification of internal BLER calculation in line with TS 25.141 (BS conformance testing) | |

CDMA2000® digital standard (R&S® SMU-K46 option)

| | | |
|--|--|---|
| CDMA2000® digital standard | release C | in line with 3GPP2 C.S0002-C |
| Frequency | band class 0 to band class 12 | 410 MHz to 2170 MHz |
| Chip rates | standard | 1.2288 MHz (1X) |
| | range | 1 MHz to 5 MHz |
| Modes | | 1× direct spread (spreading rate 1) |
| Link direction | | forward link and reverse link |
| Sequence length | sequence length entered in frames (80 ms each), max. length 1022 frames with R&S® SMU-B9, 511 frames with R&S® SMU-B10, 160 frames with R&S® SMU-B11 | |
| Baseband filter | standard for reverse link | cdmaOne |
| | standard for forward link | cdmaOne + equalizer |
| | for enhanced ACLR: | |
| | reverse link | cdmaOne 705 kHz |
| | forward link | cdmaOne 705 kHz + equalizer |
| Code channels | forward link | 4 base stations with a maximum of 78 code channels each (depending on radio configuration) |
| | reverse link | 4 mobile stations with a maximum of 8 code channels each (depending on radio configuration) |
| Clipping level | Setting of a limit value relative to the highest peak in percent. Limitation is effected prior to baseband filtering and reduces the crest factor. | value range 1 % to 100 % |
| Generate waveform file | filtering of data generated in ARB mode and saving it as waveform file | |
| Parameters of every BS | | |
| State | | ON/OFF |
| Time delay | timing offset of signals of individual base stations | |
| | BS1 | 0 chips (fixed) |
| | BS2 to BS4 | 0 chips to 98304 chips |
| PN offset | | 0 to 511 |
| Transmit diversity | If this function is activated, the output signal can be generated for either antenna 1 or 2, as defined in the standard. | OFF antenna 1 antenna 2 |
| Diversity mode | | OTD/STS |
| Quasi-orthogonal Walsh sets | | set 1 to set 3 |
| Parameters of every forward link code channel that can be set independently | | |
| State | | ON/OFF |
| Channel types Forward link | forward pilot (F-PICH) | |
| | transmit diversity pilot (F-TDPICH) | |
| | auxiliary pilot (F-APICH) | |
| | auxiliary transmit diversity pilot (F-ATDPCH) | |
| | sync (F-SYNC) | |
| | paging (F-PCH) | |
| | broadcast (F-BCH) | |
| | quick paging (F-QPCH) | |
| | common power control (F-CPCCH) | |
| | common assignment (F-CACH) | |
| | common control (F-CCCH) | |
| | packet data control (F-PDCCH) | |
| | packet data (F-PDCH) | |
| | traffic channel: | |
| | fundamental (F-FCH) | |
| | supplemental (F-SCH) | |
| | dedicated control (F-DCCH) | |
| Radio configuration | chip rate 1.2288 Mcps (1X) | RC 1 to RC 5 and RC 10 |
| Frame length | depending on channel type and radio configuration | 5 ms, 10 ms, 20 ms, 40 ms, 80 ms, 160 ms |
| Data rate | depending on channel type and radio configuration | 1.2 kbps to 1036.8 kbps |

| | | |
|-----------------------------------|---|---|
| Walsh code | depending on channel type and radio configuration | 0 to 127 |
| Quasi-orthogonal code | | ON/OFF |
| Power range | | -80 dB to 0 dB |
| Data | | all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists |
| Long code mask | | 0 to 3FF FFFF FFFF hex |
| Power control data source | | all 0 all 1 pattern (up to 64 bit) data list |
| (Mis)use for output power control | If this function is active, the power control data is used to vary the transmit power of the code channels versus time. | |
| | state | ON/OFF |
| | output power control step | -10 dB to +10 dB |
| Channel coding | All stages of channel coding specified by IS-2000 (e.g. frame quality indicator, convolutional encoder/turbo coder, symbol puncture, and interleaver) are available. All frame length and data rate combinations are supported. Four options are available: | |
| | OFF | channel coding OFF |
| | complete | channel coding completely ON |
| | without interleaving | channel coding ON but without interleaver |
| | interleaving only | channel coding OFF, only interleaver is active |
| Parameters of every MS | | |
| State | | ON/OFF |
| Radio configuration | chip rate 1.2288 Mcps (1X) | RC 1 to RC 4 |
| Channel coding | All stages of channel coding specified by IS-2000 (e.g. frame quality indicator, convolutional encoder, symbol puncture, and interleaver) are available. All frame length and data rate combinations are supported. Four options are available: | |
| | OFF | channel coding OFF |
| | complete | channel coding completely ON |
| | without interleaving | channel coding ON but without interleaver |
| | interleaving only | channel coding OFF, only interleaver is active |
| Operating mode | simulates MS operating mode and defines available channels | traffic access enhanced access common control |
| Long code mask | | 0 to 3FF FFFF FFFF hex |
| Power control data source | In reverse link, the power control data is used only for the misuse mode. | all 0 all 1 pattern (up to 64 bit) data list |
| (Mis)use for output power control | If this function is active, the power control data is used to vary the transmit power of the code channels versus time. | |
| | state | ON/OFF |
| | output power control step | -10 dB to +10 dB |

| Parameters of every reverse link code channel that can be set independently | | |
|---|--|---|
| State | | ON/OFF |
| Channel types | reverse pilot (R-PICH) | |
| Reverse link | access (R-ACH) | |
| | enhanced access (R-EACH) | |
| | reverse common control (R-CCCH) | |
| | reverse dedicated control (R-DCCH) | |
| | traffic channel | |
| | fundamental (R-FCH) | |
| | supplemental code (R-SCCH) | |
| | supplemental (R-SCH) | |
| Frame length | depending on channel type and radio configuration | 5 ms, 10 ms, 20 ms, 40 ms, 80 ms |
| Data rate | depending on channel type and radio configuration | 1.2 kbps to 1036.8 kbps |
| Power | | -80 dB to 0 dB |
| Data | | all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists |
| Error vector magnitude (EVM) | F-PICH, F-SYNC, and one F-FCH, rms | <0.8 %, typ. 0.3 % |
| Adjacent-channel leakage ratio (ACLR) | F-PICH, F-SYNC, and one F-FCH carrier frequency 800 MHz | |
| | channel spacing 0.75 MHz (bandwidth 30 kHz) | typ. 79 dB |
| | channel spacing 1.98 MHz (bandwidth 30 kHz) | typ. 91 dB |



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

IEEE 802.11 a/b/g digital standard (R&S[®] SMU-K48 option)

| | | |
|--|---|--|
| IEEE 802.11 a/b/g digital standard | | in line with IEEE 802.11a-1999, IEEE 802.11b-1999, IEEE 802.11g-2003 |
| General settings | | |
| Modes | unframed | generation of a non-packet-oriented signal without frame structure, with the modulation modes and data rates defined by the IEEE 802.11 standard |
| | framed | generation of a sequence of data packets with the frame structure defined by the standard, interrupted by an idle time |
| Sequence length | | 1 to 511 frames (depending on frame duration) |
| Clipping | | vector or scalar clipping, applied before filtering |
| Generate waveform file | filtering of data generated in ARB mode and saving it as waveform file | |
| Marker modes | | restart, frame start, frame active part, pulse, pattern, ON/OFF ratio |
| Triggering | | see I/Q baseband generator |
| Parameters in framed mode | | |
| Idle time | time between two successive packets (PPDUs) | |
| | range | 0 s to 10000 µs |
| MAC header | | activating and configuring the MAC header with the following parameters: frame control, duration/ID, address 1 to 4, and sequence control |
| Frame check sequence | | activating or deactivating a 32 bit (4 byte) check sum for protecting MAC header and user data (frame body) |
| Settings for CCK (IEEE 802.11b/IEEE 802.11g) | | |
| Chip rate | standard | 11 Mcps |
| | range | as R&S [®] SMU200A |
| Baseband filter | | spectral mask in line with IEEE 802.11b-1999 – Wireless LAN MAC and PHY specifications – chapter 18.4.7.3 |
| Parameters in framed mode | PLCP preamble and header format | long PLCP and short PLCP |
| | PSDU bit rate | 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps |
| | PSDU modulation (depending on PSDU bit rate) | DBPSK, DQPSK, CCK |
| | PSDU data length (length of user data field in bytes of the packet to be transferred) | |
| | range | 0 byte to 4095 byte |
| | scrambling | data scrambling can be activated or deactivated |
| Parameters in unframed mode | PSDU bit rate | 1 Mbps, 2 Mbps, 5.5 Mbps, or 11 Mbps |
| | PSDU modulation (depending on PSDU bit rate) | DBPSK, DQPSK, CCK |
| | scrambling | data scrambling can be activated or deactivated |
| Settings for OFDM (IEEE 802.11a/IEEE 802.11g) | | |
| Kernel sample rate | standard | 20 Msample/s |
| | range | as R&S [®] SMU200A |
| Baseband filter | | spectral mask in line with IEEE 802.11b-1999 – Wireless LAN MAC and PHY specifications – chapter 17.3.9.6.2 |

| | | |
|--|---|---|
| Parameters in framed mode | PLCP preamble and header format | long PLCP and short PLCP |
| | PLCP signal field | automatically calculated |
| | PSDU bit rate | 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, or 54 Mbps |
| | PSDU modulation (depending on PSDU bit rate) | BPSK, QPSK, 16QAM, 64QAM |
| | PSDU data length (length of user data field in bytes of the packet to be transferred) | |
| | range | 0 byte to 4095 byte |
| | number of data symbols (number of OFDM symbols in data portion of packet) | directly proportional to PSDU data length |
| | scrambling | data scrambling can be activated or deactivated; initial scrambler state can be set randomly or to a user-defined value |
| | interleaver | can be activated or deactivated |
| | time domain windowing (transition times) | 0 s to 1000 ns |
| service field | user-defined service field value supported | |
| Parameters in unframed mode | PSDU bit rate | 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, or 54 Mbps |
| | PSDU modulation (depending on PSDU bit rate) | BPSK, QPSK, 16QAM, 64QAM |
| | PSDU data length (length of user data field in bytes of the packet to be transferred) | |
| | range | 0 byte to 2312 byte |
| | number of data symbols (number of OFDM symbols to be generated) | directly proportional to PSDU data length |
| | scrambling | data scrambling can be activated or deactivated; initial scrambler state can be set randomly or to a user-defined value |
| | interleaver | can be activated or deactivated |
| | time domain windowing (transition times) | 0 s to 1000 ns |
| service field | user-defined service field value supported | |
| Settings for PBCC (IEEE 802.11b/IEEE 802.11g) | | |
| Chip rate | standard | 11 Mcps |
| | range | as R&S [®] SMU200A |
| Baseband filter | | spectral mask in line with IEEE 802.11b-1999 – Wireless LAN MAC and PHY specifications – chapter 18.4.7.3 |
| Parameters in framed mode | PLCP preamble and header format | long PLCP and short PLCP |
| | PSDU bit rate | 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps, 22 Mbps |
| | PSDU modulation (depending on PSDU bit rate) | DBPSK, DQPSK, PBCC |
| | PSDU data length (length of user data field in bytes of the packet to be transferred) | |
| | range | 0 byte to 4095 byte |
| | scrambling | data scrambling can be activated or deactivated |
| Parameters in unframed mode | PSDU bit rate | 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps, 22 Mbps |
| | PSDU modulation (depending on PSDU bit rate) | DBPSK, DQPSK, PBCC |
| | scrambling | data scrambling can be activated or deactivated |

IEEE 802.16 WiMAX digital standard including IEEE 802.16e (option R&S[®]SMU-K49)

| | | |
|--|--|--|
| IEEE 802.16 digital standard | | in line with IEEE 802.16™-2004/Cor1/D5 and IEEE 802.16e-2005 |
| Link direction | | forward link and reverse link |
| Physical layer modes | | OFDM, OFDMA, OFDMA/WiBro |
| Duplexing | | TDD, FDD |
| Frame durations | | 2 ms, 2.5 ms, 4 ms, 5 ms, 8 ms, 10 ms, 12.5 ms, 20 ms, continuous, user |
| Sequence length (frames) | depending on frame duration, sample rate, and available ARB memory | 1 to >2000 |
| Predefined frames | in OFDM mode | short, medium, and long test messages for BPSK, QPSK, 16QAM, and 64QAM modulation |
| | in OFDMA mode | predefined setups for all bandwidths and modulations specified in MRCT 1.0.0, appendix 2 |
| Level reference | in OFDM mode | FCH/burst or preamble |
| | in OFDMA/WiBro mode | preamble or subframe RMS power |
| Generate waveform file | filtering of data generated in ARB mode and | saving it as waveform file |
| Parameters in OFDM mode | | |
| Predefined frequency bands | | ETSI, MMDS, WCS, U-NII, user |
| Channel bandwidth | depending on selected frequency band | 1.25 MHz to 30 MHz |
| Sampling rate | depending on channel bandwidth | 1.5 MHz to 32 MHz |
| Tg/Tb settings | | 1/4, 1/8, 1/16, 1/32 |
| FFT size | | 256 (fixed) |
| Frame preamble | | long, short, OFF |
| Modulation and RS-CC rates | | BPSK 1/2, QPSK 1/2, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 2/3, 64QAM 3/4 |
| Subchannelization (number of possible channels) | | 1, 2, 4, 8, 16 (all) |
| Number of bursts with different modulation formats per frame | | 64 |
| Burst types | | data, DL-MAP, UL-MAP, ranging |
| Data | | all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists |
| Midamble repetition | in uplink mode | OFF, 5, 9, 17 |
| Parameters in OFDMA mode | | |
| Predefined frequency bands | | ETSI, MMDS, WCS, U-NII, WiBro, user |
| Channel bandwidth | depending on selected frequency band | 1.25 MHz to 30 MHz |
| Sampling rate | depending on channel bandwidth | 1.5 MHz to 32 MHz |
| Tg/Tb settings | | 1/4, 1/8, 1/16, 1/32 |
| FFT size | | 128, 512, 1024, 2048 |
| Preamble modes | | Auto and User with index 0 to 113 |
| Number of zones/segments | | 8 |
| Space-time coding modes | | OFF 2 antennas matrix A 2 antennas matrix B |
| Modulation and coding rates | | QPSK 1/2, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 1/2, 64QAM 2/3, 64QAM 3/4, 64QAM 5/6 |
| Channel coding modes | | OFF, CC, CTC |
| Channel coding parts | | scrambler, FEC, interleaver can be switched ON/OFF independently |
| Repetition coding | | 0, 2, 4, 6 |
| Subcarrier permutation | | FUSC, PUSC, AMC2×3 |
| Subchannel map | | user-definable for PUSC |
| Subchannel rotation | | on/off (for uplink PUSC) |
| Dedicated pilots | | on/off (for downlink PUSC and AMC2×3) |

| | | |
|--|--|---|
| Number of bursts with different modulation formats | | 64 per zone |
| Burst types | | FCH, DL-MAP, UL-MAP, DCD, UCD, HARQ, ranging, fast feedback, data |
| Data | | all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists |

TD-SCDMA digital standard (3GPP TDD LCR) (R&S[®] SMU-K50 option)

| | | |
|--|--|---|
| WCDMA 3GPP TDD LCR (TD-SCDMA) digital standard | | in line with 3GPP TDD standard for chiprate 1.28 Mcps (low chiprate mode) |
| Frequency range | frequency bands in line with 3GPP TS 25.102 in uplink and downlink range | UTRA TDD frequency bands a) to d) as R&S [®] SMU200A |
| Signal generation modes/sequence length | Simulation of up to 4 TD-SCDMA cells with variable switching point of uplink and downlink. User-configurable channel table for each slot and simulation of the downlink and uplink pilot timeslot. In uplink, a PRACH can also be generated. The sequence length can be entered in frames (10 ms each). | |
| Modulation | QPSK, 8PSK | |
| Generate waveform file | filtering of data generated in ARB mode and saving it as waveform file application: for multicarrier or multisegment scenarios | |
| General settings | | |
| Triggering | | see I/Q baseband generator |
| Chip rate | standard range | 1.28 Mcps (7 slots/subframe) 1 Mcps to 5 Mcps |
| Link direction | | uplink (reverse link) downlink (forward link) |
| Baseband filter | standard other filters | $\sqrt{\cos \alpha} \alpha = 0.22$ $\sqrt{\cos}$, cos, user filters |
| Clipping | Setting of clipping value relative to highest peak in percent. Clipping takes place prior to baseband filtering. Clipping reduces the crest factor. | |
| | modes | vector $ i + j q $ scalar $ i , q $ |
| | clipping level | 1 % to 100 % |
| Code channels | downlink/uplink: up to 16 data channels (plus special channels) per slot, 7 slots per subframe, simulation of up to 4 cells | |
| Configure cell | | |
| Reset all cells | all channels are deactivated | |
| Copy cell | adopting a specific cell configuration to another cell to define multicell scenarios parameters: source and destination of copying | |
| Predefined settings | generation of complex signal scenarios with parameterizable default settings selectable parameters: use of P-CCPCH, number and spreading factors of data channels, crest factor: minimal/average/worst | |
| Parameters of each cell | | |
| State | | ON/OFF |
| Scrambling code | scrambling code can be disabled for testing | 0 to 127 |
| SYNC-DL code | automatic selection depending on scrambling code | 0 to 31 |
| SYNC-UL code | range depending on SYNC-DL code | 0 to 255 |
| Number of users | | 2, 4, 6, 8, 10, 12, 14, 16 |
| Switching point | switchover between uplink and downlink slots | 1 to 6 |
| DwPTS power | | -80 dB to 10 dB |
| Parameters for each downlink slot | | |
| State | | ON/OFF |
| Slot mode | downlink dedicated: simulation of up to 16 DPCHs and max. 6 special channels | DPCH QPSK/8PSK: 0 to 24 DPCH PDSCH: 0 to 24 S-CCPCH: 0 to 9 |
| Parameters for each uplink slot | | |
| State | | ON/OFF |
| Slot mode | uplink dedicated: simulation of up to 16 DPCHs and 1 PUSCH PRACH: simulation of one physical random access channel | DPCH QPSK, PUSCH: 0 to 69 DPCH 8PSK: 0 to 24 |

| Physical channels in downlink | | |
|---|--|---|
| | primary common control physical channel 1 (P-CCPCH 1) | |
| | primary common control physical channel 2 (P-CCPCH 2) | |
| | secondary common control physical channel 1 (S-CCPCH 1) | |
| | secondary common control physical channel 2 (S-CCPCH 2) | |
| | fast physical access channel (FPACH) | |
| | physical downlink shared channel (PDSCH) | |
| | dedicated physical channel modulation QPSK (DPCH QPSK) | |
| | dedicated physical channel modulation 8PSK (DPCH 8PSK) | |
| Physical channels in uplink | | |
| | physical uplink shared channel (PUSCH) | |
| | dedicated physical channel modulation QPSK (DPCH QPSK) | |
| | dedicated physical channel modulation 8PSK (DPCH 8PSK) | |
| Parameters of every code channel that can be set independently | | |
| State | | ON/OFF |
| Midamble shift | time shift of midamble in chips: step width 8 chips controlled via the current user and the number of users | 0 to 120 |
| Slot format | depending on physical channel type | 0 to 69 |
| Spreading factor | depending on physical channel type and link direction | 1, 2, 4, 8, 16 |
| Spreading code | depending on physical channel type and spreading factor | 1 to 16 |
| Power | | -80 dB to 0 dB |
| Payload data | PRBS | 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 bit to 64 bit), data lists |
| Number of TFCI bits | depending on modulation type | |
| | QPSK | 0, 4, 8, 16, 32 |
| | 8PSK | 0, 6, 12, 24, 48 |
| TFCI value | | 0 to 1023 |
| Number of sync shift & TPC bits | depending on modulation type | |
| | QPSK | 0 & 0, 3 & 3, 48 & 48 |
| | 8PSK | 0 & 0, 2 & 2, 32 & 32 |
| Sync shift pattern | up to 64 UP/DOWN/HOLD commands sent periodically | "1" → up: increase sync shift "0" → down: decrease sync shift "-" → do nothing |
| Sync shift repetition M | | 1 to 8 |
| TPC source | | all 0, all 1, pattern (length 1 bit to 64 bit), data lists |
| TPC read out mode | | continuous, single + all 0, single + all 1, single + alt.01, single + alt. 10 |
| Parameters in uplink PRACH mode | | |
| UpPTS start subframe | selection of first frame in which UpPTS is sent | 1 subframe to 10 subframes |
| UpPTS power | | -80 dB to 0 dB |
| UpPTS power step | | 0 dB to 10 dB |
| Distance UpPTS | distance UpPTS to PRACH message part | 1 subframe to 4 subframes |
| UpPTS repetition | number of UpPTS repetitions | 1 to 10 |
| RACH message part state | | ON/OFF |
| Message part length | | 1 subframe, 2 subframes, 4 subframes |
| Spreading factor | | 4, 8, 16 |
| Spreading code | | 0 to (spreading factor - 1) |
| Message part power | | -80 dB to 0 dB |
| Payload data | | PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 bit to 64 bit), data lists |
| Current user | | 1 to 16 |

TD-SCDMA (3GPP TDD LCR) enhanced BS/MS test including HSDPA (R&S[®]SMU-K51 option)

At least one R&S[®]SMU-K50 option must be installed.

| | | |
|---|---|---|
| General parameters | This option extends the R&S [®] SMU-K50 (TD-SCDMA digital standard) to full channel coding and HSDPA support. Therefore, all general parameters of the R&S [®] SMU-K50 such as frequency range or modulation are also valid for the R&S [®] SMU-K51. | |
| Signal generation modes/sequence length | Simulation of up to 4 TD-SCDMA cells with generation of the coded P-CCPCH (BCH with running SFN) and the reference measurement channels RMC 12.2 kbps up to RMC 2048 kbps. Simulation of the HSDPA channels HS-SCCH, HS-PDSCH (QPSK and 16QAM modulation), HS-SICH, and the channel coded H-RMC 526 kbps and H-RMC 730 kbps. Furthermore, bit and block errors can be inserted. | |
| Modulation | QPSK, 8PSK, 16QAM | |
| HSDPA physical channels | high speed shared control channel 1 (HS-SCCH 1) | |
| | high speed shared control channel 2 (HS-SCCH 2) | |
| | high speed physical downlink shared channel QPSK (HS-PDSCH QPSK) | |
| | high speed physical downlink shared channel 16QAM (HS-PDSCH 16QAM) | |
| | high speed shared information channel (HS-SICH) | |
| Channel coding | coding of enhanced channels in line with the definition of reference measurement channels in TS 25.102, TS 25.105, and TS 25.142 | |
| | predefined channel coding schemes for | |
| | downlink | coded BCH including SFN RMC 12.2 kbps RMC 64 kbps RMC 144 kbps RMC 384 kbps RMC 2048 kbps H-RMC 526 kbps H-RMC 730 kbps |
| | uplink | RMC 12.2 kbps RMC 64 kbps RMC 144 kbps RMC 384 kbps RMC 2048 kbps |
| Applications | BER measurements in line with TS 25.102/105/142 (radio transmission and reception), e.g. adjacent channel selectivity blocking characteristics intermodulation characteristics BLER measurements in line with TS 25.102/105 (radio transmission and reception), e.g. demodulation of dedicated channel under static propagation conditions (AWGN generation together with R&S [®] SMU-K62) test of decoder in receiver | |
| Bit error insertion | deliberate generation of bit errors by impairing the data stream prior to channel coding or at the physical layer | |
| | bit error ratio | 0.5 to 10 ⁻⁷ |
| Application | verification of internal BER calculation in line with TS 25.142 (BS conformance testing) | |
| Block error insertion | deliberate generation of block errors by impairing the CRC during coding of enhanced channels | |
| | block error ratio | 0.5 to 10 ⁻⁴ |
| Application | verification of internal BLER calculation in line with TS 25.142 (BS conformance testing) | |

DVB-H digital standard (R&S[®]SMU-K52 option)

| | | |
|-------------------------------|---|--|
| DVB-H digital standard | | in line with ETSI EN 300 744 V1.5.1 standard |
| General settings | | |
| Frequency | | default VHF 212.5 MHz user-selectable in entire frequency range of R&S [®] SMU200A |
| Output level | | default -30 dBm user-selectable in entire output level range of R&S [®] SMU200A |
| Hierarchy mode | | hierarchical, non-hierarchical |
| Sequence length | number of superframes | min: 1 max: depending on baseband generator memory |
| Baseband filter | standard | cosine, $\alpha = 0.1$ |
| | other | see I/Q baseband generator |
| Clipping | Setting of clipping value relative to highest peak in percent. Clipping takes place prior to baseband filtering. Clipping reduces the crest factor. | |
| | modes | vector $ i + j \cdot q $ scalar $ i , q $ |
| | clipping level | 1 % to 100 % |
| Generate waveform file | filtering of data generated in ARB mode and | saving it as waveform file |
| Marker | | restart |
| | | superframe start |
| | | frame start |
| | | pulse |
| | | pattern ON/OFF ratio |
| Triggering | | see I/Q baseband generator |
| Signal path parameters | | |
| Input data | Zero packets are generated and filled with desired data. | PN 15, 23 all 0 all 1 |
| | transport stream | transport stream file (.GTS) |
| Scrambler | state | ON/OFF |
| Outer coder | | Reed Solomon (204, 188, t = 8) |
| | state | ON/OFF |
| Outer interleaver | | convolutional byte-wise (depth: 12) |
| | state | ON/OFF |
| Inner coder | | convolutional, punctured |
| | state | ON/OFF |
| | code rates | 1/2, 2/3, 3/4, 5/6, 7/8 |
| Inner interleaver | | bit-wise interleaving symbol interleaving |
| | state | ON/OFF |
| | symbol interleaving block size | 1512 bit in 2K mode 3024 bit in 4K mode 6048 bit in 8K mode |
| | symbol interleaving modes | native, in-depth |
| Modulation | | QPSK, 16QAM, 64QAM |
| Transmission modes | | 2K with 1705 carriers 4K with 3409 carriers 8K with 6817 carriers |
| Guard interval | cyclic continuation of useful signal part | length: 1/4, 1/8, 1/16, 1/32 of useful signal part |
| Framing and signaling | | |
| Super frame size | | 4 frames |
| Frame size | | 68 OFDM symbols |
| TPS settings | cell ID | 0000 to FFFF (user-defined) |
| | time-slicing | ON/OFF |
| | MPE-FEC | ON/OFF |

EUTRA/LTE digital standard (R&S®SMU-K55 option)

| | | |
|--|---|--|
| EUTRA/LTE digital standard | | in line with 3GPP standard release 8 |
| General settings | | |
| Frequency | | user-selectable in entire frequency range of R&S®SMU200A |
| Output level | | default –30 dBm user-selectable in entire output level range of R&S®SMU200A |
| Sequence length | number of frames | sequence length can be entered in frames (10 ms each); max. length depends on sample rate and ARB size |
| Baseband filter | standard | cosine, $\alpha = 0.1$ |
| | other | see I/Q baseband generator |
| Clipping | Setting of clipping value relative to highest peak in percent. Clipping takes place prior to baseband filtering. Clipping reduces the crest factor. | |
| | modes | vector i + j q scalar i , q |
| | clipping level | 1 % to 100 % |
| Marker | | subframe radio frame start restart pulse pattern ON/OFF ratio |
| Triggering | | see I/Q baseband generator |
| Duplexing | determines duplexing mode Note: TDD is not supported in this version. | FDD, TDD |
| Link direction | determines whether uplink or downlink is simulated Note: Uplink is not supported in this version. | downlink, uplink |
| Physical Layer mode | fixed value: depends on chosen link direction: OFDMA in downlink, SC-FDMA in uplink | |
| Frame duration | fixed value: 10 ms | |
| Subframe duration | fixed value: 0.5 ms | |
| Physical settings | | |
| Channel bandwidth | determines the channel bandwidth used | 1.25 MHz, 2.5 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz |
| Physical resource block bandwidth | determines the size of a physical resource block; this parameter will be finally determined in the R&S®SMU-K55 as soon as it is defined in the official 3GPP specification Note: 180 kHz is not supported in this version. | 180 kHz, 375 kHz |
| Sampling rate | The sampling rate is automatically set in line with the selected channel bandwidth. | |
| FFT Size | The FFT size is automatically set in line with the selected channel bandwidth. | |
| Number of occupied subcarriers | The number of occupied subcarriers is automatically set in line with the selected channel bandwidth. | |
| Number of left guard subcarriers | The number of left guard carriers is automatically set in line with the selected FFT size. | |
| Number of right guard subcarriers | The number of right guard carriers is automatically set in line with the selected FFT size. | |
| Number of resource blocks | The number of resource blocks is automatically set in line with the selected channel bandwidth and physical resource block bandwidth. | |
| Downlink reference signal structure | | |
| Reference symbol configuration | simulated antenna configuration Note: Antennas 2 to 4 are not supported in this version. | antennas 1 to 4 |
| First reference symbol position | position in subframe of the first reference symbols | 1st symbol, 2nd symbol |
| Frequency spacing | determines spacing in subcarriers between two pilots | 2, 4, 6, 8 subcarriers |
| Subcarrier offset | offset in subcarriers within one resource block | 0 to ("subcarrier_interleaving_factor" – 1) |

| | | |
|---|--|---|
| Reference symbol repetition period | determines the period in subframes after which the sequence for reference symbols is repeated Note: The uploaded sequence for the reference symbols should be long enough to fill the period selected here. | 1/2/4/5/10/20 subframes |
| First reference symbol power | power of 1st reference symbols | -80 dB to 10 dB |
| Use second reference symbols | determines whether 2nd reference symbols are used | yes, no |
| Second reference symbol power | power of 2nd reference symbols | -80 dB to 10 dB |
| Reference symbol sequence | data set for reference symbols to be uploaded (in R&S [®] SMU200A data list format) Note: QPSK is assumed to be used for reference symbols. | |
| SCH/BCH settings | | |
| SCH repetition period | determines the period in subframes between two SCH subframes | 2/4/5/10/20 subframes |
| First SCH subframe | determines the subframe in the frame in which the SCH is initially transmitted Note: The SCH is automatically mapped to the endmost symbol of the subframe. | 0 to ("SCH_rep_period" - 1) |
| SCH power | determines the power of the SCH allocations | -80 dB to 10 dB |
| SCH sequence | data set for SCH to be uploaded (in R&S [®] SMU200A data list format) Note: QPSK is assumed to be used for SCH. The first 150 bits are taken from the selected sequence and are mapped to the subcarriers used; therefore, the SCH always consists of the same sequence, regardless of the subframe. | |
| BCH subframe | determines the subframe in the frame in which the BCH is transmitted Note: Must not overlap with SCH subframes. Otherwise, last valid configuration is restored. | 0 to 19 |
| BCH length | determines the length of the BCH in OFDMA symbols Note: The BCH is automatically mapped to the endmost symbols of the subframe. | 1 to 4 OFDMA symbols |
| BCH bandwidth | determines the bandwidth of the BCH Note: BCH bandwidth of 5 MHz is only selectable if channel bandwidth \geq 5MHz. | 1.25 MHz, 5 MHz |
| BCH power | determines the power of the BCH allocation | -80 dB to 10 dB |
| BCH data source | determines the data source of the BCH allocation Note: QPSK is assumed to be used for BCH. | PN9, PN11, PN15, ..., PN 23, DList, pattern, all 0, all 1 |
| Resource allocation downlink | | |
| Number of configurable subframes | determines the number of configurable subframes; the 20 subframes of one frame are filled periodically with the configured subframes Note: SCH and BCH are configured globally and therefore not copied here. Using this function ensures a valid frame configuration. | 1 to 20 |
| Behavior in unscheduled resource blocks | determines whether unscheduled resource blocks and subframes are filled with dummy data or left DTX | dummy data, DTX |
| Cyclic prefix | determines whether a short or long cyclic prefix is used for a specific subframe Note: Automatically determines the number of OFDM symbols per subframe. | short, long |
| Number of allocations used | determines the number of scheduled allocations in selected subframe | 0 to ("total number of RBs" + SCH/BCH + L1/L2CCH) |

| Allocation table | | |
|--------------------------------|---|---|
| Modulation | determines the modulation scheme used | QPSK, 16QAM, 64QAM |
| CC (channel coding) | determines the channel coding scheme used Note: Turbo coder is not supported in this version. | TC (turbo coding)/OFF |
| Transmission | determines whether allocation is localized or distributed Note: "Distributed" is not supported in this version. | localized, distributed |
| Number of resource blocks (RB) | defines size of selected allocation in terms of resource blocks | 1 to "total number of RBs" |
| Number of symbols | defines size of selected allocation in terms of OFDM symbols | 1 to "number of OFDM symbols per sub-frame" |
| Offset RB | defines start resource block of selected allocation Note: This value is read-only if Auto mode is activated for selected allocation. | 0 to ("total number of RBs" – 1) |
| Offset symbol | defines start OFDM symbol of allocation | 0 to "number of OFDM symbols per subframe - 1" |
| Number of bits | shows size of selected allocation in bits | |
| Data source | determines data source of selected allocation Note: Data sources for users 0 to 3 can be configured in the Configure User panel | user 0, user 1, user 2, user 3, PN9, PN11, PN15, ..., PN 23, DList, pattern, all 0, all 1 |
| Power | determines power of selected allocation | –80 dB to +10 dB |
| Content type | determines type of selected allocation Note: SCH and BCH will be set automatically in line with the General E-UTRA DL Settings menu. | data, L1/L2 CCH |
| Conflict | display if an allocation collides with another allocation Note: If a resource conflict between a data allocation and a control channel occurs, the control channel wins, and no conflict is displayed here. | |
| Configure user | | |
| | The Configure User dialog offers the possibility to define and configure up to 4 scheduled UEs that can be freely distributed over the whole frame by setting the data source of a specific allocation in the allocation table to User. Thus, subframe allocations that are not adjacent or allocations of a different subframe can be configured to allow the use of a common data source. | |
| TTI | determines the transport time interval in subframes of the user currently being configured | 1 subframe |
| Channel coding | determines channel coding scheme used of the user currently being configured Note: Turbo coder is not supported in this version. | TC (turbo coding)/OFF |
| Data source | determines the data source of the user currently being configured | PN9, PN11, PN15, ..., PN 23, DList, Pattern, all 0, all 1 |
| Configure dummy data | | |
| Dummy data modulation | determines modulation of dummy data | QPSK, 16QAM, 64QAM |
| Dummy data data source | determines data source of dummy data | PN9, PN11, PN15, ..., PN 23, DList, pattern, all 0, all 1 |
| Dummy data power | determines power of dummy data allocations | –80 dB to +10dB |

XM-RADIO digital standard (R&S[®] SMU-K56 option)

| | | |
|--|--|--|
| XM-RADIO digital standard | | in line with DARS-FHG-FDSC-608-110000 edition 03/revision 01 for satellite physical layer and XM-SYS-0-0004-RD revision 1.2 for terrestrial physical layer |
| General settings | | |
| Frequency | | default carrier frequency for selected receiver segment user-selectable in entire frequency range of R&S [®] SMU200A |
| Output level | | default -30 dBm user-selectable in entire output level range of R&S [®] SMU200A |
| Frequency offset | | see I/Q baseband generator |
| Triggering | | see I/Q baseband generator |
| Signal path parameters for satellite physical layer | | |
| Data sources | | all 0 all 1 PRBS 9, 11, 15, 16, 20, 21, 23 pattern (length 1 bit to 64 bit) data list |
| Modulation | | QPSK |
| Data rate | | 1.64 Msps |
| Data generator (memory size) | | max. 4.29 Gbit (21 minutes before repletion) with R&S [®] SMU-B9 |
| Baseband filter | standard | root cosine, $\alpha = 0.15$ |
| | other | see I/Q baseband generator |
| Marker | | pulse pattern user period ON/OFF ratio |
| Signal path parameters for terrestrial physical layer | | |
| Data sources | | all 0 all 1 PRBS 9, 11, 15, 16, 20, 21, 23 pattern (length 1 to 64 bit) data list |
| Modulation | | COFDM with 647 active carriers, each DQPSK-modulated |
| Date rate | | 4.06333 Mbps |
| Data generator (memory size) | | max. 4.29 Gbit (17 minutes before repletion) with R&S [®] SMU-B9 |
| Baseband filter | standard | in line with spectral mask |
| | other | see I/Q baseband generator |
| Frequency response | -1.24 MHz < f < +1.24 MHz | ± 0.5 dB |
| | attenuation at 1.25 MHz carrier offset | -1 dB |
| | attenuation at 1.35 MHz carrier offset | -28 dB |
| | attenuation at 1.75 MHz carrier offset | -35 dB |
| | attenuation at 2.25 MHz carrier offset | -51 dB |
| | attenuation at 2.75 MHz carrier offset | -66 dB |
| attenuation at f > 2.75 MHz carrier offset | -70 dB | |
| Marker | | TPL frame MCM symbol user period ON/OFF ratio |

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

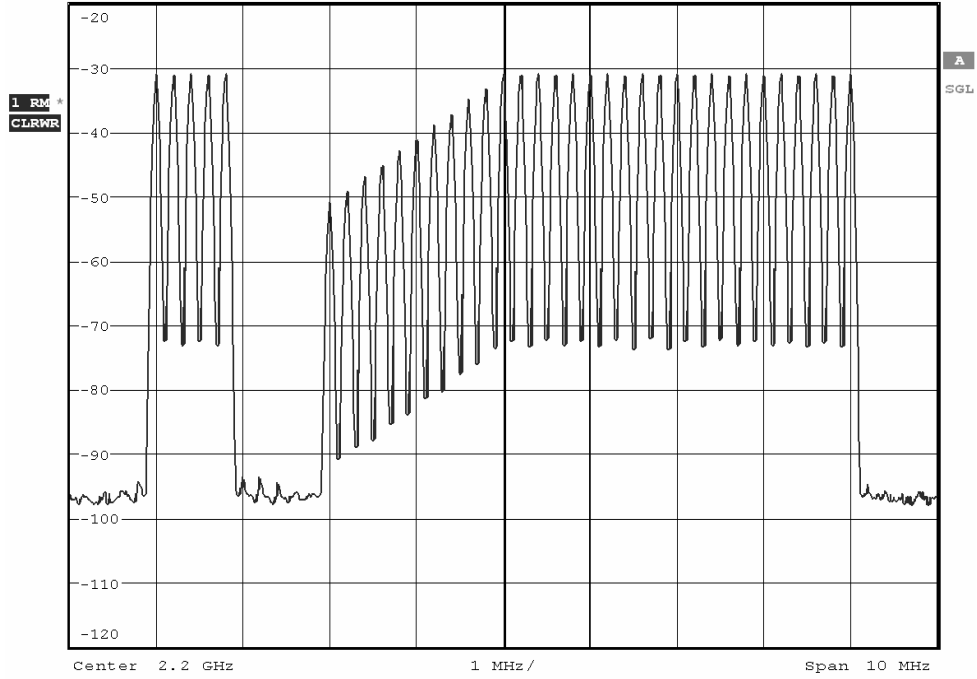
| | | |
|----------------------------------|--|--|
| Signal generation | | simulation of unmodulated multicarrier signals in arbitrary waveform mode |
| Number of carriers | | 1 to 8192 |
| Carrier spacing | user-settable, maximum spacing depending on number of carriers | 1 Hz to 80 MHz |
| Parameters of each carrier | state | ON/OFF |
| | power | -80 dB to 0 dB |
| | start phase | 0° to +360° |
| Crest factor | optimization of crest factor by varying the start phases of the carrier; available modes: | |
| | OFF | no optimization, manual entry of phase possible |
| | chirp | the phases of each carrier are set such that a chirp signal is obtained for the I and Q components |
| | target crest | iterative variation of carrier start phases until a presettable crest factor is attained |
| Trigger | In internal clock mode, a trigger event restarts the clock generation. The clock phase is then synchronous with the trigger (with a certain timing uncertainty). In external clock mode, the trigger event is synchronized to the symbol clock. | |
| | operating mode | internal, external |
| | modes | Auto, Retrig, Armed Auto, Armed Retrig |
| | setting uncertainty for clock phase related to trigger in internal clock mode | <18 ns |
| | external trigger delay | |
| | setting range | 0 sample to 2 ¹⁶ sample |
| | resolution | |
| | internal clock mode | 0.01 sample |
| | external clock mode | 1 sample |
| | setting uncertainty | <5 ns |
| | external trigger inhibit | |
| | setting range | 0 sample to 2 ²⁶ sample |
| | resolution | 1 sample |
| | external trigger pulse width | >15 ns |
| | external trigger frequency | <0.02 × sampling rate |
| Marker | number | 4 |
| | level | LVTTL |
| | operating modes | unchanged, restart, pulse, pattern, ratio |
| | marker delay (in sample) | |
| | setting range | 0 to (waveform length - 1) |
| | setting range without recalculation | 0 to 2000 |
| | resolution of setting | 0.001 |
| | setting uncertainty | <10 ns |
| RF frequency response | up to 10 MHz | <1.5 dB, typ. 0.7 dB |
| | up to 40 MHz | <4.5 dB, typ. 2.0 dB |
| Suppression of unwanted carriers | up to 10 MHz | >50 dB, typ. 56 dB |
| | up to 40 MHz | >40 dB, typ. 50 dB |



* RBW 50 kHz
* VBW 500 kHz
* SWT 800 ms

Ref -20 dBm

Att 5 dB



Example of multicarrier CW, with different carrier powers and some carriers switched off on the left half of the spectrum.

Digital standards with R&S® WinIQSIM2™ (for R&S® SMU-B9/-B10/-B11 ARB)

At least one I/Q baseband generator (R&S®SMU-B9/-B10/-B11 option) must be installed. If two I/Q baseband generators are installed and two waveforms 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-K240). If only one R&S®SMU-K240 is installed and GSM/EDGE waveforms are played in one I/Q baseband generator, the other I/Q baseband generator is disabled for GSM/EDGE waveforms. However, a software option is not tied to a specific I/Q baseband generator.

| |
|--|
| GSM/EDGE digital standard (R&S®SMU-K240 option) |
| 3GPP FDD digital standard (R&S®SMU-K242 option) |
| 3GPP FDD enhanced BS/MS tests including HSDPA (R&S®SMU-K243 option) |
| GPS digital standard (R&S®SMU-K244 option) |
| 3GPP FDD enhanced BS/MS tests including HSUPA (R&S®SMU-K245 option) |
| CDMA2000® digital standard (R&S®SMU-K246 option) |
| IEEE 802.11 a/b/g digital standard (R&S®SMU-K248 option) |
| IEEE 802.16 WiMAX digital standard including 802.16e (R&S®SMU-K249 option) |
| TD-SCDMA digital standard (3GPP TDD LCR) (R&S®SMU-K250 option) |
| TD-SCDMA (3GPP TDD LCR) enhanced BS/MS tests including HSDPA (R&S®SMU-K251 option) |
| DVB-H digital standard (R&S®SMU-K252 option) |
| EUTRA/LTE digital standard (R&S®SMU-K255 option) |
| XM RADIO digital standard (R&S®SMU-K256 option) |
| Multicarrier CW signal generation (R&S®SMU-K261 option) |
| Additive white Gaussian noise (AWGN, R&S®SMU-K262 option) |

The options are described in the R&S®WinIQSIM2™ data sheet (PD 5213.7460.22).

Digital standards with R&S® WinIQSIM™ (for R&S® SMU-B9/-B10/-B11 ARB)

At least one I/Q baseband generator (R&S®SMU-B9/-B10/-B11 options) must be installed. If two I/Q baseband generators are installed and two waveforms of the same standard (e.g. 3GPP FDD) are to be output simultaneously, two corresponding software options must also be installed (in this case R&S®SMU-K20). If only one R&S®SMU-K20 is installed and 3GPP FDD waveforms are played in one I/Q baseband generator, the other I/Q baseband generator is disabled for 3GPP FDD waveforms. However, a software option is not tied to a specific I/Q baseband generator.

| |
|---|
| IS-95 digital standard (R&S®SMU-K11 option) |
| CDMA2000® digital standard (R&S®SMU-K12 option) |
| 3GPP TDD HDR digital standard (R&S®SMU-K13 option) |
| 3GPP TDD LDR digital standard (TD-SCDMA) (R&S®SMU-K14 option) |
| OFDM with WinIQOFDM (R&S®SMU-K15 option) |
| 1 x EV-DO digital standard (R&S®SMU-K17 option) |
| IEEE 802.11 a/b/g digital standard (R&S®SMU-K19 option) |
| 3GPP FDD digital standard incl. HSDPA (R&S®SMU-K20 option) |

The options are described in the R&S®WinIQSIM™ data sheet (PD 0758.0680.32).

Fading and noise

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

The R&S® SMU-B9/-B10/-B11 or R&S® SMU-B17 is required to generate input signals for the fading simulator. All frequency and time settings are coupled to the internal reference frequency.

| | | |
|------------------------|---|--|
| Number of signal paths | with R&S® SMU-B14 | 1 |
| | with R&S® SMU-B14 and R&S® SMU-B15 | 1 or 2 |
| Signal routing | only possible with R&S® SMU-B14 and R&S® SMU-B15 | |
| | input | both signal paths split or combined |
| | output | split, one signal path only, or sum of both signal paths |
| Number of fading paths | depending on options and signal routing, see table on next page | |
| Fading path loss | setting range | 0 dB to 50 dB |
| | resolution | 0.01 dB |
| | accuracy | <0.01 dB |
| Fading path delay | setting range | 0 s to 2.56 ms |
| | resolution | 10 ns |
| | with R&S® SMU-K71 option | 0.01 ns |
| Delay groups | | max. 4 per signal path |
| | permitted delay differences within one group | <40 µs |
| Speed range | at f = 1 GHz | 0 km/h to 1725 km/h |
| | accuracy | <0.128 % |
| Doppler frequency | setting range | 0 Hz to 1600 Hz |
| | accuracy | <0.1 % |
| Restart | standard | auto |
| | with R&S® SMU-B9/-B10/-B11 options installed | auto, internal from baseband A or B, external |
| Total insertion loss | automatic or user-definable, with clipping indicator | 0 dB to 18 dB |
| Correlation | fading paths in signal path A pairwise with fading paths in signal path B | |
| | correlation coefficient | |
| | setting range | 0 % to 100 % |
| | resolution | 5 % |
| | correlation phase | |
| | setting range | 0° to 360° |
| | resolution | 1° |
| Fading profiles | | |
| Rayleigh | pseudo-noise interval | >93 h |
| Pure Doppler | frequency ratio | (-1 to +1) × current Doppler frequency |
| | resolution | 0.01 × current Doppler frequency |
| Rician | combination of Rayleigh and pure Doppler | |
| | power ratio | -30 dB to +30 dB |
| Lognormal | standard deviation | 0 dB to 12 dB |
| | resolution | 1 dB |
| | local constant at f = 1 GHz | 12 m to 200 m |
| Static, constant phase | path loss | 0 dB to 50 dB |
| | phase | 0° to 360° |
| | resolution | 1° |

Number of fading paths, RF bandwidth, and timing resolution

With R&S®SMU-K71 only

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

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

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

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

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

¹⁷ The maximum delay range of 40 µs cannot be exceeded.

Extended statistic functions (R&S® SMU-K72 option)

At least one R&S®SMU-B14 fading simulator must be installed. If both the R&S®SMU-B14 and the R&S®SMU-B15 are installed (signal path A and B), extended statistic functions can be used either on signal path A or B with one R&S®SMU-K72 option. For extended statistic functions to be used on signal paths A and B simultaneously, two R&S®SMU-K72 must be installed.

| Fading profiles | | |
|--------------------------|---|---|
| Gauss I, Gauss II | sum of two Gaussian distributions | in line with DAB standard |
| Gauss DAB 1, Gauss DAB 2 | Gaussian distribution, shifted in frequency | in line with DAB standard |
| WiMAX Doppler | rounded Doppler PSD model | in line with IEEE 802.16a-03-01 |
| WiMAX Rice | like WiMAX Doppler plus pure Doppler | in line with IEEE 802.16a-03-01 |
| Predefined settings | SUI1 to SUI6 | in line with IEEE 802.16a-03-01 |
| | ITU OIP-A ITU OIP-B ITU V-A | in line with 3GPP TS34.121-1 annex D.2.2 table D.2.2.1A |
| | DAB-RA, DAB-TU, DAB-SFN | in line with EN 50248-2001 |

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

At least one R&S®SMU-B13 baseband main module must be installed. If two R&S®SMU-B13 are installed (paths A and B), AWGN can be generated either on path A or B with one R&S®SMU-K62 option. For AWGN to be generated on paths A and B simultaneously, two R&S®SMU-K62 must be installed.

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

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

Other options

Bluetooth® digital standard (external PC software) (R&S® SMU-K5 option)

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

Pulse sequencer (external PC software) (R&S® SMU-K6 option)

The pulse sequencer software generates complex pulses and bursts for use with any of the R&S® SMU-B9, R&S® SMU-B10 or R&S® SMU-B11 baseband generators. This software is a standalone, PC-based application that creates waveform files.

| | | |
|---------------------------------|--|---|
| Typical applications | DFS pulse generation | FCC CFR 47 part 15.407 (06-96A) ETSI EN 301 893 V1.3.1 |
| | RFID signal generation | ISO/IEC 14443, 18000 |
| | radar waveform generation | receiver tests |
| | component test with pulsed signals | amplifiers, mixers, converters |
| Data structure of project files | pulse library | up to 256 pulse definitions |
| | sequence library | up to 64 sequences |
| | multisegment waveforms | up to 64 |
| | RF lists | up to 12 |
| Pulse timing parameters | settings | delay, rise, pulse ON, fall, pulse OFF, PRI, PRF |
| | resolution | 1 ns or 1/ARB clock rate, whichever is greater |
| | minimum pulse width, internal BB | 175 ns (7th harmonic, 40 MHz bandwidth) |
| | minimum pulse width, ext. wideband I/Q | 70 ns (7th harmonic, 100 MHz bandwidth) |
| Pulse level parameters | settings | attenuation, droop |
| | ON/OFF ratio | >55 dB without pulse modulator >70 dB with use of pulse modulator |
| Other pulse parameters | ramp type | linear, raised cosine, cos ² , custom |
| | frequency | frequency offset, start phase |
| Intrapulse modulation | types | ASK, FSK, BPSK, QPSK, FM chirp, FM, AM, user plugin (custom) |
| | data sources | user data, PRBS: 7, 9, 11, 15, 16, 20, 21, 23 |
| Marker settings | markers 1 to 4 | delay, rise, pulse ON, fall, OFF, restart |
| Jitter | distribution | uniform, Gaussian, list, shape |
| | number of jitters | up to 3, independent |
| | affected parameters | any timing setting, frequency offset, phase, all level settings, FM deviation |

| | | |
|------------------------|----------------------------|--|
| Baseband filter | filter function | rectangular, Gaussian, cosine, root raised cosine |
| | window functions | Rife Vincent 2, von Hann, Hamming, Blackman, Blackman-Harris, Flat Top |
| Sequences | pulse entries in sequence | up to 128 |
| | pulse data mode | append, overlay add, overlay multiply |
| | jitter mode vs repetitions | all individual, all same, continue, OFF |
| | marker mask vs repetitions | all, first only, last only, none |
| Multisegment waveforms | sequence entries in MSW | up to 64 |
| RF List mode | number of list entries | up to 10000 |
| | data sources | import, all same, uniform, unique |
| Graphical display | I/Q vs time | I/Q traces, polar, envelope in dB |
| | I/Q plane | vector, density plot |
| | FFT | entire data, view port only |
| | cursors | t1, t2, Δt , Δf |

TETRA digital standard (external PC software) (R&S[®]SMU-K8 option)

At least one baseband generator R&S[®]SMU-B9, R&S[®]SMU-B10, or R&S[®]SMU-B11 must be installed.

| | | |
|--------------------------------|---|--|
| TETRA digital standard | | in line with ETS300-392/ETS300-394 standard |
| Function | | |
| R&S [®] SMU-K8 | R&S [®] SMU-K8 is a PC-based software package for generating TETRA T1, T2, or T3 test signals in line with ETS300-392/ETS300-394. The T1 test signal is generated for the v+d (voice and data) test on MS and BS DUTs; it is designed for putting RF components into operation and supporting ETS300 394-1 tests. The R&S [®] SMU-K8 generates all data sequences including all control sequences required to operate the signal generator. | |
| Interfaces | R&S [®] SMU-K8 software calculates the appropriate TETRA T1 signal and transfers it to the R&S [®] SMU via the GPIB or LAN interface. Additionally, the R&S [®] SMU-K8 can operate a second R&S [®] SMU200A (or the second path), R&S [®] SMJ100A, or R&S [®] SMATE200A signal generator simultaneously for generating a TETRA T2 or T3 signal (TETRA T1, T2, T3, T1 and T2 or T1 and T3) | |
| General settings | | |
| Frequency | user-selectable in entire frequency range of R&S [®] SMU200A | the TETRA frequency can be set by means of frequency band, main carrier number, offset, duplex spacing and reverse operation |
| Output level | | user-selectable in entire output level range of R&S [®] SMU |
| Channel coding | | channel coding is performed for all channels; scrambling with base color code, mobile country code, and mobile network code can be set separately for each channel |
| Modulation | | $\pi/4$ -DQPSK (2 bit per symbol) |
| Baseband filter | | TETRA filter |
| Symbol rate | | 18000 symbol/s |
| Marker | | slot(s), frame(s), multiframe(s), hyperframe(s) |
| Triggering | | see I/Q baseband generator |
| TETRA specific settings | | |
| Channels | downlink | 0 to 4, 15, 17 |
| | uplink | 7 to 11, 16, 18 |
| Burst type | | control burst (CB), normal burst (NB), synchronization burst (SB) |
| Channel types | | AACH, BSCH, BNCH, TCH, STCH or SCH |
| Data | | the bit stream can be generated either from pseudo-random sequences (CCITT O.153) or from user-selectable sequences |
| Sequence length | | 1 to 511 multiframe(s) |
| TETRA T1 | | the T1 test signal is generated for the v+d (voice and data) test on MS and BS |

BER measurement (R&S® SMU-K80 option)

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

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

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

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

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

General data

Remote control

| | | |
|----------------------|--|---|
| Systems | | IEC/IEEE bus, IEC 60625 (IEEE 488) Ethernet |
| Command set | | SCPI 1999.5 |
| Connector | | |
| IEC/IEEE | | 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 |
| | input current | 5.0 A to 1.6 A |
| | power factor correction | in line with EN 61000-3-2 |
| EMC | | in line with 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 in line with DIN EN 60068-2-1, DIN EN 60068-2-2 |
| | storage temperature range | -20 °C to +60 °C |
| | climatic resistance +40 °C / 90 % rel. humidity | in line with DIN EN 60068-2-3 |
| Mechanical resistance | | |
| Vibration | sinusoidal | 5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const., in line with DIN EN 60068-2-6 |
| | random | 10 Hz to 300 Hz, acceleration 1.2 g (rms), in line with DIN EN 60068-2-64 |
| Shock | | in line with DIN EN 60068-2-27 MIL-STD-810E 40 g shock spectrum |
| Electrical safety | | in line with EN 61010-1 |
| Dimensions | width × height × depth | 435 mm × 192 mm × 460 mm (17.1 in × 7.6 in × 18.1 in) |
| Weight | if fully equipped | 25 kg (55.1 lb) |
| Recommended calibration interval | | 3 years |

Ordering information

| Designation | Type | Order No. |
|---|---------------------------|--------------|
| Vector Signal Generator¹⁸ including power cable, Quick Start Guide, and CD-ROM (with operating and service manual) | R&S [®] SMU200A | 1141.2005.02 |
| 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 |
| FM/φM Modulator | R&S [®] SMU-B20 | 1142.0006.02 |
| FM/φM Modulator and Enhanced Phase Noise Performance | R&S [®] SMU-B22 | 1160.5006.02 |
| Overvoltage Protection | R&S [®] SMU-B30 | 1159.7444.02 |
| High-Power Output | R&S [®] SMU-B31 | 1159.8011.02 |
| Overvoltage Protection and High-Power Output | R&S [®] SMU-B32 | 1160.0256.02 |
| RF path B | | |
| 100 kHz to 2.2 GHz | R&S [®] SMU-B202 | 1141.9400.02 |
| 100 kHz to 3 GHz | R&S [®] SMU-B203 | 1141.9500.02 |
| Overvoltage Protection | R&S [®] SMU-B35 | 1160.0633.02 |
| High-Power Output | R&S [®] SMU-B36 | 1160.1000.02 |
| Overvoltage Protection and High-Power Output | R&S [®] SMU-B37 | 1160.1400.02 |
| Baseband | | |
| Baseband Generator with ARB (128 Msample) and Digital Modulation (realtime) | R&S [®] SMU-B9 | 1161.0766.02 |
| Baseband Generator with ARB (64 Msample) and Digital Modulation (realtime) | R&S [®] SMU-B10 | 1141.7007.02 |
| Baseband Generator with ARB (16 Msample) and Digital Modulation (realtime) | R&S [®] SMU-B11 | 1159.8411.02 |
| Baseband Main Module | R&S [®] SMU-B13 | 1141.8003.04 |
| Differential I/Q Output | R&S [®] SMU-B16 | 1161.0066.02 |
| Analog Baseband Input | R&S [®] SMU-B17 | 1142.2880.02 |
| Digital modulation systems | | |
| Digital Standard GSM/EDGE | R&S [®] SMU-K40 | 1160.7609.02 |
| Digital Standard 3GPP FDD | R&S [®] SMU-K42 | 1160.7909.02 |
| 3GPP Enhanced MS/BS Tests incl. HSDPA | R&S [®] SMU-K43 | 1160.9660.02 |
| Digital Standard GPS | R&S [®] SMU-K44 | 1161.0566.02 |
| 3GPP FDD HSUPA | R&S [®] SMU-K45 | 1161.0666.02 |
| Digital Standard CDMA2000 [®] | R&S [®] SMU-K46 | 1160.9876.02 |
| Digital Standard IEEE 802.11 (a/b/g) | R&S [®] SMU-K48 | 1161.0266.02 |
| Digital Standard IEEE 802.16 | R&S [®] SMU-K49 | 1161.0366.02 |
| Digital Standard TD-SCDMA | R&S [®] SMU-K50 | 1161.0966.02 |
| TD-SCDMA Enhanced BS/MS Tests | R&S [®] SMU-K51 | 1161.1062.02 |
| Digital Standard DVB-H | R&S [®] SMU-K52 | 1408.7010.02 |
| Digital Standard EUTRA/LTE | R&S [®] SMU-K55 | 1408.7310.02 |
| Digital Standard XM RADIO | R&S [®] SMU-K56 | 1161.1162.02 |
| Multicarrier CW Signal Generation | R&S [®] SMU-K61 | 1160.8505.02 |

¹⁸ The base unit can only be ordered with an R&S[®]SMU-B10x frequency option.

| Digital modulation systems using R&S®WinIQSIM2™ ¹⁹ | | |
|---|--------------|--------------|
| Digital Standard GSM/EDGE (with WinIQSIM2™) | R&S®SMU-K240 | 1408.5518.02 |
| Digital Standard 3GPP FDD (with WinIQSIM2™) | R&S®SMU-K242 | 1408.5618.02 |
| 3GPP Enhanced MS/BS Tests incl. HSDPA (with WinIQSIM2™) | R&S®SMU-K243 | 1408.5718.02 |
| Digital Standard GPS (with WinIQSIM2™) | R&S®SMU-K244 | 1408.5818.02 |
| 3GPP FDD HSUPA (with WinIQSIM2™) | R&S®SMU-K245 | 1408.5918.02 |
| Digital Standard CDMA2000® incl. 1xEV-DV (with WinIQSIM2™) | R&S®SMU-K246 | 1408.6014.02 |
| Digital Standard IEEE 802.11 (a/b/g) (with WinIQSIM2™) | R&S®SMU-K248 | 1408.6114.02 |
| Digital Standard IEEE 802.16 (with WinIQSIM2™) | R&S®SMU-K249 | 1408.6214.02 |
| Digital Standard TD-SCDMA (with WinIQSIM2™) | R&S®SMU-K250 | 1408.6314.02 |
| TD-SCDMA Enhanced BS/MS Tests (with WinIQSIM2™) | R&S®SMU-K251 | 1408.6414.02 |
| Digital Standard DVB-H (with WinIQSIM2™) | R&S®SMU-K252 | 1408.7510.02 |
| Digital Standard EUTRA/LTE (with WinIQSIM2™) | R&S®SMU-K255 | 1408.7362.02 |
| Digital Standard XM RADIO (with WinIQSIM2™) | R&S®SMU-K256 | 1161.1240.02 |
| Multicarrier CW Signal Generation (with WinIQSIM2™) | R&S®SMU-K261 | 1408.6514.02 |
| Digital modulation systems using R&S®WinIQSIM2™ ²⁰ | | |
| Digital Standard IS-95 (with R&S®WinIQSIM2™) | R&S®SMU-K11 | 1160.5335.02 |
| Digital Standard CDMA2000® (with R&S®WinIQSIM2™) | R&S®SMU-K12 | 1160.5658.02 |
| Digital Standard 3GPP TDD (with R&S®WinIQSIM2™) | R&S®SMU-K13 | 1160.5906.02 |
| Digital Standard TD-SCDMA (with R&S®WinIQSIM2™) | R&S®SMU-K14 | 1160.6202.02 |
| User-Defined OFDM Signals (with R&S®WinIQSIM2™ and R&S®WinIQOFDM) | R&S®SMU-K15 | 1160.6402.02 |
| Digital Standard 1xEV-DO (with R&S®WinIQSIM2™) | R&S®SMU-K17 | 1160.7009.02 |
| Digital Standard IEEE 802.11 (a/b/g) (with R&S®WinIQSIM2™) | R&S®SMU-K19 | 1160.8805.02 |
| Digital Standard 3GPP FDD incl. HSDPA (with R&S®WinIQSIM2™) | R&S®SMU-K20 | 1160.9460.02 |
| Digital modulation systems using external PC software | | |
| Digital Standard Bluetooth® | R&S®SMU-K5 | 1161.0466.02 |
| Pulse Sequencer | R&S®SMU-K6 | 1408.7662.02 |
| Digital Standard TETRA | R&S®SMU-K8 | 1408.6714.02 |
| Fading and Noise | | |
| Fading Simulator | R&S®SMU-B14 | 1160.1800.02 |
| Fading Simulator Extension | R&S®SMU-B15 | 1160.2288.02 |
| Additive White Gaussian Noise (AWGN) | R&S®SMU-K62 | 1159.8511.02 |
| Dynamic Fading and Enhanced Resolution | R&S®SMU-K71 | 1160.9201.02 |
| Extended Statistic Functions | R&S®SMU-K72 | 1408.7062.02 |

¹⁹ R&S®WinIQSIM2™ requires an external PC.

²⁰ R&S®WinIQSIM2™ requires an external PC.

| | | |
|---|-------------|--------------|
| Other options | | |
| BER/BLER Measurement | R&S®SMU-K80 | 1159.8770.02 |
| Rear panel connectors for 1st RF path | R&S®SMU-B81 | 1159.9001.02 |
| Rear panel connectors for 2nd RF path | R&S®SMU-B82 | 1159.9501.02 |
| 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 | 1157.6870.04 |
| Mouse with USB Interface, optical | R&S®PSL-Z10 | 1157.7060.03 |
| External USB CD-RW Drive | R&S®PSP-B6 | 1134.8201.22 |



For data sheet, see PD 0758.0197.12
and www.rohde-schwarz.com
(search term: SMU200A)



ROHDE & SCHWARZ

www.rohde-schwarz.com

Europe: +49 1805 12 4242, customersupport@rohde-schwarz.com
USA and Canada: +1-888-837-8772, customer.support@rsa.rohde-schwarz.com
Asia: +65 65 130 488, customersupport.asia@rohde-schwarz.com