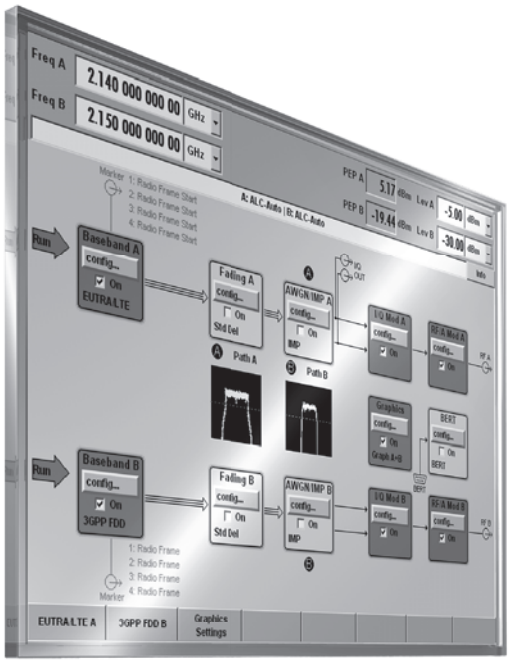
Digital Standards for R&S®SMU200A R&S®SMATE200A R&S®SMJ100A R&S®AMU200A

Specifications



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Test & Measurement

Data Sheet | 02.00

CONTENTS

Introduction

This document describes the digital standard options of the R&S®SMU200A, R&S®SMATE200A, R&S®SMJ100A vector signal generators and the R&S®AMU200A baseband signal generator and fading simulator.

Notations and abbreviations

Option names consist of the instrument name and a designation that refers to the respective standard. For example, K42 refers to 3GPP FDD. Thus, R&S®SMU-K42 is the 3GPP FDD option for the R&S®SMU200A, R&S®SMJ-K42 is the 3GPP FDD option for the R&S®SMJ100A, and so on. The functionality of a digital standard is the same for all instruments, unless otherwise stated. Therefore, the specifications of a standard (e.g. 3GPP FDD – K42 option) are valid for the respective options of all instruments (in this example R&S®SMU-K42, R&S®SMATE-K42, R&S®SMJ-K42, R&S®AMU-K42), unless otherwise stated.

I/Q baseband generators and memory size

Any digital standard requires an I/Q baseband generator installed on the respective instrument from Rohde & Schwarz. The following I/Q baseband generators are available:

For R&S®SMU200A	R&S®SMU-B9	baseband generator with ARB (128 Msample) and digital modulation (realtime)
	R&S®SMU-B10	baseband generator with ARB (64 Msample) and digital modulation (realtime)
	R&S®SMU-B11	baseband generator with ARB (16 Msample) and digital modulation (realtime)
For R&S®SMATE200A	R&S®SMATE-B9	baseband generator with ARB (128 Msample) and digital modulation (realtime)
	R&S®SMATE-B10	baseband generator with ARB (64 Msample) and digital modulation (realtime)
	R&S®SMATE-B11	baseband generator with ARB (16 Msample) and digital modulation (realtime)
For R&S®SMJ100A	R&S®SMJ-B9	baseband generator with ARB (128 Msample) and digital modulation (realtime)
	R&S®SMJ-B10	baseband generator with ARB (64 Msample) and digital modulation (realtime)
	R&S®SMJ-B11	baseband generator with ARB (16 Msample) and digital modulation (realtime)
	R&S®SMJ-B50	baseband generator with ARB (64 Msample)
	R&S®SMJ-B51	baseband generator with ARB (16 Msample)
For R&S®AMU200A	R&S®AMU-B9	baseband generator with ARB (128 Msample) and digital modulation (realtime)
	R&S®AMU-B10	baseband generator with ARB (64 Msample) and digital modulation (realtime)
	R&S®AMU-B11	baseband generator with ARB (16 Msample) and digital modulation (realtime)

As the baseband generators with the same number have the same functionality for all four instruments,
R&S®SMU-B9, R&S®SMATE-B9, R&S®SMJ-B9 and R&S®AMU-B9 are referred to as B9,
R&S®SMU-B10, R&S®SMATE-B10, R&S®SMJ-B10 and R&S®AMU-B10 are referred to as B10,
R&S®SMU-B11, R&S®SMATE-B11, R&S®SMJ-B11 and R&S®AMU-B11 are referred to as B11.

All options described in this document can be installed on baseband generators of the types B9, B10 or B11. Except for the K6 options (pulse sequencer), they cannot be installed on R&S®SMJ-B50 and R&S®SMJ-B51. These baseband generators are designed for use with R&S®WinIQSIM2™ and R&S®WinIQSIM™.

Related documents

This document contains the functional specifications of the digital standards that are running on the instrument (K40 to K61 options) as well as the digital standards that require a specific external PC software (K5, K6 and K8 options). The digital standards with R&S®WinIQSIM2™ (K240 to K262 options) are described in the R&S®WinIQSIM2™ data sheet (PD 5213.7460.22). The digital standards with R&S®WinIQSIM™ (K11 to K20 options) are described in the R&S®WinIQSIM™ data sheet (PD 0758.0680.32).

For instrument-specific signal performance data such as ACLR or EVM, see the data sheets of the respective instruments from Rohde & Schwarz:

R&S®SMU200A data sheet:	PD 0758.0197.22
R&S®SMATE200A data sheet:	PD 0758.1893.22
R&S®SMJ100A data sheet:	PD 5213.5074.22
R&S®AMU200A data sheet:	PD 5213.7954.22

Key features

Large variety of digital standards

- EUTRA/LTE
- 3GPP FDD with HSDPA, HSUPA and HSPA+ (HSPA evolution)
- CDMA2000® and 1xEV-DO
- TD-SCDMA
- GSM/EDGE
- WLAN IEEE 802.11 a, b, g and n
- WiMAX 802.16
- DVB-H, DAB, T-DMB
- GPS
- Bluetooth®
- XM RADIO
- TETRA

EUTRA/LTE

- Available channel bandwidths: 1.25/2.5/5/10/20 MHz or user-defined
- Physical layer modes: OFDMA and SC-FDMA
- Intuitive user interface with graphical display of time plan
- Ready for MIMO
- Up to 4 configurable users in downlink with continuous data across different resource blocks and subframes for receiver tests
- Support of PBCH, PDSCH, PDCCH and primary and secondary synchronization channels (P-SYNC, S-SYNC)
- Up to 4 UEs in uplink, demodulation and sounding reference signal configuration (CAZAC sequence parameters)

3GPP FDD/HSDPA/HSUPA/HSPA+

- Support of all physical channels of 3 GPP FDD, HSDPA, HSUPA and HSPA+
- HSDPA H-sets 1 to 9 with channel coding
- HSUPA fixed reference channels with channel coding and HARQ feedback simulation
- Realtime generation of P-CCPCH and up to three DPCHs in downlink
- One UE in realtime in uplink, up to 67 additional mobile stations via ARB
- External dynamic power control of a code channel possible

WiMAX IEEE 802.16

- Support of IEEE 802.16™-2004/Cor1/D5 and IEEE 802.16e-2005
- Physical layer modes: OFDM, OFDMA, OFDMA/WiBro
- Forward and reverse link, FDD and TDD duplexing
- Burst types: FCH, DL-MAP, UL-MAP, DCD, UCD, HARQ; ranging, fast feedback, data
- Multiple zones and segments (PUSC, FUSC, AMC, sounding)
- Diversity and MIMO coding (DL, UL)

WLAN 802.11n

- In line with IEEE P802.11n/D3.00-Sep 2007
- Support of 3 or 4 TX antennas, ready for MIMO
- Bandwidths 20 MHz and 40 MHz supported
- Frame block types: data, sounding
- Transmit modes: Legacy, Mixed Mode, Green Field
- Space-time block coding

Digital standards

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

Prerequisite for installation – R&S®SMU200A, R&S®SMATE200A, R&S®AMU200A

At least one I/Q baseband generator of the following types must be installed:

For R&S®SMU200A: R&S®SMU-B9, R&S®SMU-B10 or R&S®SMU-B11

For R&S®SMATE200A: R&S®SMATE-B9, R&S®SMATE-B10 or R&S®SMATE-B11

For R&S®AMU200A: R&S®AMU-B9, R&S®AMU-B10 or R&S®AMU-B11

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 for an R&S®SMU200A). 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.

Prerequisite for installation – R&S®SMJ100A

An R&S®SMJ-B9, R&S®SMJ-B10 or R&S®SMJ-B11 I/Q baseband generator must be installed. The options cannot be used with the R&S®SMJ-B50 and R&S®SMJ-B51 I/Q baseband generators.

GSM/EDGE digital standard

For the R&S®SMU-K40, R&S®SMATE-K40, R&S®SMJ-K40, R&S®AMU-K40 options.

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	depending on the respective Rohde & Schwarz instrument
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 (see frame structure 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 × T = 0.3
	range	B × 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 symbols
	ramp delay	–1.0 symbols to 1.0 symbols
	rise delay	–9 symbols to 9 symbols
	fall delay	–9 symbols to 9 symbols
Settable slot attenuation		0.0 dB to 60.0 dB, 8 different levels simultaneously possible (full level and 7 attenuated levels)
Burst ON/OFF ratio		see data sheet of the respective Rohde & Schwarz instrument, ”Signal performance for digital standards” section
Data sources	For characteristics of data sources, see the data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section.	
	internal data sources	all 0 all 1 PRBS 9, 11, 15, 16, 20, 21, 23 pattern (length 1 bit to 64 bit) data list
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 data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
Markers		convenient graphics editor for defining marker signals, and in addition: frame, multiple frame slot, multiple slot pulse pattern ON/OFF ratio
Phase error	see data sheet of the respective Rohde & Schwarz instrument, ”Signal performance for digital standards” section	
Error vector magnitude		
Power density spectrum		

3GPP FDD digital standard

For the R&S®SMU-K42, R&S®SMATE-K42, R&S®SMJ-K42 and R&S®AMU-K42 options.

WCDMA 3GPP FDD digital standard		in line with 3GPP standard, release 8
Frequency range	frequency bands in line with 3GPP TS 25.101 in uplink and downlink	UTRA FDD frequency bands I to III
	range	depending on the respective Rohde & Schwarz instrument
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) 64QAM (downlink HSPA+)
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 test model 6
	uplink (not standardized)	DPCCH + 1 DPDCH at 60 ksps DPCCH + 1 DPDCH at 960 ksps
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 Rohde & Schwarz instrument, e.g. with payload information from higher layers, on transport layer 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 AWGN K62 option) 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 data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
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	$\sqrt{\cos}$, α = 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, 16QAM or 64QAM	

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	depending on physical channel type	ON/OFF
Timing offset	depending on physical channel type, time offset that can be separately set for each code channel	0 to 150 (in units of 256 chips)
Pilot length	depending on physical channel type, 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	Preamble Only: Only preambles are generated. Application: Detection of RACH preamble in line with TS 25.141.	
	Standard: The message part of the PRACH is generated in addition to a settable number of preambles. It can also be channel-coded. Application: Demodulation of RACH message part in line with TS 25.141.	
Frame structure		preamble(s), message part consisting of data and control components
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 bit 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	Preamble Only: Only preambles are generated. Application: Detection of CPCH preamble in line with TS 25.141.	
	Standard: The message part of the PCPCH is generated in addition to a settable number of preambles. It can also be channel-coded. Application: Demodulation of CPCH message part in line with TS 25.141.	
Frame structure		access preamble(s), collision detection preamble, power control preamble, message part consisting of data and control component
Slot format control part		0 to 2
Symbol rate		15 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 bit 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 bit 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 (1 bit to 64 bit) data lists
Graphical display		domain conflicts, code domain, channel graph, slot structure and formats offered in graphics block
Error vector magnitude	see data sheet of the respective Rohde & Schwarz instrument, ”Signal performance for digital standards” section	
Adjacent-channel leakage ratio (ACLR)		

3GPP FDD enhanced BS/MS test including HSDPA

For the R&S®SMU-K43, R&S®SMATE-K43, R&S®SMJ-K43 and R&S®AMU-K43 options.

At least one K42 option must be installed on the respective instrument.

General parameters	This option extends the K42 option (3GPP FDD digital standard) to full HSDPA support and dynamic power control. Therefore, all general parameters of the K42 option such as frequency range or modulation are also valid for the K43 option.	
Downlink simulation		
HSDPA channels (HS-SCCH, HS-PDSCH, and F-DPCH)		
Enhancements	The K42 option supports simulation of HSDPA / HSPA+ channels in a continuous mode needed for TX measurements in line with TS 25.141 (test models 5 and 6). The K43 option 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 capability 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 with QPSK or 16QAM modulation)	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 or HS-SCCH packets OFF: transmission of dummy data between two HS-PDSCH or HS-SCCH packets
Fixed reference channel definition H-Set		
Enhancements	The K43 option allows HSDPA downlink channels with channel coding to be generated in line with the definition of the fixed reference channels (H-Sets 1-6) in TS 25.101; in addition, a user-editable H-Set configuration is possible, as well as user-configurable bit/block error insertion for H-Sets 1 to 5.	

Ranges	H-Set	H-Set 1 to H-Set 6, user-editable H-Set
	advanced mode	ON: The H-Set channels are generated in arbitrary waveform mode. OFF (only for H-Sets 1 to 5): The H-Set channels are generated in realtime mode.
	data source	PRBS: 9, 11, 15, 16, 20, 21, 23 all 0, all 1, pattern (length 1 bit to 64 bit), data lists
	UEID	0 to 65535
	number of HS-PDSCH channel codes	1 to 15
	HS-PDSCH modulation	QPSK, 16QAM (H-Set 1 to H-Set 3, H-Set 6, user-editable H-Set)
	UE supports 64QAM (only for 16QAM modulation)	ON: The information signaled in the HS-SCCH is provided under the assumption that the device under test basically supports 64QAM modulation. OFF: The information signaled in the HS-SCCH is provided under the assumption that the device under test does not support 64QAM modulation.
	transport block size table	0: The transport block size is evaluated in line with table 0 in TS 25.321, sub-clause 9.2.3.1. 1: The transport block size is evaluated in line with table 1 in TS 25.321, sub-clause 9.2.3.1.
	transport block size index	0 to 62. Index in line with TS 25.321, sub-clause 9.2.3.1.
	virtual IR buffer size (per HARQ process)	Up to 304000 in steps of 800. The lower limit depends on the transport block size configuration.
	number of HARQ processes per stream	1 to 6 (The actual upper limit depends on the selected inter-TTI distance.)
	HARQ simulation mode	Constant ACK: Every transmitted HS-PDSCH packet contains new data. Constant NACK: Several retransmissions of the same data take place in the HS-PDSCH packets of the individual HARQ processes.
	RV parameter (only for HARQ simulation mode set to constant ACK)	0 to 7
	RV parameter sequence (only for HARQ simulation mode set to constant NACK)	Sequence of a maximum of 8 entries in the range from 0 to 7. The number of entries also determines the number of transmissions of the same data in the HS-PDSCH packets of the individual HARQ processes before new data is transmitted.
	bit error insertion (only if advanced mode is set to OFF)	0.5 to 10^{-7} (insertion prior to channel coding or at the physical layer)
	block error insertion (only if advanced mode is set to OFF)	0.5 to 10^{-4}

Dynamic power control		
Enhancements	The K42 option provides a method to vary the output power of a code channel in arbitrary waveform mode by misusing its TPC pattern. The K43 option 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 the Rohde & Schwarz instrument 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 K42 option does not support HSDPA for uplink. The K43 option 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 HSDPA	
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 K42 option provides a method to vary the output power of a code channel in arbitrary waveform mode by misusing its TPC pattern. The K43 option now allows the variation of the output power in realtime mode for UE1 in three submodes:	
	external	Node B provides TPC info to the Rohde & Schwarz instrument by external connector (TTL level)
	by TPC pattern	TPC pattern is used to control the output power
	manual	the output power is changed incrementally by pressing buttons or sending the corresponding remote control commands
Application	RX measurements on 3GPP FDD Node Bs where closed loop power control is needed RX measurements on 3GPP FDD Node Bs with varied UE power without dropouts in the signal	
Ranges	mode	external, by TPC pattern, manual
	direction	up, down
	power step	0.5 dB to 6 dB
	up-range	0 dB to 20 dB
	down-range	0 dB to 20 dB

GPS digital standard

For the R&S®SMU-K44, R&S®SMATE-K44, R&S®SMJ-K44 and R&S®AMU-K44 options.

GPS digital standard		in line with ICD-GPS-200 revision C
General settings		
Frequency	for R&S®SMU-K44, R&S®SMATE-K44, R&S®SMJ-K44	default L1 = 1575.42 MHz user-selectable in entire frequency range of the respective Rohde & Schwarz instrument
	for R&S®AMU-K44: virtual RF frequency	default L1 = 1575.42 MHz
Output level	for R&S®SMU-K44, R&S®SMATE-K44, R&S®SMJ-K44	default –115 dBm user-selectable in entire output level range of the respective Rohde & Schwarz instrument
Modulation		BPSK (CDMA)
Symbol rate (chip rate)		1.023 MHz
Baseband filter		Gaussian, filter parameter B × T = 1 rectangular
Simulation modes		generic mode localization mode (auto SV selection)
Marker		navigation data bit (20460 chips)
		navigation data word (30 data bit)
		navigation data subframe (10 data words)
		1 PPS
		pulse
		pattern
		ON/OFF radio
Triggering		see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
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 and YUMA almanacs, any valid date and time (GMT) during almanac week
Navigation data rate		50 bps

Satellite configurations		
Number of satellites	If the Rohde & Schwarz instrument is equipped with two baseband generators and two K44 options, these can be combined to double the number of satellites.	1 to 4 satellites with C/A code or 1 satellite with C/A and P code or 1 satellite with P code in realtime
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
		P code: 37 Gold codes
Time shift	separately settable for each satellite	0 to 10000000 (C/A code chip)/40
Power	separately settable for each satellite	–50 dB to +10 dB
Doppler shift	separately settable for each satellite	±100 kHz (selectable in steps of 0.01 Hz)
Additional time shift	separately settable for each satellite to simulate multipath	0 to 10000000 (C/A code chip)/40
Additional power	separately settable for each satellite to simulate multipath	±10 dB
Additional Doppler shift	separately settable for each satellite to simulate multipath	±100 kHz (selectable in steps of 0.01 Hz)
Initial carrier phase	separately settable for each satellite	0 to 2π (selectable in steps of 0.01 rad)
Localization mode		
Latitude	latitude of simulated location	±90° (selectable in steps of 0.000001°), format selectable between “DEG:MIN:SEC” and “Decimal Degrees”
Longitude	longitude of simulated location	±180° (selectable in steps of 0.000001°), format selectable between “DEG:MIN:SEC” and “Decimal Degrees”
Altitude	altitude of simulated location	±10000 m (selectable in steps of 0.1 m)

3GPP FDD HSUPA

For the R&S®SMU-K45, R&S®SMATE-K45, R&S®SMJ-K45 and R&S®AMU-K45 options.

At least one K42 option must be installed on the respective instrument.

General parameters	This option extends the K42 option (3GPP FDD digital standard) to full HSUPA support. Therefore, all general parameters of the K42 option such as frequency range or modulation are also valid for the K45 option.	
Downlink simulation		
HSUPA channels (E-AGCH, E-RGCH, E-HICH)		
Enhancements	In downlink, the K45 option 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	In uplink, the K45 option supports simulation of one 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)	15ksps, 30ksps, 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
	separately for each E-DPDCH	
	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

For the R&S®SMU-K46, R&S®SMATE-K46, R&S®SMJ-K46, R&S®AMU-K46 options.

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, R&S®SMATE-B9, R&S®SMJ-B9, R&S®AMU-B9	
	511 frames with R&S®SMU-B10, R&S®SMATE-B10, R&S®SMJ-B10, R&S®AMU-B10	
	160 frames with R&S®SMU-B11, R&S®SMATE-B11, R&S®SMJ-B11, R&S®AMU-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		–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 link	reverse pilot (R-PICH)	
	access (R-ACH)	
	enhanced access (R-EACH)	
	reverse common control (R-CCCH)	
	reverse dedicated control (R-DCCH)	
	traffic channel	
	fundamental (R-FCH)	
	supplemental code (R-SCCH)	
	supplemental (R-SCH)	
Frame length	depending on channel type and radio configuration	5 ms, 10 ms, 20 ms, 40 ms, 80 ms
Data rate	depending on channel type and radio configuration	1.2 kbps to 1036.8 kbps
Power		–80 dB to 0 dB
Data		all 0 all 1 pattern (up to 64 bit) PN 9 to PN 23 data lists
Error vector magnitude (EVM)	see data sheet of the respective Rohde & Schwarz instrument, ”Signal performance for digital standards” section	
Adjacent-channel leakage ratio (ACLR)		

1xEV-DO digital standard

For the R&S®SMU-K47, R&S®SMATE-K47, R&S®SMJ-K47 and R&S®AMU-K47 options.

1xEV-DO digital standard	release A	in line with 3GPP2 C.S0024-A 3.0
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
Link direction		forward link and reverse link
Sequence length	sequence length entered in slots (1.67 ms each), max. length: 65536 slots with R&S®SMU-B9, R&S®SMATE-B9, R&S®SMJ-B9, R&S®AMU-B9 32768 slots with R&S®SMU-B10, R&S®SMATE-B10, R&S®SMJ-B10, R&S®AMU-B10 8192 slots with R&S®SMU-B11, R&S®SMATE-B11, R&S®SMJ-B11, R&S®AMU-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
Traffic channels	forward link	One base station generates up to 4 independent traffic channels for different users.
	reverse link	Up to 4 completely independent access terminals can be simulated.
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	
PN offset		0 to 511
System time		0 to 2199023255551
Forward link parameters		
Physical layer subtype		0&1 or 2
Continuous pilot mode	only transmits pilot and a set of MAC channels	ON/OFF
Control channel	state	ON/OFF
	data rate	38.4 kbps or 76.8 kbps
	packet start offset	0 to3
Reverse activity bit (MAC)	state	ON/OFF
	level	–25.0 dB to –7.0 dB
	length (subtype 0&1 only)	8, 16, 32, 64
	offset	0 to 7
Other users count	simulates additional MAC users	1 to 110
Settings for each forward link traffic channel		
State		ON/OFF
Number of packets to send		0 to 65536 or infinite
Packet start offset		0 to 255
Rate index		1 to 12
Packet size	for subtype 0&1 the packet size depends on the rate index only	128 bit to 12288 bit
Data rate	depending on rate index and packet size	4.8 kbps to3072.0 kbps
Slot count	depending on rate index and packet size	1 to 16
Data pattern		32 bit value
MAC index	subtype 0&1: subtype 2:	5 to 63 6 to 127
MAC level		–25.0 dB to –7.0 dB
Interleave factor		1 to 4
RPC modes		Hold, All Up, All Down, Range, Pattern
DRC lock (MAC)	state	ON/OFF
	period, subtype 0&1: period, subtype 2:	0, 8, 16 0, 4
	length	1, 4, 8, 16, 32
	frame offset	0 to 15
H-ARQ mode	subtype 2 only	Off, ACK, NAK

Settings for each reverse link access terminal in traffic mode		
Physical layer subtype		0&1 or 2
Disable quad. spreading		ON/OFF
Long code mask I		0 to 3FFF FFFF FFF
Long code mask Q		0 to 3FFF FFFF FFF
Pilot channel gain		–80.0 dB to +10.0 dB
Auxiliary pilot channel	subtype 2 only state relative gain minimum payload	 ON/OFF –80.0 dB to +10.0 dB 128 bit to 12288 bit
RRI channel	state relative gain (subtype 2 only)	ON/OFF –80.0 dB to +10.0 dB
DSC channel	subtype 2 only state relative gain length values	 ON/OFF –80.0 dB to +10.0 dB 8 to 256 slots up to 16 octal values
DRC channel	state relative gain length values cover gating	ON/OFF –80.0 dB to +10.0 dB 1, 2, 4, 8 slots up to 16 hexadecimal values 0 to 7 ON/OFF
ACK channel	state relative gain mode gating values	ON/OFF –80.0 dB to +10.0 dB BPSK / OOK (subtype 2 only) can be set individually per slot, up to 16 values possible up to 16 binary values
Data channel	number of individual packets relative gain number of packets to send subpackets (subtype 2 only) payload size modulation, subtype 0&1 modulation, subtype 2 channel coding data source append FCS	1 (subtype 0&1) / 1 to 3 (subtype 2) –80.0 dB to +10.0 dB 0 to 65536 or infinite 1 to 4 128 bit to 12288 bit BPSK B4, Q4, Q2, Q4Q2, E4E2 ON/OFF all 0, all 1, pattern (up to 64 bit), PN 9 to PN 23, data lists ON/OFF
Settings for each reverse link access terminal in access mode		
Physical layer subtype		0&1 or 2
Disable quad. spreading		ON/OFF
Long code mask I		0 to 3FFF FFFF FFF
Long code mask Q		0 to 3FFF FFFF FFF
Preamble length		1 to 7 frames
Access cycle duration		1 to 255 slots
Access cycle offset		0 to 12 slots
Pilot channel gain		–80.0 dB to +10.0 dB
Data channel	state relative gain capsule length data rate data source append FCS	ON/OFF –80.0 dB to +10.0 dB 1 to 15 frames 9.6 kbps, 19.2 kbps, 38.4 kbps all 0, all 1, pattern (up to 64 bit), PN 9 to PN 23, data lists ON/OFF

IEEE 802.11 a/b/g digital standard

For the R&S®SMU-K48, R&S®SMATE-K48, R&S®SMJ-K48 and R&S®AMU-K48 options.

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 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, addresses 1 to 4, and sequence control
Frame check sequence		activating or deactivating a 32 bit (4 byte) checksum for protecting MAC header and user data (frame body)
Settings for CCK (IEEE 802.11b/IEEE 802.11g)		
Chip rate	standard	11 Mcps
	range	depending on the respective Rohde & Schwarz instrument
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	depending on the respective Rohde & Schwarz instrument
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	depending on the respective Rohde & Schwarz instrument
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

For the R&S®SMU-K49, R&S®SMATE-K49, R&S®SMJ-K49 and R&S®AMU-K49 options.

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)

For the R&S®SMU-K50, R&S®SMATE-K50, R&S®SMJ-K50 and R&S®AMU-K50 options.

WCDMA 3GPP TDD LCR (TD-SCDMA) digital standard		in line with 3GPP TDD standard for chiprate 1.28 Mcps (low chip rate mode)
Frequency range	frequency bands in line with 3GPP TS 25.102 in uplink and downlink	UTRA TDD frequency bands a) to d)
	range	depending on the respective Rohde & Schwarz instrument
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	1.28 Mcps (7 slots/subframe)
	range	1 Mcps to 5 Mcps
Link direction		uplink (reverse link)
		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/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 readout 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 from 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

For the R&S®SMU-K51, R&S®SMATE-K51, R&S®SMJ-K51 and R&S®AMU-K51 options.

At least one K50 option must be installed on the respective instrument.

General parameters	This option extends the K50 option (TD-SCDMA digital standard) to full channel coding and HSDPA support. Therefore, all general parameters of the K50 option such as frequency range or modulation are also valid for the K51 option.	
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 the K62 option) 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

For the R&S®SMU-K52, R&S®SMATE-K52, R&S®SMJ-K52 and R&S®AMU-K52 options.

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 the respective Rohde & Schwarz instrument
Output level		default –30 dBm user-selectable in entire output level range of the respective Rohde & Schwarz instrument
Hierarchy mode		hierarchical, non-hierarchical
Sequence length	number of superframes	min.: 1 max.: depending on baseband generator memory
Baseband filter	standard	cosine, α = 0.1
	other	see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
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 %
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 data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
Signal path parameters		
Input data	Zero packets are generated and filled with the 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		
Superframe 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

DAB/T-DMB digital standard

For the R&S®SMU-K53, R&S®SMATE-K53, R&S®SMJ-K53 and R&S®AMU-K53 options.

DAB digital standard		in line with ETSI EN 300 401 V1.3.3 standard (with restrictions, see below)
Ensemble transport interface		in line with ETSI ETS 300 799 (with restrictions, see below)
General settings		
Source data	FIC and CIFs, each filled with	all 0 all 1 PN 15, 23
	ETI frames number of ETI frames to process	ETI file (.ETI) This depends on the number and size of streams contained in the ETI file and the memory size of the I/Q baseband generator. With a baseband generator with 64 Msample memory (e.g. R&S®SMU-B10) and ETI files with nearly full content, the loop duration is approx. 10 min.
Transport mode	for sources other than the ETI file	I, II, III, IV
	ETI file	specified by ETI frames
Baseband filter	standard	cosine, $\alpha = 0.1$
	other	see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
Marker		restart frame start pulse pattern ON/OFF ratio
Signal path parameters		
PN scrambler state	affects all channels	ON/OFF
Convolutional coder state	affects all channels if OFF, the missing bits are taken from source	ON/OFF
Time interleaver state	affects all channels	ON/OFF
DAB related constraints		
Max. number of streams/channels		FIC + 15 streams
ETI related constraints		
ETI type		ETI (NI, G.703)
Stream configuration	multiplex configuration number of streams size of streams protection of streams	must not change within the frames
Frame length		24 ms
Sample rate		48 kHz

IEEE 802.11 n digital standard

For the R&S®SMU-K54, R&S®SMATE-K54, R&S®SMJ-K54 and R&S®AMU-K54 options.

IEEE 802.11 n digital standard		in line with IEEE P802.11n/D3.00 – Sep. 2007
General settings		
BW		20 MHz, 40 MHz
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 Block, Frame, Frame Active Part, Pulse, Pattern, ON/OFF Ratio
Triggering		see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
Kernel sample rate	standard	20 Msample/s, 40 Msample/s
	range	depending on the respective Rohde & Schwarz instrument
Baseband filter		Spectral mask in line with ‘IEEE 802.11a-1999 – wireless LAN MAC and PHY specifications – chapter 17.3.9.6.2’ for LEGACY 20 MHz and ‘IEEE P802.11n/D3.00, chapter 20.3.20’ for other modes.
Transmit antenna setup	number of antennas	1 to 4
	mapping coefficient range	(–1000 to 1000 i) to (+1000 +1000 i) with a resolution = 0.01/dimension
	output destination	baseband, file, OFF

Frame block configuration		
Frame blocks (table rows)		Limited to 100. The wave-file size is checked at the beginning of the computation process to make sure that sufficient ARB memory is available.
Type		DATA, SOUNDING
Physical mode	type = DATA	LEGACY, MIXED MODE, GREEN FIELD
	type = SOUNDING	GREEN FIELD, MIXED MODE
Transmit mode	physical mode = LEGACY	L-20 MHz, L-Duplicate, L-Upper, L-Lower
	physical mode = MIXED MODE or GREEN FIELD	HT-20 MHz, HT-40 MHz, HT-Duplicate, HT-Upper, HT-Lower
Frames		1 to 1024 frames (depending on frame duration)
Idle time	time between two successive frames (PPDUs)	
	range	0 ms to 1000 ms with 1 µs resolution
PSDU parameters	MAC header	Activating and configuring the MAC header with the following parameters: frame control, duration/ID, addresses 1 to 4, and sequence control. For high throughput (HT), i.e. 'Not Legacy', QoS Control and HT Control are also configurable.
	frame check sequence	activating or deactivating a 32 bit (4 byte) checksum for protecting MAC header and user data (frame body)
	number of spatial streams	1 to 4
	number of space-time streams	1 to 4
	number of extended spatial streams	0 to 3
	space-time block coding	activated by simply choosing different values for number of spatial and space-time streams
	PSDU modulation/space stream	BPSK, QPSK, 16QAM, 64QAM
	data length	1 byte to 4061[1] byte for LEGACY frames, 1 byte to 65495 bytes for HT frames. 0 is permissible only with sounding frames
	number of data symbols (number of OFDM symbols in data portion of packet)	directly proportional to PSDU data length
	raw data rate	up to 600 Mbps
	preamble/header active	Preamble/header can be turned ON or OFF. By turning it OFF and setting Idle Time to 0, you get the 'unframed' mode.
	guard interval	short, long
	scrambling	Data scrambling can be activated or deactivated; initial scrambler state can be set randomly or to a user-defined value.
	coding	convolutional coding (BCC) or OFF, 1 or 2 encoders based on setup and coding rates of 1/2, 2/3, 3/4 and 5/6
	interleaver	can be activated or deactivated
	time domain windowing (transition times)	0 s to 1000 ns
	service field	user-defined service field value supported
	spatial mapping	OFF, direct, spatial expansion and beamforming (not yet implemented)

[1] The maximum PPDU length for legacy is 4095 byte. It can be obtained by activating all the MAC fields. The same applies to HT, 65535 byte can be implemented.

EUTRA/LTE digital standard

For the R&S®SMU-K55, R&S®SMATE-K55, R&S®SMJ-K55 and R&S®AMU-K55 options.

EUTRA/LTE digital standard		in line with 3GPP standard release 8
General settings		
Frequency		user-selectable in entire frequency range of the respective Rohde & Schwarz instrument
Output level		default –30 dBm user-selectable in entire output level range of the respective Rohde & Schwarz instrument
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 data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
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 data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
Duplexing	determines duplexing mode Note: TDD is not supported in this version.	FDD, TDD
Link direction	determines whether uplink or downlink is simulated	downlink, uplink
Physical layer mode	fixed value: depends on selected 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 determined in the K55 option 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 selected period.	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 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 to be used for SCH. The first 150 bit 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, the 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 ≥5 MHz.	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 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
Channel coding (CC)	determines the channel coding scheme used Note: Turbo coder is not supported in this version.	turbo coding (TC)/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	displayed 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 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 the channel coding scheme 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 +10 dB

XM RADIO digital standard

For the R&S®SMU-K56, R&S®SMATE-K56, R&S®SMJ-K56 and R&S®AMU-K56 options.

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 the respective Rohde & Schwarz instrument
Output level		default –30 dBm user-selectable in entire output level range of the respective Rohde & Schwarz instrument
Frequency offset		see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
Triggering		see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
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 B9 option
Baseband filter	standard	root cosine, $\alpha = 0.15$
	other	see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
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 bit 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 B9 option
Baseband filter	standard	in line with spectral mask
	other	see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
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

FM stereo modulation

For the R&S®SMU-K57, R&S®SMATE-K57, R&S®SMJ-K57 and R&S®AMU-K57 options.

Stereo modes	internal with modulation generator	L, R, R = L, R = -L
	internal from WAV audio file	L, R, R = L, R = -L, R ≠ L
	external digital (via S/P DIF input)	L, R, R = L, R = -L, R ≠ L
MPX frequency deviation		0 Hz to 80 kHz
	resolution	10 Hz
L, R signal	AF frequency range	20 Hz to 15 kHz
	AF frequency response (referenced to 500 Hz)	<0.2 dB
Stereo crosstalk attenuation	AF = 1 kHz	>50 dB
Distortion	67.5 kHz MPX frequency deviation, AF = 1 kHz	<0.1 %, typ. 0.05 %
S/N ratio (stereo/RDS signal)	ITU-R weighted (quasi-peak)	>60 dB, typ. 62 dB
	ITU-R unweighted (rms)	>70 dB, typ. 72 dB
	A-weighted (rms)	>70 dB, typ. 72 dB
Preemphasis		off, 50 µs, 75 µs
Pilot tone	frequency	19 kHz (fixed)
	uncertainty	typ. 2 Hz
	deviation	0 Hz to 10 kHz
	resolution	10 Hz
	phase (relative to 38 kHz phase)	–5° to +5°
	resolution	0.1°
RDS/RBDS subcarrier frequency		57 kHz (fixed)
	uncertainty	typ. 6 Hz
RDS/RBDS subcarrier deviation		0 Hz to 10 kHz
	resolution	10 Hz
RDS/RBDS functions		support PI, PS, TP, TA, PTY, PTYN, DI, MS, CT, RT, AF, EON, user-definable message type and group type

3GPP FDD HSPA+

For the R&S®SMU-K59, R&S®SMATE-K59, R&S®SMJ-K59 and R&S®AMU-K59 options.

At least one K42 option must be installed on the respective instrument. The exact functionalities of the K59 option depend on the availability of the K43 and K45 options.

General parameters	This option extends the K43 option (3GPP FDD enhanced BS/MS test including HSDPA) and the K45 option (3GPP HSUPA) to HSPA+ support in downlink and uplink. The K43 and K45 options require the K42 option (3GPP FDD digital standard). Therefore, all general parameters of the K42 option such as frequency range or modulation are also valid for the K59 option. For downlink simulation, all general parameters of the K43 option such as burst mode or the parameters for H-Sets are also valid for the K59 option, unless stated otherwise in the downlink simulation section below. HSPA+ support for the uplink simulation (also covered by the K59 option) will be included in a later release of the instument firmware.
Downlink simulation	
Continuous packet connectivity (CPC) (requires the K43 option)	
Enhancements	The K43 option supports simulation of the HS-SCCH in H-Sets with HS-SCCH type 1 (in line with TS 25.212) only. In order for the instrument to support HS-SCCH-less operation, the K59 option now supports simulation of H-Sets with HS-SCCH type 2 (for H-Set 7 and user-editable H-Set).

Ranges	H-Set	H-Set 1 to H-Set 9, user-editable H-Set. CPC (HS-SCCH less operation) can be simulated by selecting H-Set 7 or the user-editable H-Set with appropriate settings.
	advanced mode (if H-Set is set to H-Set 7 or user-editable H-Set)	always ON
	HS-SCCH type	HS-SCCH type 1 to 3, in line with TS 25.212. CPC can be simulated by selecting HS-SCCH type 2.
	number of HS-PDSCH channel codes (if HS-SCCH type is set to HS-SCCH type 2)	1 to 2
	HS-PDSCH modulation (if HS-SCCH type is set to HS-SCCH type 2)	always QPSK
	transport block size reference (if HS-SCCH type is set to HS-SCCH type 2)	0 to 3, representing the signaled transport block size information in the HS-SCCH blocks, in line with TS 25.212. Note that the actual transport block size configuration for the HS-PDSCH channel is the same as in the K43 option.
	RV parameter (if HS-SCCH type is set to HS-SCCH type 2 and HARQ simulation mode is set to constant ACK)	always 0
	RV parameter sequence (if HS-SCCH type is set to HS-SCCH type 2 and HARQ simulation mode is set to constant NACK)	The three entries are always 0, 3, 4.
Higher order modulation (HOM) (requires the K43 option)		
Enhancements	The K43 option supports simulation of HS-PDSCH channels with channel coding in H-Sets with QPSK and 16QAM modulation only. The K59 option extends the functionality by 64QAM modulation for HS-PDSCH channels inside H-Sets (for H-Set 8 and user-editable H-Set). Note that 64QAM for HS-PDSCH channels in continuous mode without channel coding is already supported by the K42 option.	
Ranges	H-Set	H-Set 1 to H-Set 9, user-editable H-Set. HOM can be simulated by selection of H-Set 8 or by selecting the user-editable H-Set with appropriate settings.
	advanced mode (if H-Set is set to H-Set 8 or user-editable H-Set)	always ON
	HS-SCCH type	HS-SCCH type 1 to 3, in line with TS 25.212. HOM (64QAM) is available only for HS-SCCH type 1 or HS-SCCH type 3.
	HS-PDSCH modulation (if HS-SCCH type is set to HS-SCCH type 1 or HS-SCCH type 3)	QPSK, 16QAM or 64QAM
	transport block size table (if HS-PDSCH modulation is set to 64QAM)	always table 1: The transport block size is evaluated in line with table 1 in TS 25.321, sub-clause 9.2.3.1.
MIMO (requires the K43 option)		
Enhancements	The K43 option does not support MIMO. The K59 option now supports MIMO for the downlink HS-PDSCH channels (double transmit antenna array, D-TxAA).	

Ranges	precoding weight pattern (w2) (if HS-PDSCH channels with MIMO are used)	A sequence of up to 16 entries in the range from 0 to 3. Specifies the MIMO precoding weight w_2 in line with TS 25.214 used for the HS-PDSCH packets.
	stream 2 active pattern (if HS-PDSCH channels with MIMO are used)	A sequence of up to 16 entries that are either “1” or “-“ and specify in which HS-PDSCH packets (TTIs) one or two transport blocks are sent.
Ranges if HSDPA mode is not set to H-Set	modulation (if HS-PDSCH channels with MIMO are used)	The modulations for the two MIMO streams can be set independently set to QPSK, 16QAM or 64QAM.
Ranges if HSDPA mode is set to H-Set	H-Set	H-Set 1 to H-Set 9, user-editable H-Set. MIMO can be simulated by selection of H-Set 9 or by selecting the user-editable H-Set with appropriate settings.
	advanced mode (if H-Set is set to H-Set 9 or user-editable H-Set)	always ON
	HS-SCCH type	HS-SCCH type 1 to 3, in line with TS 25.212. MIMO is simulated by selecting HS-SCCH type 3.
	HS-PDSCH modulation (if HS-PDSCH modulation is set to HS-SCCH type 3)	The modulations for the two MIMO streams can be QPSK, 16QAM or 64QAM. Note that only the combinations of modulations in line with TS 25.212 table 14 are possible.
	transport block size table (if HS-PDSCH modulation is set to HS-SCCH Type 3)	Can be set independently for the two MIMO streams. 0: Transport block size is evaluated in line with table 0 in TS 25.321, sub-clause 9.2.3.1. 1: Transport block size is evaluated in line with table 1 in TS 25.321, sub-clause 9.2.3.1. For 64QAM modulation, only table 1 is applicable to the respective stream.
	transport block size index (if HS-PDSCH modulation is set to HS-SCCH type 3)	Can be set independently for the two MIMO streams. 0 to 62. Index in line with TS 25.321, sub-clause 9.2.3.1.
	virtual IR buffer size (per HARQ process) (if HS-PDSCH modulation is set to HS-SCCH type 3)	Can be set independently for the two MIMO streams. Up to 304000 in steps of 800. The lower limit depends on the transport block size.
	RV parameter (if HS-PDSCH modulation is set to HS-SCCH type 3 and HARQ simulation mode set to constant ACK)	Can be set independently for the two MIMO streams. 0 to 3
	RV parameter sequence (if HS-PDSCH modulation is set to HS-SCCH type 3 and HARQ simulation mode set to constant NACK)	Can be set independently for the two MIMO streams. Sequence of a maximum of 8 entries in the range from 0 to 3. The number of entries also determines the number of transmissions of the same data in the HS-PDSCH packets of the individual HARQ processes before new data is transmitted.
Uplink simulation		
HSPA+ support for the uplink simulation (which is also covered by the K59 option) will be included in a later release of the instrument firmware.		

Multicarrier CW signal generation

For the R&S®SMU-K61, R&S®SMATE-K61, R&S®SMJ-K61 and R&S®AMU-K61 options.

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 particular 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	see data sheet of the respective Rohde & Schwarz instrument, ”Signal performance for digital standards” section	
Suppression of unwanted carriers		

Assisted GPS digital standard

For the R&S®SMU-K65, R&S®SMATE-K65 and R&S®AMU-K65 options.

Two baseband generators and two K44 options must be installed on the respective instrument.

GPS/A-GPS digital standard		in line with ICD-GPS-200 revision C, , 3GPP 34.108 v.8.0.0, 3GPP TS 34.123-3 v.6.4.0, 3GPP TS 34.171 v.7.0.1, 3GPP TS 51.010-1 v.7.7.0
General settings		
A-GPS test scenarios	The K65 option provides the GPS signals for the test scenarios.	GSM signaling test scenario (3GPP TS 51.010-1 v.7.7.0)
		GSM performance test scenario 1 (3GPP TS 51.010-1 v.7.7.0)
		GSM performance test scenario 2 (3GPP TS 51.010-1 v.7.7.0)
		GSM performance test scenario 3 (3GPP TS 51.010-1 v.7.7.0)
		3GPP FDD signaling test scenario (3GPP 34.108 v.8.0.0, 3GPP TS 34.123-3 v.6.4.0)
		3GPP FDD performance test scenario 1 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)
		3GPP FDD performance test scenario 2 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)
		3GPP FDD performance test scenario 3 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1) user-defined A-GPS test scenarios
Simulation modes		localization mode (full configuration)
Generation of assistance data		generation of assistance data like almanac file, ionospheric file, navigation file, UTC file and acquisition file for user-defined A-GPS test cases in comma-separated-values (CSV) format
Configure navigation data		
Ephemeris and clock correction parameters	separately settable for each satellite	range as defined in ICD-GPS-200
UTC parameters	separately settable for each satellite	range as defined in ICD-GPS-200
Ionospheric parameters	separately settable for each satellite	range as defined in ICD-GPS-200
AODO	separately settable for each satellite	range as defined in ICD-GPS-200
(A-S) flags and SV configurations	separately settable for each satellite	range as defined in ICD-GPS-200
Localization mode		
Location		uploadable waypoint file to simulate moving scenarios, maximum number of waypoints depends on baseband generator memory, minimum duration before repetition >1 day

Digital standards with external PC software

Prerequisite for installation – R&S®SMU200A, R&S®SMATE200A, R&S®AMU200A

At least one I/Q baseband generator of the following types must be installed:

For R&S®SMU200A: R&S®SMU-B9, R&S®SMU-B10 or R&S®SMU-B11

For R&S®SMATE200A: R&S®SMATE-B9, R&S®SMATE-B10 or R&S®SMATE-B11

For R&S®AMU200A: R&S®AMU-B9, R&S®AMU-B10 or R&S®AMU-B11

If two I/Q baseband generators are installed and two signals of the same standard are to be output simultaneously, two corresponding software options must also be installed. If only one option is installed and the standard is selected in one I/Q baseband generator, the other I/Q baseband generator is disabled for that standard. However, a software option is not tied to a specific I/Q baseband generator.

Prerequisite for installation – R&S®SMJ100A

For R&S®SMJ-K5 and R&S®SMJ-K8, an R&S®SMJ-B9, R&S®SMJ-B10 or R&S®SMJ-B11 I/Q baseband generator must be installed. The options cannot be used with the R&S®SMJ-B50 and R&S®SMJ-B51 I/Q baseband generators.

The R&S®SMJ-K6 option works with all R&S®SMJ-B9, R&S®SMJ-B10, R&S®SMJ-B11, R&S®SMJ-B50 and R&S®SMJ-B51 I/Q baseband generators.

Bluetooth® digital standard (external PC software)

For the R&S®SMU-K5, R&S®SMATE-K5, R&S®SMJ-K5 and R&S®AMU-K5 options.

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 symbols
	rise offset, fall offset	0 symbols to 32 symbols
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)

For the R&S®SMU-K6, R&S®SMATE-K6, R&S®SMJ-K6 and R&S®AMU-K6 options.

The pulse sequencer software generates complex pulses and bursts. 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 larger
	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 plug-in (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)

For the R&S®SMU-K8, R&S®SMATE-K8 and R&S®SMJ-K8 options.

TETRA digital standard		in line with ETS300-392/ETS300-394 standard
Function		
K8 option	The K8 option 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 K8 option generates all data sequences including all control sequences required to operate the signal generator.	
Interfaces	The K8 software calculates the appropriate TETRA T1 signal and transfers it to the Rohde & Schwarz instrument via the GPIB or LAN interface. Additionally, the K8 option 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 the respective Rohde & Schwarz instrument	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 the respective Rohde & Schwarz instrument
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		π/4-DQPSK (2 bit per symbol)
Baseband filter		TETRA filter
Symbol rate		18000 symbols/s
Marker		slot(s), frame(s), multiframe(s), hyperframe(s)
Triggering		see data sheet of the respective Rohde & Schwarz instrument, “I/Q baseband generator” section
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 multiframes
TETRA T1		the T1 test signal is generated for the v+d (voice and data) test on MS and BS

Ordering information

Digital standards for the R&S®SMU200A vector signal generator

Designation	Type	Order No.
Digital standards		
GSM/EDGE	R&S®SMU-K40	1160.7609.02
3GPP FDD	R&S®SMU-K42	1160.7909.02
3GPP Enhanced MS/BS Tests incl. HSDPA	R&S®SMU-K43	1160.9660.02
GPS	R&S®SMU-K44	1161.0566.02
3GPP FDD HSUPA	R&S®SMU-K45	1161.0666.02
CDMA2000®	R&S®SMU-K46	1160.9876.02
1xEV-DO	R&S®SMU-K47	1408.7410.02
IEEE 802.11 (a/b/g)	R&S®SMU-K48	1161.0266.02
IEEE 802.16	R&S®SMU-K49	1161.0366.02
TD-SCDMA	R&S®SMU-K50	1161.0966.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMU-K51	1161.1062.02
DVB-H	R&S®SMU-K52	1408.7010.02
DAB/T-DMB	R&S®SMU-K53	1400.6209.02
IEEE 802.11n	R&S®SMU-K54	1408.7562.02
EUTRA/LTE	R&S®SMU-K55	1408.7310.02
XM RADIO	R&S®SMU-K56	1161.1162.02
FM Stereo Modulation	R&S®SMU-K57	1400.6250.02
3GPP FDD HSPA+	R&S®SMU-K59	1415.0001.02
Multicarrier CW Signal Generation	R&S®SMU-K61	1160.8505.02
Assisted GPS	R&S®SMU-K65	1415.0053.02
Digital standards using external PC software		
Bluetooth®	R&S®SMU-K5	1161.0466.02
Pulse Sequencer	R&S®SMU-K6	1408.7662.02
TETRA	R&S®SMU-K8	1408.6714.02

Digital standards for the R&S®SMATE200A vector signal generator

Digital standards		
GSM/EDGE	R&S®SMATE-K40	1404.5107.02
3GPP FDD	R&S®SMATE-K42	1404.5207.02
3GPP Enhanced MS/BS Tests incl. HSDPA	R&S®SMATE-K43	1404.5307.02
GPS	R&S®SMATE-K44	1404.5407.02
3GPP FDD HSUPA	R&S®SMATE-K45	1404.7300.02
CDMA2000®	R&S®SMATE-K46	1404.5507.02
1xEV-DO	R&S®SMATE-K47	1404.7900.02
IEEE 802.11 (a/b/g)	R&S®SMATE-K48	1404.6703.02
IEEE 802.16	R&S®SMATE-K49	1404.6803.02
TD-SCDMA	R&S®SMATE-K50	1404.7100.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMATE-K51	1404.7200.02
DVB-H	R&S®SMATE-K52	1404.7800.02
DAB/T-DMB	R&S®SMATE-K53	1400.6409.02
IEEE 802.11n	R&S®SMATE-K54	1404.7951.02
EUTRA/LTE	R&S®SMATE-K55	1404.7805.02
XM RADIO	R&S®SMATE-K56	1404.7751.02
FM Stereo Modulation	R&S®SMATE-K57	1400.6450.02
3GPP FDD HSPA+	R&S®SMATE-K59	1415.1320.02
Multicarrier CW Signal Generation	R&S®SMATE-K61	1404.5707.02
Assisted GPS	R&S®SMATE-K65	1415.1372.02
Digital standards using external PC software		
Bluetooth®	R&S®SMATE-K5	1404.7000.02
Pulse Sequencer	R&S®SMATE-K6	1404.8006.02
TETRA	R&S®SMATE-K8	1404.7600.02

Digital standards for the R&S®SMJ100A vector signal generator

Digital standards		
GSM/EDGE	R&S®SMJ-K40	1404.0305.02
3GPP FDD	R&S®SMJ-K42	1404.0405.02
3GPP Enhanced MS/BS Tests incl. HSDPA	R&S®SMJ-K43	1404.0505.02
GPS	R&S®SMJ-K44	1404.1401.02
3GPP FDD HSUPA	R&S®SMJ-K45	1409.1816.02
CDMA2000®	R&S®SMJ-K46	1404.0605.02
1xEV-DO	R&S®SMJ-K47	1409.2306.02
IEEE 802.11 (a/b/g)	R&S®SMJ-K48	1404.1001.02
IEEE 802.16	R&S®SMJ-K49	1404.1101.02
TD-SCDMA	R&S®SMJ-K50	1404.1660.02
TD-SCDMA Enhanced BS/MS Tests	R&S®SMJ-K51	1404.1760.02
DVB-H	R&S®SMJ-K52	1409.2106.02
DAB/T-DMB	R&S®SMJ-K53	1400.6309.02
IEEE 802.11n	R&S®SMJ-K54	1409.2506.02
EUTRA/LTE	R&S®SMJ-K55	1409.2206.02
XM RADIO	R&S®SMJ-K56	1404.1806.02
FM Stereo Modulation	R&S®SMJ-K57	1400.6350.02
3GPP FDD HSPA+	R&S®SMJ-K59	1415.1508.02
Multicarrier CW Signal Generation	R&S®SMJ-K61	1404.0705.02
Digital standards using external PC software		
Bluetooth®	R&S®SMJ-K5	1404.1301.02
Pulse Sequencer	R&S®SMJ-K6	1409.2558.02
TETRA	R&S®SMJ-K8	1409.1716.02

Digital standards for the R&S®AMU200A baseband generator and fading simulator

Digital standards		
GSM/EDGE	R&S®AMU-K40	1402.6106.02
3GPP FDD	R&S®AMU-K42	1402.6206.02
3GPP Enhanced MS/BS Tests incl. HSDPA	R&S®AMU-K43	1402.6306.02
GPS	R&S®AMU-K44	1402.6406.02
3GPP FDD HSUPA	R&S®AMU-K45	1402.8909.02
CDMA2000®	R&S®AMU-K46	1402.6506.02
1xEV-DO	R&S®AMU-K47	
IEEE 802.11 (a/b/g)	R&S®AMU-K48	1402.6706.02
IEEE 802.16	R&S®AMU-K49	1402.7002.02
TD-SCDMA	R&S®AMU-K50	1402.8950.02
TD-SCDMA Enhanced BS/MS Tests	R&S®AMU-K51	1402.9005.02
DVB-H	R&S®AMU-K52	1402.9557.02
DAB/T-DMB	R&S®AMU-K53	1402.9957.02
IEEE 802.11n	R&S®AMU-K54	1402.9705.02
EUTRA/LTE	R&S®AMU-K55	1402.9405.02
XM RADIO	R&S®AMU-K56	1402.9905.02
FM Stereo Modulation	R&S®AMU-K57	1403.0001.02
3GPP FDD HSPA+	R&S®AMU-K59	1403.0053.02
Multicarrier CW Signal Generation	R&S®AMU-K61	1402.7102.02
Assisted GPS	R&S®AMU-K65	1403.0101.02
Digital standards using external PC software		
Bluetooth®	R&S®AMU-K5	1402.9257.02
Pulse Sequencer	R&S®AMU-K6	1402.9805.02

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 line 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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Rohde&Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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Data without tolerance limits is not binding | Subject to change

*0.14 €/min within German wireline network; rates may vary in other networks (wireline and mobile) and countries.